Optimising the Efficiency and Effectiveness of Enforcement to Achieve Compliance in the Western Rock Lobster Fishery

Final Report to the
Fisheries Research and Development Corporation

By

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7 December 2002

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ISBN 1 877098 13 2

Table of Contents

Abbreviations

Abbreviation	Explanation
AUD	Australian dollars
FRMA 1994	Fisheries Resource Management Act 1994
GPS	Global Positioning System
GVP	Gross Value of Production
ITE	Individual Transferable Effort
ITQ	Individual Transferable Quota
MAC	Management Advisory Committee
MSC	Marine Stewardship Council
OS	Oversize
PFA	Professional Fishing Association
RLIAC	Rock Lobster Industry Advisory Committee
RL	Rock Lobster
TAC	Total Allowable Catch
TPF	Totally Protected Fish
US	Undersize
VMS	Vessel Monitoring System (satellite enabled)

NON-TECHNICAL SUMMARY

1998/156	Optimising the Efficiency and Effectiveness of Enforcement to Achieve Compliance in the Western Rock Lobster Fishery

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OBJECTIVES:

1) Estimate the level of non-compliance in the Western Australian rock lobster industry.
2) Determine factors such as seasonal, regional and factory, which may affect the level of non-compliance in order to better target the timing of enforcement effort.
3) Develop relationships between enforcement and compliance with the regulations to enable an assessment of increasing or decreasing the level of enforcement on the level of compliance.
4) Determine the reasons and motivations for the non-compliance of commercial fishers with the regulations in terms of the expected gains versus the probability of detection.
5) Ascertain the perceptions of the fishing regulations and enforcement measures including the perceived probability of detection for commercial fishers.
6) Ascertain whether commercial fishers are aware of the full extent and frequency of inspections.

NON TECHNICAL SUMMARY:

The enforcement program in the western rock lobster fishery, like many national enforcement programs, is a complex mix of activities designed to maximise the opportunity for fishers to voluntarily comply with fishery rules, while at the same time providing a reasonable threat of detection, successful prosecution, and significant penalties for those who do not. This is achieved by effective monitoring and surveillance, appropriately trained enforcement staff, suitable deterrents in the form of fines and administrative penalties, and targeted educative campaigns. This project focused on four broad areas to optimise the efficiency and effectiveness of enforcement:

a) An examination of the importance of fisher involvement in enforcement; b) Inspections of catch in rock lobster processing factories; c) Attitudinal surveys of fishery participants; and, d) Experimentation to

examine specific compliance issues. In addition, a general review of the enforcement/compliance literature was undertaken.

Fisher involvement in enforcement

I explore possibilities for fishers increasing their participation in management, particularly in relation to enforcement and compliance. I advocate that co-management systems should, to some degree, be extended to encourage fisher involvement in ensuring compliance with fishery rules. This can be achieved by involving fishers in compliance processes, such as compliance risk assessments or other working groups. I also discuss management authority responsibilities in fostering moves toward self-regulation in fisheries.

Inspections of catch in rock lobster processing factories

Data were systematically collected in rock lobster processing factories to create standardised measures of enforcement effort and compliance. These data are vessel and factory specific, and differentiated with respect to targeted and random inspections. Analyses provide Fisheries Officers and managers with a range of information used to help optimise enforcement activities, and this work has become an integral and continuing part of the rock lobster enforcement program.

Key results from this study indicate that commercial compliance with catch-related rules is exemplary, with only 1.1-2.4 illegal lobsters detected in every 1,000 animals checked. In the 2000/01 season, total illegal catch consigned to processors was estimated in the range 16.3-16.9 tonnes; compared to a total catch of 11,273 tonnes this only accounts for 0.15% of the total landed catch. Experimental manipulation of enforcement effort indicated that non-compliance rates are inversely proportional to levels of inspection effort, a result that has allowed industry and enforcement staff to have informed debates about appropriate levels of factory inspections for the fishery.

Attitudinal surveys of fishery participants

Mail surveys were conducted in the commercial and recreational sectors of the rock lobster fishery to gain an understanding of fisher attitudes and perceptions toward management, regulations, levels of compliance, and enforcement. Results for both surveys were highly instructive in gaining a broad understanding of how each sector views particular problems in the fishery, the perceived legitimacy of rules, and the deterrent effect of particular enforcement activities. Perceptions of each sector about the other may prove useful in future discussions relating to resource shares. Generally, results indicate that respondents from both sectors believe that a majority of fishers comply with rules, but that for most rules a small number of individuals are non-compliant. While support for fishery rules was high among most commercial respondents, a small number were unhappy with the formulation of several fishing regulations. Many commercial fishers nominated monetary gain as the primary reason for fishers breaking rules, although small numbers of respondents also thought competition between fishers and financial hardship were strong motivating factors.

Experimentation to examine specific compliance issues

Designed experiments were conducted in order to assist enforcement staff detect rule breaches that are particularly difficult to prove by conventional investigative techniques. In particular, a biological survey was conducted to determine the relative abundance of illegal animals available for capture on the fishing grounds. Results were compared with fishers' consigned catch in order to identify those fishers with catch that was unlikely to have arisen from legitimate fishing practices. These experiments were successful in identifying offending fishers and, subject to further refinements, may in future contribute important supporting evidence in cases of prosecution.

Outcomes Achieved

Analyses of factory data provide a range of information now regularly used in management of the enforcement program, including: i) inspection levels are adjusted regionally through time in response to changing conditions in the fishery and predicted levels of catch; ii) fishers who habitually infringe regulations are tracked, and targeting occurs based on consignment history; iii) total levels of illegal catch consigned to processing factories are estimated; iv) compliance rates for individual factories and locations are monitored.

Attitudinal surveys of fishery participants have allowed managers and enforcement staff to identify several areas of concern held by recreational and commercial fishers. Through continuing consultation with resource users (eg. through risk assessment processes) strategies are developed to address compliance issues in the fishery. An important outcome to arise from these surveys is that the Department has taken strategic steps to increase the awareness amongst fishery participants about the nature and extent of the enforcement program; many perceived shortcomings in the enforcement program related by survey participants were in fact just that – perceptions – and did not accord with the range of activities undertaken or observed compliance rates.

Overall, the project has been of benefit to industry through improved cost-effectiveness of the enforcement program, and to the community through improved education of fishers and higher compliance with fishery rules. Results have also been of benefit to interstate agencies (who have been involved through national workshops), in that the project has demonstrated that careful collection of enforcement and compliance related data can be used to provide sound information on which to base decisions regarding enforcement service delivery.

KEYWORDS: Enforcement, compliance, legitimacy, deterrence, co-management, western rock lobster, *Panulirus cygnus*.

Acknowledgements

The author would like to thank all those at the Western Australian Marine Research Laboratories who provided their advice and help throughout this project. In particular I would like to thank Nick Caputi and John Looby for continued encouragement, assistance and supervisory support.

The assistance and input of Peter Millington regarding co-management and fisher involvement in the enforcement process (Chapter 2) proved invaluable, as did the contributions of John Mutter and Bruce Webber toward my understanding of over-potting and other compliance issues. Emily Stewart assisted with the work on analysing recreational survey data. Eric "Stix" Barker kindly exercised some grey cells on my behalf, recalling bygone days in the lobster fishery.

Thanks are also extended to those national compliance managers, recreational sector representatives, and professional rock lobster fishers who provided valuable insights into the strengths and weaknesses of enforcement activities in Western Australia and other jurisdictions. Particular thanks are extended to the Fisheries Officers of Western Australia, without whose support this project would not have been possible.

The expertise of the fish pathology section of the Department of Fisheries WA, and in particular the contributions of Brian Jones and Alana Kidd in respect of Section 5.4, is gratefully acknowledged.

The advice and critical suggestions of Frank Morgan from the Crime Research Centre of the University of Western Australia assisted my understanding of certain areas of criminal psychology relevant to fisheries crime.

Finally, sincere thanks are extended to my immediate co-workers and colleagues, Anita Ward, Rob Humphreys, Tara Baharthah and Sarah Anderson. Their support and patience while I have completed this report has been greatly appreciated.

1. Background

1.1 Overview

In this study I examine the fisheries enforcement program in place for the western rock lobster fishery, with a view to providing analyses that will assist the Department of Fisheries, Western Australia, and industry improve the effectiveness and efficiency of their program. In a broad sense, improvement of the enforcement program can be defined as improving stakeholder compliance with fishery rules, and optimising enforcement activities to achieve the best compliance outcomes within available resources. This definition encompasses many issues important to modern fisheries management, ranging from stakeholder attitudes and perceptions toward fishery rules, to how the field activities of fisheries enforcement officers affect compliant behaviour. A central question explored in the report is: what motivates fishers to break fishery rules? To answer this I examine aspects of criminal psychology, relating this theory to information collected through surveys of fishery participants. Adaptive management, through experimental manipulation of enforcement effort, forms another important aspect of this study, allowing the relationship between enforcement activities and non-compliant behaviour to be examined. I also provide a discussion of how involving stakeholder groups in management and enforcement programs can help to foster compliance behaviour.

This introduction provides a review of literature relevant to the body of the report, and comprises three main sections:

a) The western rock lobster fishery

Here I provide an overview of the fishery, including descriptions of the recreational and commercial sectors, basic biology of the target species (principally as it applies to the behaviour of fishers), fishing rules, the enforcement program and management arrangements.

b) Overview of enforcement and compliance in fisheries

In this section I explore concepts relating to the motivational aspects of criminal behaviour, and how these might be applied to the study of fisheries crime. I also provide a synthesis of literature concerned with analysis of fisheries enforcement and compliance information. I also introduce the concept of positive compliance outcomes and the mechanisms that might be employed to achieve them.

c) Study rationale, need and objectives

This section provides an overview of why this work was undertaken, the approaches adopted for this study, and the objectives. I also provide a summary of the structure of the report.

1.2 The Western Rock Lobster Fishery

1.2.1 Fishery Overview

Rock lobster is a highly prized food fish throughout the world, with palinurid annual average global production of around 74,000 tonnes over the period 1991-1995 (Lipcius and Eggleston 2000). Australia contributes over 20% of this catch, the overwhelming majority of which arises from the fishery for western rock lobster, *Panulirus cygnus*. There are eight species of rock lobster caught in Western Australian waters, but the western rock lobster is by far the most abundant and economically important. The fishery for this species is interesting, and important, from many perspectives. Nationally, the fishery is Australia's most valuable single-species fishery, with annual commercial catches in the 1990's ranging between 9,000 and 13,000 tonnes for a value (ex vessel) of between \$200 and \$300 million AUD. In 1997/1998 this corresponded to around 39% of the total value of Western Australian fisheries production, and approximately 11% of the total value of national fisheries production (ABARE 1998). The fishery is estimated to have a total capitalisation of \$2 billion AUD, with market values for individual fishing operations of between \$2 and \$3 million AUD. Live lobster exports to Japan, Taiwan, and China account for the majority of the value of the commercial catch (Marec 1997). The fishery also supports a substantial recreational sector, with catches over the last 10 years of between 3-5% of total commercial landings (Melville-Smith *et al.* 2001).

The fishery is also significant from an international perspective, not simply in terms of it's contribution toward total world catch, but rather from its reputation of being one of the world's few fisheries being managed on an ecologically sustainable basis. In an era when world fisheries are increasingly in decline, the total commercial catch of 14,400 tonnes in the 1999/2000 season was the largest catch from a lobster fishery for any country. Furthermore, the sustainable management of the fishery was recently recognised when the Marine Stewardship Council (MSC), an international body charged with assessing sustainable fisheries management, granted certification in 2000. The western rock lobster fishery was the first fishery in the world to receive MSC accreditation. It is also worth noting that the fishery has been judged economically sustainable, with resource rents maintained at around \$30 million AUD annually (Lindner 1994).

Geographically, the fishery operates over a wide area along the Western Australia coastline, ranging between latitudes 21°44'S and 34°24'S, although fishing is generally concentrated between 26°S and 33°S. In the 2000/2001 season there were around 600 licensed commercial vessels fishing a total of 56,800 pots over 1200 km of coastline, and a recreational sector of approximately 37,000 licensed participants. There is some degree of spatial separation between the commercial and recreational sectors (fishing generally occurs for these groups within 60 and 2 nautical miles of the coast, respectively), but high inshore catches during seasonal lobster migrations does present the opportunity for conflict between the groups. Commercial fishers are restricted by licence to operate within designated zones, including a highly productive off-shore island region, the Abrolhos Islands. Recreational fishers are generally not restricted in where they may fish, the exception being restrictions against fishing in certain marine protected areas that apply equally to the commercial sector.

Management is by a variety of effort restrictions, including closed seasons, spatial closures, gear restrictions, size-limits on lobster, juvenile and breeding-stock protection, and bag-limits for recreational fishers. Entry to the commercial fishery has been limited since 1963, and current management arrangements centre around a system of limited-entry individual transferable effort; that is, individuals control rights to use a certain number of lobster pots, and these may be bought and sold among existing fishery participants. There are currently no direct output controls in the form of an annual Total Allowable Catch (TAC), the management instead controlling the exploitation rate in order to ensure the escapement of animals to the breeding stock. Entry to the recreational sector is not limited, with licence sales doubling over the period 1987-1999 (Melville-Smith and Anderton 2000).

The management measures in place for the rock lobster fishery have largely succeeded in limiting fishing pressure to a point where the latent effort has been removed and the fishery is biologically sustainable. Declining breeding stock indices and predictions of environmentally driven low puerulus settlement in the early 1990's prompted the introduction in 1993/1994 of a management plan designed to boost breeding stock levels. These changes were designed to increase levels of egg production to the level it was in the late 1970's and early 1980's, and indications are that this target has been exceeded (Hall and Chubb 2001). While biological monitoring of fish stocks and recruitment continue on an annual basis, management issues in recent years have tended to focus on maintaining equity among resource users, and maximising the economic return from the fishery.

1.2.2 Commercial Fishery

The commercial fishery operates as two distinct but related components, the catching sector and the processing sector. The catching sector comprises individual fishing operations that, during the fishing season 15 November – 30 June, travel by boat to the fishing grounds to catch lobster. Lobsters are brought back to the coast by the catching vessels, and then are consigned to a limited number of licensed processing factories. I consider each of these processes separately.

1.2.2.1 Catching Sector

Commercial fishing for rock lobster in Western Australia has existed at low levels since the 1890's, with effort and catches increasing significantly from the mid-1940's onward. Many in the fleet today are third or even fourth generation rock lobster fishers, engendering a strong sense of history and ownership among industry members. The commercial fishery has been regulated as limited-entry since 1963 (Bowen 1971), and since that time the number of vessels has decreased from over 800 to around 600. Unlike many post-industrial fisheries, most fishing operations are still owner-operated, with the majority of fishers owning only one licence. This is slowly changing, however. Although the exact number is unknown, discussions with commercial fishers and fishery managers reveal that as many as 25% of all skippers may be employed on a contract basis. A related development in the fishery in recent years is that there is an increasing prevalence of leasing of vessels and/or pots. Fishers who lease boats or pots are generally more greatly affected by variations in catches and prices compared with owner-operated fishing operations, making it difficult to maintain profitability during environmentally driven periods of low catch.

In the 2000/2001 fishing season the catching sector comprised 597 licensed commercial vessels, each fishing with an average of around 110 lobster traps ("pots"). Vessels are relatively technologically advanced when compared with many coastal fishing fleets around Australia, with a large proportion of the fleet equipped with colour echo sounders, computerised satellite-enabled navigational equipment, and modern satellite communications. Most vessels are 9-20m in length and are highly mobile. The average capitalisation for a single vessel is around $0.5 million AUD, and, with pot prices currently trading at over $25,000, typical fishing operations of 110 pots have a market value of $2-3 million AUD.

On almost every day of the 230 day fishing season, fishers travel to sea to raise their pots, remove the captured lobster, rebait and reset the pots, and return to the coast with their catch. Pots may be pulled a maximum of once per day, and most fishers do, however during low catching periods of the season, or during periods of bad weather, fishers may decide to only attend their pots every 2-3 days. Boats are crewed by a skipper and, depending on the size of boat, 1-3 crew. Pots are generally of two basic designs, and are subject to a maximum size, must contain gaps to allow the escapement of undersized lobsters, and must have clearly marked floats identifying the fishing licence of the owner. Before the introduction of global positioning system (GPS) technology, fishers set their quota in long lines of 5-20 pots. Since the widespread introduction of GPS systems in the 1980's and 1990's the fishing characteristics of the fleet have changed dramatically. Fishers now set their pot quota in fractions as small as 1-2 pots per line, and can spread them considerable distances since they can be accurately relocated using GPS. This has substantial implications for the fishery compliance program, as will be discussed later.

Pots are brought to the surface with mechanised pot winches, then "skinned"; this is the colloquial term for removing lobster from the pots. Pots are then rebaited and replaced on the ocean floor ("reset") in anticipation of catching lobsters during the night for the next days fishing. Captured animals are individually examined to ensure they comply with minimum size rules and restrictions on taking breeding females. Non-legal animals must be immediately returned to the water. Legal catch is placed in plastic holding crates ("baskets"), and these are placed into aerated sea-water holding tanks where animals are kept alive before consignment to a processor at the end of the trip.

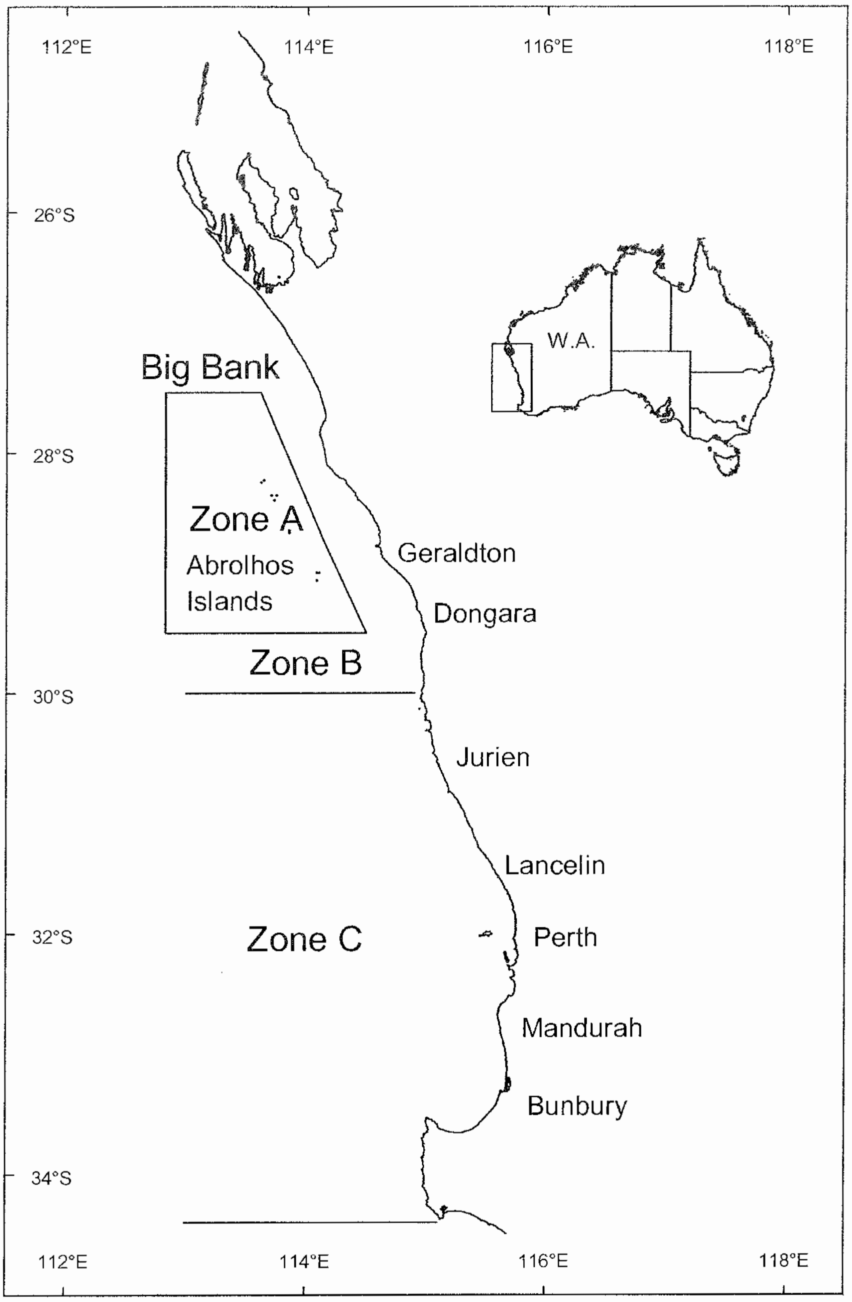


Figure 1.1 Western Australia coastline showing zones of the commercial rock lobster fishery.

The commercial fishery is divided into three zones by licence restriction (Figure 1.1). Zone A comprises the waters between 21° 44' south latitude and 30° south latitude, and includes the Abrolhos Islands area. The islands comprise many small continental islands (around 60 km offshore) surrounded by fringing reef, both limestone and coral, that supports highly productive rock lobster habitat. Fishers who hold an A Zone licence must fish the Abrolhos Islands area from 15 March to 30 June, and must fish outside this area during the earlier part of the season. Zone B is defined as this same area comprising Zone A, but excluding the Abrolhos Islands fishing zone. Zone A and Zone B fishers therefore share the same fishing grounds prior to 15 March.

Zone C comprises the waters between 30° south latitude and 34° 24' south latitude. Smaller rock lobster fisheries, mainly targeted toward southern rock lobster (*Jasus edwardsii*), occur below 34° 24' south latitude, but these are not considered in this study.

There is one other gazetted area of the fishery, known as "Big Bank", that occurs to the north of Zone A. Big Bank is predominantly a deep water part of the fishery, where fishers target lobsters migrating northward along the continental shelf. The fishery commences on 10 February each year, and fishers in either Zone A or B may nominate to participate. Once nominated, fishers must remain in the Big Bank area until midday of the last day in February. Big Bank catches can be particularly high, however there is some risk involved since fishers must locate the migrating lobsters in order to achieve reasonable catch rates, and cannot retreat to grounds with more consistent catch rates once they have commenced in the fishery.

1.2.2.2 Processing Sector

Limited entry to the processing sector was introduced in 1966, primarily to restrict the number of legal consignment points so that the (then) widespread practice of landing and processing undersize lobster could be adequately enforced. Less than 20 licensed processing factories operated during the 2000/2001 season, in addition to which there are a small number of licences that are issued but inactive. Approximately 95% of the total catch is processed for overseas export as either live, whole cooked, or whole raw product, and processors are equipped to comply with the requirements for food export. Importantly, 30-40% of the catch is exported as live product, so most processors have facilities to hold live lobster on their premises, sometimes for lengthy periods of time prior to export.

On returning from the fishing grounds, fishers consign their catch to (usually) a single processing factory. Factories are generally located close to larger fishing harbours, but they also operate around 60 receiving depots at smaller anchorages along the coast. Fishers may consign catch at receiving depots to be transported in salt-water reticulated refrigerated trucks to factories. Fishers and processors often have a close relationship, forged under conditions of mutual dependence. Factory operators require a stable number of fishers to provide them with catch throughout the season in order to ensure continuity of supply to overseas markets. To encourage this, factories offer long-standing clients (fishers) monetary bonuses based on the quality of the catch, or may assist in the supply of gear, bait, or other supplies. They are currently also offering pots for lease at discounted rates compared with open-market prices. Fishers, for their part, require stable catch prices for the efficient operation of their business, and this may be difficult for processors to provide due to the seasonal nature of lobster abundance and fluctuating world markets.

Fishers deliver their catch to factories in plastic holding containers ("baskets"), each typically containing between 10 and 80 lobsters depending on lobster size. A majority of the total catch from the fleet is consigned in this way, accounting for in excess of 95% of the total catch over the previous 10 years, with the remaining catch sold as direct sales by fishers into the domestic market. Factory workers weigh the catch, tip the catch out onto sorting tables, and grade lobsters into size and quality categories. Lobsters in good condition (e.g. most appendages attached) are stored in saltwater holding tanks to await packing for live export; lesser quality animals are prepared for export as cooked or green frozen product.

1.2.3 Recreational Fishery

Like the commercial fishery, there is a long history of recreational fishing for rock lobster in Western Australia. The western rock lobster (*P. cygnus*) is the species most commonly exploited by recreational fishers, with Melville-Smith and Anderton (2000) estimating that in the 1998/1999 season only 2% of recreational rock lobster fishers targeted southern or tropical species of rock lobster. The size of the recreational lobster catch was first estimated in the 1970's at around 174 tonnes, or 1.6% of the commercial catch in that season (Norton 1981). Estimates in recent years suggest that the recreational catch in the late 1990's has increased to about 400-500 tonnes, or 5% of the commercial annual catch (Melville-Smith and Anderton 2000).

Recreational fishers are required to hold an annual recreational lobster fishing licence that entitles them to fish from mid-November to the end of June (the same period as the commercial season). However, unlike the commercial fishery, there is no upper limit on effort, and licence sales have steadily increased over the previous 10-year period. There is currently a lively debate between sectors about how catch shares should be divided between recreational and commercial fishers in light of increasing recreational effort.

The recreational catch is regulated through a variety of measures. Fisher catches are restricted by an individual bag limit of eight lobsters per licensee per day, and a maximum of 16 lobsters per boat per day regardless of whether there are more than two licence-holders aboard. Like commercial fishers, recreational fishers may only take lobsters within prescribed size limits, and must not take lobsters that are in breeding condition. Rock lobster may be legally captured by a variety of methods, but predominantly fishers use pots (a maximum of two pots may be fished per licence), or dive to capture lobster using a noose or a crook. Recreational fishers are required to "tail clip" lobsters in order that they may be distinguished from commercial catch; this involves removing or punching a hole in the central flap of the telson. This rule is important since fisheries enforcement staff must be able to distinguish between catch caught recreationally and commercial catch, since the former may not be legally sold.

1.2.4 Basic Biology

The biology of the western rock lobster has been extensively studied in the last 30 years (e.g. Chittleborough 1976, Morgan 1977, Joll and Phillips 1984). This section examines aspects of the biology that are important to the operational characteristics of the commercial and recreational fisheries. It is not intended as a comprehensive review, but is nonetheless important since there are particular characteristics of the life-cycle of *P. cygnus* that render the lobster more (or less) vulnerable to illegal exploitation.

Western rock lobster are a long lived species. Wild caught animals have been known to exceed 5 kg, and, although exact longevity is unknown, a captive specimen lived 28 years at the Western Australian Marine Research Laboratories to achieve a final weight of 3.2 kg. The life cycle of rock lobster begins when mature females (6-7 years old) release fertilized eggs into deep water (40-100 m) many kilometres off the Western Australian coast. Resulting larvae undergo a 9-11 month open-water planktonic period, feeding and developing through several larval stages. The pre-settlement stage, termed puerulus, are transparent miniature lobsters around 25 mm in length. Through passive and active transport systems the tiny lobsters travel to inshore reefs where they settle and undergo a prolonged period of growth. Scientific monitoring of puerulus settlement allows catches to be predicted up to 4 years in advance, something that has contributed significantly to the successful management of stock exploitation (Caputi *et al.* 1995).

Tagging studies have shown that young animals (0-4 years old) show little offshore movement. However, at an age of 4-5 years lobsters undergo an offshore migration in November-January to join the breeding stock in deeper water (Morgan 1977, Phillips 1983). Most animals have been shown to move directly offshore from the coast, but a significant number undergo longer migrations in a north-westerly direction along the edge of the continental shelf (Cheng and Chubb 1998). Migrating animals are newly moulted, and their pale colouration and extensive movement in high numbers leads the migration to be termed the "whites run". These animals are typically 76-77 mm carapace length, weigh 0.4 - 0.5 kg, and are just becoming legally available to the fishery. With the exception of the Abrolhos Island population, where animals spawn at a younger age than in other areas of the fishery, "just sized" lobsters are yet to spawn for the first time. During this migratory phase the animals are highly vulnerable to exploitation, and commercial and recreational catches usually peak during December of each season. A catch peak also occurs in March for the commercial fishery with the commencement of the Abrolhos Island (Zone A) season.

Prior to mating and laying eggs, female lobster show anatomical signs they are mature, and these are important since fishery rules have been devised to protect females in breeding condition. Three stages of the female breeding cycle are currently protected:

i) *Setose*: refers to females that have developed setae (fine hair-like filaments) on the endopodites that form part of their swimmerets. Setae allow the lobster to carry eggs beneath their tails for an incubation period of 3-9 weeks prior to release into the water column.

ii) *Tarspot*: refers to females that have mated, and have a black or dark grey sperm packet deposited on their abdomen just behind their hindmost pair of legs. Females scratch this packet to fertilize eggs when spawning.

iii) *Berried*: refers to females that are carrying eggs.

Peaks in catches occur in December and March following synchronised moults that occur in November and February. Moon phase also plays an important role in the catchability of lobsters, with lower catch rate observed during periods of full-moon.

1.2.5 Management

The western rock lobster fishery has been managed since the late nineteenth century, when the first rules designed to protect small animals and females in breeding condition were introduced. Commercial catch statistics were first collected in the 1940's, along with basic biological data relating to growth, reproduction and distribution. The first formalised management plan was introduced in 1963. Gray (1999) provides a discussion of the historical development of the fishery, including management arrangements.

The Department of Fisheries Western Australia manages the fishery through the Fish Resources Management Act (FRMA) 1994, Western Australia, legislation that gives consideration to environmental, social, and economic issues surrounding exploitation of the lobster resource. This determines that the State Minister responsible for fisheries is the ultimate manager of fisheries resources within Western Australia. The rules of the fishery are set out in the West Coast Rock Lobster Fishery Management Plan 1993, the Fisheries Resource Management Regulations 1995, and a number of recognised policies. The power to alter these instruments rests with the Minister, but there is an obligation set out in the FRMA 1994 for the Minister to consult with stakeholder representatives prior to any change in the management arrangements.

The concept of user-participation in the management process plays an important role in most Australian fisheries. Many agencies have adopted Management Advisory Committee (MAC) structures in order to provide expert (and hopefully balanced) corporate advice to the Minister responsible for management decisions affecting a fishery. In Western Australia, the Minister is provided advice by the Rock Lobster Industry Advisory Committee (RLIAC), a ministerially appointed, expertise-based advisory body. RLIAC undertakes investigations relevant to the industry as a whole and provides advice to the Minister on its findings; the Minister may also canvass the committee on particular issues. RLIAC has established several subcommittees to examine issues specific to the areas of research, compliance, finance, and marketing. The role of RLIAC, and in particular the compliance subcommittee, is discussed further in Chapter 2.

Management measures (summarised in Table 1.1) are specified in the management plan, regulations, and the RLIAC's 1999 *Operational and Work Plans for the West Coast Rock Lobster Managed Fishery.* Measures currently in place have largely succeeded in limiting fishing pressure to a point where breeding stock and egg production are maintained at levels measured in the late 1970's and early 1980's, a level considered biologically sustainable.

Table 1.1 **Major management regulations controlling exploitation of the stock (modified from Caputi *et al.* 2000)**

Year/Season	Regulation
1897	Minimum legal whole weight of 12 oz (340 g). This measurement is equivalent to, and eventually evolved into, the 76 mm carapace length minimum size currently in force in the fishery.
1899	Females carrying spawn were given full protection by requiring them to be returned to the sea.
1962	Closed seasons: coastal fishery 16 August – 14 November; Abrolhos Islands fishery 16 August – 14 March
1963	Limited entry introduced: boat numbers were fixed (858) and the number of traps per boat was limited to 3 per foot-length of boat.
1965	Boat replacement policy required a boat to be replaced with one of exactly the same length. This stopped fishers replacing a boat with a larger one and hence obtaining additional traps to use under the three traps/foot of boat length regulation. This froze the total number of traps at 76 623.
1966	A 51 x 305 mm escape gap was introduced into all traps to allow sub-legal size lobster to escape before traps are brought to the surface.
1971/1972	Escape gap was increased to 54 x 305 mm.
1973	Multiple entrances in pots were banned.
1977/1978	Fishing season was shortened by 6 weeks from 15 November – 15 August to 15 November – 30 June to protect newly mated females and to constrain fishing effort.
1979	Boat replacement policy was changed to allow a boat's trap quota (entitlement) to vary from 7 to 10 traps per metre of boat length. This gave fishers flexibility in the size of the replacement boat they could have for a given trap quota.
1984	Maximum size for traps was established based on a maximum volume of 0.257 m^3.
1986	Number of escape gaps (54 x 305 mm) in traps was increased (from one) to three or four (depending on the position of gaps).
1986	Trap numbers of all licence holders were reduced temporarily by 10% for the 1986/87 season. Total trap numbers were reduced from 76,623 to 68,961 for one season.

Table 1.1 cont.

Year/Season	Regulation
1987-1991	Trap numbers were permanently reduced permanently by 10%, at 2% per year for 5 years.
1992/1993	10% reduction in traps in Zone B (15 November – 9 January) Closure in Zone B (10 January – 9 February) Total protection of setose females (November – February) Maximum size for females (115 mm)
1993/1994	Replaced the 1992/93 management arrangements by: 18% reduction in traps Minimum size increased to 77 mm in November – January Return of females which were setose or above a maximum size (105 mm Zones A and B and 115 mm Zone C)

1.2.6 Rules and Regulations

1.2.6.1 Minimum and Maximum Sizes Limits

Minimum sizes for the legal retention of fish are usually introduced to reduce exploitation and protect against the removal of fish from a stock before they have had an opportunity to breed. Lobsters in the western rock lobster fishery are measured for legal size by determining the linear distance from the front to the back of the head carapace; this is usually done by applying a plastic or metal gauge to the head of the lobster (referred to as "gauging" the lobster). Minimum sizes in the fishery apply to both recreational and commercial fishers, such that lobster below the prescribed size must be returned to the water within five minutes of capture.

Current minimum sizes are a carapace length of at least 77 mm between 15 November and 31 January, and 76 mm between 1 February and 30 June, each fishing season. The "split" minimum size was introduced in the 1993/1994 management package designed to boost egg production; the larger minimum size at the beginning of the season allows 76 mm lobsters an opportunity to join the breeding stock in deeper off-shore water, where exploitation rates are considered to be lower, before they become available for capture by the fishery. The "split" also has the flow-on benefit of allowing animals normally caught as "whites" in the first half of the season to be captured as more valuable "reds" in the second half (Marec 1997).

In the 1992/1993 season a maximum size of 115 mm for female western rock lobster lobsters was introduced. This rule, which was modified in the 1993/1994 season to provide different maximum sizes between zones, was designed to protect large females in the stock, further contributing to the recovery in egg production experienced through the late 1990's. Since breeding stock indices are currently exceeding target levels, the rule was removed for the 2001/2002 season to coincide with a year of lower than average predicted catch. The protection of "oversized" females will be reinstated for the 2002/2003 fishing season.

1.2.6.2 Bag limits

Recreational fishers are subject to a daily bag limit of 8 lobsters per licensed fisher per day, with an additional restriction that no more than 16 lobsters may be held aboard a vessel at any one time regardless of the numbers of fishers present. Reduced bag limits may apply for fishing within prescribed marine conservation areas (eg. Ningaloo Marine Park).

1.2.6.3 Breeding Stock Protection

Since the 1993/1994 season it has been illegal to take female rock lobsters that are in breeding condition. This rules covers three stages of the female lobster breeding cycle, and lobsters in these conditions are colloquially known as "setose", "tarspot", or "berried" (see Section 1.2.4). The protection of oversize female lobsters also contributes toward conserving and improving the breeding stock.

1.2.6.4 Licences

The commercial fishery is limited entry by means of a licensing system administered by the Department of Fisheries, Western Australia. Vessels, skippers, and crew must be licensed to participate in the fishery. Recreational fishery participants must purchase a seasonal licence (15 November – 30 June) for the capture of rock lobster. Numbers of recreational licences are currently not capped in any way.

1.2.6.5 Gear and Fishing Restrictions

For both recreational and commercial fishers, pots must be within prescribed maximum dimensions and contain at least three appropriately sized escape gaps to allow small lobsters to exit the pot. Each pot must be fitted with a rope and a float, and the float must be inscribed with the licence holder's gear identification number. Recreational fishers are limited to using 2 pots, while commercial fishers may not use more than their licence conditions prescribe. Pots may only be pulled once per day, and it is an offence to pull another fisher's pots. There are restrictions on the times pots may be attended, effectively limiting fishing to daylight hours. Pots may be legally constructed in any shape and of any material provided they conform to maximum size limitations, but in practice only 2-3 types of pots are used. Commercial fishers generally use "batten" (or slat) type pots that are constructed of pine slats built around a steel base. These are heavy, up to 40kg each, and are especially suited for shallow-water fishing. Alternatively, some commercial fishers, especially in Zone C, use "beehive" (also known as "stick") pots; these are circularly constructed of woven cane, and are often used for deep water, reef-associated fishing. Recreational fishers often use beehive pots, but are somewhat restricted in their use of batten pots due to the weight of the pots; mechanical pot winches are only occasionally observed on recreational vessels, and it is a strenuous exercise to manually raise batten pots. A variety of plastic pots are also available and are used exclusively by recreational fishers.

Recreational fishers, but not commercial operators, may dive for lobsters, either by free-diving or by using underwater breathing apparatus. Divers can use hand-held snares or blunt crooks to assist in the capture of lobsters, but it is an offence to use any instrument that could potentially damage lobsters during capture (eg. spears).

1.2.6.6 Other Restrictions

Since it is an offence for recreational fishers to sell their catch, there is a requirement that recreational catch must be marked to distinguish it from commercial catch. This is achieved by a requirement that fishers must clip the central flap of the tail fan. It is also a rule that fishers must not process the lobster (ie. remove the head carapace, referred to as "tailing") until they take the catch home. This rule is to ensure that Fisheries Officers can check fishers for the retention of non-legally sized lobster, since the minimum and maximum sizes are determined from carapace measurements.

1.2.7 Enforcement and Compliance

As demands on a fishery increase, effective regulation and a high level of compliance become vital. Enforcement effort in the western rock lobster fishery is designed to maximise the potential for fishers to voluntarily comply with fishery rules, while at the same time providing a reasonable threat of detection, successful prosecution, and significant penalties for those who do not. This is achieved by effective monitoring and surveillance, appropriately trained enforcement staff, suitable deterrents in the form of fines and administrative penalties, and targeted educative campaigns.

The Department of Fisheries employs approximately 45 Fisheries Officers involved in rock lobster compliance monitoring around the state each season. Most Officers are permanently located in the population centres of Perth and Geraldton, however there is a permanent presence maintained in six smaller regional towns. Four Officers are specifically employed to undertake mobile patrols along the length of the fishery. These Officers are able to conduct "surprise" inspections, an activity that is particularly important in smaller towns where fishers can quite easily learn the movement patterns of local Officers. Fisheries Officers access the rock lobster fishery at sea by three large patrol vessels (greater than 20 m), 8 small patrol vessels (up to 8 m), and trips aboard commercial fishing vessels.

Compliance activities include at-sea inspections of licences, catch and fishing gear, land inspections of catch and fish processing factories, aquaculture facilities, retail outlets, delivery routes, and educational initiatives aimed at promoting awareness of fisheries regulations (Table 1.2). A Serious Offences Unit of between 5 and 10 officers has the task of conducting complex investigations into serious fisheries offences. Members of the public and commercial fishers are able to report instances of observed illegal activity through the "Fishwatch" system, a state-wide 24-hour telephone hot-line.

Table 1.2 Compliance related data collected for the western rock lobster fishery. Symbols indicate that data are either collected (☑), not collected (☒), or infrequently/non-systematically collected (☐) for each cross-categorisation of infringement type and inspection point.

	Commercial and Recreational				Commercial		Recreational
Infringement Type	Sea[1]	Air[2]	W/R[3]	Road[4]	Factory[5]	POL[6]	POL[6]
Catch Restrictions							
Undersize	☒	☒	☑	☑	☑	☑	☑
Oversize (female)	☒	☒	☑	☑	☑	☑	☑
Setose	☒	☒	☑	☑	☑	☑	☑
Tarspot	☒	☒	☑	☑	☑	☑	☑
Out of season	☑	☑	☒	☐	☒	☑	☑
Gear Restrictions							
Number of pots	☑	☒	☒	☒	☒	☒	☑
Pot dimensions	☑	☒	☒	☒	☒	☒	☑
Escape gaps	☑	☒	☒	☒	☒	☒	☑
Pot identification	☑	☐	☒	☒	☒	☐	☑
Licence Restrictions							
Check licences	☑	☒	☑	☑	☒	☑	☑
Area restrictions	☑	☑	☒	☒	☒	☑	☑

1. **Sea:** checks undertaken by Fisheries Officers operating from agency patrol vessels.
2. **Air:** surveillance activities undertaken from low-flying small aircraft.
3. **W/R:** refers to inspections undertaken in the wholesale/retail sector, including any premises dealing in fish product.
4. **Road:** checks of vehicles involved in the transit of lobsters, including commercial rock lobster transit trucks and domestic vehicles.
5. **Factory:** inspections undertaken at rock lobster processing factories.
6. **POL:** checks made at point of landing. For recreational fishers this includes boat ramps and beaches, for commercial fishers this primarily refers to consignment depots or anchorages.

In addition to the Fisheries Officers dedicated to rock lobster compliance, there are approximately 200 Voluntary Fisheries Liaison Officers (VFLOs) that assist educating recreational fishers about fishing rules and regulations for all fisheries. VFLOs are fishing enthusiasts who donate their time to educate other fishers about conservation and fish management. They are formally engaged as volunteers with the Department of Fisheries WA, and receive training on fishing regulations, fish handling and care, and habitat protection. Although VFLOs do not have the statutory powers of Fisheries Officers, they play an important educative – and possibly deterrent – role on the beaches and boat ramps of Western Australia.

Penalties for illegal activity in the rock lobster fishery are commensurate with the value of the illegal fish involved, and the type of illegal activity. This can sometimes result in large monetary penalties for certain types of activity, with large penalties considered necessary in order to create a deterrent effect for a high value species like the western rock lobster. For example, commercial fishers found over-potting are fined for each pot they fish over their legal entitlement. In addition, the fisher's normal pot entitlement is permanently reduced by the number of excess pots they were found fishing, a substantial loss considering pots currently trade at around $25,000 AUD each. Major offences also attract a "black mark" against the fishing licence; three black marks in a ten year period can result in licence suspension or cancellation, a substantial penalty by any measure.

Breaches of fishery rules may occur for a variety of reasons, including fishing in closed waters, fishing out of season, taking protected fish, use of illegal fishing gear, illegal sale of lobster, unlicensed fishing, or interfering with other fishers' gear. Breaches usually fall into one of three categories according to a set of Departmental guidelines and rules set out in the *Fish Resources Management Act (1994)*:

i) Infringement Warnings – these are written warnings issued for minor fishery offences. They do not incur a fine, but are a written record of a minor offence that may be referred to by Fisheries Officers in the future. A certain number of infringement warnings for similar offences in a designated period may result in an infringement notice.

ii) Infringement Notice – these are written notifications of a requirement to pay a monetary penalty for an observed offence. Fishers issued infringement notices may choose to defend the matter in court, however most fishers simply choose to pay the fine (the system is analogous to motorists who speed and are issued a speeding ticket). The Department of Fisheries may initiate a prosecution brief for those fishers who appear to be habitual offenders.

iii) Prosecution Briefs – these are offences of a serious nature (prescribed in the FRMA 1994) that immediately proceed to formal, legal prosecution. Such matters often incur hefty fines, or can even result in incarceration, and matters brought before the court are often vigorously defended (especially by commercial fishers). For the commercial fishery, a successful prosecution for a serious offence may result in a "black mark" against the fisher or the commercial licence. Since the accumulation of three black marks in a ten-year period may result in the cancellation or suspension of an authorisation to fish, the high value of commercial rock lobster licences means this law provides a substantial deterrent against serious offences.

Additionally, Fisheries Officers record instances of where they issue verbal warnings for minor infractions that do not warrant a written warning and are best dealt with in an educative manner. Total numbers (excluding any personal details) are recorded since this may provide an indicator of the where educational initiatives may be effectively targeted.

The level of enforcement required to maintain an acceptable level of compliance at different stages of the fishing process is developed through regional compliance meetings involving program managers and field staff. In accordance with the National Fisheries Compliance Committee (1999) stated commitment to collaborate with fisheries stake-holders to develop and implement fisheries policies and laws, stakeholder groups have input to the compliance program through the management advisory committee (RLIAC), and a Compliance Subcommittee created to specifically examine compliance related issues.

In 1995/1996 the commercial rock lobster fishery began operating on the basis of partial cost recovery from license fees, with full cost-recovery implemented in the 2001/2002 season. The compliance budget for 2001/2002 was around $3.8 million AUD, accounting for approximately 50% of the total costs recovered from industry. Research accounts for the second largest expenditure at 30% of total costs, with management accounting for the remaining 20%. The compliance budget accounts for 2-3% of the total value of production from the fishery, which compares favourably with many other national and international fisheries compliance expenditures. Stakeholder participation, and in particular their responsible attitude toward compliance, plays an important role in ensuring that limited compliance resources are targeted to best effect among competing compliance activities.

Compliance in the rock lobster fishery today is generally thought to be high (Donohue 1998), although this has not always been the case. In the early 1960's a Royal Commission into illegal activity in the fishery revealed evidence of large-scale removal of totally protected fish, and collusion between commercial fishers and factory workers to process the illegal catch. Findings from the Commission prompted the introduction of amendments to the fishery legislation providing for larger fines, and a redirection of enforcement activities towards checking more factory consigned catch. Since that time, enforcement activities in the fishery have focused on inspection of catch as the primary, but not the only, method for minimising illegal landings, and the at-sea inspection of gear to maintain effort restrictions.

The rock lobster resource in Western Australia is easily accessible and of sufficiently high value to create incentives for both commercial and recreational fishers to break fishery rules. In a later section I discuss the reasons why some fishers may choose to disobey fisheries laws, but for the moment it is sufficient to state that monetary gain is often a motivating factor. In many high value fisheries (eg. abalone, Hauck and Sweijd 1999), illegal poaching and black-market sales can quickly put the sustainability of a fishery under threat. Continued sustainability relies on effective regulation and high compliance with rules, and in Western Australia this is ensured by public education and a multi-faceted enforcement program that is continually re-evaluated in response to changing conditions in the fishery. While it is often difficult to accurately measure non-compliance (McKinlay and Millington 2002), careful measurement can lead to meaningful estimation of compliance rates, and all indicators in the western rock lobster fishery point to high levels of compliance with fishery rules. Notwithstanding, there are several emerging compliance issues that are particularly difficult to measure, and these, along with all other known compliance issues, are discussed below.

1.2.8 Current Compliance Issues in the Western Rock Lobster Fishery

In addition to engaging stakeholders in compliance management through the RLIAC process, the Department of Fisheries W.A. also conducts an annual risk assessment process that involves management, field-based Fisheries Officers, and fishers and lobster processors not normally associated with the RLIAC committee structure. Risk assessments describe the formal process of determining threats to achieving desired outcomes from a given process. The idea is to establish desired outcomes, exactly what processes may lead to the outcomes (by systematically describing them), and the impacts (risks) upon the process that may deleteriously affect outcomes. If possible, it is desirable to quantify risks at each stage of the process. Risk assessments historically arose from the business community, but the practice has since been adopted in many disciplines as way of methodically describing processes and impacts. The main objective is to minimise (through affirmative action) those risks that may threaten preferred outcomes, thereby allowing optimal allocation of resources between "competing" risks.

Based on the last two risk assessments for the fishery, as well as discussions with Fisheries Officers and rock lobster fishers, the current compliance issues in the fishery can be summarised as follows.

1.2.8.1 Over-Potting

Over-potting refers to the practice of commercial or recreational fishers operating more pots than they are legally licensed to fish. If widespread, the practice has the potential to seriously affect stock sustainability, since effort limitation through a cap on total pot numbers is an integral part of the management of the fishery. There are several issues to consider when evaluating over-potting. Prior to the introduction of GPS technology, commercial fishers set their pots in long lines of between 10 and 20 pots, each with distinctive header floats. This made it relatively easy for Fisheries Officers to find and count the number of pots being fished by individual fishers. Since GPS, however, fishers can set their pots in groups of as few as one or two pots, making an accurate pot count difficult for Officers.

The problem described above is compounded by the recent introduction of time-release corrosive links to the fishery. Illegal in Western Australia, these are small devices designed to hold pot floats and ropes underwater for predetermined periods of time. The basic principle is that exposure to salt-water slowly corrodes metallic components of a fastener holding ropes and floats under the waters surface. Such devices were devised to allow "set" fishing gear to be deployed in congested waterways (eg. NSW estuaries), but have the unfortunate side-effect of providing a mechanism whereby western rock lobster fishers can potentially fish undetected with more pots than they are legally entitled.

Despite the relative ease with which fishers might successfully over-pot, this issue is considered only a minor risk in the fishery for two reasons. First, Fisheries Officers can and do conduct complex covert investigations into fishers suspected of over-potting, and some of these have led to successful prosecutions. The penalties for over-potting are such that fishers face a substantial monetary fine for each pot they use in excess of their entitlement, and their entitlement is permanently reduced by the number of pots they are caught with – since pot prices currently trade at around $25,000 AUD per pot, such losses are not inconsequential. Additionally, for serious over-potting breaches fishers may have their licence cancelled, or suspended for a period. Second, for those fishers wishing to increase catches by breaking rules, it is relatively easy for fishers to illegally pull other fishers pots, obviating the need to risk being caught with excess pots themselves (see Section 1.2.8.2). With the introduction of corrosive links, however, some fishers may consider over-potting a low-risk method of illegally obtaining extra catch, and continued monitoring of the problem is necessary.

1.2.8.2 Illegal Pot Pulling

Illegal pot-pulling (or "pot-poaching") refers to the practice of fishers pulling other fishers pots in order to steal the catch. This activity occurs both between and within the recreational and commercial sectors of the fishery, with more interaction between the different sectors occurring in the near-shore, shallow fishing grounds. Although the practice poses little threat to the sustainability of the stock (since the total number of pot-lifts remains approximately the same), it does encourage "copycat" crimes, retaliation, and in some cases violent retribution against suspected offenders. Fishers state that the problem was less of an issue when the fleet was less mobile, but with the introduction of larger and faster boats in the last 10-20 years there is now extensive overlaps in fishing grounds, providing greater opportunity for illegal pot-pulling. The perception, at least, is that the practice is increasing, particularly among commercial fishers who are leasing large numbers of pots.

Commercial fishers claim they are able to tell when their pots have been illegally pulled, with 7 out of 8 commercial fishers attending the 2001 risk assessment stating they had experienced their pots being illegally pulled at least once in the previous season. At face value this would indicate the practice is widespread, however this judgement is often made without any evidence and requires some qualification. For example, most fishers judge their pots to have been pulled by another fisher if the pot is empty (or only contains protected animals) when in the vicinity of other pots that have caught legal lobsters, especially if the pot in question has moved some distance down-current (indicative that the pot has been pulled and reset). While this type of example is suggestive, it is certainly not conclusive of illegal pot-pulling since in congested fishing areas pots may be accidentally moved due to entanglements.

The extent to which illegal pot-pulling is a problem remains unknown at the present time, with no obvious way of quantifying the extent to which the activity may be taking place. Investigations into suspected pot-poaching are complex, requiring elaborate operations involving marked lobsters, covert surveillance, and a certain amount of luck. There is also reluctance on the part of industry to help participate in operations to catch offenders, mainly because of lost income that occurs when they are required to leave a number of pots unattended for a period. Commercial representatives at the 2001 risk assessment suggested the need for an industry compensation fund to recompense fishers who are cooperating with enforcement personnel by not lifting their pots for a set period, and this idea is currently being investigated.

1.2.8.3 Use of Non-compliant Gear

Use of non-compliant gear, while not thought to be a major concern in the fishery, has the potential to increase catches rates, and therefore increase effective fishing effort.

There are several ways in which gear can be illegally modified to increase catches, including:

i) Removal of pot doors from batten pots – fishers may remove the 2nd and/or 3rd batten on the door of pots set in deep water to target migrating lobster. The practice has the effect of allowing more lobsters to quickly enter the pot, but does increase the ease with which lobsters can escape from the pot if it is not pulled within a sufficiently short time. Anecdotal evidence suggests that current flows in deep water assist in aligning modified pots such that the open side points toward the direction from which migrating lobster approach. Although no direct evidence of the practice exists, it is thought to be occurring among some fishers during high catch periods of the season, particularly during the "whites run" and the Big Bank fishery. This is likely to be a problem only during periods of high catch, and is usually associated with the (illegal) practice of pulling pots on multiple occasions on a single day.

ii) Blocking pot escape gaps – this practice involves obstructing the three mandatory escape gaps on rock lobster pots. Escape gaps are designed to allow the escapement of smaller sized lobster, and blocking these gaps will cause the animals to be retained (and perhaps illegally taken). This type of activity can usually be checked when Fisheries Officers conduct gear inspections, however some unscrupulous fishers make detection particularly difficult by arranging gap obstructions such that they dislodge when the pot is pulled. For example, instances have occurred where fishers fix ceramic tiles over escapement gaps, and rig the pot rope such that it passes between the tiles and the escape gap; when the pot is retrieved, the tiles are sprung loose and not raised to the surface. Although tiles are lost with every pot pulled, the practice is still potentially profitable at certain times of the year for those fishers willing to undertake the illegal activity. Ironically, unpublished Department of Fisheries research data indicates blocking escape gaps actually decreases legal catch rates by saturating pots with small animals.

iii) Use of oversize pots – this problem involves fishers who utilise pots larger than the maximum prescribed size limits. Although not thought to be a significant problem prior to the 2000/2001 fishing season, it has recently come to the attention of Fisheries Officers that some fishers have manufactured pots slightly larger that the prescribed limits, with the potential of increasing effective effort. Fisheries Officers check for these types of breaches by conducting gear checks.

1.2.8.4 Fishing in Closed Waters

Marine protected areas ("no take" zones), habitat protection areas, zonation by licence conditions, and closed seasons all play an important part in the management of the western rock lobster fishery. Detection of recreational infringements of this type are generally undertaken by shore-based Fisheries Officers operating out of small (< 8 metre) vessels, while off-shore commercial infringements are more usually detected by Fisheries Officers aboard large, ocean-going patrol vessels.

Some commercial fishers choose to disobey area restriction rules in order to increase catches, and this is often linked to competition between fishers, and perceptions of equity among differently zoned fishers. Two noteworthy examples include:

i) The "30^{th} Parallel" (latitude 30° South) describes the boundary line that separates Zones B and C of the fishery. As lobsters migrate northward as part of the "whites run", some move from Zone C to Zones B/A. Fishers from Zone B, particularly if catches during the whites migration have been low, can be tempted to increase catches by crossings the Zone C/B boundary-line to target the migrating lobster.

ii) The Big Bank region of the fishery is located at the Northern boundary of the Abrolhos Islands area (Zone A), and it is illegal for Big Bank fishers to capture lobsters South of this line. During the Big Bank season, however, lobsters are migrating in high numbers northwards of the Abrolhos Islands boundary line, and those boats that are able to set their pots closest to the boundary are able to obtain catch rates far in excess of those vessels with gear set even moderate distances from the boundary. This causes intense competition between skippers to set gear as close to the boundary as possible, and creates a strong monetary incentive to broach the boundary. Despite high penalties, and the presence of an enforcement vessel for much of the Big Bank season, this poses a continuing problem for the fishery. It should be noted that, under current levels of control, this primarily represents a problem of equity between competing fishers, not an ecological risk, since the lobsters available for capture are simply caught at a slightly different location. A more significant risk would emerge if current enforcement measures were not undertaken, however, as fishers would likely make substantial encroachments into the Abrolhos Islands area. Fishing pressure on the boundary line has also been alleviated by a later start to the Big Bank fishery, so that a proportion of the migrating lobsters have crossed the boundary line before the start of the season.

1.2.8.5 Holding Undersize Lobster Prior to Gauge Change

Recall from Section 1.2.6.1 that the fishery operates under a split minimum size rule, with a minimum legal carapace length of 77 mm from 15 November – 31 January, with a decrease in legal carapace length to 76 mm from 1 February until 30 June. While this rule has been effective in increasing escapement of juvenile animals to the breeding stock, with consequent increases in egg production, it has also created a compliance problem among certain commercial fishers.

During normal fishing operations prior to 1 February, captured 76 mm lobsters should be immediately returned to the water. In the week leading up to 1 February, however, some fishers have adopted a practice of storing 76 mm animals in holding pots at sea until 1 February, at which time the lobsters can be legally retained and consigned to processors. Holding pots may consist of one or more legal pots, or they may be specific, unmarked pots, with the escape gaps obstructed. Animals that are consigned on 1 February after having been held captive for up to a week are generally in poor condition, showing signs of disease and substantial limb loss. While this problem does not present a biological threat to the fishery, the deterioration in the quality of lobsters consigned around the time of the gauge change has caused industry (through the RLIAC process) to place a high priority on ensuring this practice is effectively policed.

Perhaps the easiest way to eradicate the problem would be to make the minimum size uniform throughout the season, however industry representatives are reluctant to adopt this approach: to make the minimum size 76 mm all season would increase exploitation and inhibit the continuing recovery of the breeding stock; to make the minimum size 77 mm all season would reduce catches and cause some fishers financial hardship. For the moment, at least, the split minimum size rule will remain in the fishery, and this poses problems for enforcement personnel since the practice is particularly difficult to police. Chapter 1 examines an experimental approach to determining those fishers who may be holding-over 76 mm lobsters prior to 1 February. Although the statistical evidence from the study is yet to be legally tested, the method shows promise in helping to identify and prosecute those fishers engaging in the practice.

1.2.8.6 Interference With Fishing Gear

Interference refers to the practice of moving another fisher's gear away from where it is set, or, more destructively, by cutting the pot floats of another's gear. When gear is moved it is usually pulled away from a productive area of fishing ground (e.g. particular ledges or "lumps" on the ocean floor), often because the individual engaging in interference feels that another fisher has encroached on existing pot placements. While clearly illegal, most activity of this type is settled between the fishers concerned, principally because fishers rarely come forward to report their suspicions unless they are sure loss of product is occurring. In other words, unless a fisher strongly suspects another of theft of lobster, they will almost always try to settle the dispute without the involvement of Fisheries Officers. Like the offence of illegal pot pulling and lobster poaching described earlier, detecting and catching fishers illegally interfering with another's gear is not a straightforward process – this is true from the perspective of fishers and Fisheries Officers alike. If particular pots are consistently being moved, and are being recovered empty of lobster, this at least provides circumstantial evidence to a fisher that pots are being illegally pulled and lobster removed. If, however, pots move but are still catching lobster (albeit fewer), then it is more difficult to conclude that the pots have been intentionally moved, another reason why fishers are sometimes reluctant to involve enforcement personnel in suspected cases of gear interference.

1.2.8.7 Translocation of Product

In Section 1.2.8.5 I described the practice of fishers illegally holding undersize (76 mm) lobsters in sea cages prior to the minimum size change of 1 February, with the intention of consigning them as legal catch on or after 1 February. Translocation of product is a similar offence, in that fishers "store" illegal animals by translocating them to isolated, small areas in the fishing grounds, hoping to re-catch them when the animals become legal. Undersized lobster, and lobster that are in breeding condition, are accumulated on board during normal fishing, then transported to isolated patches of reef surrounded by sand. Animals deposited in this manner will likely find immediate shelter in the nearby reef, and, if deposited around the time of a full moon, are unlikely to move from the immediate vicinity. Fishers mark the position of such areas with GPS, and return at a later date to "harvest" the lobsters that have grown into legal condition.

There is anecdotal evidence in the form of intelligence from fishers that this practice is becoming widespread, particularly in the North of the fishery. For those wishing to illegally increase catches, the practice provides an attractive alternative to holding pots around the time of the gauge change – even if some animals are not recaptured from their new location, translocation is a much more difficult offence to detect and prove, and fishers are aware of this. It is speculated that some fishers may be engaging in the practice throughout the season, and while animals are not actually consigned in an illegal state, the practice does increase effective effort within the fishery. Continued monitoring of this practice is necessary, however it is questionable whether current enforcement techniques can adequately detect the activity.

1.2.8.8 Seeding Pots With Non-Legal Animals

In some lobster fisheries, such as in Florida (Hunt *et al.* 1986), fishers place undersized lobster in pots in order to attract other lobsters to the traps. "Seeding" pots in this way, while legal in Florida, is illegal in Western Australia where effort limitation is central to management of the fishery. The practice undoubtedly attracts lobsters into pots (Florida lobster fishers do not use bait), but it is questionable whether the practice increases catch rates over and above those experienced by using baited pots. Like many "on the water" illegal activities, evidence of the practice is difficult to collect, and at the present time the number of fishers engaging in the activity is unknown. There is currently no research underway in Western Australia to test the effects on catching efficiency by "seeding" pots, and until such time it remains an important rule to be enforced.

1.2.8.9 Illegal Sale or Purchase of Lobster

The illegal sale, trade, or barter in lobster is a potential problem in both the commercial and recreational sectors of the fishery. There are important distinctions between the sectors, however. Commercial fishers may legally sell catch to the public provided it complies with legal requirements. Commercial fishers are required to issue a receipt for all sales (trade or barter is illegal), and transactions must be accounted. However, only a relatively small proportion (certainly less than 5%, and estimated at <1% in many seasons) of all landed commercial catch is sold in this manner, since prices paid by licensed processing factories generally exceed the price that can be obtained from ex-vessel sales. There exists some risk that commercial operators may sell non-legal catch directly from the vessel, but routine, random boat searches by enforcement staff have uncovered little evidence of this practice.

In contrast, recreational fishers are only allowed to catch lobsters for consumption by themselves, family, or friends, and are not entitled to sell, trade or barter catch whatsoever. With a daily bag limit of 8 lobsters, some proficient recreational fishers can accumulate large amounts of catch, and the high value of the product creates a demand for black-market sales. Periodically, Fisheries Officers detect non-commercial fishers, who may or may not hold a recreational licence, catching and illegally selling rock lobster. The extent of illegal sales by non-licensed fishers is difficult to measure, particularly when lobsters are only sold to close associates. Illegal sales into the retail/wholesale restaurant market are easier to quantify, since purchases must be substantiated with appropriate documentation, and animals must have their telsons intact (ie. not "tail-clipped").

Periodic checks of the wholesale/retail sector by Fisheries Officers have shown only low levels of illegal activity. For example, immediately prior to Christmas in the 2000/2001 season Fisheries Officers conducted random inspections of 106 retail outlets that could potentially be selling rock lobster. Of these, 28 outlets had rock lobster on premises at the time of the inspection, and only one establishment was found in possession of illegal lobster. Despite apparent low levels of illegal sales, both industry and enforcement personnel feel continued monitoring of this type of activity is desirable.

1.2.8.10 Commercial Fishers Consigning Protected Lobster to Processing Factories

With over 95% of the commercial catch in each season consigned to a limited number of licensed processing factories, inspection of factory consigned catch is an important part of the enforcement program for the western rock lobster fishery. Consequently, these types of inspection have become increasing sophisticated in recent years, and will be discussed in some detail in a later section. Briefly, Fisheries Officers check a proportion of commercially consigned catch to ensure it complies with size and breeding condition rules. The large volume of catch in the fishery makes checking all consigned catch impractical, so officers undertake random inspections of all fishers, and targeted inspections of those who are suspected of deliberately consigning non-legal catch or who have a history of rule breaches detected from previous random inspections. Compliance is generally high among the large majority of fishers, with an overall average infringement rate in the last three years of 1-3 illegal animals in every 1000 animals consigned. There remains some risk that individual factory processors may collude with fishers to periodically accept large numbers of illegal animals (such as occurred in the 1960's), but it is likely that the current regime of random inspections (random with respect to both fishers and time of inspection) would detect the practice if it were occurring.

1.3 Enforcement and Compliance in Fisheries

1.3.1 Introduction

Fisheries monitoring, surveillance, and enforcement activities are an integral part of any well-managed fishery. Indeed, the failure of many fishery management programs in the United States has been ascribed to non-compliance with fisheries law (Sutinen *et al.* 1990). Around the world, demands on fisheries resources are increasing, requiring strict regulation to ensure that stakeholders use resources responsibly. Unfortunately, some people choose to disobey fisheries law, so that regulations in themselves are rarely sufficient to ensure responsible resource use. Measures must be undertaken to encourage an acceptable level of compliance with regulations in order to ensure that management objectives are not compromised. An acceptable level of compliance will vary according to how particular rules affect management objectives in individual fisheries, but will generally relate to preserving resource sustainability, ensuring efficient economic returns from the fishery, and providing equitable access to all who may legitimately use the resource.

In this section I outline some of the social and economic theories of crime, examining why people may commit crime, how they justify criminal behaviour to themselves, and how fisheries crime may fit within established theoretical perspectives. I contend that knowing fishers' motivations for undertaking illegal activity is vital to developing meaningful education or enforcement programs designed to increase fisheries compliance. I also develop the concept of achieving positive compliance outcomes in a fishery, and methods that might be employed to reach that goal. I define positive compliance outcomes as achieving acceptable levels of compliance, sufficient to ensure the biological sustainability of a stock and preserve equity among stakeholder groups, for a reasonable cost to enforcement services. I explore considerations surrounding the allocation of enforcement effort, measuring non-compliance, and determining enforcement-compliance relationships. Finally, I discuss some strategies to achieve positive compliance outcomes, including individual and community regulation, non-judicial and judicial approaches to deterrence, and fisher education.

1.3.2 Social and Economic Theories of Crime

Generally, criminological theories may be divided into those that focus on how society influences the incidence of crime (sociological approach) and those that focus on the individual and their experiences (psychological approach). These distinctions are not always straightforward, however, since individual beliefs and experiences can rarely be separated from prevailing societal structures. In a sense, psychological approaches focus on the micro-scale causes of crime, while sociological approaches consider the macro-scale. Within these broad categorisations there exists a large number of theories about why people choose to commit crime, ranging from those focusing on genetics and biology, to those concerned with social learning and moral development. The proliferation of new theories published in the last 20 years is considerable, and perhaps surprising given a general lack of empirical research to substantiate many of the propositions (Feldman 1993).

In the fisheries literature, many theories have been proposed to explain illegal fishing activity, and most of these focus on the role of monetary factors in explaining non-compliant behaviour (often referred to as the "instrumental approach") (see Hatcher *et al.* 1998 for review). Furthermore, many economic studies have focused on theoretical, rather than empirical, analysis (eg. Sutinen and Anderson 1985, Milliman 1986). More recently several authors have recognised the importance of non-monetary factors in determining fisher behaviour with respect to fisheries regulations ("normative approach") (e.g. Sutinen and Gauvin 1989a, Furlong 1991, Hatcher *et al.* 1998, Kuperan and Sutinen 1998).

It is not my intention to provide a comprehensive review of the myriad of theories on the causes of crime, but rather to selectively discuss some of the more established theories as they might apply in fisheries contexts. I focus on those theories I believe may be important in explaining fisher motivations for breaking fishery rules, particularly social and economic theories, however I do not discount the possible importance of other theories in individual cases, or that fishers may be influenced by multiple factors in their decision to break rules.

I examine three theories that may have relevance in explaining illegal behaviour among fishers. The theories of differential association and neutralisation stem from the idea that criminal behaviour is a learnt process; the former suggests that exposure to patterns of deviant behaviour induces criminality, the latter that people learn ways in which to rationalise criminal behaviour. Rational choice theory proposes that people choose deviant activities through a kind of "cost-benefit" analysis, taking into account their probability of detection, the type of punitive action that they might incur if caught, and the benefits they will receive if their activity is undetected. I also discuss the main features of economic and white-collar crime, since I believe most fisheries criminal activity in Australian jurisdictions fall within these frameworks.

1.3.2.1 Differential Association

Differential association (Sutherland and Cressey 1970) is a theory that focuses on individual criminality, and proposes that criminal behaviour is learnt through association with others engaged in deviant activity. The theory suggests that a person becomes delinquent through exposure to delinquent patterns, and isolation from anti-delinquent patterns. People tend to assimilate their surrounding culture, so that exposure to criminal activity helps to establish patterns that lead to criminal behaviour. It is generally thought that the longer a person is exposed to criminal behaviour, the greater the chance of succumbing to criminal actions themselves.

The mechanisms involved in learning criminal behaviour are thought to be the same as mechanisms involved in learning other behaviours. Usually, learning criminal behaviour involves acquiring the techniques for committing crime, and attaining the attitudes, rationale and motives necessary for commissioning the crime. It also involves learning to view criminal and legal codes negatively. Occasional deviant acts rarely alter a person's perception of what constitutes deviant behaviour, but repeated acts of prolonged duration are thought to desensitise our ability to differentiate between positive and negative social behaviour.

1.3.2.2 Neutralisation

Neutralisation theory (Sykes and Matza 1957) is also based on the premise that deviance is a learnt behaviour, but focuses on the rationalisations people require in order for them to invalidate the legal code. In other words, personal rationalisations are used to excuse illegal behaviour, and it is thought that these rationalisations are a learnt behaviour. Neutralisation is a cognitive technique that allows people to engage in deviant activity, yet still maintain a positive self-image. Some of the ways people use rationalisations in order to justify illegal activity are outlined in Table 1.3.

Table 1.3 Types of Rationalisations Used To Justify Criminal Behaviour

Type of Rationalisation	Example
Denial of injury	"I committed the crime, but no-one got hurt". The offender admits responsibility for the act, but denies causing any serious injury.
Appeal to social patterns	"I know what I did was against the law, but it's OK because everyone is doing it".
Denial of victim	"I committed the crime, the victim did get hurt, but they got what they deserved". The offender reverses the role of offender and victim.
Condemnation of the condemners	"I committed the crime, but its OK because you are just as guilty as me". The offender justifies their actions by defining those who condemn as immoral, hypocritical or criminal.
Denial of responsibility	"I committed the crime, but I'm not responsible – it was an accident". If acts are beyond the control of the individual then the individual is guilt free, and also free to act.
Denial of the law	"I know what I did was wrong, but the law is wrong - it should not be illegal".
Appeal to higher loyalties	"I know what I did was wrong, but I did it for others". eg. I must kill for my country, steal for my family.

Modified from Andrews and Bonta 1994

1.3.2.3 Rational Choice Theory

Rational choice theory (Cornish and Clarke 1986) focuses on the concept that people engage in deviant behaviour through personal choice and rational calculation of "result" from "process". The main concept of this theory is that people freely choose all behaviour – conforming and deviant – based on rational calculations something akin to a cost-benefit analysis. Actions that result in benefits, with little or no cost, are obviously to be preferred over those that do incur costs. The state imposes costs (through laws and penalties) when it considers personal choices to be in violation of the social good. The swiftness, sureness and severity of punishment are classically thought to be the main factors affecting a law's ability to control human behaviour. The expected utility of the offender can be summarised:

$$E(benefit) = reward \times prob(crime\,not\,detected) - punishment \times prob(crime\,detected)$$

where the expected benefit is dependent on the reward, punishment (fine) and the probability of the illegal act being detected. This classical view was extended as a result of research into factors – social, biological, and psychological – that impose constraints onto the rational choices of individuals. According to the theory, an individual considering breaking the law will do so after considering (from Siegel 1992):

a) Their own personal situation:

  i) Need for money

  ii) Learning experiences

  iii) Personal values and motivations

  iv) The seriousness of punitive measures if caught

b) The circumstances surrounding the execution of the crime:

  i) The effectiveness of the police force and risk of apprehension

  ii) How well the target is protected

  iii) The expected return from the crime.

This perspective focuses on the act of crime, and crime prevention then becomes policies or activities that encourage criminals not to engage in deviant activity, to delay their actions, or to avoid particular targets. Two common strategies are target hardening (eg. security screens, neighbourhood watch) and legal deterrents (eg. mandatory sentencing, "three strikes" laws, more police). Two broad approaches to deterrence are generally recognised:

  a) General Deterrence – deterrence activities that focus on reducing the incidence of future deviant activities in the general population by impacting on their rational decision making process. Examples include public education programs, drink-driving crackdowns, and specially commissioned police units (eg. anti-burglary squads).

b) Specific Deterrence – it is thought that some people engaging in deviant behaviour will never be deterred from committing specific offences, but that their behaviour may be controlled through the application of negative sanctions. Specific deterrence therefore focuses on punishing known offenders so as to prevent them from violating the societal norms they have broken. In Australia, the most extreme form of this type of deterrence is incarceration.

Although there is a growing body of evidence to support many of the tenets of rational choice theory (reviewed by Feldman 1993), a number of questions remain unanswered:

- What is the relationship between severity of punishment and deterrent effects? Studies have shown this is not simply a linear effect (Siegel 1992), so that an incremental advancement in punishment does not necessarily show a consistent decrease in the propensity for individuals to commit particular crimes. Furthermore, it is likely that for some crimes there exists a threshold probability of detection, below which individuals undertake deviant behaviour without regard for punishment. In other words, if a fisher is willing to risk breaking a fisheries law provided the probability of detection is less than 1 in 20, then detection rates of 5%, 1% and 0.1% are all considered equivalent as far as the fishers propensity to violate is concerned. This situation would have serious implications for enforcement expenditure.
- How are the probability, speed and severity of punishment interrelated? There is some evidence to suggest that as the severity of punishment goes up, the probability of punishment (by a judge or jury) goes down (Siegel 1992). For example, there may be a reluctance to find someone guilty if the penalty is severe.
- What are the mechanisms that contribute to low crime rates? When enforcement activity is highly visible and effective, crime rates are low. As crime rates rise, enforcement services become stretched and the rate may rise even further. The question is whether it is the low level of crime that increases certainty of apprehension, or does certainty of apprehension lead to the low level of crime?

1.3.2.4 Economic and White-Collar Crime

Economic and white-collar crime share many similarities, some aspects of which I think operate in fisheries contexts. Here I briefly describe the characteristics of economic and white-collar crime, the motivations often associated with these types of behaviour, and the inherent problems with policing these types of crime compared with other criminal activity.

There are many types of economic crime, and many reasons for engaging in it, but all are linked by the common theme of theft for economic gain (Feldman 1993). It is useful to classify people who engage in economic crime into two types – those who do so only occasionally, and those who do so habitually. People who only occasionally commit economic crimes usually do so on an opportunistic basis, often by virtue of a particular situation, or sometimes because of inducement by a third party. On reflection they often recognise their behaviour as deviant and take steps to avoid repeating the behaviour. Most people at some time in their lives commit (very minor) occasional economic crimes. Alternatively, people may commit economic crime in a professional, repetitive way; they consider themselves professionals, and associate with their actions with traits such as competence, integrity, specialisation, and elements of esteem (by avoiding detection). Professional criminals are not nearly as numerous as people who only occasionally engage in economic crime, but their impact is usually much greater. They are often highly motivated and proud of their crimes; there is often no neutralisation occurring.

For a great many fishers engaging in occasional economic crime, I suspect they treat their infringement activity something akin to employee pilferage. In this scenario the fisher is the "employee", and the fishery (or by proxy, the fishery agency that provides management) is the "employer". Under this analogy, the fishery as a shared resource employs all commercial and recreational fishers, who in turn must comply with the company rules of employment (fisheries regulations). As with employee pilferage, the perpetrator often finds it easy to justify the crime – for example, to compensate for low wages (brought about by catch or effort restrictions) or tough working conditions (e.g. limits on fishing practices). Employee pilferage is generally viewed as more respectable than other types of economic crime (e.g. personal robbery), usually because it is difficult to identify the victim. In the case of the fishery there is no clearly identifiable victim – is it the lobster, the ecological sustainability of the fishery, or other fishers? In the western rock lobster fishery this has sometimes led to problems in obtaining sufficient penalties for successful convictions.

White-collar crime, as a subset of economic crime, refers to illegal acts committed for monetary gain by the affluent in the course of their normal business activities. It differs from many other types of economic crime in that it usually involves legitimate businesses carrying out deviant activity motivated by profit (this contrasts with organised crime who – at least historically – do not operate legitimate businesses). White-collar criminals often "learn how" through corporate culture or family enterprises (differential association theory), and may invoke elaborate rationalisations to justify their criminal behaviour (neutralisation theory). Many consider themselves respectable community members; indeed, many hold positions of prestige and influence within their community. Behaviour is further justified because offenders often only violate civil codes, not criminal codes (Goode 1996).

It is particularly difficult to effectively police white-collar crime. Activities are generally hidden in normal business routines, making illegal acts difficult to detect or trace. Successful prosecutions are generally difficult to obtain, and penalties are often small compared with the potential gains from illegal activity. This is in part due to the perceived respectability of the offender, and in part because it is often not clear who is to blame (diffuse responsibility). Perpetrators often argue that what they did was illegal but not criminal, relying on the defence that the demands of corporate reality can legitimately override individual awareness of criminality. Crimes "in the name of the company" are often motivated by demands for profit or performance (Goode 1996).

It might be argued that at least some rock lobster fishers who habitually engage in illegal fishing activities share many of the characteristics associated with white-collar crime. Illegal activity can be "hidden" among legitimate activities conducted in the course of their normal business. Those who stand to benefit most from illegal fishing (e.g. licence owners) may be quite removed from actual fishing activity, may participate in the management of the fishery, and may be well respected within the fishing community. Indeed, with the movement of a significant proportion of the fleet toward leasing arrangements, an imperative to break rules in order to for a skipper to retain a fishing contract can be created by an owner through catch-rate dependent contract renewal agreements. Of particular concern in the western rock lobster fishery is the emerging issue of defences against prosecution that effectively argue for diffuse responsibility (e.g. owners blaming skippers, skippers blaming crew), although this line of argument has been countered somewhat in recent times by statistically profiling offenders against their peers.

1.3.3 Motivations for Fisheries Crime

In this section I explore the types of, and motivations for, illegal behaviour occurring in regulated national fisheries. Examples are drawn from the western rock lobster fishery, but discussions with Australasian compliance managers have shown that the issues discussed are common to many nationally managed fisheries. I propose there are six main reasons why fishers may engage in non-compliant activity.

a) Fishers do not know the fisheries regulations.

While most fishers are aware of the main laws applicable to their fishery, many are unaware of secondary, support regulations. For example, the size of licence numbers on fishing boats must be a prescribed minimum size to enable Fisheries Officers to identify vessels from a distance (e.g. while undertaking aerial surveillance). Interpretations of regulations may also be ambiguous – for example, in the rock lobster fishery the definition of setose female lobster (those capable of carrying eggs) was in recent years successfully challenged in court. The wording of this regulation was consequently amended to remove the ambiguity, and Fisheries Officers undertook an extensive education campaign to alert commercial fishers to the correct interpretation. It is generally recognised that recreational fishers are aware of fewer regulations than their commercial counterparts.

b) Fishers do not believe in the fisheries regulations.

Fishers may not believe in fishery rules because the rules do not accord with their view of the fishery, or because the rationales for particular rules are poorly understood. Consequently, fishers who do not agree with fishery regulations are less likely to comply with those regulations. Reasons for not accepting fishery rules include:

i) A rule may not accord with a fisher's view of the status of the stock. For example, a fisher may ignore size restrictions if the rules do not logically coincide with personal perceptions of the stock structure and abundance (e.g. in the rock lobster fishery some fishers do not believe in the protection of large female lobsters).

ii) A rule may not reflect a fisher's view of rational or equitable multi-use of the resource. Evidence suggests that interference with fishing gear by competing rock lobster fishers (commercial and recreational) is problematic within some areas of the rock lobster fishery, and stems from perceptions held within both sectors that the other has unfair access to fishery resources.

iii) A rule may be considered unfair for historical reasons. For example, many new regulations are introduced over the life of a fishery, usually to limit catch and/or effort as demands on a resource increase. Fishers may not comply with regulations if they feel their historical use of the resource is not sufficiently protected when new rules are introduced. An example from the rock lobster fishery relates to fishing practices. Commercial fishers traditionally emptied a series of pots (a "line") at a time, storing all animals (legal and illegal) until all pots in the line were checked. Animals were then sorted and illegal animals returned to the water. This resulted in high mortality for non-legal animals, so new rules were introduced to compel fishers to check and sort their catch after pulling each pot. This may slow down the fishing process (introduce inefficiencies compared with previous practices), and some fishers do not obey this rule because they were historically allowed to pull multiple pots before sorting catch.

c) Fishers believe in the rules, but are willing to break them for personal gain.

Many fishers appreciate the need for fisheries regulations in order to maintain the resource's economic viability and ecological sustainability. Unfortunately, some fishers are willing to sacrifice the long-term sustainability of a fishery for immediate personal gain, often rationalising that their individual illegal catch would not have a major impact on the fishery. A relatively minor example might be a recreational fisher who, after not catching any legal-sized lobster many days running, decides to keep one or two undersize animals for personal consumption. More problematic is the commercial or recreational fisher who habitually retains all illegal lobster for personal consumption, or barter/sale on the black market.

d) There is an existing culture of non-compliance with regulations.

Social influence is a powerful motivating force for making individuals conform to the expectations of others, often in areas of activity they would rather not engage. If an individual's peers are breaking regulations, and not being caught, there is a strong incentive for the individual to engage in similar activity. In the 1960's and early 1970's there was a strong culture of illegal activity in the rock lobster fishery, followed by greater enforcement of the laws and the introduction of high penalties aimed at discouraging illegal activity. I have no direct evidence of a continuing culture of illegal activity, although the large proportion of multi-generational owner-operators in the fishery admits the possibility that the poor ethic of the 1960's may still exist within a small number of fishing families.

e) Fishers are suffering financial hardship.

Some fishermen may undertake illegal activities because of financial hardship. While closely related to breaking rules for personal gain, the motivation due to financial hardship is considered separately because of the imperative it can create for breaking rules. For example, fishers may be poorly capitalised, mediocre fishers, or leaseholders working for a smaller profit margin than owner-operators. Consider a fisher who is hired as a skipper by a license owner. He is likely renumerated by a share of the catch, so the amount of catch determines his share of the profit, as well as the amount of profit he makes for the owner. Further, fishers may be dependent on catch levels to retain their skipper's position, known as contingent contract renewal (Matthiasson 1997). There may therefore be large incentives for fishers to maximise catch to ensure future employment, creating an incentive to infringe fisheries regulations if sufficient catch is not achievable by legal means. Another situation where fishers may suffer financial hardship occurs when leaseholders are required to pay an up-front fee to utilise a license, rather than by paying a proportion of the catch on an on-going basis. If the up-front fee is high, but catches for a particular year are low, fishers may be inclined to break regulations to maintain their employment in the fishery.

f) Competition between fishers.

The problem of competition between resource users was first described by Hardin's (1968) concept of the "tragedy of the commons". This refers to the idea that people who utilise a shared resource will often do so for short-term gain, in spite of long-term detrimental effects to the resource. In the case of compliance in fisheries, if it is well known that many fishers do not obey fisheries laws, there is no incentive for any individual fisher to comply with the rules (see also point d above). For example, there is no benefit in returning undersize or mature female rock lobsters to the sea if someone fishing next to you is keeping them. When this becomes the case, fishers will compete for illegal catch in much the same way they compete for legal catch.

Finally, of concern to some fisheries managers is the proposition that some fishers engage in particular types of illegal activity because *fisheries enforcement personnel* do not believe in the rules. Although evidence of this problem is only anecdotal (and not, to my knowledge, apparent in W.A.), it is intuitively easy to understand how this might occur. Fisheries Officers deal with fishers on a day-to-day basis, and are well aware of those rules that are difficult to enforce or impractical with regard to the operational aspects of the fishing process. Furthermore, the reasons that fishers may not believe in regulations (point b above) may apply equally to Fisheries Officers, especially those who have a long association with a fishery. If Officers choose not to enforce particular regulations, then there will obviously be no deterrent effect against fishers breaking the rules.

1.3.4 Positive Compliance Outcomes

In this section I explore the idea of achieving positive compliance outcomes in a fishery through enforcement and education. I define positive compliance outcomes as:

> *A positive compliance outcome is one in which an acceptable level of compliance is achieved, and can be maintained, at a reasonable cost for enforcement services. This level of compliance should be developed in conjunction with an appropriate management plan, and serve to protect the long-term sustainability of the fishery for all stakeholders.*

Modified from "Strategic Direction for Australian Fisheries Compliance & Framework for Fisheries Agencies"

National Fisheries Compliance Committee 1999

There are a number of components to this definition of Positive Compliance Outcome, the first of which concerns the concept of an acceptable level of compliance. An ideal level of compliance would, of course, be complete voluntary compliance with all fisheries regulations. In practice this is rarely achieved, although some fisheries do approach this level through self-regulation (e.g. Maine lobster fishery (Houtman and Lignell 1996)). Normally, however, an acceptable level of compliance is determined by examining the trade-off between enforcement costs, requirements imposed by the current management strategy, and the effect a particular level of compliance has on competing interest groups. For any particular interest group within a fishery, there are three questions that should be asked when trying to determine a level of non-compliance that may be tolerated:

a) Will the biological sustainability of the fishery be threatened?

b) What would be the costs of greater enforcement activity (including educational activities), and what would be the costs – social, economic and biological – of not imposing greater enforcement activity?

c) What effect will non-compliant behaviour have on other (compliant) members of the same interest group, or on other fisheries or community stakeholders?

The second key point in the definition of Positive Compliance Outcome is that levels of compliance should be developed in close association with the wider management plan for a fishery. For example, most published biological models of fisheries assume that current (or future) management schemes work perfectly, and do not explicitly consider what the effect of non-compliant behaviour has on fished stocks (Hemming and Pierce 1997). This has the potential for under-estimating stock removed from a fishery, especially those fish that may be assumed protected by virtue of their size or reproductive state. Management plans and stock assessments need to recognise that enforcement programs cannot be 100% effective, and there will always be some level of non-compliance with regulations (Jennings 1994).

Identifying compliance risks and developing ways to minimise those risks in a cost-effective manner can encourage positive compliance outcomes. This requires a good understanding of fisher responses to the regulatory mechanisms operating within a fishery, and an appreciation of why they choose to obey or disobey regulations. This latter point is particularly important; most enforcement agencies concentrate on the "who", "where" and "how" of illegal activities, but often neglect the "why". Perhaps the most cost effective way of encouraging compliance is through positive educative programs, and these cannot be effectively targeted without knowing why fishers choose to break fisheries laws. I will discuss approaches to fisher education in a later section.

1.3.4.1 Allocation of Enforcement Effort

Effective allocation of limited enforcement resources is a primary goal in most regulated fisheries (e.g. Fuss *et al.* 1980) and integral to the definition of a positive compliance outcome. Allocation of enforcement effort must balance the risks of infringement associated with various stages of the fishing process against the associated enforcement costs (Anderson 1989). Most fisheries operate a range of regulatory mechanisms, some of which can be monitored at the point of landing (or processing), while others must be enforced at sea. Effort controls may include restrictions on the amount, size and type of fishing gear, as well as the areas and times that may be fished. Catch controls may include the size or condition of species taken, and the total allowable catch. Still other regulations relate to licences and reporting procedures. Generally, sea-based enforcement activities are much more costly than land-based activities. Enforcement effort allocation within a fishery will largely depend on the management objectives, and identified risks to those objectives, however in any specific fishery it is useful to consider the following questions:

a) Fisher contacts

Is there an acceptable number of contacts a fisher should have with enforcement personnel each year or season? Should there be a fixed probability of contact, or are different probabilities of contact acceptable for different regulations?

b) Air vs sea vs land based inspecting

What is the optimal allocation of effort between air, sea and land based enforcement activities? What types of regulations are best policed by each of these approaches?

c) Types of infringement

Are some regulations more important than others in achieving management goals, and should these be afforded more attention than others? How should enforcement effort be allocated between infringement types?

d) Geographic area

What is the geographic extent of the fishery, and should some fishing areas be monitored more closely than others? Can some regulations be effectively monitored remotely (eg. by satellite vessel monitoring systems or acoustic buoys)?

e) Temporal components

Are there specific times during the year when infringements of fisheries regulations are more likely to occur? (e.g. holiday periods or during fish spawning periods)

f) Biological information

Is there other information to suggest that enforcement effort should be targeted in particular ways? For example, fisher behaviour during species migrations or spawning aggregations might suggest how to best optimise enforcement activity.

In order to answer these questions, information about existing levels of non-compliance is required, and how those levels vary with the amount of enforcement effort. In Western Australia, annual risk assessment workshops are undertaken to identify compliance risks within fisheries. These typically involve representatives from the commercial and recreational sectors of a fishery, as well as management and enforcement personnel. Risks are identified and prioritised as part of the risk assessment process, however often only anecdotal evidence can be offered regarding the extent to which particular risks are a problem within a fishery – the next step is to collect data that can attempt to quantify non-compliance. In the following section I examine methods for collecting this data, focusing on approaches adopted for the West Australian rock lobster fishery.

1.3.4.2 Measuring Non-Compliance

Measuring compliance and the effectiveness of law enforcement can be difficult. People engaging in illegal behaviour can, and do, go to great lengths to hide their activities. While detection of a breach can indicate the effectiveness of an enforcement program, detecting no breaches can mean that there are no offences occurring, or that the enforcement program is deficient in some way. There are also many problems particular to the fisheries context. A fishery may range over vast geographic areas but be serviced by only a relatively small number of enforcement officers and vessels. Fishers, whether engaging in illegal activity or not, are in constant communication with one another. Typically, vessels will know about an approaching fisheries patrol boat before they can even see it. Even if they are not warned, most skippers can easily recognise patrol boats at a distance and may take steps to hide illegal activity. In this regard, it is better to check at sea only those infringements that cannot be easily "hidden" if fishermen are forewarned of an impending fisheries inspection (e.g. gear and licence checks).

The first step in optimally allocating enforcement effort should be to quantify the amount and type of non-compliance occurring at different stages of the fishing process. Where possible, this should be done separately for individual stakeholder groups. It is important to clearly identify the various stages in the fishing operation, including the movement of gear and the transit of fish from the point of capture to the table. This allows identification of optimal points in the fishing process – from a logistic and cost-effective viewpoint – for checking compliance with fishing regulations. In commercial fisheries, for example, catch is brought to shore for sale so that for most catch-related rules it rarely makes sense to undertake checks at sea[1]. Conversely, commercial rock lobster fishers leave gear at sea for most of the season, so it can only be checked at sea.

When collecting information on infringement activity it is important to distinguish between targeted and random inspections. A large proportion of checks undertaken by fisheries officers are random. Here I refer to inspections where a Fisheries Officer has no preconceived idea that a fisher may be violating regulations prior to conducting a check. Data from random inspections allows estimation of the proportion of fishers engaging in non-compliant activity. Alternatively, Fisheries Officers may be aware of suspected or known offenders who they may check more regularly. I consider these types of checks targeted routine inspections (organised covert surveillance operations, as might be undertaken by the Serious Offences Unit, are not considered in this category). If suspected offenders are checked more frequently, and they indeed break regulations more often than the "average" fisher, then not differentiating between targeted and random routine inspections will result in over-estimates of non-compliant activity in the fishery as a whole. The approach adopted in the present study is to separately report results from random and targeted inspections.

The number of attempted or successful prosecutions is also a legitimate measure of illegal activity, although care must be taken when comparing between different time periods. It is especially important that any measure of enforcement activity be converted to reflect a standard unit of effort. In other words, it is important to record the number of fishers who do not break regulations, as well as those who do. The following hypothetical example helps to illustrate this point:

[1] Although there are obvious exceptions, such as ensuring catch does not arise from within areas closed to fishing.

Hypothetical Example

In 1997, fisheries officers carry out 793 checks on vessels, find 121 infringements, decide to prosecute 87 of these, and successfully prosecute 56 cases. In 1998 there were 534 checks on vessels, 67 infringed regulations, prosecutions were initiated for 60 of these, and we were successful in 52 cases.

Comparing between years, a naive interpretation of this scenario is that:

- The number of infringements went down by half (121 compared with 67).
- Attempted prosecutions fell substantially, from 87 in 1997 to 60 in 1998.
- The number of successful prosecutions didn't change very much (56 compared with 52).

A more realistic interpretation is given by standardising on level of enforcement, thus converting absolute figures to rates:

- Infringement rates didn't drop by half (121/793 = 15.3% compared with 67/534 = 12.5%).
- The attempted prosecution rate rose dramatically, from 87/121 in 1997 to 60/67 in 1998.
- The rate of successful prosecutions rose by 20% (56/87 compared with 52/60 – here it appears there may have been some change in the decision rules for attempting prosecution).

It should be evident from this simple example that interpretations can be reversed if all available information is not taken into account. Note also that other rates are potentially useful (e.g. the number of attempted prosecutions out of the total number of inspections).

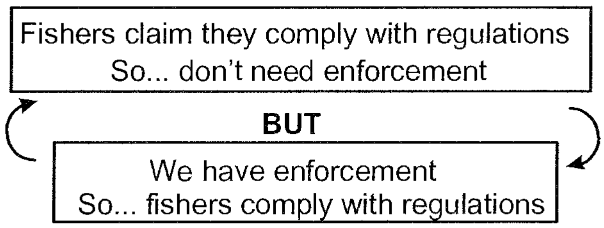
When considering attempted or successful prosecutions as measures of compliance it is worth remembering that it may be perfectly acceptable (in fact desirable) to have low levels of attempted prosecution provided compliance rates are high. Low levels of successful prosecution, on the other hand, indicate that the application of particular fisheries laws may not work in practice, and should possibly be reviewed. Hemming and Pierce (1997) note that many fisheries have in place some regulations that are difficult to enforce, won't hold up in court, or require resources which are simply not available for their effective enforcement (although such regulations may still be useful if they encourage the right behaviour amongst most fishers).

DGR Consulting (1996) summarise a range of performance indicators for assessing the efficacy of fisheries enforcement programs, some of which I have discussed. Many of these indicators provide useful clues to designing ways in which to measure non-compliance. For example, the Fishwatch program is a national toll-free telephone service set up to receive public information about illegal fishing activity. Monitoring the percent change over time of telephone calls to Fishwatch might give an indication of trends in non-compliance (although by no means unambiguously – a rise in the number of reported incidents could also result from increased community awareness). Many more performance indicators can be developed from qualitative evaluation of interest group perceptions, something I discuss further in Chapters 6 and 7.

Finally, measures of compliance should be formulated in close consultation with fishery interest groups. The people who may be most aware of the types and extent of illegal activity in a fishery are the fishers themselves. Industry feedback should therefore play an integral part in formulating and assessing fisheries compliance monitoring programs.

1.3.4.3 Determining Enforcement/Compliance Relationships

This section discusses the rationale and methods we are using to determine relationships between levels of enforcement and compliance in the West Australian rock lobster fishery. Examining such relationships are important for a number of reasons. Firstly, fisheries enforcement is a costly business, with up to 65% of all Western Australian enforcement costs associated with commercial fisheries met by industry. This has led to increasing industry pressure for enforcement groups to justify their expenditure. In the absence of hard evidence to the contrary, it is relatively easy for industry groups to argue that current enforcement levels are unnecessarily high. However, their argument is often circular:



How, then, is it possible to demonstrate that enforcement is necessary if this can't be shown by simply measuring infringement rates? The answer is to conduct planned experimental manipulations of enforcement effort and monitor how this affects compliance. As part of the current study two experimental manipulations of enforcement effort in rock lobster processing factories were undertaken in order to assess how the levels of inspection affect compliant behaviour. This work is described in detail in Chapter 4, but the important components in such studies can briefly be summarised:

- Treatment and control groups should be used to unambiguously identify changes in compliance with changes in enforcement effort.
- Measurements should be taken before and after treatment effects are applied.
- Possible time lags between changes in enforcement effort and changes in compliance should be considered.
- Enforcement effort should be quantified and standardised over the period of the experiment.

In addition, the possibility of natural experiments should not be ignored. Natural experiments are unplanned situations that may provide useful insight into the relationship between compliance and enforcement. For example, an area may not be policed (or policed less frequently than usual) for a period of time because of staffing difficulties or vessel maintenance. When inspections recommence it is desirable that they recommence with approximately the same level of enforcement effort as when inspections ceased. In this way it is possible to compare the "usual" level of compliance with the level that occurs after a prolonged absence of enforcement activity.

1.3.4.4 Attitudinal Surveys

The attitudes and perceptions of fishers toward management, compliance and enforcement are vital to the optimal allocation of enforcement effort (Clay and McGoodwin 1995). I discussed previously that the most cost-effective way of encouraging compliance is through positive educative programs, and these cannot be effectively targeted without knowing why fishers choose to break fisheries laws. Dissatisfaction with resource conservation or allocation decisions often leads to conflict among stake-holders and resentment of particular management measures, that may, in turn, lead to increased levels of non-compliance. Determining fishers' views on management measures and their attitudes toward other stakeholder groups is therefore vital information in an overall enforcement strategy. By carrying out surveys management authorities also foster interest group support – people like to have their opinion canvassed, especially on issues they see as important to their livelihood or recreational pursuits. The fact alone that fishers are surveyed about their opinions indicates a willingness on the part of management and enforcement to take notice of stakeholder's opinions. Finally, as well as the "why", surveys of this kind provide enforcement agencies with some of their most useful information regarding the "who, how and where" of illegal activity.

As part of the current study I have conducted surveys of recreational and commercial rock lobster fishers regarding their perceptions about compliant behaviour and management controls. This work is reported in Chapters 6 and 7.

1.3.4.5 Targeting Enforcement Activities

The object of targeting enforcement activities is to optimally direct limited resources to those areas thought to be high-risk for non-compliant activity. Targeting resources shifts the enforcement paradigm from one of reactive catch-up policing to a pro-active, planned approach. This requires the collection and effective use of a variety of information, such as catch and effort data, biological research data, attitudinal and demographic data, and intelligence from fishers, fisheries officers and the wider public. A targeting approach to enforcement can work at a number of scales. On one level, a Fisheries Officer may "keep an eye" on particular fishers suspected of illegal activity. On another, resources may be diverted to specific spatial and/or temporal regions of a fishery based on a combination of information. There are a number of ways in which fisheries enforcement activity can be targeted to obtain maximum effect within resource constraints, and I discuss four approaches:

a) Focusing on known offenders

Targeting enforcement effort at known or suspected offenders has a number of advantages over a purely random selection of fishers for inspection. Firstly, those fishers suspected of regularly breaking fisheries regulations are likely to have a greater deleterious effect on the management goals for the fishery compared with those who only occasionally or opportunistically break the regulations. It is also likely that targeting, catching, and prosecuting known offenders sends an important deterrent message to other fishers.

The Department of Fisheries W.A. maintains an extensive intelligence database that records reports of illegal activity submitted by Fisheries Officers, fishers, and members of the public. Several hundred information reports received each year, the majority of which come from recreational fishers. Recording and cataloguing this information provides enforcement personnel with an important historical record of reported infringement activity. As cross-referenced data accumulate, patterns may emerge and seemingly unrelated incidents become recognised as related. This has proved invaluable in establishing connections between some of the more organised groups undertaking illegal activity, and also provides district-based enforcement staff with knowledge of fishers' activity in other regions of the state.

b) Focus on known spatial and/or temporal "hot-spots"

Most fisheries management agencies collect a range of data that may be potentially useful for determining spatial or temporal "hot-spots" where illegal activity may be taking place. For example, there may be certain times of the year when non-legal fish are more abundant, or when prices for fish are particularly high – both these instances may result in higher than normal illegal fishing. Infringement rates can be analysed to empirically determine where and when the highest infringement activity is occurring. In particular, analyses have the potential to highlight regional differences in compliance that may not be otherwise apparent to fisheries staff dispersed over wide geographic areas. In Section 3.4.4 I present work undertaken to identify spatial and temporal "windows of opportunity" for illegal fishing in the western rock lobster fishery.

c) Focus on particular points in the fishing process

In many fisheries it may be useful to target particular points in the fishing process in order to optimise the use of enforcement resources and encourage compliance. In the commercial arm of the rock lobster fishery one of the focus points is catch inspections at rock lobster processing factories. Since most of the commercial catch is sold overseas, and lobster must be processed through a licensed factory prior to export, factories provide an ideal "bottleneck" through which almost all catch passes. As long as export prices remain high, lobster-processing factories will provide a convenient point of inspection for the commercial catch. Of course, the corollary of this is that, because Fisheries Officers regularly police processing factories, fishers are unlikely to sell illegal lobster to the factories. Anecdotal evidence suggests that some fishers use illegal catch to barter for goods and services, however it is believed there is currently no major market for illegal rock lobster in Western Australia (see Chapter 3).

d) Creative approaches to targeting

Part of the challenge of enforcement work is to think more imaginatively than those engaging in the illegal activity. Fishers engaging in illegal activity think creatively – they have to in order to avoid detection – and so should enforcement services. Thinking of novel approaches to fisheries enforcement problems is something about which it is difficult to provide prescriptive advice. However, my experience with the western rock lobster fishery has shown that two approaches can be particularly useful.

The first approach is to utilise all the data collected by the fisheries agency, and to think laterally about how this data may be cross-referenced. Fisheries management agencies generally maintain many databases, including economic, licensing, biological, legal, and catch/effort data. Rarely, however, are all data considered when assessing the efficiency or optimisation of enforcement activities. This is unfortunate because correctly utilising information already available to an agency is perhaps the least expensive method of determining where enforcement activities should be targeted. I mentioned earlier investigations into using biological data in order to predict the availability of illegal animals in the water. Other data-driven ideas that may prove useful include:

- Check catch and effort data for periods immediately following the introduction of new effort controls – those vessels whose catch does not change in the way anticipated from the introduction of the rule change may be breaking regulations.
- In many fisheries, processing factories must submit records about how much product they receive from fishers. A check of factory records against fisher logbook information may reveal discrepancies that indicate how much product is sold outside of processing factories. If commercial fishers are required by law to sell to licensed factories (or fish wholesalers), then differences between factory processing records and fisher catch/effort returns may be indicative of non-declaration of catch.

Another useful approach is to create opportunities for broad agency input into discussions about enforcement problems (e.g. see Section 1.2.8 on risk assessment). Fisheries agencies are often composed of a broad range of people with a diversity of skills. This diversity should be used to an agencies advantage, and fresh outlooks to old problems should be encouraged.

1.3.5 Strategies to Achieve Positive Compliance Outcomes

In this section I identify and discuss five broad approaches to overcoming the problems of non-compliance in managed fisheries. These are:

a) Individual regulation

b) Community regulation

c) Punitive measures without prosecution

d) Effective deterrence through prosecution

e) Educating for positive compliance outcomes

Often all five approaches will be employed simultaneously, however emphasis on one approach or another may be appropriate for different interest groups at different times. It is worth noting that educative programs designed to ensure a high level of understanding of fisheries laws will assist all approaches to achieving positive compliance outcomes.

1.3.5.1 Individual Regulation

I use the term individual regulation to refer to processes that lead to self-motivated compliant behaviour with fisheries rules. Voluntary compliance with fisheries regulations is arguably the most desirable outcome for an enforcement section of a fisheries management agency. Programs to encourage voluntary compliance are typically inexpensive compared with other types of enforcement activities such as vessel-based patrols. In fact, preventative campaigns designed to encourage compliance are likely to pay for themselves many times over, either in terms of harm reduction to a fished stock, through reduced enforcement costs, or both. There are also no losers – no-one has to catch someone, no-one has to be caught, there are no fines, no user groups are disadvantaged, and no animals are taken illegally.

High levels of individual compliance can result from a variety of mechanisms. Individual regulation is perhaps best fostered in an environment where there are a high proportion of owner-operators in a rights-based fishery. Under these circumstances fishers are likely to have a desire to maintain the value of their licence by protecting fish stocks for the future. Fishers with an uncertain future in a fishery (e.g. those who lease vessels) do not have the same incentives for conserving fish stocks and may be less likely to be self-regulating. High levels of voluntary compliance may also be encouraged when fishers are involved in designing fisheries laws and compliance planning. In this way fishers share a vision for the future of compliance in their fishery.

Self-reporting of illegal activity is common in many other law enforcement situations, and usually occurs when illegal activity has occurred by accident (e.g. traffic accidents or pollution). In order to encourage the practice, self-reporting often incurs lower sanctions than might otherwise be the case (Polinsky and Shavell 1998). Self-reporting of illegal activity does not often operate in fisheries contexts, probably because most illegal fishing activity cannot be said to have occurred by accident. Notable exceptions exist, however, including reporting of over-quota fishing, or reporting of fishing that mistakenly occurred within "no-go" zones (especially by vessels equipped with Vessel Monitoring Systems). This type of reporting usually only occurs, however, when transgressing fishing operations have a reasonable chance of being independently detected. There is no appreciable history of self-reporting within the western rock lobster fishery.

Forewarning people of impending enforcement activities can often assist self-regulation. Non-fishery examples might include publishing the locations of traffic speed-cameras, or advertising the commencement of a police crackdown on drink-driving. An example from the rock lobster fishery where this might be advantageous in terms of enforcement expenditure and agency-fisher relations is as follows. Suppose Fisheries Officers become aware that a number of fishers are over-potting in a particular region of the fishery. One approach would be to advise all fishers in the region of their legal pot entitlement, and provide a warning that Officers will be targeting over-potting in the near future. This should have the effect of discouraging a (hopefully large) proportion of fishers from engaging in over-potting. While checks of some fishers will remain necessary, such an approach is useful because it saves the labour-intensive task of checking pot numbers of all suspected fishermen, and at the same time demonstrates that enforcement services have a sense of "fair play". Of course, this would only work fishers believe that there will be checks, and that there is a potential to be caught if engaging in the practice.

1.3.5.2 Community Regulation

Many authors have suggested that traditional fisheries management, based on a "command and control" model of governance, is less than ideal since it does not foster a sense of ownership by stakeholders of management decisions (Dubbink and van Vliet 1996, Jentoft 1989, Nielsen and Vedsmand 1997). I consider fisher involvement in the formulation of fisheries regulations to be of the upmost importance, and consider this topic in detail in Chapter 1. I introduce the topic here, however, by citing one example of how user-groups can help to implement and enforce fisheries rules.

Some years ago, the Tasmanian Marine Police initiated a Fisherman's Watch program in an effort to promote community support for fisheries regulations. The idea was to encourage friendly cooperation between fisheries enforcement staff (police, in the case of Tasmania) and fishers in a joint effort to fight fisheries crime. This program involved particular commitments on the parts of police and stakeholders (Massie 1992); these are worth repeating here:

1. The fishing community commitment:

    a) That they advise the Division of their greatest concerns regarding illegal activities;

    b) That they encourage their members to be more active by promptly reporting to police suspicious or illegal fishing activities which they may observe;

    c) That they pay more attention to their own protection of fish and fishing equipment by securing fish and clearly marking and identifying fishing equipment.

2. The police commitment:

   a) That it will consult and advise the groups on patrolling activities, problem areas and results;

   b) It will direct priorities to those commonly perceived as the greatest threat to marine resources;

   c) It will treat as strictly confidential any information passed to police regarding illegal fishing activity.

This approach has at least two advantages. Firstly, it encourages fishers to participate in the policing process. Rather than being passive participants in law enforcement activities, fishers can have an active role in directing police business. The second advantage is that, as mentioned previously, fishers are best placed to know how and where illegal activity is occurring. One drawback noted in the rock lobster fishery, however, is that some fishers are often reluctant to engage in activities they feel are prejudicial to other fishers, even those engaging in illegal activity. In Chapter 6 I explore reasons why such attitudes might prevail.

1.3.5.3 Punitive Measures Without Prosecution

In the previous two sub-sections I considered methods of promoting self- and peer-regulation; in this and the next sub-section I return to the idea of specific enforcement activity and the punishments that may arise for offenders. I first consider punitive measures that do not involve legal prosecution. Legal action, although obviously necessary for serious offences, must in normal circumstances be considered an undesirable outcome. Legal sanctions are costly to impose, may be liable to fail because of minor technicalities, and may be variable in their effectiveness. In the western rock lobster fishery, for example, judicial discretion exercised by different magistrates sometimes leads to quite different findings for similar offences.

There are a range of alternative punitive measures that may be suitable in lieu of legal prosecution, but for most fisheries their application will depend on the statutory powers of the management organisation. These may include:

- Administrative sanctions: Often the Executive Director of fisheries organisations will have, under specific circumstances, discretionary power to cancel, suspend, or refuse to renew fishing licenses (this is the case for the Department of Fisheries, W.A.). Other types of administrative sanctions may include probationary periods after an offence, community service, or attendance at compulsory education programs, although such mechanisms are currently not employed in Western Australia.

- Warnings notices: Many fisheries enforcement agencies (including the Department of Fisheries W.A.) utilise warning notices of some description when breaches of regulations are relatively minor. Warnings are an attractive deterrent option when the cost of imposing a fine is out-weighed by the expected return from prosecution (if indeed a successful prosecution can be secured) (Polinsky and Shavell 1998).

- On-the-spot fines: Issuing small monetary penalties, in much the same way as parking inspectors issue parking tickets for motor vehicles, is one alternative to warning notices for dealing with relatively small infractions of fisheries law. Such a system would be expected to have a greater deterrent effect than warning notices, and should be easily implemented (often as an extension of existing warning notice systems).

1.3.5.4 Effective Deterrence Through Prosecution

Enforcement programs should undertake reasonable steps to inform stakeholders of their legal obligations and the consequences of not meeting them, but at the end of the day fisheries agencies must be prepared to prosecute those who operate outside the law. Fishers must believe that if they cheat there is a reasonable chance they will be caught, and, if caught, that prosecution will be successful. It is also important that deterrent penalties be sufficiently greater than the gains made through illegal activity, taking into account the probability of detection and successful prosecution. In the case of the rock lobster fishery, monetary sanctions are typically a prescribed penalty, plus court costs, plus (if applicable) approximately 10 times the value of the catch. Sanctions are also dependent on offence history, since this provides additional incentives not to repeatedly violate fishery laws. For major offences in the commercial rock lobster fishery W.A. has adopted a "three strikes" law – a fisher may lose their licence for a period of time if they are convicted of three serious fisheries offences in a 10 year period.

Educating fishers about the nature of successful prosecutions is also very important, and serves a number of useful purposes. Firstly, it educates people about the types of penalties they are likely to receive for particular fisheries offences, hopefully providing as deterrent mechanism against other people committing similar acts. It can also serve as a "shaming penalty", as is the case for Western Australian fisheries, whereby the Department of Fisheries publishes the detailed outcomes (including names) of successful prosecutions in a quarterly magazine.

1.3.5.5 Educating for Positive Compliance Outcomes

Throughout this chapter I have constantly used the term "enforcement effort", conjuring up images of patrol boats, fisheries officers, and covert surveillance from the beach. Importantly, many of the issues discussed have centred around stopping illegal activity once it is already occurring. In this section, however, I focus on educative measures designed to encourage compliance rather than discourage non-compliance. In particular, I discuss three educative approaches the Department of Fisheries W.A. undertakes in order to encourage an understanding of fisheries regulations:

a) Fishcare Western Australia

The Department of Fisheries promotes public awareness and encourages participation in caring for the marine environment through the Fishcare program, a funding initiative providing financial and scientific support for community-based marine projects. There is a strong focus on projects that promote the conservation of fish and their habitats. Since the program commenced in 1996, Fishcare W.A. has provided funding to 34 community-based projects to a value of approximately $70,000 (Anon. 1999).

b) Voluntary Fisheries Liaison Officers

Perhaps the single biggest public education program conducted by the Department of Fisheries in Western Australia is the Voluntary Fisheries Liaison Officer (VFLO) program. This program solicits volunteers from the public to act in an unpaid capacity to educate recreational fishers about fishing regulations and habitat protection. VFLO's operate in an advisory/educative role only – they cannot confiscate fish or gear, and have no powers of apprehension under governing legislation. It is estimated that the 220 VFLO's in Western Australia make approximately 70,000 recreational fisher contacts a year through over 2000 beach patrols (Vanstein 1999). This number is even higher if contacts at expos, fishing clinics, and visits to school and community groups are considered.

VFLO's provide invaluable assistance to enforcement personnel in that they provide a positive educative message as well as placing an agency presence on jetties and on beaches. The department in turn provides training in basic ecological principles, fish handling and care, and fishing regulations. The success of the VFLO program as an approach to fisheries co-management has been recognised around Australia, with South Australia, Victoria, Queensland and Tasmania all adopting similar programs.

c) User Participation In The Management Process

The National Fisheries Compliance Committee (1999) has a stated commitment to collaborate with fisheries stake-holders to develop and implement fisheries policies and laws. To this end, many Australian fisheries agencies have adopted Management Advisory Committee (MACs) structures in order to provide expert (and hopefully balanced) corporate advice to the Minister responsible for management decisions affecting a fishery. The system for user-participation in management of the rock lobster fishery is discussed in some length in Chapter 2.

In this section on enforcement and compliance in fisheries I have shown that achieving positive compliance outcomes in a fishery should comprise a dynamic mix of preventative and punitive measures. Compliance should be measured through time, and steps taken to ensure that enforcement approaches are responsive to changing regulatory measures and fishing practices. Not all the enforcement initiatives suggested will be effective for all fisheries; indeed, they are not all implemented in the West Australian rock lobster fishery. Many of the issues discussed, however, are common to a range of fisheries, and some approaches to combating non-compliance can perhaps be universally adopted. In particular, targeted educative programs and the adoption of co-management principles should be important components of any effective enforcement program.

It is worth stressing the importance of including non-compliant activity as a tangible component of fisheries stock assessment models, if only to the extent that risk analyses are carried out under different assumptions of non-compliant activity. When this happens perhaps the true cost of illegal fishing will be recognised.

Finally, a major deficiency with many enforcement programs is that they fail to adequately quantify the amount of enforcement effort, and the amount of non-compliant behaviour, that occurs in a fishery. Without this information it is not possible to examine the relationship between enforcement effort and compliance, nor can realistic performance indicators to measure the effectiveness of enforcement work be developed. This is an important consideration, since enforcement programs in Australia operating in cost-recovered environments will remain open to criticisms of unnecessary expenditure until such time as credible performance indicators are developed.

1.4 Need, Objectives, and Report Structure

1.4.1 Need for this Study

Fisheries enforcement and related educative activities form the basis for ensuring that fishers comply with management plans, and for the continued sustainability of fisheries. Ensuring adequate levels of fisher compliance in fisheries is expensive, and the cost of enforcement activities in most fisheries can be substantial compared with other management costs. Given the importance and expense of ensuring compliance, it is perhaps surprising that there has been relatively little published research on the effectiveness of enforcement programs (compared with, for example, fishery stock assessments or fish biology/ecology). Why is this so? One reason is that crime research presents particular difficulties compared with other areas of fisheries science. Enforcement programs often comprise a complicated mix of activities spread across a large number of fisheries simultaneously. Sampling programs to obtain measures of non-compliance are particularly problematic – enforcement activities are, by their nature, often non-random, and those being "measured" (ie. fishers) can go to extraordinary lengths to conceal illegal activity. Another reason is that enforcement personnel often do not have the scientific background or analytic skills to design sampling programs or experiments to assess the effectiveness of enforcement activity.

Despite the difficulties in conducting enforcement/compliance related research, the demand for work in this area is increasing. In almost all law enforcement contexts it is accepted that achieving 100% compliance with rules is impractical, prohibitively expensive, or impossible. Since resources directed toward enforcement activities are invariably limited, it is important to ensure that the best compliance outcomes are achieved within available resources. In Australia there has historically been little external review of how fisheries enforcement budgets are expended. This is changing, however. In the 1990's most Australian fisheries agencies began implementing "costs-recovery" of management, research and enforcement costs associated with commercial fisheries; that is, commercial fishers began bearing the costs of managing their fishery. With this shift in funding arrangements, fisheries agencies are increasingly asked by commercial fishing representative groups to justify enforcement expenditure, and to demonstrate the effectiveness of chosen strategies. Scrutiny by industry groups, provided it is at a broad level and does not impair or compromise compliance operations, can be highly desirable since it potentially focuses enforcement on the most serious problems in a fishery.

How, then, can research improve the effectiveness and efficiency of enforcement? Three main approaches are explored in this report. The first involves standardised collection and careful analysis of data relating to the activities of Fisheries Officers – what they do, and the offences they find. Such data can be used to examine spatial and temporal pattern in non-compliance, and to direct enforcement staff to focus attention on particular times or locations, or on individual fishers or fish processing establishments. Such data provides Officers with an opportunity to plan the allocation of enforcement effort based on a detailed assessment of previous fishing seasons, and to modify strategies in response to changing conditions within and between seasons.

The relationship between the level of enforcement effort and the degree of fisher compliance is not well understood for fisheries, and the second approach adopted in this report is to experimentally examine this relationship. A small-scale manipulative experiment, and later a large-scale adaptive management experiment, varying the amount of enforcement effort in rock lobster processing factories was conducted to examine changes (if any) in fisher compliance. The motivation for such experiments is simple: if enforcement effort could be significantly reduced without consequent increases in non-compliance, savings to the enforcement budget might be realised. On the other hand, if the rate of compliance is highly sensitive to the amount of enforcement effort it should be possible to determine the amount of effort required to obtain desired levels of compliance.

The third approach adopted was to ascertain, through structured surveys, fisher perceptions and opinions about enforcement and compliance. In particular, understanding fishers' perceptions about levels of non-compliance, probability of inspection, motivations for non-compliance, legitimacy of regulations, and the deterrent effect of penalties will allow managers to assess the effectiveness of current enforcement practices, and to develop strategies to improve compliance with regulations. Surveying stakeholders also provides an opportunity for fishers who are not normally associated with the formal MAC processes to provide feedback about the effectiveness of the enforcement program, and may potentially alert managers to emerging problems within a fishery.

1.4.2 Objectives

The objectives are defined as:

1) Estimate the level of non-compliance in the Western Australian rock lobster industry.

2) Determine factors such as seasonal, regional and factory, which may affect the level of non-compliance in order to better target the timing of enforcement effort.
3) Develop relationships between enforcement and compliance with the regulations to enable an assessment of increasing or decreasing the level of enforcement on the level of compliance.
4) Determine the reasons and motivations for the non-compliance of commercial fishers with the regulations in terms of the expected gains versus the probability of detection.
5) Ascertain the perceptions of the fishing regulations and enforcement measures including the perceived probability of detection for commercial fishers.
6) Ascertain whether commercial fishers are aware of the full extent and frequency of inspections.

The original objectives have been largely satisfied, however some qualifying remarks are required. For Objectives 1-3 I have focused on analyses of data arising from inspections of catch in processing factories. These data have been collected historically, and are of higher quality than other types of data available. Evidence indicates only a small local black-market in illegal lobster product, so factory inspection data naturally captures the overwhelming majority of catch (legal and illegal) landed by the commercial sector of the fishery. There has additionally been considerable effort devoted to using these data to help enforcement staff target individual fishers based on offence history, and to direct effort toward particular factories; these analyses are not presented since they concern individual fishers and factories.

Objectives 4-6 are addressed by attitudinal surveys conducted in both the commercial and recreational sectors of the fishery. The recreational survey was not including in the original project proposal, however when an opportunity arose I decided to develop some compliance-related questions for inclusion in an existing annual survey of recreational rock lobster fishers. This proved a successful exercise, and results provide interesting and complimentary views to those expressed by the commercial sector of the fishery.

The experimental work regarding the problem of commercial fishers holding-over undersize lobsters prior to a change in the minimum size rule (Chapter 5) was not anticipated in the original project proposal. This type of offence is particularly difficult to detect and prosecute using traditional enforcement techniques. Two data-based approaches were used in an effort to assist Fisheries Officers detect and prosecute offenders: a statistical survey approach combining at-sea and factory sampling of catch, and haemolymph sampling to detect increased stress levels in rock lobster held for an extended period. Each approach proved useful, if not definitive, in aiding Officers to detect those fishers illegally holding-over undersize lobsters.

It is pertinent to briefly mention analyses presented in this report. I have, where possible, focused on *estimation* rather than statistical *testing*. To this extent I have written the report with my target audience in mind; enforcement personnel are, in a scientific sense, generally a lay audience, and I could see no point in introducing technical and potentially confusing results. More formal analyses will continue to be published in the scientific literature.

1.4.3 Content and Structure of this Report

In Chapter Two, I explore the concept of stakeholder participation in the management process, the structures in place to facilitate participation in the western rock lobster fishery, and how increased participation in aspects of a fishery's compliance program might be accommodated (McKinlay and Millington 2002). I also examine how the type of regulatory system can affect the effectiveness of user participation in compliance, since there is a common perception that strong access rights to a fishery, combined with output controls, can engender ownership among fishers that leads to increased observance of fishery rules. I critically examine this perception in light of the western rock lobster fishery, where strong access rights under an input regulatory system apparently contradicts much of the rhetoric surrounding improved compliance in the presence of output controls.

In Chapter Three, I explore temporal and spatial trends in non-compliance observed in factory consigned commercial catch. Since factory consigned catch represents the overwhelming majority of landings from the fishery, this forms an important basis for monitoring the continued effectiveness of the rock lobster compliance program. I explore how different measures of compliance might be formulated, and calculate estimates of total illegal catch removed from the fishery by the commercial sector that is consigned to processing factories. I also present, using data from fishers' logbook data, a graphical analysis of the spatial and temporal availability of non-legal lobster on the fishing grounds.

In Chapter Four, I present an experimental approach to examine how the level of enforcement effort in rock lobster processing factories can affect observed levels of compliance. A traditional repeated measures experimental design provided mixed results, and consequently a large-scale adaptive management experiment was undertaken in order to avoid some of the difficulties encountered in the planned experiment.

In Chapter Five, I present results from two experiments designed to examine the problem of commercial fishers illegally "holding over" undersized lobsters immediately prior to a minimum size change on 1 February each season. This has proved a difficult enforcement problem to police, and I examine two data-related methods for detecting those fishers who may be guilt of this offence.

In Chapters Six and Seven, I present results from attitudinal surveys of commercial and recreational fishers in the western rock lobster fishery. In Chapter Six I present results from a mail survey of commercial rock lobster fishers, crew, and non-fishing licence-holders. Survey recipients were asked several questions relating to their attitudes toward management, their perceptions about non-compliant behaviour, and opinions about other stakeholder groups. In Chapter Seven I present results from a mail survey of 4000 recreational fishers conducted immediately following the 1998/1999 fishing season (Stewart and McKinlay 2000; Anderson 2001). Fishers were asked to respond to a number of questions concerning enforcement, management, and perceived compliance within the recreational and commercial rock lobster fisheries. The commercial and recreational survey questionnaires can be found at Appendices 3 and 4.

Chapter Eight concludes the report with a discussion of the potential applications of the techniques proposed and developed in earlier chapters. I review limitations of the study, and explore how the work might usefully be extended or improved.

2. *Co-management, Property Rights, and Relationship to Compliance*

2.1 Overview

In this chapter I explore possibilities for fishers increasing their participation in management, particularly in relation to enforcement and compliance. Fisher organisations frequently advocate for increased management responsibility for fishers, and for the adoption of rights-based access to resources. Such moves, however, may be resisted by existing management structures, often because of a belief that fishers will not accept the responsibilities of management concomitant with resource access rights. One way for fishers to advance their case is to demonstrate a responsible attitude toward compliance with, and enforcement of, fisheries rules.

I advocate that commercial fishers (and commercial fishing organisations) must play an active role in enforcement/compliance activities. Until such time as fishers' attitudes toward compliance and enforcement change from those of either antagonist or neutral observer, to one of pro-active involvement in helping to ensure compliance, moves toward further devolvement of management responsibility are likely to be hindered. Two key areas where active involvement could be encouraged include:

a) Steps should be taken to marginalise habitual law-breakers, to an extent that the majority of fishers (who by and large are honest) do not feel obliged to 'protect' them by inaction. A barrier to effective enforcement in many commercial fisheries is the reluctance of professional fishers to inform on other professional fishers whom they know to be breaking regulations; and,

b) Disciplinary action against fishers who break regulations could be decided by joint management/industry committees. There is often a reluctance by fisher organisations to engage in peer review, mainly for fear of being seen to 'side with management' in unfavourable decisions against fishers. In an environment of responsible co-management this view must change.

Finally, moves toward self-regulation in fisheries also impart certain responsibilities on management authorities. In particular, enforcement authorities must ensure quick and effective responses to fisher information, confidentiality issues must be respected, and confidence in the judicial process must be engendered. Only in this way will fishers feel confident in taking the final step toward responsible resource stewardship.

2.2 Introduction

Fisheries management is a difficult juggling act between protecting resource sustainability, ensuring equitable resource access between competing user groups, and promoting economic efficiency in exploitation of the resource. How to best achieve these objectives continues to be a topic of vigorous debate (Hannesson 1996, Stephenson and Lane 1995, Caddy 1999), but most analysts agree that formal or informal property rights go a long way toward ameliorating the problems of open access to common resources, particularly with regard to resource over-exploitation and non-compliance with fishery rules. Much of this discussion focuses on the relative merits of input controls (restrictions on effort) versus output controls (catch quotas). Overwhelmingly the evidence is still that compliance failure in either input or output controlled fisheries ultimately leads to collapse of the fishery.

National fisheries resources in Australia, like in many developed countries worldwide, are generally regulated by one or both of these approaches, namely:

a) Access rights – typically access is granted to particular fishing areas or to specific stocks, through licensing systems.

b) Harvesting rights – quota systems allow particular fishers to remove specific amounts of fish from a stock, also through licensing systems.

Both approaches establish a continuing legal fishing right for those involved, and such rights are thought advantageous since they may promote responsible resource use among participants. Specifically, if fishers have a guaranteed stake in the future of a fishery resource there is an expectation that they will actively work to ensure the continued sustainability of the resource. This process is enhanced when fishers perceive management goals and fishing regulations to be fair, equitable, and necessary to maintain the biological integrity of the resource. To this end, resource stewardship is thought to be greatly enhanced when fishers are actively involved in the management process, both in terms of setting management priorities and designing fishery rules. In Australia, the principles of co-management and cooperative management are well established, with fishers in many states enjoying substantial input into the management process (Exel and Kaufmann 1997, House 1998). Fishers also contribute financially to the management process, especially in Australia's most valuable fisheries where a large proportion of management costs are cost-recovered from industry through licence fees (Sutinen 1994, Penn *et al.* 1997). As a result, the costs of management, research and compliance are closely monitored by industry, and fisheries agencies are increasingly required to justify their expenditure. Under this financial incentive it is little wonder that fishers themselves are entering into the property rights debate. In this chapter I propose that property rights, combined with co-management, create an atmosphere in which fishers can be encouraged to assist management agencies in the enforcement of fishery rules. Furthermore, I argue that stewardship may be fostered under either access rights or harvest rights approaches to management, and that fisher cooperation with compliance personnel is equally likely under either system. First, however, I make some brief comments about the merits of quota systems in this regard, since these systems are often (perhaps unjustifiably) promoted as the prime method for engendering resource stewardship.

Proponents of catch quotas suggest a system of management designed to optimise economic efficiency and foster resource stewardship among fishers (Hannesson 1996). They claim that allocating a proportion of the total allowable catch among a limited number of fishers protects the value of capital investment in the fishery. This most often takes the form of individual transferable quotas (ITQs) (Grafton 1996), although other systems involving individual transferable effort units have been utilised in WA fisheries for more than three decades (Bowen 1994). Still other approaches, such as the share-based fishing-rights system in the New South Wales fisheries of Australia (Young 1995), are emerging.

Catch quota approaches are thought to be important because many poorly managed input systems of management have resulted in over-capitalisation, over-fishing, and the collapse of numerous fisheries worldwide, typically because proper attention was not given to latent effort and efficiency increases. Responsible resource use is apparently better engendered under ITQs since fishers own a continuing right to harvest a specific amount of fish, and as such will fish responsibly to ensure the continued ecological health of their resource. For instance, Walters and Pearce (1996) suggest that ITQ's, particularly when rights are long-term, encourage fishers to participate in the research and enforcement processes since their input is reflected in the future value of the catch. Others criticise the use of catch quotas, arguing that the deleterious social consequences such systems have on fishing-dependent communities are unacceptable (Rennie 1998, Davis 1996). Fishers themselves are often critical of quota management for this very reason, claiming that market-driven allocation of property rights inevitably leads to rationalisation and concentration of ownership that progressively forces "traditional" fishers from the industry (McCay 1995, Charles 1992). This is an important point, since it would appear prima facie that responsible resource use under ITQs is most likely to occur among owner-operators, and may not be as easily encouraged among contract skippers who hold no property rights themselves. Fishers also often lament the fact that fisher competence becomes secondary under ITQs, although it is questionable whether the incentive to compete amongst one another is removed, possibly leading to increased incentives to under-report catch. Evidence for increased compliance with conservation measures under ITQs appears mixed, with practices such as high-grading, discarding, and under-reporting of catches common in some fisheries (McCay 1995, McCay *et al.* 1995, Grafton 1996, Rennie 1998). The misreporting of commercial catch may have serious consequences for determining biologically appropriate TACs (Walters and Pearce 1996).

Illegal fishing practices, such as those described above, are critical to any debate about the relative merits of input versus output approaches to fisheries management. Under an assumption of optimum enforcement of fishery rules and near-perfect compliance by fishers, quota management indeed appears an attractive solution to the problem of simultaneously promoting resource sustainability and economic efficiency. However, this is rarely the case in any fishery, making the issues of enforcement and compliance central to both sides of the ITQ debate. It is generally recognised that enforcement procedures and costs may be substantially different between the two approaches to management (O'Boyle and Zwanenburg 1997, McLaughlan 1994). While enforcement costs typically account for a large proportion of management budgets, experience has shown that effective enforcement under quota management may be far more expensive than under effective effort control schemes (Buck 1995, McLaughlan 1994). It is therefore surprising that discussion of enforcement under ITQs is not more prevalent in fisheries literature than it otherwise appears. There are perhaps three reasons why this may be so. First, non-compliant behaviour is notoriously difficult to measure with any certainty, with evidence of illegal activity often difficult to gather, anecdotal, or gathered after the fact. Second, the shift in enforcement resources needed to accommodate quota monitoring may mean that other areas of potential non-compliance (such as at-sea fisher behaviour) may be neglected. Thirdly, fishers and management agencies may be reluctant to advertise the fact that non-compliance with fishery rules may have increased under quota management, or that enforcement procedures and capabilities may be ill-equipped (or under-equipped) to deal with illegal activity. Proponents of quota management often suggest improved compliance is a primary reason for considering quotas in the first place (Hannesson 1996); this argument may be questionable if evidence suggests that compliance problems and enforcement costs increase under quota management.

The issue of quota management is of particular interest in Western Australia, where there has been much discussion within management and industry about the relative merits of introducing such a system to the Western Australian rock lobster fishery (Bowen 1994). While there is no clear consensus among professional fishers on the value of quota management, a recent industry survey has shown that a majority of fishers are opposed to any change from the current individual transferable effort (ITE) management arrangements (The Marketing Centre 1996; see also Davis (1996) for a discussion of the opposition to quota management in the Maine lobster fishery). This begs the question: would compliance with regulations be better under quota management? In fact, do catch-based property rights in the long term provide fishers with any increased incentives for implementing conservation measures than those existing under well managed effort-based access rights? If the proponents of quota management are to be believed, the answer is yes. However, there is little information to substantiate claims that either effort or catch based property rights should be favoured because of their ability to encourage responsible fisher behaviour. Theoretically, responsible behaviour can be engendered under either system of management, particularly when fishers are provided with substantial input to the management process (Hønneland 1999).

This chapter therefore seeks to address the issue of responsible resource use among fishers, and fisher involvement in the enforcement process in rights-based fisheries. I do not presuppose that effort controls or quota management necessarily engenders more or less resource stewardship, but rather that under any management system small numbers of fishers will regularly break regulations regardless of any real or perceived incentive for resource conservation. I examine the role of compliant fishers, who usually form the majority in any fishery, in assisting with the enforcement of regulations within their fishery. Fisher organisations frequently advocate increased management responsibility for their members, but seldom extend this request to the realm of enforcement. Increased management involvement for the fishing industry also brings responsibilities, one of which is a need for fishers, individually and collectively, to participate in the enforcement of rules within their fishery. In the following sections I outline ways in which fisher involvement in enforcement could be encouraged, around the management table and on the water. Examples are drawn from experience with the western rock lobster fishery, but the ideas advocated could apply to many input or output controlled fisheries.

2.3 Co-management

In recent years fisher participation in the management process has become commonplace in many fisheries around the world (Wilson *et al.* 1994, Nielsen and Vedsmand 1999). Australian fisheries are no exception, with the establishment in many fisheries of management advisory committees comprised of representatives from resource stakeholders, the management authority, and relevant scientific bodies. In Western Australia, stakeholder membership of these committees is drawn mainly from the commercial catching and processing sectors, with some representation from the recreational sector of the fishery and conservation interests. Advisory committees are usually charged with making recommendations about issues affecting the fishery to the government Minister responsible for fisheries. Although final responsibility rests with the Minister, to a large degree management advisory committees steer the future direction of many of the management, research, and marketing (insofar as it affects management) activities in their fishery.

There is a long history of industry participation in management of the Western Australian rock lobster fishery. In 1966 the Fisheries Act was amended to establish the Crayfish Industry Advisory Committee, an expert body charged with providing advice and recommendations about matters affecting the rock lobster fishery (Anon. 1968). This committee comprised a Chair (appointed by the Minister), fisher representatives, scientific advisors, and one person to represent interested parties not engaged in the commercial fishing industry. Over the last 30 years this committee has undergone many changes to bring it to its present form, the Rock Lobster Industry Advisory Committee (RLIAC). Established under the Fish Resources Management Act 1994, RLIAC is an expertise-based statutory advisory committee with a membership of eight commercial fishers, two rock lobster processors, the Executive Director of the Department of Fisheries WA (plus one other staff member), and an expert in recreational fishing. Department of Fisheries research and management personnel are granted observer status to attend RLIAC meetings to provide advice, as is a representative from the Western Australian Fishing Industry Council[2], the Western Rock Lobster Council[3], and the Conservation Council of WA. The Minister appoints an independent Chair, and a full-time Executive Officer runs the day-to-day business. RLIAC itself establishes a number of sub-committees, each chaired by a RLIAC member, which include additional industry and Department of Fisheries representation. These subcommittees include the Marketing Research, Finance, Compliance, and Research Subcommittees.

In addition to identifying issues that affect rock lobster fishing, and providing advice and recommendations to the government Minister responsible for fisheries, RLIAC itself has defined its role as:

> '*to primarily provide advice for the sustainability of the rock lobster resource, taking into account the social, economic and other implications of its advice on the benefits or otherwise derived from the fishery.*'

Information is disseminated to the fishing industry by a variety of mechanisms, including popular magazines, discussion papers, management reports, newsletters, and coastal tours where fishers are provided with up to date fishery information from fisheries scientists, and access to managers and RLIAC members. The success in implementing many of the current management measures in the rock lobster fishery attests to the overall success of the consultative and collaborative relationship that exists between the Department of Fisheries WA and the fishing community.

2.4 Fisher Involvement in Enforcement

Traditional fisheries management operates on a "command and control" model of governance (Dubbink and van Vliet 1996); that is, management authorities attempt to regulate fishing processes by means of legal and administrative means. Such an approach has long been considered inadequate, primarily because it does not foster an environment where fishers feel they have part-ownership of management decisions (Jentoft 1989, Nielsen and Vedsmand 1997). Jentoft (1989) suggests that the legitimacy of any regulatory scheme is subject to at least four constraints:

a) Content of the regulations: greater legitimacy occurs when fishers perceive regulations to coincide with their view of the issues.

b) Distributional effects: the more equitably regulations are imposed, the greater their legitimacy.

c) Formulation of the regulations: the more that fishers are involved in developing regulations, the more legitimate the regulatory process will be regarded.

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[2] WAFIC is an elected peak body representing all commercial fishing interests in Western Australia. It generally confines its representations to broad-scale issues affecting commercial fishing, but liaises closely with, and provides assistance to, fishery-specific representative bodies.

d) Implementation of regulations: regulations will be considered more legitimate when fishers are involved in their implementation and enforcement.

If management agencies can institute practices that encourage fisher involvement in the formulation and implementation of regulations (c and d), then in some sense the content and distributional effects (a and b) will take care of themselves. I consider fisher involvement in the formulation and enforcement of fisheries regulations to be of the utmost importance. In this section I examine three ways in which the fishing community should be actively involved in the enforcement process.

2.4.1 Commercial Fishers Reporting Illegal Activity

Let's start with a story.

> *At a compliance committee meeting between managers, fishers, and compliance personnel a report was presented detailing an investigation that had uncovered substantial out of quota fishing in the valuable red herring fishery. The reaction from fisher representatives on the committee, which included several well-respected fishers of considerable influence in the fishing community, was one of "Well done! Bravo! But we could have told you about those guys years ago."*

This is a true story that, sadly, could be about many of Australia's co-managed fisheries, and probably many other fisheries around the world. The problem I am alluding to is the reluctance of many commercial fishers to report on other commercial fishers they know (or suspect) to be breaking fishing regulations. I am not suggesting that fishers never report illegal activity; indeed, many compliance managers in Australia can cite notable instances where this has occurred, but in general these tend to be the exception rather than the rule. This phenomenon may have detrimental implications for the management of a fishery, particularly in regard to the efficiency and effectiveness of enforcement programs.

Working as a fisher may be arduous and sometimes dangerous. Few other professions (policing is an obvious exception) place participants in potentially life-threatening situations where they may rely on the help of others for their survival. The concept of loyalty is therefore important to many fishers. Traditional fishing communities are often close knit, with allegiances formed through common experience, shared ethnicity, and family ties. Combine this with the fact that fishers and enforcement personnel have historically been pitted in adversarial roles, and it is perhaps little wonder that many fishers are reluctant to assist in policing fishery rules. It can be argued, however, that co-management places an imperative on fishing communities to take responsibility for policing their fishery, and this means co-operating with enforcement services. In my experience, fishers are often opposed to involvement in enforcement activity,

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[3] The WRLC is an elected peak body specifically representing commercial rock lobster fishers.

arguing that: "We are fishers, not enforcement officers. Through cost-recovery we contribute money toward enforcement, but that is where our role should end." There are problems with this line of argument, however.

Firstly, people engaging in illegal fishing can, and do, go to great lengths to hide their activities (Anderson 1989). This may be helped by the fact that a fishery often ranges over vast geographic areas, but is only serviced by a relatively small number of enforcement officers and vessels. Recent technological advancements also assist those engaged in illegal fishing to avoid detection; powerful vessels allow fishers to range over greater distances, satellite telephones provide secure channels for communication, and radar ensures fishers are forewarned of approaching vessels well before visual contact is made. Advances in fish-finding technology in the western rock lobster fishery present particular problems for policing gear restrictions. Differential GPS allows fishers to place and retrieve gear with high precision. The consequence of this is that lobster pots are often placed in small, dispersed clusters of less than five pots, instead of the more traditional method of setting "lines" of 20-30 pots. The implications for enforcement of gear restrictions, such as carrying out pot counts, are obvious.

It is in this climate that enforcement officers must try to police fisheries regulations. It is simply not realistic to expect effective enforcement of regulations by means of random checks of fisher activity. While random checks are necessary for measuring overall compliance rates within a fishery, to a large extent enforcement effort must be targeted at known or suspected offenders (i.e. "intelligence" driven). These are usually fishers suspected of regularly breaking fisheries regulations, and as such are likely to have a greater deleterious effect (at least on an individual level) on the management goals for the fishery compared with those who only occasionally or opportunistically break the regulations. It is also likely that targeting, catching, and prosecuting known offenders sends an important deterrent message to other fishers (Sutinen 1996). Targeted enforcement operations can only be initiated, however, with access to information about illegal activities, and the fishing community is best placed to provide information about how and where illegal activity is occurring.

A second reason why fishers should provide enforcement personnel with information about illegal fishing is a practical one, namely cost-effectiveness. Enforcement, especially at-sea enforcement, is very costly. This has led to increasing industry pressure for enforcement groups to justify their expenditure. An obvious way for industry to ensure that enforcement expenditure is used efficiently is to assist enforcement groups to effectively target their effort. It is perhaps ironic that the same fishers who claimed prior knowledge of "those guys" in the red herring fishery are also the fishers charged with assessing the legitimacy of compliance budgets and expenditure.

How, then, can fishers be encouraged to report illegal activity undertaken by other commercial fishers? Experience in the rock lobster fishery has shown that commercial fishers are most likely to report illegal activity when they perceive other fishers to be "taking money directly from their pockets" (such as poaching lobster from other fishers pots), or when they perceive illegal activities to be highly detrimental to the sustainability of the resource. Fortunately, almost all rules in the rock lobster fishery are designed to protect against these exact circumstances; that is, to protect fair and equitable access to the resource, and to protect the biological sustainability of the fishery. If this premise is assumed, then *a priori* it seems reasonable that, at least for rules which are perceived as legitimate, fishers can be convinced that it is in their interests to report on fishers they know to be breaking fishing rules. I suggest six practical ways in which this can be encouraged:

a) ***Codes of conduct for ethical fisher behaviour.*** Fishers who hold access rights to a fishery are responsible for the maintenance of a public resource, and should be subject to the same ethical standards as the public officials who are seen to more directly manage it. Codes of conduct for ethical fisher behaviour in a range of "scenario" situations should be developed in conjunction with fisher representatives. Such a code would: i) serve as a "plain English" interpretation of fishery rules in a variety of circumstances; and, ii) help establish the legitimacy of fishery rules by providing context to their interpretation. It is also desirable that similar codes of conduct be developed for all stakeholders in a resource (e.g. recreational fishers).

b) ***Education on the legitimacy of regulations***. Many fishers make subjective judgments about what constitutes "bad behaviour" among their peers – fishers deem some offences less important than others, and may not consider particular offences worthy of reporting. Through education, fishers must be made aware that the cumulative effect of many small breaches of regulations may indeed endanger the sustainability of the resource, and ultimately threaten their own livelihoods.

c) ***Illegal activity "hotlines"***. Management agencies should establish mechanisms for fishers to easily report any illegal activity they witness. Western Australia has established the Fishwatch program, a 24 hour toll-free telephone service set up to receive public information about illegal fishing activity; similar programs have subsequently been adopted in most other Australian states. Internet reporting provides another method that is likely to become increasingly accessible for fishers. For example, an Australian fishing company (Austral Fisheries) and the Tasmanian Conservation Trust have established a website to monitor illegal fishing for Patagonian toothfish in the Southern Ocean.

d) ***Rewards for information***. In many law enforcement contexts, agencies offer monetary rewards for the provision of information leading to the successful prosecution of offenders. Rewards are usually staggered to be commensurate with the severity of the offence and the magnitude of the penalty. In New South Wales, for instance, industry funded rewards of up to $500 may be paid for information leading to the conviction of persons undertaking illegal rock lobster fishing. Such a system is yet to be introduced in Western Australia, although there are currently discussions under way concerning compensating fishers who suffer a financial loss because of assistance they provide to enforcement staff (e.g. Fisheries Officers may need the use of a fisher's pots to apprehend someone engaging in illegal pot-pulling).

e) ***Foster good relations between fishers and fisheries officers.*** Good relations based on mutual trust and respect between fishers and Fisheries Officers is perhaps the most important mechanism for encouraging fishers to volunteer information about illegal activity. This is best engendered by one-to-one contact, and should not be restricted to those situations where fishers are inspected to check their compliance with fishery rules. A simple "Hello, how's it going?" on the wharf goes a long way. Maximising the time spent by Fisheries Officers in the field, and reducing their administrative paper burden, enhances such a strategy.

f) ***Effective administration and legislation.*** Central to the issue of commercial fishers reporting illegal activity is the effectiveness of the administrative and legal environment in which they do so. Fishers must feel confident that the information they provide will be acted on promptly, and with due concern for issues of confidentiality. It is also important that the legal system is both capable and willing to impose realistic sanctions; I discuss this point in greater detail in the Section 2.5, Management Agency Responsibilities.

2.4.2 Disciplinary committees

Legal action, although obviously necessary for serious fisheries offences, must in normal circumstances be considered an undesirable outcome. Legal sanctions are often costly to impose, liable to fail because of minor technicalities, and variable in their effectiveness (Franzoni 1988). For example, judicial discretion exercised by different magistrates sometimes leads to quite different findings for similar offences. Courts often do not appreciate the seriousness of fisheries crime, especially in high value fisheries such as the western rock lobster fishery. Fishers themselves lament the fact that prosecutions often result in penalties that are not commensurate with the potential gains to be made from illegal activities. Another problem is that court proceedings are often lengthy processes, resulting in a loss of immediacy between crime and punishment. For many in the fishing community such delays are perceived as inaction on the part of the management agency, and the potential deterrent value of prosecution is diminished as a result.

Peer review by disciplinary committees composed of management and fisher representatives may offer a viable alternative or addition to the judicial process when legal prosecution is deemed unwarranted or impractical. Indeed, it is the fishers and managers themselves who are best equipped to decide reasonable and realistic penalties for fisheries crimes. Peer review is likely to be more cost-effective than court proceedings, would take place in a timely manner, and could encompass a wide range of penalties designed to match the seriousness of the offence. Perhaps most importantly, peer review provides for greater legitimacy and consistency of outcomes, from the point of view of both the fishing community and individual offenders. For example, fishers breaking regulations may do so under an assumption that in a judicial setting where magistrates have little knowledge of the fishing process they can foster doubt about their guilt; such an approach is unlikely to succeed if judged by their peers. It is also possible that judgement by peers may create a deterrent effect in itself, since fishers are unlikely to relish their dishonest behaviour paraded before fellow fishers. Such an approach has parallels in community policing initiatives where juveniles confront and possibly make atonement to their victims as an alternative to judicial approaches to disciplinary action.

In the case of the Department of Fisheries W.A., the discretionary powers of the Executive Director do allow some scope for peer review, however there has been strong opposition from fishers (and their representatives) against participating in such proceedings. The argument against involvement has centred around the fact that fishers feel peer review may create conflict within fishing communities, and that undesirable pressure may be brought to bear on fishers serving on such committees. While these may be legitimate concerns, in an environment of co-management the onus falls upon fishers (the majority of whom are honest) to take collective responsibility to ensure such pressure is not brought to bear against members of disciplinary committees. Nonetheless, to address these concerns I propose two mechanisms that may alleviate fisher anxiety about serving on disciplinary committees:

a) It has been suggested that retired fishers may be suitable candidates to participate in peer-review situations. Retired fishers often maintain an active interest in their fishery, have the respect of existing fishers, but are independent of fisher organisations and management. Representatives should be chosen on the provision that they no longer hold a financial interest in the fishery.

b) A second approach would involve choosing a number of fisher representatives from different regions of the fishery. If a fisher caught conducting illegal fishing is brought before the disciplinary committee, then the representative from that area of the fishery could act as an observer only, or be excluded from the process altogether. The case would then be heard and determined by fishers from areas other than the region of the fishery where the offence took place.

As indicated, there are a range of alternative punitive measures that may be suitable in lieu of legal prosecution, the application of which will depend on the statutory powers of individual management organisations. For example, the Executive Director of the Department of Fisheries W.A. has, under certain circumstances, discretionary power to cancel, suspend, or refuse to renew fishing licenses. Other types of administrative sanctions may include probationary periods after an offence, community service, attendance at compulsory education programs, or installation of compulsory electronic vessel monitoring systems. There are particular legal implications for administering such penalties, however. Peer review processes do not have the traditional safeguards associated with the criminal justice system, such as the right to a jury trial (although this is rare for statutory offences or breaches of fishery management plans) or the requirement that charges are proved beyond a reasonable doubt. It would be appropriate that any peer review process be subject to careful scrutiny to ensure that sanctions were issued with caution and discretion.

2.4.3 Involvement in Compliance Working Groups

The National Fisheries Compliance Committee (1999) has a stated commitment to collaborate with fisheries stakeholders to develop and implement fisheries policies and laws. They also support the co-management of fisheries through Management Advisory Committees, the membership of which can be held accountable for meeting duties and obligations as stakeholder representatives. In the Western Australian rock lobster fishery it is the RLIAC Compliance Subcommittee that operates as a compliance working group for the fishery. This subcommittee is responsible for providing advice to RLIAC on enforcement budgets, the compliance implications of changes to fishing rules, and alerting the enforcement manager to trends in compliance. Involving fishers in this process is beneficial in a number of respects. High levels of voluntary compliance may be encouraged when fishers are involved in designing fisheries laws and compliance planning, since fishers are more likely to be responsive to self-developed regulations than rules imposed from an autonomous management agency (Jentoft 1989). Many fisheries have in place regulations that are difficult to enforce (Hemming and Pierce 1997), but equally fishers may have difficulty complying with some rules. This may occur when rules are developed without due regard to the realities of the fishing process. At best, rules perceived as flawed may be pushed to the limit; at worst they will be openly ignored (Kesteven 1987). Involvement in formulation of rules therefore gives fishers the opportunity to contribute in developing rules with the practicalities of fishing foremost in mind.

Members of RLIAC and its subcommittees are encouraged to liaise with industry, the Department of Fisheries, and other interested parties on issues under its consideration. There is also a clear imperative for RLIAC to solicit industry input on alternate courses of action under consideration. The reasons and rationale behind committee recommendations are conveyed to representative groups by way of a Chair's Summary, most usually distributed to the fishing community as a newsletter after each RLIAC meeting. In these reports it is important to inform the fishing community about the discussions – the compromises and trade-offs – which lead to the final formulation of a decision or new rule. It is this process, perhaps more than any other, that affects the fishing community's perceived legitimacy of rules. It is also important that fisher representatives do not paint the management agency as the "bad guys" when unpopular decisions must be made; if fishers are part of the decision making process, they should be equally accountable for difficult decisions that must be made in a fishery. If legitimate reasons exist for deciding a particular course of action, then these reasons need to be put reasonably, but strongly, to fishers.

The attitudes and perceptions of fishers toward management, compliance and enforcement are vital to the effectiveness of any regulatory effort (Clay and McGoodwin 1995). It is important to know why fishers choose to break fisheries laws, and it is not sufficient to rely solely on the information supplied by fisher representatives on management committees. Industry surveys to ascertain views on management measures and attitudes toward other stakeholder groups should be undertaken on a periodic basis to monitor trends over time. The effectiveness of education programs can often only be measured in this way. By carrying out surveys of this kind management authorities foster interest group support – people like to have their opinions canvassed on issues they see as important to their livelihood. The fact alone that fishers are surveyed indicates a willingness on the part of management and enforcement to take notice of fisher opinions. Finally, as well as the "why", surveys of this kind provide enforcement agencies with some of their most useful information regarding the who, how, where, and extent of illegal activity. Chapters 5 and 6 provide results from compliance-related attitudinal surveys of commercial and recreational fishers in the western rock lobster fishery.

2.5 Management Agency Responsibilities

Encouraging fishers to participate in enforcing fisheries law imparts certain responsibilities on management agencies. Governments need to ensure that appropriate legislation and policy is provided to ensure that fisher involvement in enforcement is both encouraged and supported. In this section I examine three agency responsibilities I feel are particularly important in encouraging fisher involvement in the enforcement process.

2.5.1 Responsiveness

Fisheries enforcement services must make every effort to ensure they are responsive to information about illegal activities reported to them by the fishing community, both in terms of direct action and feedback to those providing the information. This should operate on a formal basis by reporting the results of investigations to Management Advisory Committees, but also on an informal basis between Fisheries Officers and the individual fishers who report the activity. Fishers in the rock lobster fishery have in the past been critical of the Department of Fisheries on this point, and mechanisms have recently been implemented to ensure feedback mechanisms are in place and that information received is acted on in a timely manner. There is also a responsibility to consult with fishers on priorities for patrolling activities, and about the existence of problem areas within a fishery. This make good sense since it is usually fishers who are best informed about the nature and extent of illegal activities in a fishery. Priorities should be directed to those illegal activities commonly perceived as harmful to the sustainability of the fishery.

2.5.2 Confidentiality

I have suggested that individual fishers have a responsibility to speak out when they hear of other fishers who are breaking regulations. In turn, fisheries agencies have a responsibility to ensure fishers may do so in a climate that is safe and free from recrimination. This is not always an easy task, but is greatly assisted by ensuring that information received from fishers is treated as strictly confidential. Most government agencies relying on the receipt of information that would otherwise not be obtained except under circumstances of confidentiality have the power to suppress the source of such information. The rationale is that, were the flow of information to cease, the effective operation of the agency may be prejudiced. This is certainly the case for investigations into fisheries crime, and agencies should ensure that appropriate legislation is in place to ensure confidentiality, both during inquiries and in any subsequent legal proceedings. Tasmania's illegal fishing telephone hotline service provides an interesting example. Tasmanian Fisheries offer monetary rewards for information leading to successful prosecutions of fisheries offences, however informants do not have to identify themselves in order to participate in the reward scheme; they are simply assigned a number and are able to collect any reward which may result from their information on that basis.

Enforcement agencies also have a duty of care to ensure they deal with confidential (and often anonymous) information in responsible ways. By this I mean that information, especially when provided anonymously, should be treated cautiously until such time as enforcement officers can independently determine the validity (or otherwise) of the intelligence received. Informants sometimes make mistakes about what constitutes illegal activity, either by misinterpreting events they have witnessed, or by relying on circumstantial evidence. Malicious accusations, with no basis in fact, are also possible. Fisheries officers should ensure that when investigating suspected offenders they do so without prejudice.

2.5.3 Judicial Process

Enforcement programs should undertake all reasonable steps to inform stakeholders of their legal obligations and the consequences of not meeting them, but at the end of the day must be prepared to prosecute those who wilfully operate outside the law. Fishers must believe that if they cheat there is a reasonable chance they will be caught, and, if caught, that prosecution will be successful. It is also important that deterrent penalties are larger than the gains made through illegal activity, taking into account the probability of detection and successful prosecution (Beddington *et al.* 1997). In the case of the rock lobster fishery, monetary sanctions are typically a nominal penalty, plus court costs, plus a fine (if applicable) approximately 10 times the value of the illegal catch. Sanctions should also be dependent on offence history, since this provides an additional deterrent not to repeatedly violate fishery laws.

Management agencies need to ensure that the judiciary is well educated with regard to the deleterious consequences of fisheries crime, which is itself a subset of "environmental crime". This requires a recognition on the part of magistrates that the judgments they make affect not simply the individual who has committed the crime, but also the wider fishing (and non-fishing) community, and in turn the sustainability of the resource. To be effective, criminal sanctions must not only punish the individual, they should also serve to deter others from engaging in similar activities. This point cannot be stressed enough; the legitimacy of fishery rules, and the willingness of honest fishers to report on those they know to be breaking regulations, hinges on fisher confidence in the legal system to adequately deal with fisheries crime. There must also be willingness for fishers, fisheries officers, and police to cooperate in ensuring that fishers who report fisheries crime are not unduly harassed or victimised in their communities.

In Western Australia, commercial rock lobster fishers have in the past lamented about the inappropriateness of penalties imposed by some magistrates in successful prosecutions against offending fishers, and in particular that penalties imposed are sometimes insufficient for the nature or extent of the crime. In many instances this problem has arisen because magistrates are unfamiliar with the fishing process, and fishers facing prosecution have successfully argued that illegal activity occurred because of "a reasonable and honest mistake". To overcome this problem, at least in the case of prosecutions arising from the consignment of illegal catch to processing factories, I provide reports on alleged offenders to the Department of Fisheries prosecuting council. These reports profile individual fishers against their peers, stratified according to the time of year and location in the fishery, and serve to educate magistrates about the likelihood (or otherwise) of particular offences occurring. Although this information is confidential and not presented as part of this report, in Chapter 3 I provide analyses of factory consigned commercial catch, and it is against this type of information that offending individuals may be assessed in cases for prosecution. Since the overwhelming majority of commercial fishers are observed to be compliant with fishery rules, the initiative of profiling suspected offenders has generally been well accepted by the commercial fishing community.

Finally, it is important to inform fishers about the nature of successful prosecutions. Advertising successful prosecutions educates fishers about the types of penalties received for particular fisheries offences, acting as a deterrent mechanism against other people committing similar acts. It can also serve as a "shaming" penalty, as is the case for Western Australian fisheries where detailed outcomes (including names) of successful prosecutions are published in a quarterly magazine, Western Fisheries. Indeed, commercial fishers have related that it is the offences section of Western Fisheries that they first turn to when opening a new copy!

2.6 Conclusion

There is an increasing awareness among fisheries managers and industry that the principles of co-management, in conjunction with rights-based access to fisheries resources, can help mitigate many of the problems associated with open access and over-capacity in fisheries. Difficulties with ensuring compliance in open-access fisheries are often cited as one reason why management agencies may wish to move toward rights-based management strategies, since it is generally held that rights-based access engenders responsible resource use. Fisher organisations frequently advocate increased management responsibility for fishers, and for the adoption of rights-based access to resources. One way for fishers to advance their case is to demonstrate a responsible attitude toward compliance with, and enforcement of, fisheries rules. I have contended that it is insufficient for fishers to simply contribute money toward compliance expenditure – commercial fishers (and commercial fishing organisations) must play an active role in enforcement/compliance activities. Until such time as fishers' attitudes toward compliance and enforcement change from those of either antagonist or neutral observer, to one of pro-active involvement in ensuring compliance, further development of co-management is likely to be hindered.

I have advocated increased management responsibility for fishers, particularly in the area of fisheries enforcement. In the Western Australian rock lobster fishery access is pursuant to a limited-entry management plan, within which catch shares are indirectly allocated through pot holdings. There is the possibility of strengthening these access rights, thereby ensuring for fishers continuity of access should management plans be amended or revoked. However, if fishers wish for greater security of access, and increased devolution of management responsibility in general, it is important they demonstrate a responsible attitude toward compliance with, and enforcement of, fisheries rules. Fishers should be involved in the formulation, and assist in the implementation, of fisheries rules on both an individual and collective basis.

In a very real sense the legitimacy of fishery rules centres around explaining to the fishing community how and why particular rules have arisen. This flow of information should operate both ways, however. Managers and scientists need to educate fisher representatives about the scientific and management processes; fishers, for their part, need to educate managers and scientists about the realities of the fishing process and how this impacts upon compliance with rules. It is perhaps in this exchange of information that the true value of co-management may be found. I have suggested three mechanisms for increasing fisher involvement in the enforcement process: i) encouraging fishers to help enforcement staff by providing information about illegal activities; ii) participating in peer review of fishery offences; and iii) involvement in compliance working groups. These processes will only be effective, however, if management agencies can ensure appropriate administrative and legislative structures are in place to encourage and support fisher involvement in enforcement.

3. *Compliance in Factory Consigned Commercial Catch*

3.1 Overview

Examination by of commercial catch consigned to processing factories represents the principal mechanism for checking the legality of landings in the western rock lobster fishery. As factory consigned catch accounts for an overwhelming majority of landings from the fishery, this forms an important basis for monitoring the continued effectiveness of the rock lobster compliance program. In this chapter I examine temporal and spatial trends in non-compliance observed in factory consigned commercial catch. I also explore how different measures of compliance might be formulated, and calculate estimates of total illegal catch removed from the fishery and consigned to processing factories by the commercial sector. Finally, using fishers' logbook data I present a graphical analysis of the spatial and temporal availability of non-legal lobster in the fishing grounds.

Fisheries Officers typically check 2-5% of the total catch landed by commercial fishers in each season. Results indicate that commercial compliance with catch-related rules is exceptionally good. For seasons 1998/1999-2000/2001 non-compliance was estimated as 1.1-2.4 illegal lobsters detected in every 1,000 animals checked. A majority of detected illegal animals are undersized, although small numbers of illegal female lobsters in breeding condition are occasionally detected. In the 2000/01 season, total illegal catch was estimated in the range 16.3-16.9 tonnes; in the context of a total catch of 11,273 tonnes this only accounts for 0.15% of the total landed catch.

3.2 Introduction

Inspections by Fisheries Officers of commercial catch consigned by fishers to licensed processing facilities (factories) provide the primary mechanism for determining compliance with many of the catch-related rules in the commercial western rock lobster fishery. While individual commercial fishers maintain a right under their licence conditions to sell catch directly to the public, most do not. The reasons for this are twofold; the domestic market for rock lobster in Western Australia is quite small compared with the volume of the total catch, and processors (who export a large proportion of the catch live to lucrative overseas markets) generally pay higher catch prices than can be obtained through sales direct to the domestic market. This has meant that over 95% of the commercial catch in the last 10 years has been consigned to a limited number of processing factories, providing a convenient "bottleneck" for Fisheries Officers to relatively easily check a known proportion of the catch.

Under certain assumptions, it is possible to calculate infringement rates from standardised catch checks, and to extrapolate these to provide estimates of total illegal catch removed from the fishery by the commercial sector for product being consigned to processors. There is an argument, however, that since Fisheries Officers maintain a seasonal presence in processing factories, commercial fishers who are landing illegal catch are unlikely to consign this catch in the normal way to factory processors. Such an argument opens the possibility that fishers may be either consigning illegal catch to factories in a manner not readily detectable by standard factory inspections (e.g. "out-of-hours" consignments), or that illegal catch is sold through non-factory avenues. If this were the case there might be substantial illegal commercial catches that go undetected, at least insofar as factory inspections are concerned.

While these scenarios are possible, and perhaps occur to some small extent, they seem unlikely to be a large problem in the fishery. Concerning illegal catch sold through non-factory avenues, this is unlikely since there is no substantial local market for lobster. There is a large recreational fishery of 35,000-40,000 fishers, each of which have a generous 8 lobster/day bag limit. This means that a large proportion of the population has relatively easy access to the fish resource, and this contributes toward the small size of the local market. Enforcement personnel from time-to-time do detect black market sales, but these apprehensions typically involve fishers who are neither licensed recreational fishers nor licensed commercial fishers. These fishers are termed "unlicensed commercial fishers" since they profit from sale or barter of the catch (colloquially they are known as "shamateurs" or "fish thieves"). While I am not suggesting that commercial fishers never deal in illegal product outside of processing factories (see Section 1.2.7), it is fair to say that evidence, anecdotal and otherwise, suggests this happens only infrequently.

It is also unlikely that commercial fishers are consigning illegal catch to factories in ways that are currently not detectable by Fisheries Officers. During the 2000/01 fishing season, mobile factory patrols were introduced to complement factory inspection activities undertaken by district-based enforcement personnel. Mobile patrol teams comprise two Fisheries Officers that patrol the length of the fishery conducting random inspections of factory consigned catch. This serves to add an "element of surprise", both in time and space, to the normal factory inspections conducted by district-based Fisheries Officers. This initiative was introduced to counter the possibility that some fishers, particularly in small population centres, could determine the movement patterns of district-based Fisheries Officers and take advantage of periods of absence to consign illegal catch to factories. It is worth noting that commercial fishers, through the RLIAC process, endorsed the establishment of mobile patrols in spite of the additional costs to industry, an indication of the mature view taken by industry regarding illegal activity.

For the reasons discussed above, it is likely that an overwhelming majority of illegal catch taken by the commercial sector is consigned (along with legal catch) to processing factories. Discussions with commercial fishers and Fisheries Officers reveal three scenarios when this might occur. First, small amounts of illegal catch may occasionally be consigned by accident along with legal catch. This can happen due to measurement errors that might arise when skippers are training new crew, carelessness or concentration loss. Second, fishers are aware that only a relatively small proportion of the catch is inspected by Fisheries Officers (typically less than 5%), and for some fishers there exists the temptation to habitually consign small numbers of illegal animals amongst legal catch. Penalties for detection of small numbers of illegal animals are relatively minor, and, although more severe penalties are imposed on fishers repeatedly making minor transgressions, commercial operators are aware that small, continuing profits can be made in this manner. Finally, some fishers consign large numbers of illegal animals in a single consignment in the hope that their catch will successfully "run the gauntlet" and not be inspected. Although the probability of detection is relatively low, penalties received for large illegal consignments can be severe and usually attract a "black mark" against the skipper and the licence (see Section 1.2.7). It should be noted at this point that, while it is an offence for factories to be in possession of illegal product, there is no legal imperative for factory staff to report fishers they believe to be consigning illegal catch, although on an informal basis this often does occur.

Results from analyses of factory-detected infringements are used for a number of purposes in management of the rock lobster fishery. They are provided to compliance staff, fishery managers and to the Rock Lobster Industry Advisory Committee (RLIAC), and are used to monitor the effectiveness of enforcement activities in rock lobster processing factories. Fisheries Officers, through the RLIAC and risk assessment processes, use analyses of data to ensure that enforcement resources are directed to those areas of the fishery where non-compliance with fishery rules appears a higher risk. This includes examining spatial and temporal trends in non-compliant activity, and ascertaining how non-compliant behaviour is dependent on the amount of enforcement effort in individual processing factories. Data are also used to help Fisheries Officers target those fishers who appear to be systematically consigning small numbers of illegal animals. Such analyses have become increasingly important as fishers, motivated by sometimes intense competition among factories to secure catch, are increasingly making consignments in different districts of the fishery, with the result that district-based Fisheries Officers are often unaware of illegal consignments that occur in adjacent districts. Finally, results are used to profile serious offenders against their peers for the purpose of providing advice to magistrates, thereby strengthening cases for prosecution. This serves to educate the judiciary about the likelihood of particular offences occurring by accident, and also acts as a significant deterrent to other commercial operators since the information is presented (without displaying individual vessel details) to fishers on an annual tour of coastal towns.

The remainder of this chapter is divided into three sections: i) Section 3.3 provides detail about how the data are collected, processed, analysed, and presented; ii) Section 3.4 presents summary results from historical factory inspection data (seasons 1989/1990 – 1997/1998), and more detailed results from the three most recent seasons' data (98/99 – 00/01); and, iii) Section 3.5 provides a discussion of the results and the implications for continued monitoring of factory compliance.

3.3 Methods

3.3.1 Data Collection

At the end of each fishing day, commercial fishers consign their catch to one of several licensed processing factories (described in Section 1.2.2). The fishery regulations stipulate that fishers must consign catch in labelled baskets identifying the Fishing Boat Licence number of the fishing operation. While catch can be consigned at a large number of points along the fishing grounds, there are only a small number of locations where catch can actually be processed. Catch that is consigned some distance from a factory must be transported, usually by road in refrigerated trucks, to the point of processing. Once consigned, the catch becomes the property of the factory, however the fisher remains liable under law for consigning protected fish until such time as catch it is emptied from the labelled containers ("baskets") by factory workers. Once processing commences lobsters are rendered indistinguishable from any other fishers' catch, but before that point Fisheries Officers can always unambiguously identify the fishing vessel from which particular catch arose.

Officers may check catch in a number of situations: a) as it is removed from the fishing vessel (point of landing); b) in transit by truck; c) at a receival depot; or, d) in the processing factory itself. Most catch is checked in factories, although there are particular locations around the coast where Fisheries Officers, due to the absence of factories, only check catch at receival points. During a check Officers will pull aside one or more baskets of catch from an individual fisher. Officers usually check a subset of the total catch consigned by a fisher during an inspection, but may check all of a fisher's catch if there is only a small amount, if they detect breaches in the catch they have checked, or if they suspect a fisher to be breaking fishing regulations. A catch inspection can be designated as either a random or a targeted inspection; the former occurs when

Fisheries Officers have no *a priori* knowledge that would lead them to believe that a fisher may be breaking fishing rules, while the latter refers to an inspection purposefully directed at a particular fisher because of prior information received. Lobsters are individually checked to ensure they comply with the minimum and maximum size rules, and that restrictions on taking mature females are observed. If Officers detect a violation of the rules, they will take action depending on the nature and extent of the infringement.

Working in pairs, Fisheries Officers record information on the catch they inspect in a systematic manner on predetermined data recording sheets, including the date and time the inspection takes place, the fishing vessel that consigned the catch, the number of baskets inspected, and the numbers of illegal animals detected in various categories. Fisheries Officers keep separate counts of illegal animals detected, including lobsters that are smaller than the minimum legal size, female lobster larger than the maximum allowable size, setose lobster, and tarspot lobster. Officers also record whether a fisher's catch was chosen randomly for inspection, or whether the fisher was targeted. Finally, Officers record any formal penalties (see Section 1.2.7) that may be issued as a result of detecting illegal catch.

Completed data sheets are forwarded to the statistician responsible for compliance statistics in the Research Division of the Department of Fisheries W.A. to be entered into electronic format for analysis. Prior to analysis, data are subject to various forms of validation in order to isolate and correct possible transcription or other typographical errors. This is accomplished by a combination of internal validation techniques[4], and by cross-referencing data against other information collected by the Department of Fisheries. Most data are analysed using the statistical software package S-Plus.

3.3.2 Estimating Non-Compliance

Compliance rates can be measured and presented in a number of ways, but are generally presented as the proportion (i.e. in the range 0-1) of fishers in a defined group that, on the basis of measured inspections, were found to be observing fishing rules (compliant) or not (non-compliant), noting that non-compliance rates are simply 1 minus the compliance rate. Compliance rates may be estimated at a number of levels of aggregation of the data, including seasonal, factory, district and individual fisher estimates. Furthermore, rates can be estimated on a per-fisher basis (e.g. 0.1 = 1 fisher in every 10 is breaking rules), a per-inspection basis (e.g. 0.05 = 1 in 20 inspections detects a breach of rules), a per-basket basis (e.g. 0.067 = 2 in 30 baskets inspected contained illegal animals), or on a per-animal basis (e.g. 0.001 = 1 in every 1000 animals consigned is illegal). For the rock lobster fishery it is informative to consider compliance rates on a per-animal basis, since this can be used, under certain assumptions, to estimate the total amount of illegal catch removed from the

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[4] *Internal validation* refers to techniques that check the accuracy of data against known properties of the data, and often incorporates reference to similar data to that under consideration. Two examples would include: vessel numbers are checked for validity against Fisheries WA licensing records, and the number of baskets inspected for an individual vessel should be greater than zero.

fishery to factory processors. Where appropriate, however, I consider different aggregations of the data and different types of compliance rates.

Estimation is a straightforward process utilising the number of baskets checked, an assumption about the average number of animals consigned in each basket (for per-animal estimation), and the number of illegal animals detected in several types of infringement category (e.g. undersize, setose, etc).

Rates, on an individual animal basis, are calculated as:

$$\text{non-compliance} = \frac{\text{number illegal animals detected}}{\text{number baskets checked} \times \text{average number animals per basket}}$$

The average number of lobsters in each basket was estimated in the 1998/1999 season by individually measuring over 60,000 lobsters in about 1,200 baskets of consigned catch (see Section 4.3). Although it is recognised that there may be considerable variation in the number of lobsters consigned per basket due to seasonal and spatial variability within the fishery, this figure is considered sufficiently robust for the purpose of estimating compliance rates. It is also consistent with previous estimates used for the average number of lobsters per basket (Eric Barker, pers. comm.).

Since compliance in the rock lobster fishery is typically very high, non-compliance rates are often close to zero. This can make interpretation difficult, particularly when trying to assess if estimated non-compliance is consequential in light of the total catch in the fishery. Some conversions for per-animal non-compliance rates are provided below to help assist with interpreting rates (Table 3.1).

Table 3.1 Interpretation of per-animal non-compliance rates.

Per-Animal Non-Compliance Rate	**Percent of total Catch Illegal**	**Number of Illegal Animals in Every 10,000 Checked**	**Number of Baskets Checked to Detect <u>One</u> Illegal Animal**
0.0001	1/100 of 1 %	1	200
0.0005	1/20 of 1%	5	40
0.0010	1/10 of 1%	10	20

Fisheries Officers typically inspect only a small proportion of the total catch consigned to processing factories. However, utilising information from random inspections it is reasonable to extend inferences about non-compliance to the larger fishing population. Fishers are often not chosen for inspection randomly, however. Fisheries Officers purposely "target" particular fishers for inspection based on a belief that a fisher may be breaking fishing regulations. A targeted inspection is defined as one that is initiated because available information indicates that an offence may have been committed, or may be more likely to have been committed, and the fisher is chosen for inspection on that basis. "Available information" includes intelligence received from the public, contacts within the fishing industry (e.g. fishers, factory workers, ex-deckhands, etc.), the Serious Offences Unit (an operational unit designed to deal with serious, often organised, fisheries crime), as well as an individual Fishery Officer's knowledge of the past activities of particular fishers.

In the 1998/1999 season Fisheries Officers were instructed to begin recording whether fishers were chosen for inspection randomly, or whether they were targeted because of known information. It is considered important to differentiate between these types of inspection, since failing to distinguish targeted inspections in calculation of an overall non-compliance rate would effectively bias any estimate upward (i.e. estimated non-compliance rates would be too high).

Consider the following example (see over page). In this example I consider the simple case of per-fisher compliance rates, although the case for per-animal compliance is a straightforward extension. I present three alternatives for calculating compliance rates. Alternative A is considered misleading since it effectively over-estimates non-compliance due to the targeted nature of one-third of all inspections. In the absence of information on the targeting behaviour of Fisheries Officers, such an estimate may be all that exists, and this is the case for historical rock lobster factory inspection data prior to the 1998/99 fishing season. Alternative B considers targeted and non-targeted inspections separately. This has the advantage of providing a quantitative measure of the effectiveness of the targeting behaviour of Fisheries Officers; that is, how effective is the information Officer's canvass or receive in helping detect breaches of fisheries rules? Alternative C combines targeted and non-targeted infringement information by calculating a weighted average, providing a single estimate from all available information. This is not the preferred method, however, since it confounds inferences by combining random and non-random information. In other words, it is preferable to treat fishers inspected as a result of targeted and non-targeted inspections as separate populations since to do otherwise reduces the information content of the data. Alternative C is also questionable on the grounds that a single, weighted infringement rate may be unduly biased upward due to those targeted inspections that detect very high infringement rates. It is questionable whether data on the small number of fishers who flagrantly break fishery rules should contribute toward characterising overall fleet behaviour. Unless otherwise stipulated, compliance rates are presented for targeted and random inspections separately.

Example: Consider 100 fishers in a simple hypothetical fishery

For 95 fishers we ***have no prior information***, ∴ subject to random inspection.

For 5 fishers we ***have prior information***, ∴ purposely targeted for inspection.

On patrol over a specified period of time, fisheries officers:

- Inspect 5/5 of the fishers for whom we have prior information (targeted inspections) and detect 4 infringements
- Inspect 10/95 of the fishers for whom we have no prior info (random inspections) and detect 1 infringement

How should this information be interpreted?

A) Total 5 infringements from 15 inspections, or 33% non-compliance

Adoption of this approach biases the rate upward due to the targeted contacts

OR

B) Total 4 infringements from 5 targeted inspections (80% non-compliance) and 1 infringement from 10 random inspections (10% non-compliance)

Adoption of this approach partitions out non-compliance in the general fishing population (10%) from that evident in the "known (or suspected) non-compliant sector" (80%).

OR

C) If we know the size of our fishing population (in this case 100), a weighted average of: ((0.1 x 95) + (0.8 x 5)) / 100 = 0.135, or 13.5%

Adoption of this approach combines all information into one estimate, providing an alternative to B.

When calculating estimates of total illegal catch removed from the fishery and consigned to processing factories it is necessary to sum illegal catch arising from random and targeted inspections. I have adopted the view that non-compliance rates observed as a result of targeted inspections apply only to the *actual* catch inspected during the targeted inspections. In other words, non-compliance rates from random inspections are presumed to apply to the >95% of catch not inspected, but non-compliance rates for targeted inspections are not assumed to apply to any catch *other than the targeted inspections themselves*. The rationale for this decision is that Fisheries Officers can only act upon information they receive, and it is reasonable to assert that they act on all information received. Unlike randomly determined infringement rates, there is simply no larger population to which targeted non-compliance rates might be extended.

Estimated illegal catch (IC) is thus calculated:

$$IC = \frac{ICDR \times (TC - TCI)}{RCI} + ICDT$$

where ICDR is illegal catch detected from random inspections, TC is the total catch consigned to processors (determined from processor documentation provided to the Department of Fisheries), TCI is the total targeted catch inspected, RCI is the total random catch inspected, ICDT is the illegal catch detected from targeted inspections.

3.3.3 Expressing Uncertainty

Fisheries Officers have been collecting records about the inspections they conduct in rock lobster processing factories each fishing season over the period 1989-2001. I use these data to estimate the proportion of the total commercial catch inspected by Fisheries Officers, and, in conjunction with infringement information, the total amount of illegal product consigned to processing factories. It is desirable to indicate the precision of these estimates so that managers are alerted to the uncertainty surrounding calculations. This is problematic in the present case, since a lack of empirical data for some parameters requires them to be estimated by using a "best guess" approach (albeit utilising extensive knowledge of the biological characteristics of the species). In doing so, I have chosen an upper and lower bound for parameters estimated in this way; utilising the most and least conservative of these in subsequent calculations provides an upper and lower bound to the estimate of the proportion of the total catch inspected and the total illegal catch removed by the commercial sector. This has the effect of providing a "best" and "worst" case scenario under the assumptions made about unknown parameters.

The first assumption to be made concerns the average weight of a landed lobster. Most "just-sized" animals (i.e. 76-77 mm carapace length) are around 0.4-0.5 kg. Since the catch composition is generally positively skewed with seasonal peaks around the minimum size limit, I have chosen values of 0.45 kg per animal (lower bound) and 0.55 kg per animal (upper bound) for use in further calculations. Discussions with colleagues in the Western Australian Marine Research Laboratories confirm these are reasonable assumptions.

Second, an assumption must be made regarding the average number of animals consigned in a single basket. As discussed previously, this was measured to be 51.2 ($\pm$ 0.47 SE) in an experiment conducted in the Fremantle area of the fishery during the period March-May 1999. The estimate arose from individual counts of the number of lobsters in almost 1,200 baskets of catch consigned during this time. I use the mean number of lobsters per basket +2 SE in the calculation for the upper bound, and the mean –2 SE for the lower bound.

3.3.4 Graphical Display Techniques

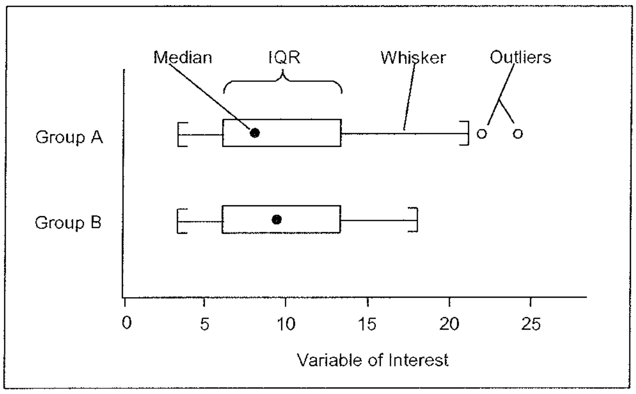
I use a number of graphical techniques that may be unfamiliar to some readers, and I briefly explain these below.

3.3.4.1 Boxplots

Boxplots, also known as "box and whisker plots", are an exploratory graphical technique used to compare the distributions between different groups (Tukey 1977). Boxplots may be constructed in a variety of ways, but classically consist of a number of elements summarising a distribution of data, including (following the terminology of Cleveland 1993):

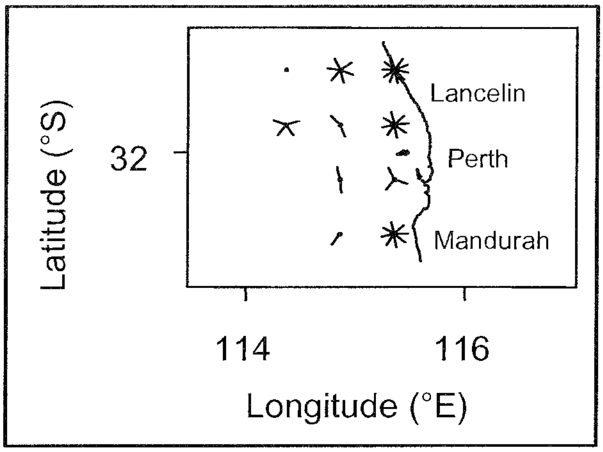
- A symbol to indicate the median of the distribution
- A box extending from the 25% percentile to the 75% percentile encloses the middle 50% of the data values. The difference between the upper and lower bound of this box is referred to as the inter-quartile range (IQR).
- Adjacent values are enclosed by "whiskers" extending from the upper and lower edge of the box to the lowest and highest data values, or to 1.5 times the IQR, whichever is larger (or smaller).
- Values that occur outside the whiskers are termed outside values, or outliers, and these are plotted individually to highlight behaviour in the tails of the distribution.

In the example below two groups are represented. Group A is positively skewed, indicated by the short lower whisker and position of the median toward the lower end of the box. Two extreme values are indicated. Group B appears approximately normally distributed.



3.3.4.2 Sunflower Plots

Sunflower plots are a technique for displaying tri-dimensional data. The first two dimensions are used to display (usually) quantitative data on the abscissa and ordinate axis of the plot, while the third quantitative variable is displayed as a glyph located at the position defined by the values of the first two variables. The plot is similar to the more familiar "bubbleplot", where circles are plotted at their centre in two dimensions, with radii proportional to the value of a third variable. Unlike bubbleplots, sunflower plots allow more precise discrimination of actual values in the third dimension by drawing radial spokes, each representing a defined increment in the third variable, centred on the values defined in the first two variables.



In Section 3.4.4 I use sunflower plots to show the spatial distribution of the average number of non-legal lobster landed per *n* pot lifts based on fisher logbook data for the 1999/2000 fishing season. *n* can be varied dependent on the absolute value of the third dimension to allow best discrimination in the display. In all plots showing spatial information data are aggregated so they are centred on each 0.5° of latitude/longitude.

The example above shows a small section of coast in the Perth region of the fishery. The catch rates of undersize lobster are represented as sunflowers centred on each 0.5° of latitude/longitude. Dots (·) indicate an average in the range 1-100 undersize per 100 pot lifts. Each radial spoke ("petal") represents an increment of 100 in the average value (e.g. ⅄ represents an average of 300-400 undersize lobster in every 100 pot lifts).

3.3.5 Spatial and Temporal Characteristics

Where appropriate I present results on a regional basis. There are two levels of spatial demarcation used by the Department of Fisheries in managing the enforcement program in the rock lobster fishery. First, the coastline covered by the fishery is divided into two regions, the Midwest and Metropolitan. Within each region, individual officers operate out of district offices located in coastal towns. In order to maintain reasonable sample sizes, data collected at some smaller districts have been combined with adjacent districts (Table 3.2; see also Figure 1.1). Also, catch inspected at points along the coast not associated with town-based processing factories (e.g. receival depots or beach inspections) have been grouped with data arising from the nearest district. Where appropriate, temporal trends are summarised by presenting information on a monthly basis. This provides an annual time series of 8 months, noting that data for November only comprise data collected 15-30 November.

Table 3.2 Breakdown of Regions, and Districts within Regions, used for reporting purposes.

Region	District Name Used for Reporting	Locations
Midwest	Jurien	Cervantes
		Jurien
	Dongara	Dongara
	Geraldton	Geraldton & Abrolhos Islands
		All landings North of Geraldton
Metropolitan	Fremantle	Fremantle
		Hillaries
		Mandurah
	Lancelin	Lancelin

3.3.6 Structure

The results section is divided into a number of components. First, I present an overview of the historical factory inspection data (Section 3.4.1). This overview shows the broad annual trends in the number of catch inspections conducted and the amount of illegal product detected, and provides annual estimates of total illegal catch consigned to processing factories by the commercial sector of the fishery.

Next, I examine the frequency of inspection across the fleet; how many vessels are inspected, how often are they inspected, and how much catch is inspected from each (Section 3.4.2). Where available, I present results from all seasons between 1989 and 2001. However, I place particular focus on seasons 1998/1999, 1999/2000 and 2000/2001 since these are the seasons monitored over the life of this study. For these seasons factory inspections took place in all districts of the fishery, and Officers for the first time distinguished between random and targeted inspections. The information collected for this period is of higher quality than that collected during previous seasons; discrepant information was queried with reporting Fisheries Officers, and more rigorous forms of data validation were undertaken. In earlier seasons, some data are missing entirely for particular district-season combinations, and in tables of results these are shown as shaded cells.

Next, I present an analysis of the detection of illegal catch in each district of the fishery. I estimate compliance rates at a number of levels, and calculate amounts of illegal catch removed from the fishery and consigned to factory processors for seasons 1998/1999-2000/2001 (Section 3.4.3). Finally, by utilising fisher research logbook data, I present the monthly spatial distribution of non-legal lobster in the fishing grounds for the 1999/2000 season (Section 3.4.4). These results are an important complement to compliance rate information, allowing Fisheries Officers to gain an understanding of the spatial and temporal variation in the availability of non-legal animals.

3.4 Results

3.4.1 Summary of Historical Inspection Data

Dependent on resources available within the rock lobster enforcement program, Fisheries Officers have typically inspected between 0.5% and 5% of the total commercial rock lobster catch landed in any one season (Table 3.3)[5]. This has resulted in considerable seasonal variation in the number of catch inspections carried out, and in the number of baskets of rock lobster inspected. Officers generally inspected 3000-5000 baskets each season, although notable exceptions occurred in the 1993/1994, 1996/1997 and 2000/2001 seasons (12,000-14000 baskets inspected), and in the 1998/1999 season (26,500 baskets inspected).

Table 3.3 Seasonal information available on number of catch inspections, number of baskets inspected, total amount of commercial catch processed through factories, and the percent of the total catch that was inspected by Fisheries Officers.

Season	Number of Individual Catch Inspections	Number of Baskets Inspected[a]	Total Catch Processed in Factories ('000 kg)[b]	% of Total Commercial Catch Inspected[c]	
				Lower Bound	*Upper Bound*
89/90	1052	2053	10298	0.45	0.57
90/91	1760	3307	9220	0.81	1.03
91/92	1507	4048	12164	0.75	0.95
92/93	2021	3969	12303	0.73	0.93
93/94	4455	13743	11011	2.82	3.58
94/95	1408	3018	10802	0.63	0.80
95/96	1441	4140	9786	0.96	1.21
96/97	5725	13742	9902	3.14	3.98
97/98	2553	5271	10418	1.14	1.45
98/99	9951	26559	13009	4.62	5.85
99/00	2288	6421	14437	1.01	1.28
00/01	4498	12658	11273	2.54	3.22

a. Prior to the phasing-in of standard sized baskets in the early 1990's a small number of fishers consigned catch in "bags"; these typically accounted for 1-2% of all catch consignments in seasons 89/90 - 93/94. Catch consigned in bags has been standardised to an equivalent number of baskets by using a ratio of 2 baskets for every 1 bag.

b. Provided to the Department of Fisheries on an annual basis from all licensed rock lobster processing establishments.

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[5] Prior to the 1998/1999 fishing season there are missing data for some districts of the fishery. Fisheries Officers state that factory inspections did take place, but that data were either not recorded, or recorded but misplaced. The pattern of missing data by district and season can be seen by examining Table 3.8.

c. Upper bound calculated assuming 52.14 lobsters per basket (mean + 2 SE, see Section 4.3) and an average lobster weight of 0.55 kg; lower bound calculated assuming 50.26 lobsters per basket (mean - 2 SE, see Section 4.3) and an average lobster weight of 0.45 kg.

Recall that when conducting a catch inspection, Officer's may check one or more baskets of catch from a single fisher. Table 3.4 examines infringements on the level of individual inspections, independent of the number of baskets checked during each inspection or how many illegal animals were detected. Infringement levels detected from random inspections varied seasonally between 5% and 15%, noting that the 1993/1994 season (coinciding with the introduction of a new management package) showed the highest percentage of inspections containing some illegal product.

In the 1998/1999 season Fisheries Officers began distinguishing between random and targeted catch inspections. Only a small percentage of all inspections were targeted on the basis of prior information received, with 2.5%, 5.1% and 2.7% designated as targeted for seasons 1998/1999-2000/2001. These inspections were highly effective in detecting infringements; for these three seasons, random inspections showed that less than 10% of all fishers inspected had some amount of illegal product in their consigned catch, while 20-30% of targeted inspections revealed some level of infringement activity (Table 3.4). Random and targeted inspections were not distinguished prior to the 1998/1999 season, and as such comparisons between years may be confounded if the proportion of targeted inspections differed between seasons (as did occur during the 1998/1999-2000/2001 period).

Table 3.4 Seasonal information on number of non-targeted and targeted catch inspections for which data are available, and the number of fisher catch inspections during which an infringement was detected. Note that differentiating targeted from non-targeted inspections only commenced in the 1998/1999 season. Bracketed numbers indicate the percentage of inspections where infringements were detected.

Season	Non-Targeted Inspections: Total Number of Catch Inspections	Non-Targeted Inspections: Number of Inspections where Infringement Detected (%)	Targeted Inspections: Total Number of Catch Inspections	Targeted Inspections: Number of Inspections where Infringement Detected (%)
89/90	1052	104 (9.9)		
90/91	1760	102 (5.8)		
91/92	1507	91 (6.0)		
92/93	2021	216 (10.7)		
93/94	4455	697 (15.6)		
94/95	1408	195 (13.8)		
95/96	1442	150 (10.4)		
96/97	5725	560 (9.8)		
97/98	2553	139 (5.4)		
98/99	9706	595 (6.1)	245	72 (29.4)
99/00	2175	191 (8.8)	117	23 (19.7)
00/01	4374	292 (6.7)	120	26 (21.7)

Turning to per-animal infringement rates, Table 3.5 shows the infringement rates (as percentages) for seasons 1989/1990-2000/2001. The highest infringement rate detected occurred for targeted inspections in the 2000/2001 season, when around 10 in every 1000 lobster inspected were found to be illegal. For non-targeted inspections, infringement rates were between 0.11% and 0.31% for all seasons, indicating illegal detections of 1-3 illegal lobster in every 1000 animals checked. Comparing between seasons 1998/1999- 2000/2001, in 1998/1999 Officers were directed to conduct a record number of inspections (almost 5% of the total catch), and this resulted in an historically low infringement rate of 1.1 illegal animals in every 1000 animals checked[6]. In the 1999/2000 season the level of catch inspected was purposefully dropped to around 1% of total consigned catch, resulting in increased infringement rates (based on random inspections) to around 2.4 animals in every 1000 lobsters checked, or an increase over 1998/1999 detections of 120%. In the next fishing season, 2000/2001, around 2.5% of the total catch was inspected, resulting in an intermediate level of infringement of around 1.5 illegal lobster in every 1000 checked. While not conclusive, these results are indicative of a causal relationship between the level of inspection by Fisheries Officers in processing factories and the rate of compliance.

Targeted inspections revealed infringement rates 4-5 times greater than corresponding random inspections for those seasons in which random and targeted inspections were differentiated (Table 3.5). Infringement rates from targeted inspections were between 6 and 10 illegal animals in every 1000 animals checked, indicating the important role directed enforcement effort plays in detecting breaches of fishery rules.

From the information provided in Table 3.3-Table 3.5, it is useful to estimate the total amount of illegal catch consigned by the commercial sector to processing factories. Using the previously discussed upper and lower bound estimates for the number of lobsters per basket and the average weight of a consigned lobster, and combining random and targeted inspection information in the manner described in Section 3.3.2,"Best Case" and "Worst Case" scenarios for estimates of total illegal catch removed by the commercial sector and consigned to processing factories are provided in Table 3.6 and Table 3.7.

[6] Based on random inspections only, noting that the term "historically low" is used advisedly since infringement rates resulting from targeted and non-targeted inspections could not be partitioned prior to the 1998/1999 season.

Table 3.5 Seasonal information available on number of baskets inspected, number of illegal animals detected, and estimated infringement rates. The latter are expressed as percentages, noting that infringement rates are uniformly less than 1%. Note also that differentiating targeted from non-targeted inspections only commenced in the 1998/1999 season.

Season	Non-Targeted Inspections			Targeted Inspections		
	Number of Baskets Inspected	Number of Illegal Animals Detected	Infringement Rate (%)	Number of Baskets Inspected	Number of Illegal Animals Detected	Infringement Rate (%)
89/90	2053	257	0.24			
90/91	3307	301	0.18			
91/92	4048	259	0.12			
92/93	3969	593	0.29			
93/94	13743	1610	0.23			
94/95	3018	479	0.31			
95/96	4157	395	0.19			
96/97	13742	1829	0.26			
97/98	5271	683	0.25			
98/99	25627	1403	0.11	932	289	0.61
99/00	5892	736	0.24	536	257	0.94
00/01	12213	918	0.15	438	222	0.99

Table 3.6 Seasonal estimates of total illegal product removed from the fishery and consigned to licensed processing factories. Assumptions have been chosen to provide the most conservative estimate of illegal catch.

Season	*Best Case Scenario*[a]					
	Total Weight Inspected (Kg)		Total Detected Weight Illegal (Kg)		Estimated Total Illegal Catch (Kg)	Percentage of Total Catch Illegal
	Random	Targeted	Random	Targeted		
89/90	58,874		141		24,733	0.240
90/91	94,835		166		16,100	0.175
91/92	116,085		143		14,932	0.123
92/93	113,819		326		35,260	0.287
93/94	394,108		886		24,740	0.225
94/95	86,547		264		32,888	0.304
95/96	119,210		217		17,838	0.182
96/97	394,079		1,006		25,278	0.255
97/98	151,157		376		25,894	0.249
98/99	734,906	26,727	772	159	13,791	0.106
99/00	168,965	15,371	405	141	34,692	0.240
00/01	350,232	12,561	505	122	16,355	0.145

a. Assuming an average of 52.14 lobster per basket, and an average lobster weight of 0.55 kg.

These results show that between 13 and 36 tonnes of illegal product was consigned by the commercial sector each year over the period 1989-2001. In the context of the total catch, which has typically exceeded 10,000 tonnes p.a. during this period, illegal catch has accounted for just 0.1% to 0.3%. There was little observed variation in estimates of total illegal catch between the "Best Case" and "Worst Case" scenarios (Table 3.6 and Table 3.7), indicating that calculations were not particularly sensitive to variation in the estimates used for average lobster weight and average number of lobsters consigned per basket.

Table 3.7 Seasonal estimates of total illegal product removed from the fishery and consigned to licensed processing factories. Assumptions have been chosen to provide the least conservative estimate of illegal catch.

	Worst Case Scenario[a]					
Season	**Total Weight Inspected (Kg)**		**Total Detected Weight Illegal (Kg)**		**Estimated Total Illegal Catch (Kg)**	**Percentage of Total Catch Illegal**
	Random	Targeted	Random	Targeted		
89/90	46,433		116		25,660	0.249
90/91	74,794		136		16,703	0.181
91/92	91,554		117		15,492	0.127
92/93	89,767		267		36,580	0.297
93/94	310,825		725		25,665	0.233
94/95	68,258		216		34,119	0.316
95/96	94,019		178		18,506	0.189
96/97	310,803		823		26,223	0.265
97/98	119,214		307		26,863	0.258
98/99	579,606	21,079	631	130	14,279	0.110
99/00	133,259	12,123	331	116	35,967	0.249
00/01	276,221	9,906	413	100	16,944	0.150

a. Assuming an average of 50.26 lobster per basket, and an average lobster weight of 0.45 kg.

A question of particular interest is how the level of enforcement effort in processing factories affects non-compliant behaviour. To explore this question I have examined the monthly percentage of catch inspected in each district of the fishery for seasons 1989/1990-2001/2002, and the percentage of the total catch predicted to be illegal based upon detected infringements[7].

The relationship for 275 distinct district-month-season combinations is shown in Figure 3.1. This shows a clear, albeit variable, relationship between the percentage of total catch inspected and the percentage of the total catch estimated to be illegal. In most months across districts for the previous 13 years Fisheries Officers

[7] Estimates utilised arise from an average of the "Best Case" and "Worst Case" scenarios.

have typically inspected 1-5% of the total catch, with less than 0.5% of the total catch usually estimated to be illegal.

The relationship was formally examined by fitting a non-linear model (Bates and Chambers 1992) of the form:

$$\% \textit{ total catch illegal} = \alpha + \beta e^{\phi . Inspect}$$

where *Inspect* is the percentage of catch inspected in each district-month combination, and α, β, and ϕ are parameters estimated as 0.268806, -0.833481 and -7.940080. Weighting the analysis by the number of baskets inspected in each month had no appreciable affect on the fitted model. There is a clear propensity for those months with low inspection rates to result in high detections of illegal catch, and vice versa. An approximate 95% confidence interval for the mean relationship shows that it is reasonably precisely defined except when levels of inspected catch are low (Figure 3.1).

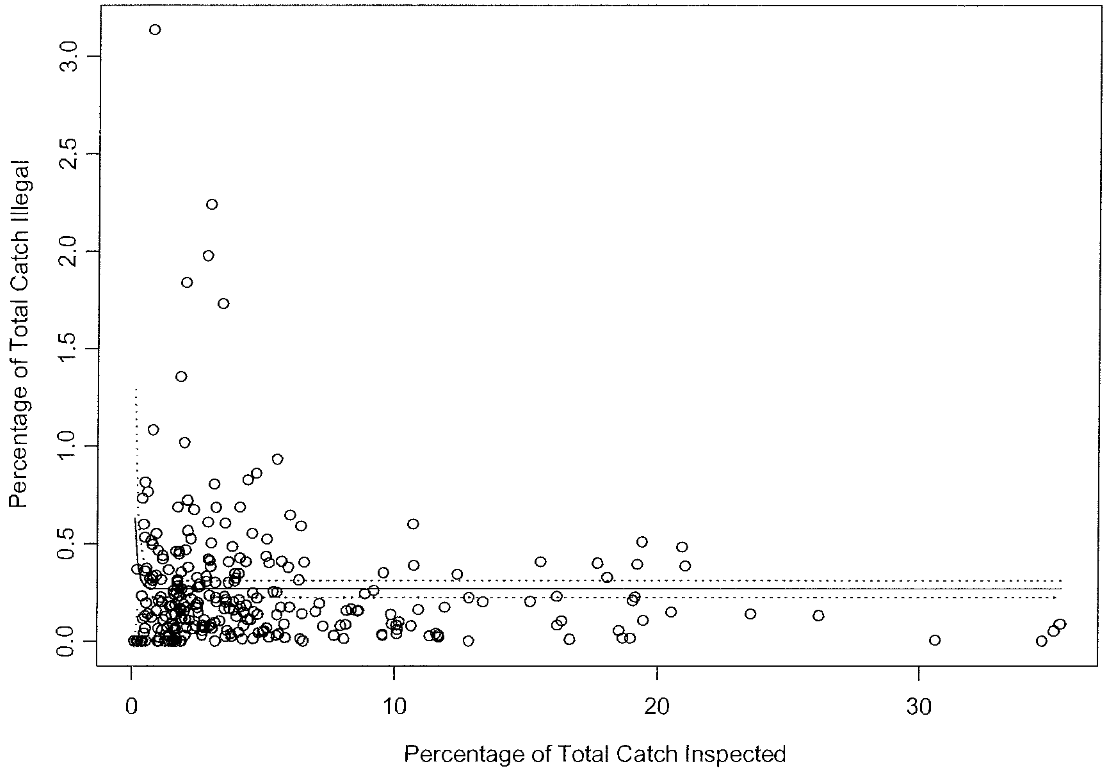

Figure 3.1 Non-linear fit and approximate 95% confidence interval for the relationship between the percentage of the total catch inspected in each Season-District-Month combination and the percentage of the total catch estimated to be illegal for seasons 1989/1990 – 2001/2002.

3.4.2 Frequency of Inspection Across the Fleet

A count of unique vessels inspected in the fishery over the period 1989-2001 shows considerable variation in the number of vessels inspected within each district of the fishery (Table 3.8). This largely reflects the spatial distribution of vessels in the fishery, with most commercial operators fishing out of the population centres of Geraldton and Fremantle. Inter-annual variation may also occur due to the operational demands on Fisheries Officers (eg. duties in other fisheries), and because of changes in processing arrangements. Considering seasonal trends in the number of vessels inspected within districts is problematic, since for many districts (Fremantle being the obvious exception) there are many seasons where no factory inspections took place, or at least were not recorded. This creates difficulties in assessing the total proportion of vessels inspected within the fishery prior to the 1998/1999 season. It should be noted that the number of unique vessels inspected in individual districts will not necessarily sum to the number of unique vessels inspected in the entire fishery (last column, Table 3.8), since vessels may consign catch, and therefore be inspected, at more than one district during a season.

Table 3.8 Count of the number of unique fishing vessels that had factory consigned catch inspected, stratified by season and district. Since vessels may be inspected in more than one district during a season, the total column will generally sum to less than the total for districts combined. Shaded cells indicate missing data.

Season	Metropolitan		Midwest			Total
	Fremantle	Lancelin	Dongara	Geraldton	Jurien	
89/90	279					279
90/91	295					295
91/92	308					308
92/93	303					303
93/94	326	89	74	226	75	669
94/95			63	235	83	371
95/96	261				52	290
96/97	260		133	289	137	618
97/98				280	125	360
98/99	301	152	92	288	77	629
99/00	236	93	78	232	55	580
00/01	308	157	85	359	77	634

Recall from Section 1.2.2.2 that fishers may consign catch to receival depots along the coast prior to it being transported to processing factories. It is possible that catch may be consigned to a receival depot in one district, and transported to a factory in another. This phenomenon is evident in the count of vessels inspected in the Dongara district in the 1996/1997 season (Table 3.8), where 133 individual vessels were inspected. During 1996/1997, Fisheries Officers conducted a "blitz" on receival depots, inspecting catch from vessels that would normally have had their catch inspected at processing factories in other districts. The extra attention afforded to receival points only lasted for the 1996/1997 season, and the number of boats inspected dropped to below 100 in subsequent seasons.

It is also interesting to note that the apparent increase in the number of vessels inspected in the Jurien district in the 1996/1997 and 1997/1998 seasons when >120 vessels were inspected, compared with adjacent seasons when < 85 vessels were inspected. This anomaly arises because in 1996/1997 and 1997/1998 the Department of Fisheries employed personnel to specifically conduct catch inspections in the township of Cervantes, however before and after these seasons the factory in Cervantes was either closed, or only sporadically inspected by Fisheries Officers operating out of the township of Jurien (see Table 3.2).

Examining the number of catch inspections, it is evident there is considerable variation in the number of inspections conducted between districts and seasons (Table 3.9). Variation between districts is to be expected since the frequency of inspection is closely linked to district staffing levels, which are in turn linked to the proportion of the rock lobster fleet serviced by a particular district. The reason for seasonal variation is not so easily deduced since, prior to the 1998/1999 season, enforcement services did not keep records detailing why particular levels of inspection were undertaken. It is likely that much of the variation in catch inspection levels arose due to a combination of environmentally driven seasonal catch differences, staffing changes in district offices (and differential efficiencies of different Fisheries Officers), and imperatives that from time to time arose in other fisheries. The large number of inspections undertaken in the 1998/1999 season (9951) occurred due to a decision to increase the level of inspection to approximately 5% of the total catch. The jump in the number of catch inspections in this season is evident compared with previous seasons in all districts except for Jurien, where the decrease in the number of inspections is linked to fewer inspections in the Cervantes area.

Table 3.9 Total number of catch inspections, stratified by season and district. Shaded cells indicate missing data.

Season	Metropolitan		Midwest			Total
	Fremantle	Lancelin	Dongara	Geraldton	Jurien	
89/90	1052					1052
90/91	1760					1760
91/92	1507					1507
92/93	2021					2021
93/94	2215	648	393	864	335	4455
94/95			213	863	332	1408
95/96	1325				117	1442
96/97	780		996	3061	888	5725
97/98				1833	720	2553
98/99	3078	704	2221	3506	442	9951
99/00	815	208	334	777	158	2292
00/01	2146	820	341	900	287	4494

Information on the total number of baskets inspected shows a similar pattern to that observed for catch inspections (Table 3.10). Again, the increased inspections in the 1998/1999 season shows a marked increase in the number of baskets inspected compared with other seasons.

Table 3.10 Total number of baskets inspected, stratified by season and district. Shaded cells indicate missing data.

Season	Metropolitan		Midwest			Total
	Fremantle	Lancelin	Dongara	Geraldton	Jurien	
89/90	2053					2053
90/91	3307					3307
91/92	4048					4048
92/93	3969					3969
93/94	6660	1698	2327	2664	394	13743
94/95			611	1832	575	3018
95/96	3944				213	4157
96/97	1916		3452	6584	1790	13742
97/98				3864	1407	5271
98/99	10648	2212	5748	7013	938	26559
99/00	2673	885	846	1792	232	6428
00/01	6530	2256	632	2787	446	12651

The average number of catch inspections per fisher (Table 3.9) and the average number of baskets inspected per fisher (Table 3.10) show that fishers in some districts tend, on average, to be inspected more frequently than fishers in other districts. For example, highest inspection rates occurred for fishers in the Dongara district in the 1998/1999 season, when fishers had catch inspected an average of 24 times during the season, with each fisher having an average of 62 baskets inspected. These figures are much higher than adjacent districts, and to some extent regional differences such as these are a reflection of the type of work Fisheries Officers conduct in different parts of Western Australia. In adjacent districts, such as Fremantle or Geraldton, Fisheries Officers are required to service a more diverse group of fisheries compared with some of the smaller population centres along the coast where the primary fishery is rock lobster.

One problem with assessing mean inspection figures for individual vessels is that some vessels are inspected many more times than others. This is to be expected since some fishers are targeted for inspection on the basis that Fisheries Officers suspect they may be consigning illegal product. Additionally, some fishers may appear to be inspected less frequently (in respect to within-district data) because they consign catch to multiple districts. For example, a small stable group of vessels regularly land catch at Dongara and may account for those vessels checked many times (eg. greater than 20) in the year. Itinerant vessels that only occasionally land catch at Dongara might account for those vessels that are checked less frequently.

Table 3.11 Average number of catch inspections per fisher, stratified by season and district. Shaded cells indicate missing data.

Season	Metropolitan		Midwest			Total
	Fremantle	Lancelin	Dongara	Geraldton	Jurien	
89/90	3.77					3.77
90/91	5.97					5.97
91/92	4.89					4.89
92/93	6.67					6.67
93/94	6.79	7.28	5.31	3.82	4.47	6.66
94/95			3.38	3.67	4.00	3.80
95/96	5.08				2.25	4.97
96/97	3.00		7.49	10.59	6.48	9.26
97/98				6.55	5.76	7.09
98/99	10.23	4.63	24.14	12.17	5.74	15.82
99/00	3.45	2.24	4.28	3.35	2.87	3.95
00/01	6.97	5.22	4.01	2.51	3.73	7.09

Table 3.12 Average number of baskets inspected per vessel, stratified by season and district. Shaded cells indicate missing data.

Season	Metropolitan		Midwest			Total
	Fremantle	Lancelin	Dongara	Geraldton	Jurien	
89/90	7.36					7.36
90/91	11.21					11.21
91/92	13.14					13.14
92/93	13.10					13.10
93/94	20.43	19.08	31.45	11.79	5.25	20.54
94/95			9.70	7.80	6.93	8.13
95/96	15.11				4.10	14.33
96/97	7.37		25.95	22.78	13.07	22.24
97/98				13.80	11.26	14.64
98/99	35.38	14.55	62.48	24.35	12.18	42.22
99/00	11.33	9.52	10.85	7.72	4.22	11.08
00/01	21.20	14.37	7.44	7.76	5.79	19.95

Examining the distribution (rather than the mean) of the number of baskets inspected per vessel on a seasonal basis shows a markedly skewed distribution, with some vessels having in excess of 100 baskets checked within a season (Figure 3.2). To put this figure in context, in an average season of 10,000 tonnes checking 100 baskets from a single (average) fisher would be equivalent to checking 13-17% of total landings for that fisher (using the upper and lower bounds to assumptions described in Section 3.3.3).

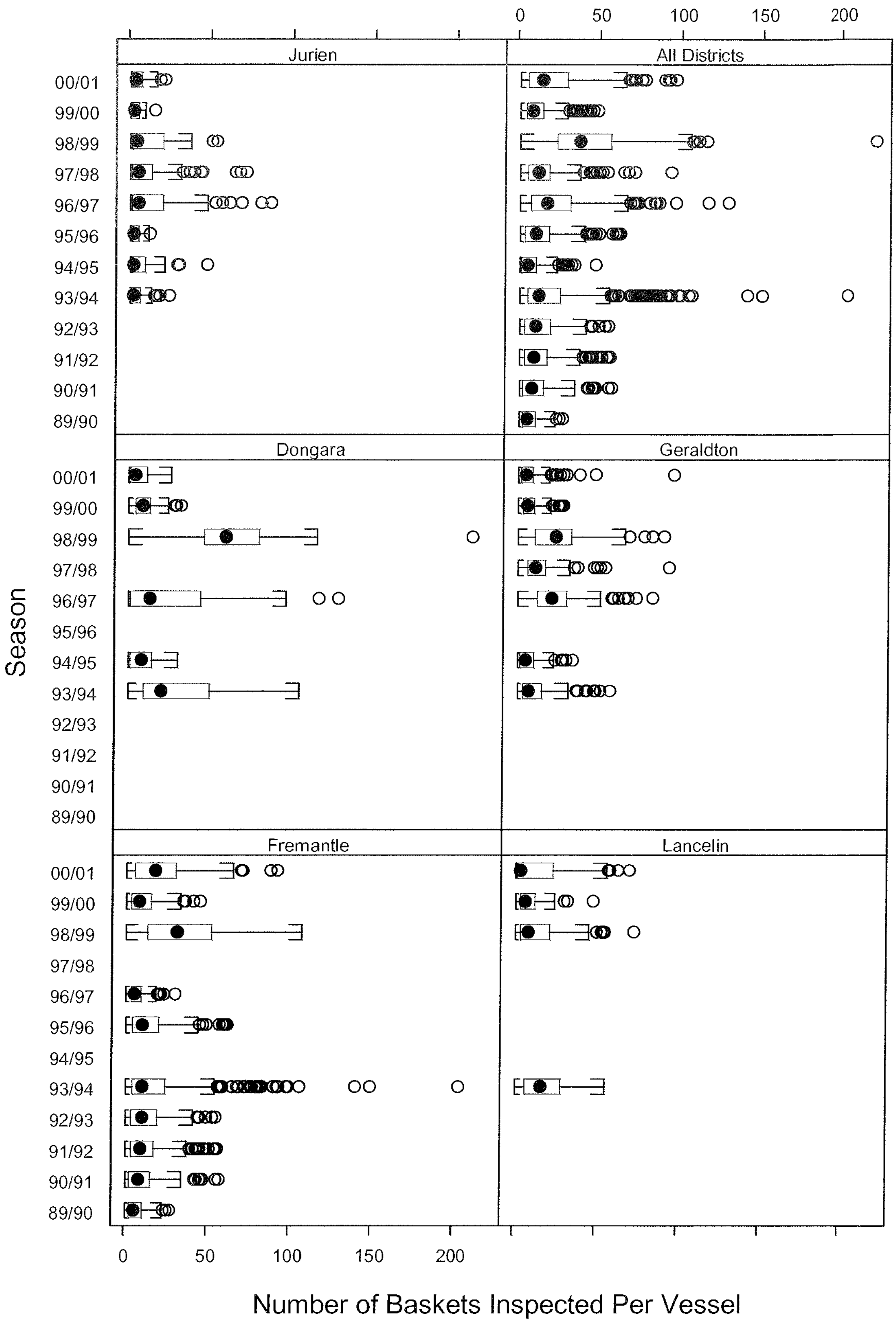

Figure 3.2 Boxplots showing the distribution of number of baskets inspected for individual vessels, stratified by season and district.

3.4.3 Detection of Illegal Catch

This section examines the amount of illegal lobster detected in factory inspections, and non-compliance rates both regionally and temporally. This differs from the information provided in Section 3.4.1 in that I focus on information from the 98/99, 99/00 and 00/01 seasons, presenting results according to the types of infringement detected, and comparing random and targeted inspections. Results are presented for three types of infringement categories: undersize, setose, and "other". The "other" category includes all tarspot, spawning, and oversize animals, which were pooled due to their low occurrence. Three different types of infringement rates are presented:

a) Inspection-level non-compliance rates. Recall that a single inspection may involve examining several baskets of catch from an individual fisher. These non-compliance rates are interpreted as the proportion of inspections that result in the detection of *some* amount of illegal product, regardless of the number of baskets inspected or numbers of illegal animals detected.

b) Basket-level non-compliance rates. This type of non-compliance rate is calculated as the number of baskets in which illegal product is detected divided by the total number of baskets inspected. It differs from the inspection-level non-compliance rate in that the rate is generally higher, largely attributable to non-compliant fishers consigning illegal animals in a number of baskets in a single consignment.

c) Per-animal non-compliance rates. These rates are calculated as the number of illegal animals detected divided by an estimate of the number of animals checked. Since certain assumptions must be made regarding the number of animals checked (Section 3.3.2), "Worst Case" and "Best Case" scenarios are presented to provide the least and most conservative estimates based on assumptions.

I also present "Worst Case" and "Best Case" estimates, by district, of the total illegal catch removed from the fishery by the commercial sector. I do not present such estimates for separate infringement categories, however, due to limitations inherent to the data. When Fisheries Officers are asked to collect information about the work they conduct in processing factories there is a trade-off between the detail they are able to record, and the efficiency with which they are required to carry out their duties. Currently, when Officers conduct an inspection of a fisher they record the number of baskets checked, and the total number of illegal animals in each of several infringement categories. In practical terms this has two implications for examining compliance rates.

First, consider an inspection where a small number of illegal animals are detected in a multi-basket consignment, such that Fisheries Officers detect fewer illegal animals than baskets checked. For example, an Officer may detect 3 undersize animals in an inspection of 6 baskets from a single fisher. It is not evident in the data whether the 3 animals were detected in just a single basket, or whether they were spread through a number of baskets. Since some baskets contained illegal animals, then all baskets inspected are deemed to be "a group of baskets in which illegal animals were detected" for the purpose of calculating basket-level non-compliance rates. This can provide some anti-intuitive results. For example, consider detections of undersized lobster in targeted inspections in the Fremantle district of the fishery in the 98/99 season (Table 3.14). This shows that of 37 baskets targeted for inspection, 17 were examined during inspections when undersized lobsters were detected – but only three undersize animals were found! This artefact of the (imperfect) sampling process needs to be carefully considered when examining basket-level non-compliance rates.

The second implication is that infringement categories are not mutually exclusive across baskets, such that projections of total illegal catch by infringement category may be confounded due to the presence of multiple types of infringement in the same consignment. This problem is avoided by pooling infringement categories, and it is for this reason that estimates of total illegal catch have been based upon all categories combined.

Categorising the numbers of inspections according to the number of illegal animals detected (Table 3.13) shows that a majority of inspections result in no illegal product being detected. For the three seasons presented, greater than 90% of random inspections, and greater than 70% of targeted inspections, found no illegal animals in consigned catch. This difference in random and targeted inspections is further reflected in numbers of inspections detecting illegal animals; generally a greater proportion of targeted inspections resulted in high numbers of illegal animals being found. For example, in all seasons 5-10% of targeted inspections resulted in detections of >5 illegal animals, compared with generally less than 1% of random inspections detecting this many illegal animals. Considering only random inspections, it is evident that a higher proportion of inspections in the 1999/2000 season resulted in detections of many illegal animals compared with adjacent seasons. This small but significant shift ($\chi^2 = 64.08$, df = 10, P<0.001) is almost certainly due to the decreased presence of Fisheries Officers in processing factories during the 1999/2000 season.

Table 3.13 Number of random and targeted inspections resulting in 1, 2, etc. illegal animals (all infringement categories pooled) for seasons 1998/1999-2000/2001. Bracketed numbers indicate column-wise percentages.

Number of Illegal Animals Detected	Random			Targeted		
	98/99	**99/00**	**00/01**	**98/99**	**99/00**	**00/01**
0	9111 (93.8)	1984 (91.2)	4082 (93.3)	173 (70.6)	94 (80.3)	94 (78.3)
1	358 (3.7)	81 (3.7)	137 (3.1)	26 (10.6)	6 (5.1)	15 (12.5)
2	109 (1.1)	39 (1.8)	58 (1.3)	15 (6.1)	2 (1.7)	2 (1.7)
3-5	86 (0.9)	39 (1.8)	66 (1.5)	16 (6.5)	0 (0.0)	2 (1.7)
6-20	41 (0.4)	27 (1.2)	27 (0.6)	13 (5.3)	11 (9.4)	4 (3.3)
>20	1 (0.0)	5 (0.2)	4 (0.1)	2 (0.8)	4 (3.4)	3 (2.5)
Total	9706	2175	4374	245	117	120

It is worth noting that the maximum number of illegal animals detected in a single inspection in each season (pooled into the category ">20" in Table 3.13). For random inspections, 94 illegal animals were detected in a single inspection in 1998/1999, 47 were detected in 1999/2000, and 64 were detected in 2000/2001. For targeted inspections, 30 were detected in 1998/1999, 57 in 1999/2000, and 95 in 2000/2001. Such high numbers of illegal animals are clearly atypical of the majority of the commercial fleet, however.

The following six tables present detailed results for seasons 1998/1999-2000/2001, stratified by district in the fishery and targeted status (targeted or random) (Table 3.14-Table 3.19). Even numbered tables show different non-compliance types, estimated total illegal catch removed from the fishery in that season, and the proportion of the total catch inspected in each district. Odd numbered tables show per-animal non-compliance rates for each of three infringement types, undersize, setose and "other". Each "even-odd" table pair presents information from a single season (ie. Table 3.14 and Table 3.15 comprise information from the 1998/1999 season). Columns in individual tables show results from each district, and a total for the entire fishery. It is important to note that the total fishery statistics represent an unweighted average of all combined district information; as such, estimates of total illegal catch will not necessarily comprise the sum of estimated illegal catch from individual districts. Since the information presented is largely self-explanatory, I restrict interpretation to the main features of the results leaving the interested reader to examine individual tables in greater detail.

During the 1998/1999 season, inspection-level non-compliance rates arising from random inspections (all infringement types pooled) were uniformly around 5% across all districts of the fishery, with the exception of Dongara where the rate was 10% (Table 3.14). This rate rose substantially for the Fremantle (10%), Lancelin (25%) and Dongara (12%) districts in the 1999/2000 season when only 1% of the total catch was inspected. In the 2000/2001 season, when inspection levels rose to around 3% of the total catch, inspection-level non-compliance from random inspections dropped, with the exception of Geraldton, to similar levels experienced in the 1998/1999 season. Targeted inspection-level non-compliance in all seasons varied substantially (up to as high as 80%), although much of this fluctuation was attributable to small numbers of targeted inspections in some districts. Generally, targeted inspections detected non-compliance rates 2-3 times higher than detected by random inspections.

Random basket-level non-compliance appeared appreciably higher during 1998/1999 in the Geraldton (10%) and Dongara (17%) districts compared with other districts (5-6%). This is reflected in estimates of illegal catch for this season; 75% of predicted illegal catch arises from the (combined) Dongara and Geraldton districts, even though less than half the total number of baskets were inspected in those areas of the fishery. However, this pattern did not continue into the 1999/2000 season when the proportion of the total catch inspected decreased. Instead, southern districts showed marked increases in all measures of non-compliance, while non-compliance in northern districts remained approximately the same. In the 2000/2001 season, when (on average) districts inspected 3% of all commercially consigned catch, non-compliance rates in southern districts dropped to levels comparable to those evident in 1998/1999. Non-compliance rates in the northern districts, however, remained high, in some cases actually increasing. In fact, the random basket-level and per-animal non-compliance rates experienced in Geraldton in the 2000/2001 season were appreciably higher than random rates experienced in any other district during the period 1998-2001. This apparent anomaly remains unexplained, and compliance during the 2001/2002 season is being closely monitored.

It is worth noting that the proportion of the total catch inspected within each district shows some degree of variability, such that districts did not uniformly follow the (average) pattern of inspecting 5%, 1% and 3% of the total catch consigned within the district over seasons 1998/1999-2000/2001. For example, Fisheries Officers in the Dongara district inspected 8-10% of the catch consigned in their district in the 1998/1999 season, but only inspected 1.0-1.5% in seasons 1999/2000 and 2000/2001. Such anomalies must be considered when interpreting non-compliance rates, and in particular when examining estimated illegal landings on a district basis.

Generally, many more undersized animals are detected in northern districts compared with southern districts, and this is reflected in northern per-animal non-compliance rates for undersize. Non-compliance for this infringement type typically increased in 1999/2000 compared with 1998/1999 rates, but in 2000/2001 dropped to rates comparable with 1998/1999. The prominent exception to this pattern was the Geraldton district, which showed a dramatic increase in undersize non-compliance in the 2000/2001 season to around 5 undersized animals in every 1,000 animals checked. This increase was not observed in either the setose or "other" infringement categories, and is the main effect driving the overall increase in non-compliance (all infringement categories pooled) discussed previously.

Setose non-compliance rates typically varied between one setose animal in every 10,000 animals checked to one setose animal in every 1,000 animals checked across all districts in all seasons. Fisheries Officers anecdotally make reference to the fact that more setose animals are detected in southern districts compared with the northern districts, however the data do not bear this out. The highest rate of setose non-compliance from random inspections was observed in the Dongara district in the 1999/2000 season, where Fisheries Officers detected around one setose animal in every 1,000 animals checked.

Detections of illegal animals in the "other" infringement category, including tarspot, spawners, and oversize lobsters, typically were low in all districts in all seasons. Total detections across the entire fishery from random inspections were only 112, 100 and 63 for the 1998/1999, 1999/2000 and 2000/2001 seasons.

Table 3.14 Non-compliance statistics for the 1998/1999 season for all infringement categories combined, stratified by district and inspection type (random or targeted).

98/99 Season	District	Fremantle		Lancelin		Dongara		Geraldton		Jurien		Total	
	Random/Targeted	R	T	R	T	R	T	R	T	R	T	R	T
Nbr of Catch Inspections		3069	9	703	1	2037	184	3461	45	436	6	9706	245
Nbr Inspections When Infringement Detected		128	4	31	0	221	56	195	7	20	5	595	72
Inspection-Level Non-Compliance Rate		0.042	0.444	0.044	0	0.108	0.304	0.056	0.156	0.046	0.833	0.061	0.294
Nbr of Baskets Inspected		10611	37	2210	2	5027	721	6874	139	905	33	25627	932
Nbr of Baskets Where Infringement Detected		590	23	122	0	839	324	669	23	55	30	2275	400
Basket-Level Non-Compliance Rate		0.056	0.622	0.055	0	0.167	0.449	0.097	0.165	0.061	0.909	0.089	0.429
Nbr of Illegal Animals Detected		227	4	101	0	459	218	578	18	38	49	1403	289
Per-Animal Non-Compliance Rate (x 100) [a,b]	"Worst Case"	0.043	0.215	0.091	0	0.182	0.602	0.167	0.258	0.084	2.954	0.109	0.617
	"Best case"	0.041	0.207	0.088	0	0.175	0.58	0.161	0.248	0.081	0.848	0.105	0.595
Estimated Total Illegal Catch (Kg) [a]	"Worst Case"	2124		800		3110		7951		624		14279	
	"Best case"	2048		771		3015		7665		607		13791	
Proportion of Total Catch Inspected [a]	"Worst Case"	0.048		0.057		0.078		0.033		0.029		0.046	
	"Best case"	0.061		0.072		0.099		0.042		0.037		0.059	

a. "Best" and "Worst" case scenarios calculated using the assumptions detailed in Section 3.4.1, and combining random and targeted inspection information in the manner described in Section 3.3.2.

b. Due to low non-compliance rates, these have been presented as: true rate multiplied by 100 (effectively displaying percentages).

Table 3.15 Non-compliance statistics for the 1998/1999 season for each of three infringement types, stratified by district and inspection type (random or targeted).

98/99 Season	District		Fremantle		Lancelin		Dongara		Geraldton		Jurien		Total	
	Random/Targeted		R	T	R	T	R	T	R	T	R	T	R	T
Number of Baskets Inspected			10611	37	2210	2	5027	721	6874	139	905	33	25627	932
Undersize	**Nbr of Baskets Where U/S Detected**		186	17	26	0	502	235	425	10	25	22	1164	284
	Basket-Level Non-Compliance Rate		0.018	0.459	0.012	0	0.100	0.326	0.062	0.072	0.028	0.667	0.045	0.305
	Nbr of U/S Animals Detected		96	3	41	0	265	142	433	3	19	41	854	189
	U/S Per-Animal Non-Compliance Rate (x100) [a,b]	**"Worst Case"**	0.018	0.161	0.037	0	0.105	0.392	0.125	0.043	0.042	2.472	0.066	0.403
		"Best case"	0.017	0.156	0.036	0	0.101	0.378	0.121	0.041	0.040	2.383	0.064	0.389
Setose	**Nbr of Baskets Where Setose Detected**		398	6	70	0	259	106	215	11	20	4	962	127
	Basket-Level Non-Compliance Rate		0.038	0.162	0.032	0	0.052	0.147	0.031	0.079	0.022	0.121	0.038	0.136
	Nbr of Setose Animals Detected		126	1	53	0	127	56	117	11	14	1	437	69
	Setose Per-Animal Non-Compliance Rate (x100) [a,b]	**"Worst Case"**	0.024	0.054	0.048	0	0.050	0.155	0.034	0.157	0.031	0.060	0.034	0.147
		"Best case"	0.023	0.052	0.046	0	0.048	0.149	0.033	0.152	0.030	0.058	0.033	0.142
"Other"	**Nbr of Baskets Where "Other" Detected**		9	0	28	0	227	97	87	2	14	14	365	113
	Basket-Level Non-Compliance Rate		0.001	0	0.013	0	0.045	0.135	0.013	0.014	0.015	0.424	0.014	0.121
	Nbr of "Other" Animals Detected		5	0	7	0	67	20	28	4	5	7	112	31
	"Other" Per-Animal Non-Compliance Rate (x100) [a,b]	**"Worst Case"**	0.001	0	0.006	0	0.027	0.055	0.008	0.057	0.011	0.422	0.009	0.066
		"Best case"	0.001	0	0.006	0	0.026	0.053	0.008	0.055	0.011	0.407	0.008	0.064

a. "Best" and "Worst" case scenarios calculated using the assumptions detailed in Section 3.4.1, and combining random and targeted inspection information in the manner described in Section 3.3.2.

b. Due to low non-compliance rates, these have been presented as: true rate multiplied by 100 (effectively displaying percentages).

Table 3.16 Non-compliance statistics for the 1999/2000 season for all infringement categories combined, stratified by district and inspection type (random or targeted).

99/00 Season	District	Fremantle		Lancelin		Dongara		Geraldton		Jurien		Total	
	Random/Targeted	R	T	R	T	R	T	R	T	R	T	R	T
Nbr of Catch Inspections		778	37	203	5	329	5	723	54	142	16	2175	117
Nbr Inspections When Infringement Detected		74	3	50	1	39	2	26	13	2	4	191	23
Inspection-Level Non-Compliance Rate		0.10	0.08	0.25	0.20	0.12	0.40	0.04	0.24	0.01	0.25	0.09	0.20
Nbr of Baskets Inspected		2488	185	871	14	811	35	1557	235	165	67	5892	536
Nbr of Baskets Where Infringement Detected		391	18	260	3	142	15	117	108	2	20	912	164
Basket-Level Non-Compliance Rate		0.157	0.097	0.299	0.214	0.175	0.429	0.075	0.460	0.012	0.299	0.155	0.306
Nbr of Illegal Animals Detected		280	23	206	1	126	20	122	127	2	86	736	257
Per-Animal Non-Compliance Rate (x 100) [a,b]	"Worst Case"	0.224	0.247	0.471	0.142	0.309	1.137	0.156	1.075	0.024	2.554	0.249	0.954
	"Best case"	0.216	0.238	0.454	0.137	0.298	1.096	0.150	1.036	0.023	2.462	0.240	0.920
Estimated Total Illegal Catch (Kg) [a]	"Worst Case"	13309		4651		5369		7678		251		35967	
	"Best case"	12829		4483		5177		7414		250		34692	
Proportion of Total Catch Inspected [a]	"Worst Case"	0.010		0.020		0.011		0.008		0.006		0.010	
	"Best case"	0.013		0.026		0.014		0.011		0.008		0.013	

a. "Best" and "Worst" case scenarios calculated using the assumptions detailed in Section 3.4.1, and combining random and targeted inspection information in the manner described in Section 3.3.2.

b. Due to low non-compliance rates, these have been presented as: true rate multiplied by 100 (effectively displaying percentages).

Table 3.17 Non-compliance statistics for the 1999/2000 season for each of three infringement types, stratified by district and inspection type (random or targeted).

99/00 Season		District	Fremantle		Lancelin		Dongara		Geraldton		Jurien		Total	
		Random/Targeted	R	T	R	T	R	T	R	T	R	T	R	T
Number of Baskets Inspected			2488	185	871	14	811	35	1557	235	165	67	5892	536
Undersize	Nbr of Baskets Where U/S Detected		167	4	192	3	77	15	78	99	0	10	514	131
Undersize	Basket-Level Non-Compliance Rate		0.067	0.022	0.22	0.214	0.095	0.429	0.050	0.421	0	0.149	0.087	0.244
Undersize	Nbr of U/S Animals Detected		158	11	178	1	81	17	106	122	0	52	523	203
Undersize	U/S Per-Animal Non-Compliance Rate (x100) [a,b]	"Worst Case"	0.126	0.118	0.407	0.142	0.199	0.966	0.135	1.033	0	1.544	0.177	0.754
Undersize		"Best case"	0.122	0.114	0.392	0.137	0.192	0.932	0.131	0.996	0	1.489	0.170	0.726
Setose	Nbr of Baskets Where Setose Detected		153	14	77	0	84	15	23	19	1	10	338	58
Setose	Basket-Level Non-Compliance Rate		0.061	0.076	0.088	0	0.104	0.429	0.015	0.081	0.006	0.149	0.057	0.108
Setose	Nbr of Setose Animals Detected		44	1	21	0	40	56	7	11	1	1	113	51
Setose	Setose Per-Animal Non-Compliance Rate (x100) [a,b]	"Worst Case"	0.035	0.011	0.048	0	0.098	3.183	0.009	0.093	0.012	0.030	0.038	0.189
Setose		"Best case"	0.034	0.010	0.046	0	0.095	3.069	0.009	0.090	0.012	0.029	0.037	0.182
"Other"	Nbr of Baskets Where "Other" Detected		163	10	22	0	5	0	27	17	1	0	218	27
"Other"	Basket-Level Non-Compliance Rate		0.066	0.054	0.025	0	0.006	0	0.017	0.072	0.006	0	0.037	0.05
"Other"	Nbr of "Other" Animals Detected		78	1	7	0	5	0	9	2	1	0	100	3
"Other"	"Other" Per-Animal Non-Compliance Rate (x100) [a,b]	"Worst Case"	0.062	0.011	0.016	0	0.012	0	0.012	0.017	0.012	0	0.034	0.011
"Other"		"Best case"	0.060	0.010	0.015	0	0.012	0	0.011	0.016	0.012	0	0.033	0.011

a. "Best" and "Worst" case scenarios calculated using the assumptions detailed in Section 3.4.1, and combining random and targeted inspection information in the manner described in Section 3.3.2.

b. Due to low non-compliance rates, these have been presented as: true rate multiplied by 100 (effectively displaying percentages).

Table 3.18 Non-compliance statistics for the 2000/2001 season for all infringement categories combined, stratified by district and inspection type (random or targeted).

00/01 Season	District	Fremantle		Lancelin		Dongara		Geraldton		Jurien		Total	
	Random/Targeted	R	T	R	T	R	T	R	T	R	T	R	T
Nbr of Catch Inspections		2144	2	820	0	328	13	823	77	259	28	4374	120
Nbr Inspections When Infringement Detected		117	0	13	0	23	0	129	20	10	6	292	26
Inspection-Level Non-Compliance Rate		0.05	0	0.02	0	0.07	0	0.16	0.26	0.04	0.21	0.07	0.22
Nbr of Baskets Inspected		6520	10	2256	0	603	29	2445	342	389	57	12213	438
Nbr of Baskets Where Infringement Detected		470	0	59	0	54	0	633	136	26	13	1242	149
Basket-Level Non-Compliance Rate		0.072	0	0.026	NA	0.090	0	0.259	0.398	0.067	0.228	0.102	0.340
Nbr of Illegal Animals Detected		213	0	18	0	45	0	619	212	23	10	918	222
Per-Animal Non-Compliance Rate (x 100) [a,b]	"Worst Case"	0.065	0	0.016	NA	0.148	0	0.504	1.233	0.118	0.349	0.150	1.008
	"Best case"	0.063	0	0.015	NA	0.143	0	0.486	1.189	0.113	0.336	0.144	0.972
Estimated Total Illegal Catch (Kg) [a]	"Worst Case"	3052		82		2014		20557		759		16944	
	"Best case"	2941		79		1941		19829		732		16355	
Proportion of Total Catch Inspected [a]	"Worst Case"	0.032		0.099		0.011		0.016		0.016		0.025	
	"Best case"	0.040		0.125		0.013		0.020		0.020		0.032	

a. "Best" and "Worst" case scenarios calculated using the assumptions detailed in Section 3.4.1, and combining random and targeted inspection information in the manner described in Section 3.3.2.

b. Due to low non-compliance rates, these have been presented as: true rate multiplied by 100 (effectively displaying percentages).

Table 3.19 Non-compliance statistics for the 2000/2001 season for each of three infringement types, stratified by district and inspection type (random or targeted).

00/01 Season	District	Fremantle		Lancelin		Dongara		Geraldton		Jurien		Total	
	Random/Targeted	R	T	R	T	R	T	R	T	R	T	R	T
Number of Baskets Inspected		6520	10	2256	0	603	29	2445	342	389	57	12213	438
Undersize	Nbr of Baskets Where U/S Detected	114	0	31	0	39	0	565	100	18	2	767	102
Undersize	Basket-Level Non-Compliance Rate	0.017	0	0.014	NA	0.065	0	0.231	0.292	0.046	0.035	0.063	0.233
Undersize	Nbr of U/S Animals Detected	73	0	11	0	34	0	559	197	18	5	695	202
Undersize	U/S Per-Animal Non-Compliance Rate (x100) [a,b] "Worst Case"	0.022	0	0.010	NA	0.112	0	0.455	1.146	0.092	0.175	0.113	0.918
Undersize	U/S Per-Animal Non-Compliance Rate (x100) [a,b] "Best case"	0.021	0	0.009	NA	0.108	0	0.438	1.105	0.089	0.168	0.109	0.885
Setose	Nbr of Baskets Where Setose Detected	212	0	20	0	18	0	132	53	13	11	395	64
Setose	Basket-Level Non-Compliance Rate	0.033	0	0.009	NA	0.030	0	0.054	0.155	0.033	0.193	0.032	0.146
Setose	Nbr of Setose Animals Detected	95	0	5	0	11	0	44	9	5	5	160	14
Setose	Setose Per-Animal Non-Compliance Rate (x100) [a,b] "Worst Case"	0.029	0	0.004	NA	0.036	0	0.036	0.052	0.026	0.175	0.026	0.064
Setose	Setose Per-Animal Non-Compliance Rate (x100) [a,b] "Best case"	0.028	0	0.004	NA	0.035	0	0.035	0.050	0.025	0.168	0.025	0.061
"Other"	Nbr of Baskets Where "Other" Detected	196	0	8	0	0	0	153	39	0	0	357	39
"Other"	Basket-Level Non-Compliance Rate	0.030	0	0.004	NA	0	0	0.063	0.114	0	0	0.029	0.089
"Other"	Nbr of "Other" Animals Detected	45	0	2	0	0	0	16	6	0	0	63	6
"Other"	"Other" Per-Animal Non-Compliance Rate (x100) [a,b] "Worst Case"	0.014	0	0.002	NA	0	0	0.013	0.035	0	0	0.010	0.027
"Other"	"Other" Per-Animal Non-Compliance Rate (x100) [a,b] "Best case"	0.013	0	0.002	NA	0	0	0.013	0.034	0	0	0.010	0.026

a. "Best" and "Worst" case scenarios calculated using the assumptions detailed in Section 3.4.1, and combining random and targeted inspection information in the manner described in Section 3.3.2.

b. Due to low non-compliance rates, these have been presented as: true rate multiplied by 100 (effectively displaying percentages).

3.4.4 Availability of Non-Legal Animals

As part of a wider research program on western rock lobster, the Department of Fisheries WA maintains a voluntary logbook program for the commercial fishery. In the 1999/2000 season a third of the commercial fleet (around 200 fishers) provided to the agency detailed information about where and how they fished, and their catch composition. In addition to supplying details of the legal catch landed, fishers also provide information on the numbers of non-legal animals that are captured and returned to the water. This is useful information from a compliance perspective, since knowledge of the temporal and spatial availability of non-legal animals to the fishery might help predict when large numbers of illegal animals might be consigned to processing factories. In effect, such information would allow Fisheries Officers to focus inspections on those "windows" in time and space when the opportunity for capturing (and perhaps consigning) non-legal lobsters is highest.

To this end, I have examined the spatial distribution of captured undersize, setose and berried lobster in each month of the 1999/2000 fishing season. I present these distributions as sunflowers (described in Section 3.3.4.2) overlain on a map of the fishing grounds. Maps are provided for each month of the 1999/2000 season for each of the non-legal categories undersize, setose and berried (Figure 3.3-Figure 3.8). I also present displays to compare the spatial distribution longitudinally with changes through time (Figure 3.9-Figure 3.11). Scales differ between non-legal categories, and are noted in figure legends.

Recall that the A Zone fishery (Abrolhos Islands area, bounded by a polygon in Figures 3.3-3.8) does not commence until March each season. Despite this, maps of non-legal animals show catch occurring in A Zone during November to February. This has occurred for two reasons. First, commercial operators fish hard up against the Abrolhos Islands boundary prior to the opening of the Zone A season. Since landings data have been aggregated spatially to be centred on each 0.5° of latitude/longitude, catch that was reported just outside the boundary will appear, when centred, inside Zone A. The vast majority of catch appearing within the Zone A boundary prior to March has arisen in this way. Second, checking the primary data shows that a small number of catch records are reported as arising from within Zone A prior to commencement of the season. Since it is not possible to historically determine whether these represent recording mistakes or honest reporting of illegal fishing activity (!), for completeness these records have been included. In a similar fashion, catch can sometimes appear to be landed in inland areas; again, this is simply an artefact of aggregating catch landed close to the coast to 0.5° of latitude/longitude.

At the beginning of the season (November), it is evident that catch rates of undersized animals are low in the southern parts of the fishery, but reasonably high in areas adjacent to Geraldton, and particularly high toward the south-eastern boundary of Zone A (Figure 3.3). Catch rates for undersize increase in December, particularly in near-coastal areas, coinciding with the off-shore migration of 70-85 mm animals to join the breeding stock in deeper water. Catch rates in January declined, with the exception of high undersize catch rates occurring North of Jurien to the Southern boundary of the Abrolhos Island zone. Stable, high catch rates of undersize West and North-West of Geraldton, between the A Zone boundary and the coast, first appear in December and persist almost until the end of the season in June (Figure 3.4). This may, in part, explain the high number of undersize animals detected in Geraldton factory inspections compared with southern districts.

Setose lobster are less abundant than undersized lobster, and so are displayed with each sunflower petal representing an average increase in 50 setose lobster captured per 100 pot lifts (Figure 3.5 and Figure 3.6). Early in the fishing season (November and December) most setose lobster are reported to occur immediately North of the Abrolhos Islands boundary (latitudes 27-28°). As the season progresses (January-February), the catch rate for setose animals generally increases throughout the fishery, particularly in those areas of high setose catches North of Zone A. Also of interest is the "hotspot" evident in deep water West of Perth during February. Between March and June, catch rates for setose animals diminish, although particularly high catches were evident immediately West of Mandurah in the South of the fishery during June.

Berried lobster, like setose, are much less abundant than undersized animals, and their distribution over the fishing grounds is generally similar to that of setose animals; high catch rates occur in the early part of the season North of the Abrolhos Islands, with catches lower in Southern waters, and generally declining as the season progresses (Figure 3.8 and Figure 3.9). Very few berried lobsters were detected March-June in the 1999/2000 season.

Since lobsters are typically consigned on the coast close to the latitude they are captured, it is useful to aggregate the data presented in Figure 3.3-Figure 3.8 to 0.5° increments of latitude (i.e. collapse over longitude), and to present changes in catch rates of non-legal animals across months (Figure 3.9-Figure 3.11). These figures are largely self-explanatory, clearly showing the abundance, and seasonal change in abundance, for the non-legal categories considered. Note that the reference line appearing at 30° latitude indicates the boundary line between Zones B and C.

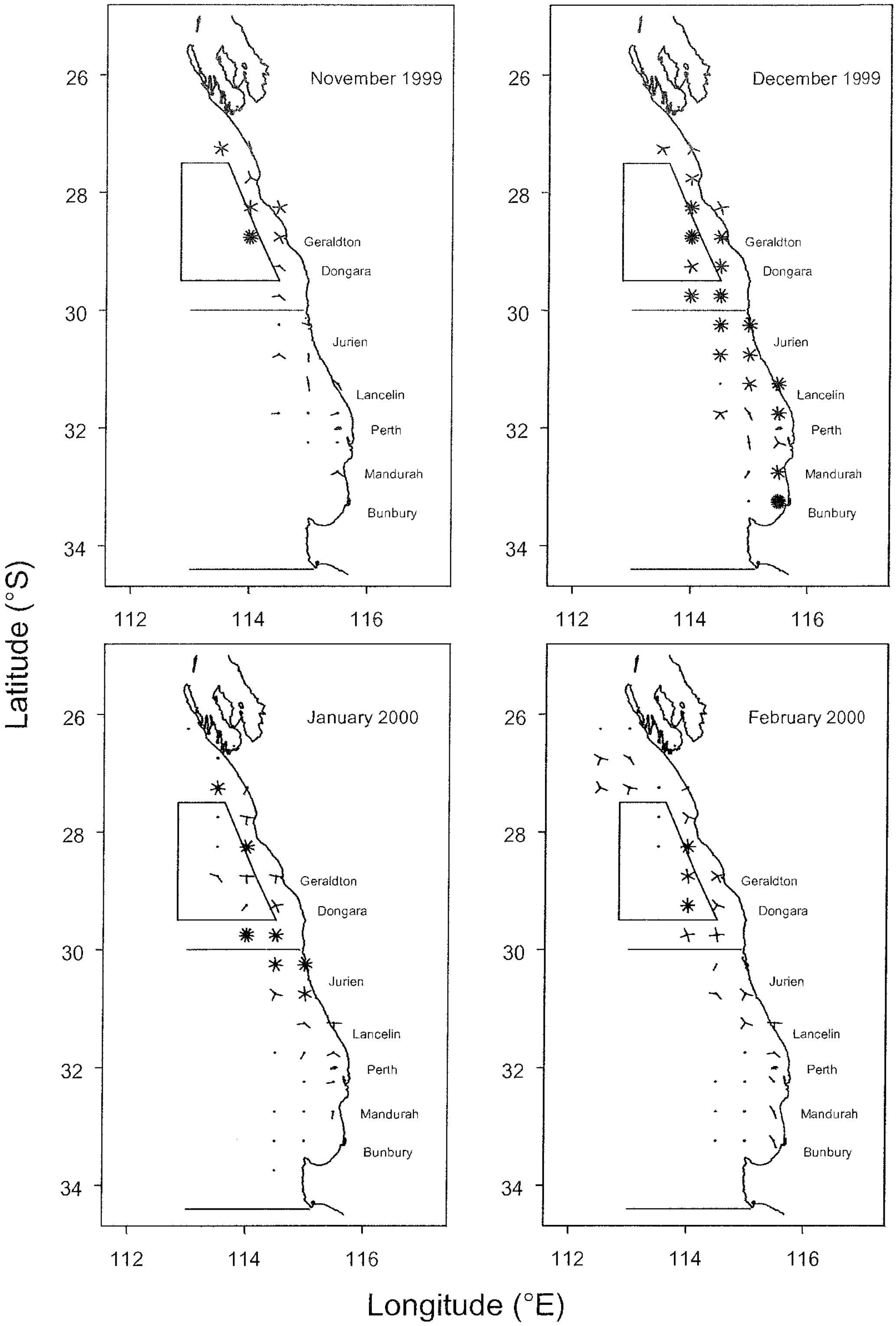

Figure 3.3 **Sunflower plots showing spatial distribution of average number of undersize lobster landed per 100 pot lifts based on logbook data, November 1999 – February 2000. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude/longitude. Dots (•) indicate an average in the range 1-100 undersize per 100 pot lifts. Each radial spoke ("petal") represents an increment of 100 in the average value (eg. ★represents an average of 500-600 undersize lobster in each 100 pot lifts).**

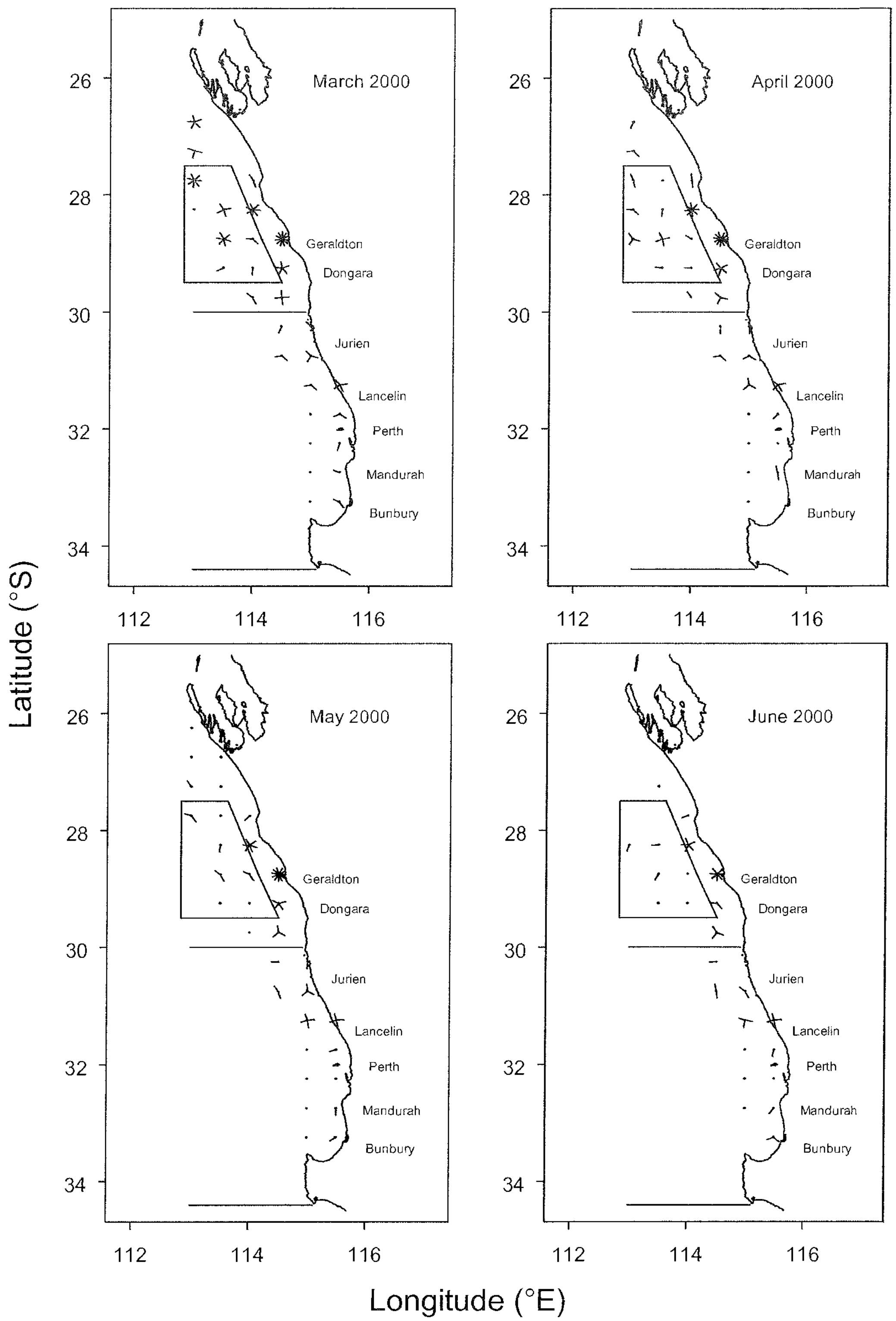

Figure 3.4 **Sunflower plots showing spatial distribution of average number of undersize lobster landed per 100 pot lifts based on logbook data, March 2000 – June 2000. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude/longitude. Dots (•) indicate an average in the range 1-100 undersize per 100 pot lifts. Each radial spoke ("petal") represents an increment of 100 in the average value (eg. ★represents an average of 500-600 undersize lobster in each 100 pot lifts).**

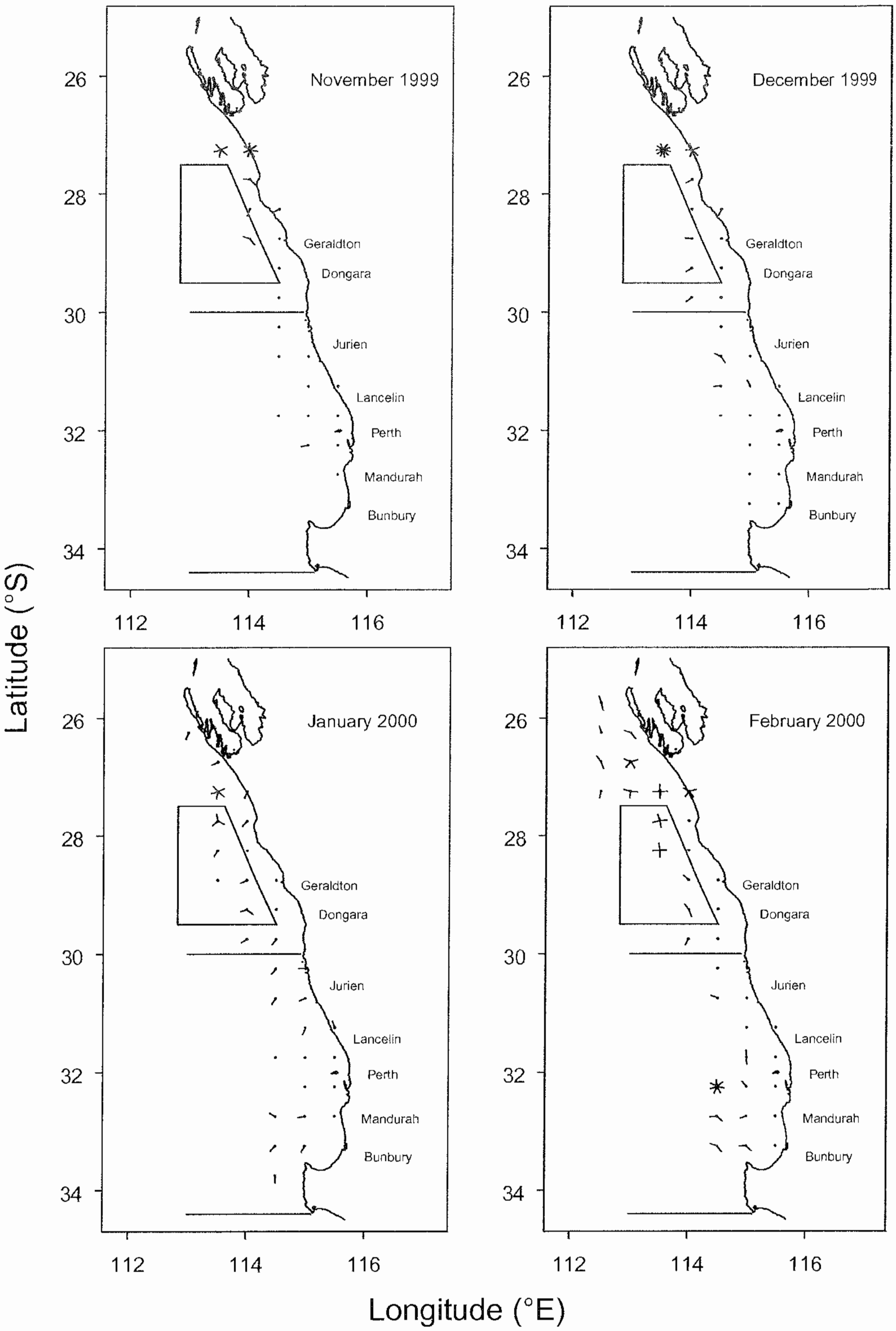

Figure 3.5 **Sunflower plots showing spatial distribution of average number of setose lobster (not including spawners) landed per 100 pot lifts from logbook data, November 1999 – February 2000. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude/longitude. Dots (•) indicate an average in the range 1-50 setose per 100 pot lifts. Each radial spoke ("petal") represents an increment of 50 in the average value (eg. ★ represents an average of 250-300 setose lobster in each 100 pot lifts).**

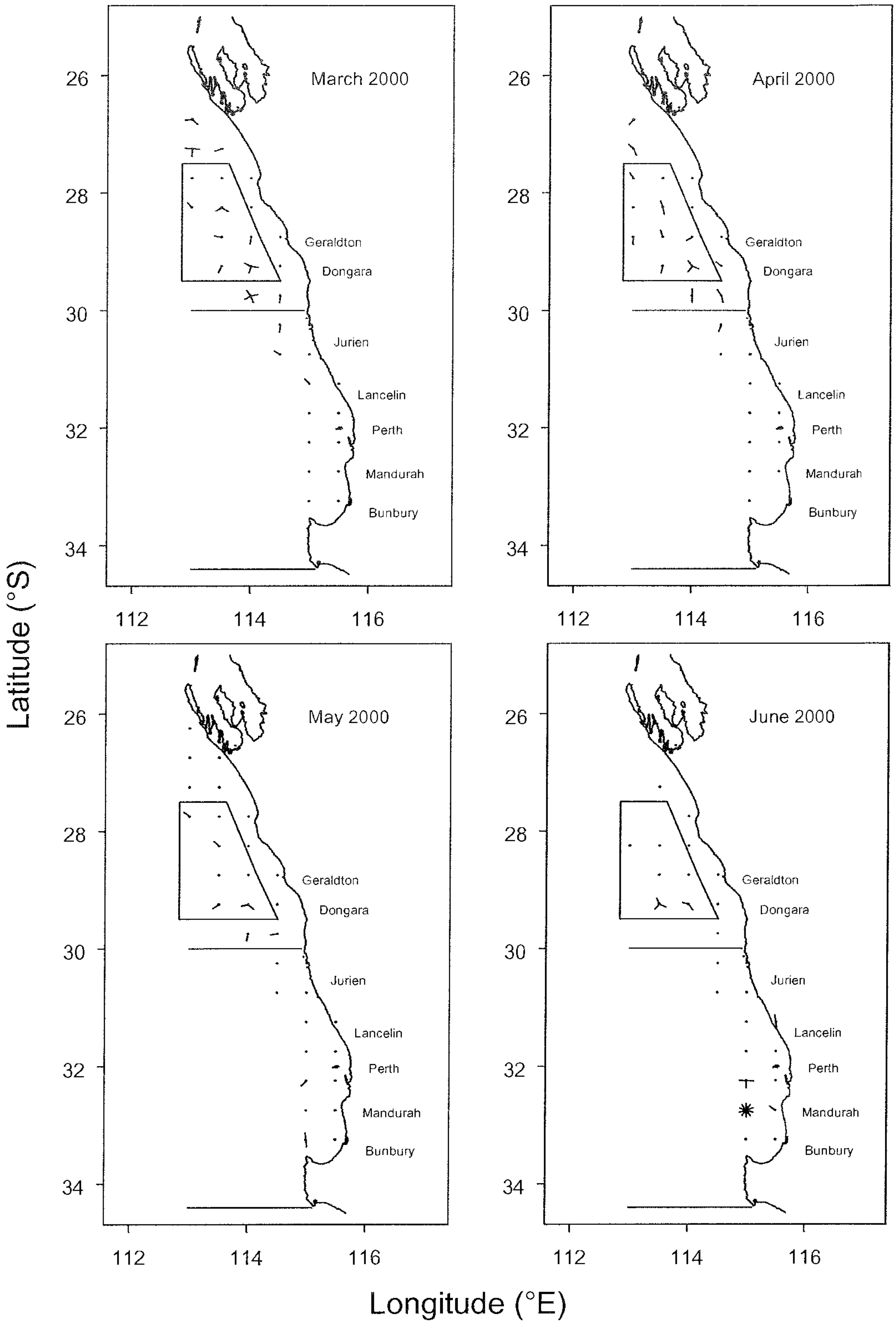

Figure 3.6 Sunflower plots showing spatial distribution of average number of setose lobster (not including spawners) landed per 100 pot lifts from logbook data, March 2000 – June 2000. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude/longitude. Dots (•) indicate an average in the range 1-50 setose per 100 pot lifts. Each radial spoke ("petal") represents an increment of 50 in the average value (eg. ★ represents an average of 500-600 undersize lobster in each 100 pot lifts).

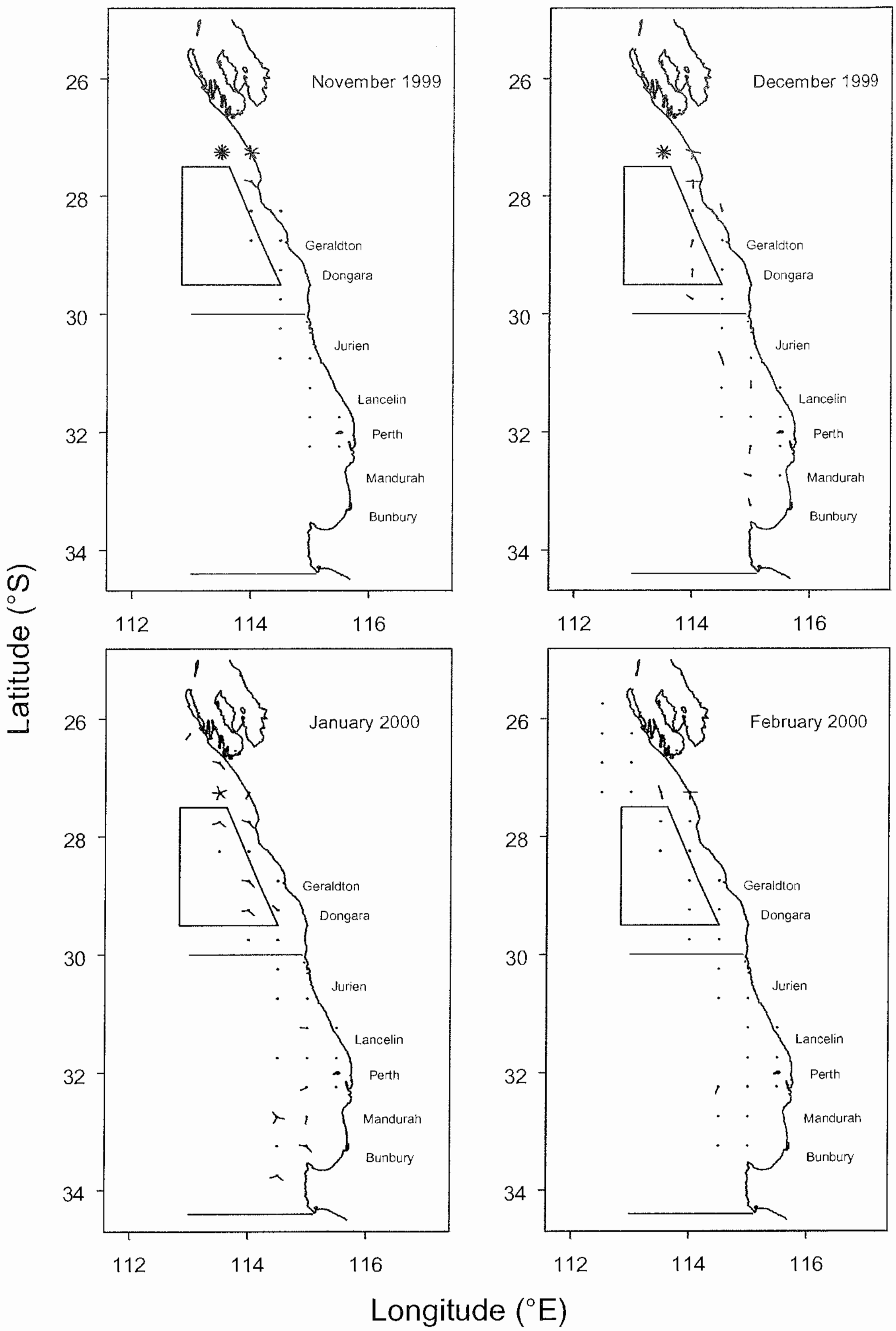

Figure 3.7 Sunflower plots showing spatial distribution of average number of berried lobster landed per 100 pot lifts from logbook data, November 1999 – February 2000. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude/longitude. Dots (•) indicate an average in the range 1-50 berried per 100 pot lifts. Each radial spoke ("petal") represents an increment of 50 in the average value (eg. ★ represents an average of 250-300 berried lobster in each 100 pot lifts).

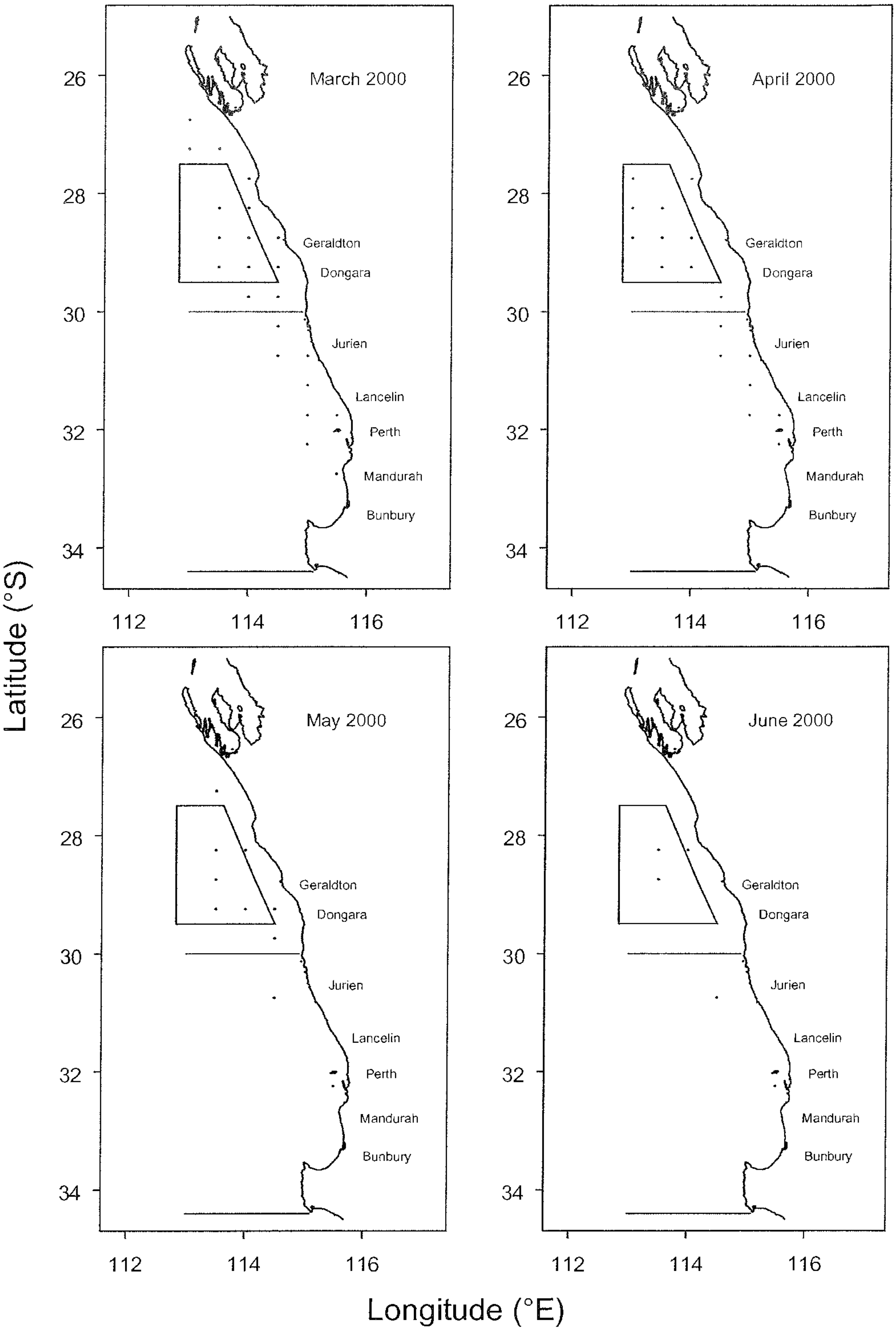

Figure 3.8 **Sunflower plots showing spatial distribution of average number of berried lobster landed per 100 pot lifts, March 2000 – June 2000. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude/longitude. Dots (•) indicate an average in the range 1-50 berried per 100 pot lifts. Each radial spoke ("petal") represents an increment of 50 in the average value (absent in these graphs due to the low occurrence of berried lobster in these months).**

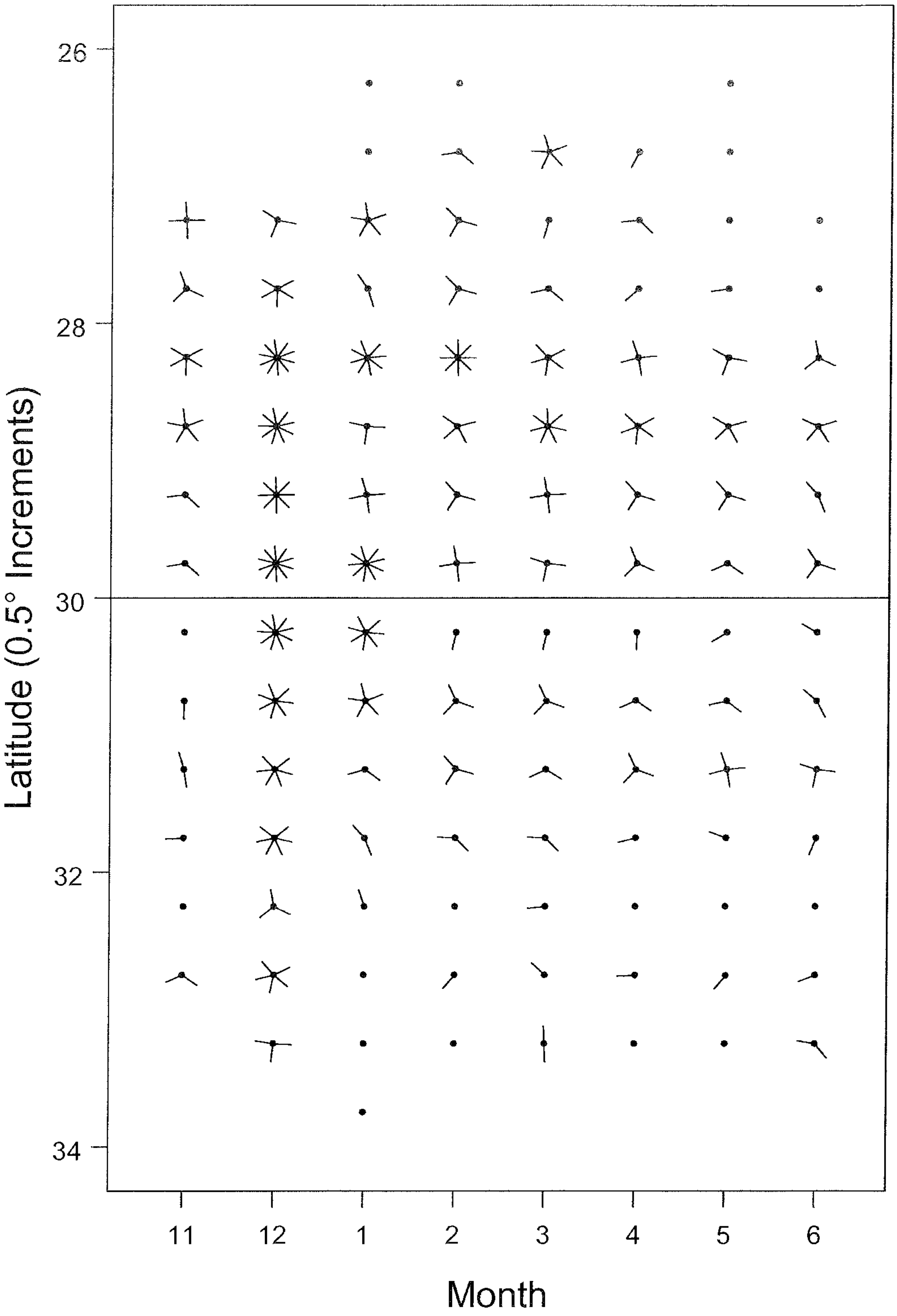

Figure 3.9 **Sunflower plots showing spatial and temporal distribution of average number of undersized lobster landed per 100 pot lifts in the 1999/2000 rock lobster season. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude. Dots (•) indicate an average in the range 1-100 undersize per 100 pot lifts. Each radial spoke ("petal") represents an increment of 100 in the average value (eg. ★ represents an average of 500-600 undersized lobster in each 100 pot lifts).**

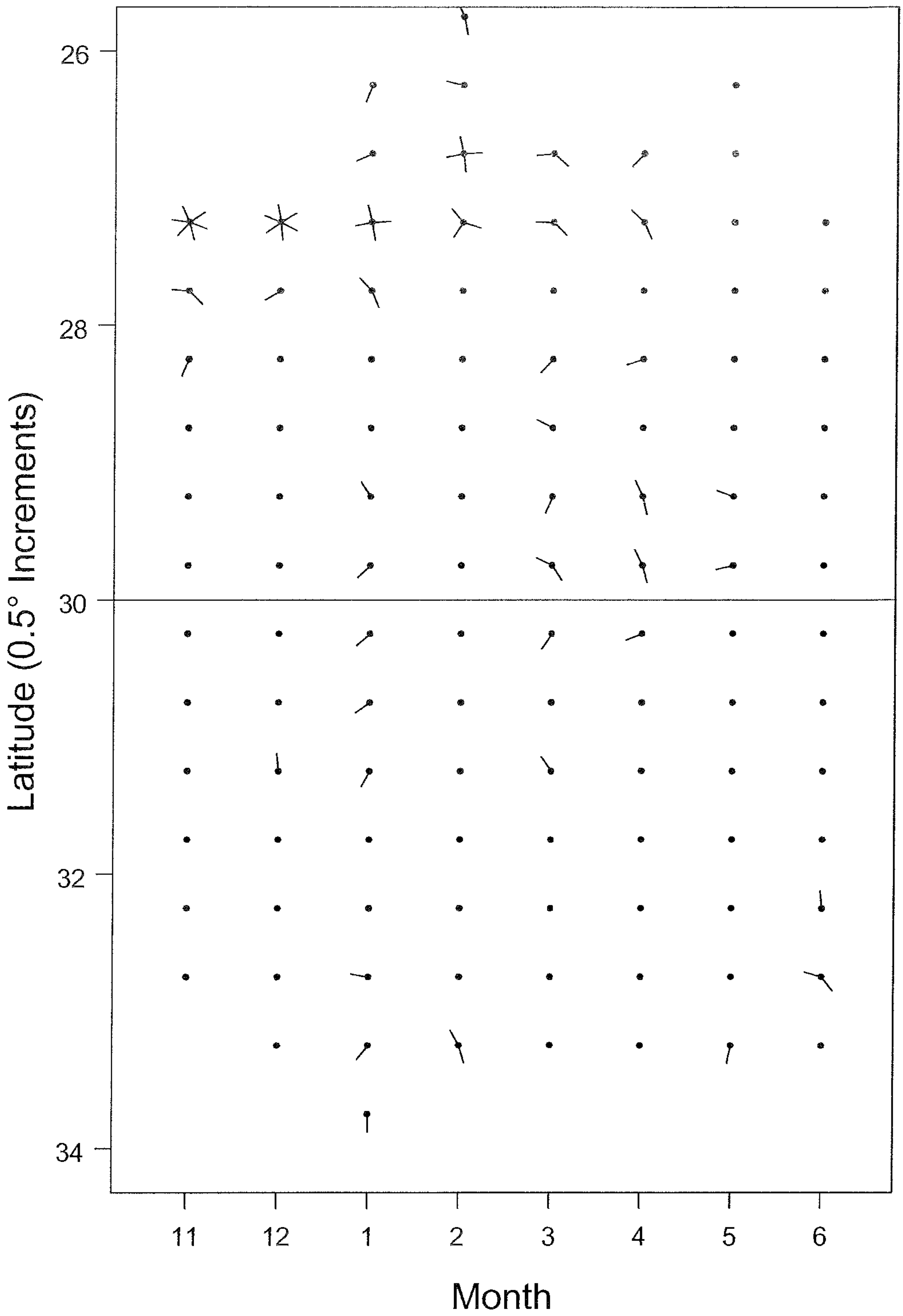

Figure 3.10 Sunflower plots showing spatial and temporal distribution of average number of setose lobster landed per 100 pot lifts in the 1999/2000 rock lobster season. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude. Dots (•) indicate an average in the range 1-50 setose per 100 pot lifts. Each radial spoke ("petal") represents an increment of 50 in the average value (eg. ★ represents an average of 250-300 setose lobster in each 100 pot lifts).

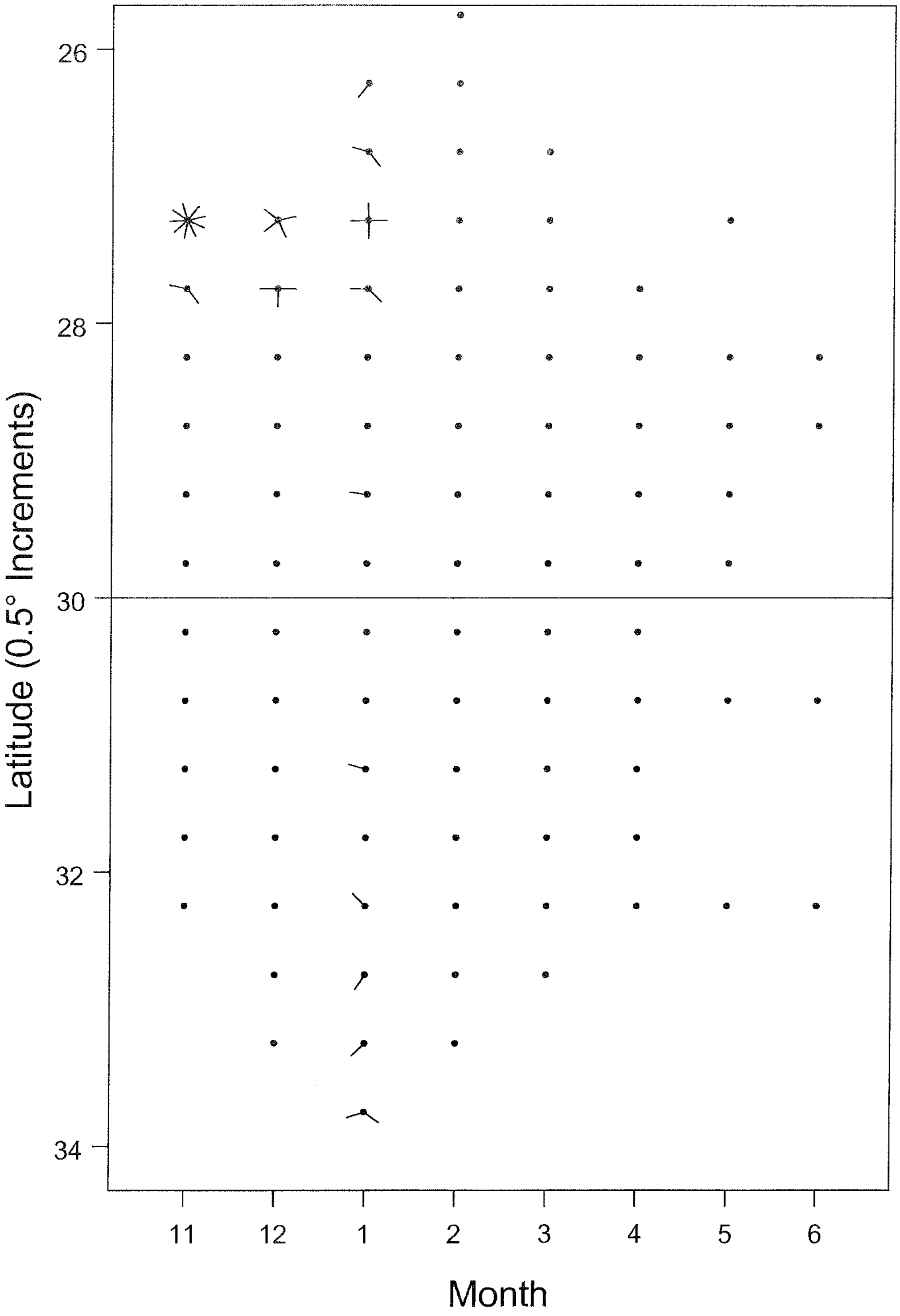

Figure 3.11 **Sunflower plots showing spatial and temporal distribution of average number of berried lobster landed per 100 pot lifts in the 1999/2000 rock lobster season. Values are represented as glyphs ("sunflowers") centred on each 0.5° of latitude. Dots (•) indicate an average in the range 1-50 berried per 100 pot lifts. Each radial spoke ("petal") represents an increment of 50 in the average value (eg. ★ represents an average of 250-300 berried lobster in each 100 pot lifts).**

3.5 Discussion

Checking of commercial catch in processing factories has historically been the primary mechanism for checking compliance with rules relating to the protection of undersize rock lobsters, and female lobsters at particular stages of the breeding cycle. The convenient "bottleneck" for checking catch created by a limited number of factories licensed for overseas export will ensure that checking catch in factories remains an important component of the overall mix of enforcement services provided to the rock lobster industry. Indeed, enforcement costs recovered from industry have remained relatively low (1-2% of GVP) largely due to the efficiencies that can be gained by checking a known, small proportion of the total catch in order to monitor ongoing compliance. However, the Federal Government, under National Competition Policy guidelines, has requested that processing for the domestic market be deregulated by 2003, and that a review be undertaken on the current limit on the availability of overseas export licences. Increased compliance costs under a deregulated processing sector are likely to form a major focus for discussion during this review.

In the context of the total catch removed from the fishery each season, compliance rates in factory consigned commercial catch in the western rock lobster fishery are exceptional. With over 90% of all catch inspection inspections detecting no illegal animals, clearly the overwhelming majority of commercial fishers in the western rock lobster fishery are compliant almost all of the time. While available historical data (1989-1997) are often incomplete, data for the last three seasons indicates that illegal animals are detected in less than 5% of all inspections, and that less than one quarter of one percent (ie. < 0.25%) of the total catch landed from the fishery and consigned to factories is estimated to be illegal. A majority of this illegal catch consists of undersized lobster, much of which arises from the northern parts of the fishery.

Examining the fishery as a whole, a relationship was apparent between the level of inspection and observed compliance, although their appeared considerable variability between season-district-month combinations at low levels of factory inspection. This showed that when Fisheries Officers inspected more than 5% of the catch consigned to factories in any one month, non-compliance rates were low and the percentage of the total catch estimated to be illegal was typically less than half of one percent. As the percentage of the total catch inspected fell below 5%, however, non-compliance rates indicated that the percentage of the total catch comprising illegal animals rose to 0.5-1.0%, or even higher in a small number of months. This is suggestive of a causative relationship between enforcement effort and compliance in factory consignments of rock lobster, although the apparent variability in this relationship indicates there may be important factors not yet incorporated into the model. Several deficiencies in the data may also contribute toward the observed variability, including: i) data are highly unbalanced in respect of certain season-district-month combinations; ii) the nature of the enforcement-compliance relationship admits the possibility that data are correlated (ie. enforcement effort in one month may affect compliant behaviour of fishers in adjacent months); and, iii) it was necessary to combine random and targeted inspections for seasons 1998/1999-2000/2001, since this distinction in inspection type did not exist for data prior to 1998/1999. Further modelling work is being undertaken in an attempt to account for these problems and refine the relationship presented in this chapter.

While results were variable between districts, pooling to the level of season indicates that targeted inspections are typically 2-10 times more effective in detecting illegal animals than simple random inspections. Since Fisheries Officers typically only inspect 2-5% of the total catch, effectively utilising information received from fishers and from analysis of enforcement data plays an important role in ensuring factory inspections pose a credible deterrent to the consignment of illegal catch.

Spatial differences in the availability and detections of illegal animals were evident in both fishers' logbook data and in compliance data collected by Fisheries Officers. Most illegal factory consigned catch during seasons 1998/1999-2000/2001 comprised landings of undersized lobsters, and most of these were detected in the Northern districts of the fishery. Fishers' logbook data indicate particular "hot-spots" for the availability of illegal animals, and Fisheries Officers might consider examining vessels fishing those areas.

Data arising from factory inspections of commercial catch has also been utilised to assess individual fisher compliance rates. Results have been used to provide Fisheries Officers with list of fishers with a poor history of compliance, according to a number of criteria. For example, fishers may be brought to the attention of Fisheries Officers if they have consigned large numbers of illegal animals, if they consign small number of illegal animals on a continuing basis, or if they have simply not been checked for a period of time. Results concerning individual fishers have not been presented in this document due to the confidential nature of analyses concerning individuals. However, this work has played an important part in improving the efficiency of Fisheries Officers, and I would recommend that all Australian fisheries agencies contemplate mechanisms for improving targeting of non-compliant fishers.

4. *Experimentation To Determine Enforcement-Compliance Relationships*

4.1 Overview

In this Chapter I examine the relationship between enforcement and compliance in commercial rock lobster processing factories. This is a topical issue within the fishery since a large proportion of the enforcement budget goes toward providing a continuous seasonal presence of Fisheries Officers in factories. Considerable savings to the compliance program might be realised if, for example, the level of factory inspections could be reduced without consequent increases in non-compliant activity. The question to be addressed, therefore, is: does reducing enforcement effort in processing factories result in consequent increases in non-compliant behaviour, and to what extent?

Determining the relationship between enforcement and compliance provides difficulties for traditional enforcement practices. The method I advocate for examining the issue is an experimental, analysis-based approach. Such an approach, while not without its own difficulties, has the potential to increase our understanding of this relationship. In this chapter I present two separate experiments designed to quantify changes in non-compliance due to modifications to the factoring monitoring program. The first experiment involves a pilot manipulation of enforcement effort. In this experiment Fisheries Officers measured compliance before and after four weeks of reduced inspection effort in several lobster processing factories. This planned manipulation did not reveal any appreciable shift in detected levels of non-compliance, indicating that either: a) enforcement effort could indeed be reduced without risking increased non-compliant activity; b) the timescale of the experiment was insufficient to detect increasing levels of non-compliance; or, c) the experiment was deficient in some way.

The pilot experiment led to the adoption of an adaptive management approach, in which inspection levels were reduced for a prolonged period across the entire fishery. This served to remove some of the potentially confounding effects present in the planned experiment, and further tested the idea that enforcement effort could be lowered without consequent increases in non-compliance. In the 1999/2000 season enforcement effort was reduced by 80% compared with the previous season, with Fisheries Officers inspecting only 1% of the total catch. Detected infringements were observed to more than double compared with pre-experiment levels (0.24% in 1999/2000, compared with 0.11% in 1998/1999), indicating that decreased inspection levels led to an increase in non-compliant behaviour. In 2000/2001 the decision was taken to increase inspection levels to around 3% of the total catch, with consequent increases in compliant behaviour. Improved compliance was not evident among all fishers, however, suggesting that some fishers considered the probability of detection in 2000/2001 to be small enough to warrant continued non-compliance with fishery rules.

4.2 Introduction

An appropriate level of compliance is normally determined by examining the trade-offs between the cost of enforcement, requirements imposed by the current management strategy, and the effect particular levels of non-compliance may have on stock sustainability and equity between fishery participants. For many fisheries agencies, however, there are few systems in place for formally measuring or assessing the performance of enforcement programs. A primary objective in evaluating any fisheries enforcement program is to quantify non-compliant behaviour at different stages of the fishing process. Using this information, enforcement resources may then be weighted towards those points in the fishing process where there appears a high risk of non-compliant activity, and to points where rules can most effectively be checked. Intuitively, areas where compliance is high might usefully have the amount of enforcement effort reduced – or can they? This is in fact the nub of the problem concerning allocation of enforcement effort: if compliance is high, will reducing enforcement effort cause non-compliance to increase, over what time-scale, and how might this effect best be measured?

Determining and quantifying the relationship between levels of enforcement and observed levels of compliance is a difficult, but increasingly important, task for fisheries management agencies. Faced with increasing pressure from industry participants in cost-recovered fisheries to demonstrate that enforcement resources are usefully expended, compliance managers must be able to show the linkages between enforcement effort and compliant behaviour. Consider, for example, reducing enforcement expenditure by 50% in a particular fishery. If under this scenario non-compliance with fishery rules increases by a once-only jump of 10%, and the increase does not threaten the sustainability of the stock, it might be reasonable to argue that the fishery was originally over-serviced. If, however, the observed increase was an additional 10% non-compliance *per year* until a new equilibrium is reached, and such increases would soon put the stock at risk of future collapse, then the resources needed to secure the original level of compliant behaviour might well be justified.

This leads to the question of how compliance-enforcement relationships might be measured in an experimental sense. One approach is to apply different levels of enforcement effort to treatment and control groups, where enforcement effort in treatment groups is increased or decreased over usual (control) levels. "Groups", in this sense, refers to collections of fishery units thought to be relatively homogenous within and between groups, with the exception of the variation in enforcement effort introduced by the experiment. For example, a coastline might be divided into similar sized transects (with respect to area and numbers of fishers), and different levels of enforcement activity might be applied to some of these areas. Differences in compliance rates between treatment and control groups should, all other things being equal, indicate the nature of the relationship between enforcement effort and compliance. Traditional repeated measures sampling designs are useful in this regard, and the important components in such studies can be summarised:

- Replicated treatment and control groups should be used to unambiguously identify changes in compliance with changes in enforcement effort.
- Measurements should be taken before and after treatment effects are applied.
- The period of increased/decreased enforcement effort should be explicitly considered as one of the factors in the experiment.
- Possible time lags between changes in enforcement effort and changes in compliance need to be considered.
- Enforcement effort should be quantified and standardised over the period of the experiment.

Notwithstanding these considerations, experiments measuring human behaviour, especially illegal human behaviour, are difficult and can be subject to severe practical limitations. In a manner analogous to the Heisenberg uncertainty principle in quantum mechanics, measuring illegal human behaviour can have the effect of actually modifying the behaviour of the subjects being observed, such that observations may not represent reality in the absence of the observer. For example, if fishers were to suspect a shift in normal enforcement practices had been *planned*, they might modify their behaviour and in fact become more compliant even with reduced amounts of enforcement effort. This might occur, for example, in a fishery with an established and predictable enforcement regime. Such possibilities should be considered and, where possible, steps aimed at ameliorating factors that might affect fishers' normal behaviour should be incorporated into the study design.

In the event that traditional small-scale experimental approaches prove impractical or cannot be sufficiently disguised from fishers, then an adaptive management approach might be considered. When managing complex systems, such as fisheries enforcement programs, it is often difficult to predict outcomes that may arise from the introduction of different management strategies. Holling (1978) and Walters (1986) recognised this in terms of natural resource management, and introduced the concept of adaptive management as a method to try to reduce uncertainties associated with managing such systems. The principal tenet of adaptive management is that perturbing systems through changes in the management regime, and observing outcomes, can lead to a greater understanding of how the system works compared with small, incremental changes whose effects are difficult to measure.

Finally, the possibility of natural experiments should not be ignored. Natural experiments are unplanned situations that may provide useful insight into the relationship between compliance and enforcement. For example, an area may not be checked (or checked less frequently than usual) for a period of time because of staff shortages or vessel maintenance. When inspections resume it is desirable that they recommence with approximately the same level of enforcement effort as when inspections ceased. In this way it is possible to compare the "usual" level of compliance with the level that occurs after a prolonged absence of enforcement activity.

The remainder of this chapter is divided into two distinct sections. Section 4.3 provides results from a pilot experimental manipulation of enforcement effort in rock lobster processing factories conducted in 1999. The pilot experiment revealed several difficulties associated with enforcement/compliance conducting experiments of these types. A large-scale adaptive management approach was adopted as an alternate approach, and Section 4.4 presents results from a "whole-of-fishery" experiment designed to overcome some of the complications experienced in the pilot experiment.

4.3 Factory Experiment to Determine Enforcement-Compliance Relationships

4.3.1 Introduction

This section outlines the rational, experimental design, rules for data collection, and results from a pilot experiment to examine the relationship between enforcement effort and compliance with fishery rules by commercial fishers consigning catch to rock lobster processing factories. Fisheries Officers, fishery managers, and research staff were involved in planning the experiment, with discussions focusing on practical and scientific considerations, the relationship between the Department of Fisheries and fishers/processors, and the legal implications of such an experiment.

The principal object of the experiment was to examine if high compliance rates observed in rock lobster processing factories were being achieved as a result of: i) the level of inspection; ii) the fact that Officers visit factories (irrespective of the level of inspection); or, iii) the infringement warning/notice system that provides a feedback mechanism to fishers that their catch is being inspected. In other words, is it simply the presence of Fisheries Officers in processing factories that leads to high compliance rates, the frequency of inspection, or is it the fact that fishers regularly receive feedback when their catch is found to contain illegal animals. If successful, it was anticipated that the study would serve as a pilot for a larger experiment to be carried out in the 1999/2000 rock lobster season.

4.3.2 Methods

4.3.2.1 Experimental Design

The study involved controlled monitoring of six rock lobster processing factories by Fisheries Officers over a six-week period in March-April 1999. Two factories were assigned to each of two different treatment groups, with a further two factories assigned no treatment (control group) (Table 4.1). Fishers within factories represent the observational units for the study, such that all fishers consigning catch to a single factory were subject to the same treatment effect.

The first treatment (Impact A) involved Fisheries Officers examining catch, but not issuing infringement notices when they discovered illegal animals. The aim of this treatment was to discover if non-compliance would rise in the absence of a feedback mechanism to fishers when Officers detect illegal catch. The second treatment (Impact B) aimed to determine if excluding Fisheries Officers from factories might encourage increased non-compliance with rules. The contrast between these effects should allow estimation of the relative impacts on infringement activity caused by: i) the presence of Fisheries Officers; and, ii) the presence of Fisheries Officers *and* the issuing infringement notices. Subtracting the effect of i) from ii) should provide an estimate of the deterrent effect attributable to the infringement notice system.

Table 4.1 Experimental design

	Pre-Treatment (1 week)	Treatment (4 weeks)	Post-Treatment (1 weeks)
Impact A 2 factories (FA1, FA2)[1]	Inspect animals daily Record breaches Issue infringements	Inspect animals daily Record breaches DON'T Issue infringements[2]	Inspect animals daily Record breaches Issue infringements
Impact B 2 factories (FB1, FB2)[1]	Inspect animals daily Record breaches Issue infringements	DO NOT Inspect	Inspect animals daily Record breaches Issue infringements
Control 2 factories (FC1, FC2)[1]	Inspect animals daily Record breaches Issue infringements	Inspect animals daily Record breaches Issue infringements	Inspect animals daily Record breaches Issue infringements

1 Individual factory names are confidential and are only provided for limited distribution on a need-to-know basis (refer Appendix 3)

2 EXCEPT in exceptional circumstances (see data collection below)

The purpose of the control group in the pilot study was to establish that any observed treatment effects are unambiguously due to the treatments and not some other unmeasured factor. The purpose of the pre-treatment (1 week), treatment (4 weeks), and post-treatment (1 week) periods are to show that levels of enforcement affect compliance rates (as measured by detected infringements). If the proposition that infringements are likely to rise as levels of inspection decrease is true, then I would expect higher levels of infringement for the impact groups during the treatment periods, noting that any change in Impact B factories will only be detectable once post-treatment monitoring commences. During the post-treatment period I would expect the infringement levels of the impact groups to decrease to around those levels observed during the pre-treatment period. Infringement levels for the control group should remain constant over the study period, and be similar to those levels evident for the impact groups during the pre-treatment and post-treatment periods.

4.3.2.2 Timeline and Sample-Sizes

It was important that enforcement effort was standardised for the study period. Discussions with Fisheries Officers revealed that it was feasible to examine 500 lobster per factory per day, and that inspections could be conducted on four days during each week of the study. Timelines and target sample-sizes are provided in Table 4.2.

Table 4.2 Proposed sample sizes (number of lobster) in each of six rock lobster processing factories involved in the experiment.

		Pre-Treatment Week 1 1/3-7/3/1999	**Treatment** Weeks 2-5 8/3/1999 - 4/4/1999	**Post-Treatment** Week 6 5/4-11/4/1999
Impact A	FA 1	2000	8000	2000
	FA 2	2000	8000	2000
Impact B	FB 1	2000	0	2000
	FB 2	2000	0	2000
Control	FC 1	2000	8000	2000
	FC 2	2000	8000	2000
	TOTALS	12000	32000	12000

4.3.2.3 Choice of Factories and Allocation to Treatment Groups

The Perth/Fremantle area of the fishery supports seven processing factories and two receival depots. In most instances, receival depots take delivery of lobster before transporting them to processing factories, however in peak catching periods some processing may occur at receival depots. Six processing factories were required for the study, and these were chosen according to the criteria:

a) The factory must be a *processing* factory (as opposed to a receival depot) with the potential for a constant supply of lobster for the duration of the study period.

b) The geographical location of a factory chosen for a treatment group must not impact on the treatment applied to any other factory. For example, the proximity of Fisheries Officers' vehicles to factories may influence compliance activity if fishers use the presence of vehicles as an indicator of enforcement activity. Factories were therefore chosen and assigned to treatment groups so as to minimise this possibility.

The single factory and two receival depots not involved in this study continued to be subject to random catch inspections during the period of the experiment.

4.3.2.4 Data Collection

During normal inspections of factory consigned catch, Fisheries Officers collect information on who is inspected, how much catch is involved, and what breaches are detected. However, there is a limit to the amount of data Officers can usefully collect and still be able to adequately perform their duties. For the purposes of the present study, Officers were required to collect information on the number of lobsters inspected, rather than simply the number of baskets inspected (as is the case during normal factory inspections). This has implications for an experiment of this nature, since any deviation from normal inspection practice may potentially change the infringing behaviour of fishers. While requiring Fisheries Officers to modify their usual inspection method was less than ideal, it was considered necessary since data collected under the "usual" inspection regime would be unsuitable for the purposes of this experiment.

The modified inspection procedure required Fisheries Officers to pull baskets aside to enable counting of individual animals, rather than inspecting catch as it was emptied from fishers' baskets into the processors' sorting trays. In order to alleviate suspicion on the part of factory workers and fishers in regard to this modified inspection practice, Fisheries Officers were instructed to explain that they had been directed by the Research Division of the Department to obtain counts of the number of lobster in baskets. They were asked to give the impression they knew little about the change aside from the fact it was "some sort of research initiative". It was considered that such a change in inspection practice should not be considered unduly strange by fishers, since from time to time Fisheries Officers are required to participate in research initiatives.

Second, since factories process catch on a "per-vessel" basis, Officers were also required to inspect catch in that manner. For example, if lobsters from five vessels arrive by truck, inspecting Fisheries Officers were required to take aside all the catch from a single vessel being inspected in order to check a subsample, rather than a proportion of the catch from all vessels. This was important since the modified inspection procedure had the potential to slow catch processing, and in this way the impact of data collection on processor activity could be minimised. An important consideration was that Officers should not sample *all* the catch from a single vessel, since processors might realise that illegal animals were going unchecked (Impact A). By only examining some of the baskets from an individual vessel, Fisheries Officers ensured they had an "excuse" for letting illegal animals go unnoticed.

There may have been circumstances when Fisheries Officers needed to issue infringements, even during the treatment period for Impact A factories. For example, if a factory worker alerted a Fisheries Officer to the presence of an illegal animal, Officers were instructed to respond that the animal(s) must have been in one of the baskets not checked, and Officers were instructed that they *must* issue an infringement for these animals. This circumstance did not arise during the course of the experiment. Finally, Fisheries Officers were instructed to sample as many boats as possible from factories involved in the experiment, and that the timing of inspection visits should remain essentially "ad-hoc", as they are normally, so as to maximise the probability of inspecting when processing was occurring.

4.3.3 Results

Over the period of the experiment, Fisheries Officers examined 1173 baskets, containing over 60,000 lobsters, from 190 fishing operations. Of the 190 vessels, 15 fishers consigned catch to two different factories during the study period, and all other vessels consigned catch to a single processor only (Table 4.3). No vessels consigned catch to more than two factories during the period.

Table 4.3 Number of vessels consigning to each of the experimental factories during the study period. Off-diagonal elements indicate the number of vessels consigning to each factory-pair combination.

	FA1	FA2	FB1	FB2	FC1	FC2
FA1	20	--	2	1	2	2
FA2		31	1	--	1	4
FB1			27	--	--	--
FB2				22	--	--
FC1					37	2
FC2						38

Due to competition between processors to secure fishers' catch, it is known that fishers will sometimes consign catch to more than one processor. Of interest in the present study might be those vessels that swapped from consigning to either Treatment A or Control group factories to Treatment B factories, and the *timing* of any swap in consignment behaviour. In other words, if fishers became aware that FB1 and FB2 were not being inspected, would they start consigning catch to those factories in preference to their usual factories? Conversely, if fishers became aware that Treatment B factories were not being inspected for a period of time, they might suspect some kind of covert surveillance operation on the factories and start consigning to either Treatment A or Control factories.

Results indicate that no vessels consigned catch to both the Control group and Treatment B, and that only four vessels consigned catch to both Treatment A and Treatment B during the period of the study. Examining the timing of these consignments to multiple factories, two of the four vessels only consigned catch to both factories in the pre-treatment week of monitoring, and the remaining two vessels only consigned 12% and 7%

of their catch to Treatment B factories. This indicates a low likelihood that fishers switched their usual point of consignment based on the removal of enforcement effort from Treatment B factories.

Excluding Impact B factories for weeks 2-5, Fisheries Officers inspected between 1568 and 3010 (average 2162) lobsters in each factory in each week of the experiment (Table 4.4). Variation in numbers of baskets and numbers of animals inspected arose due to normal fluctuations in catch, as might occur due to the lunar period and/or weather conditions.

Table 4.4 Number of lobsters (upper) and number of baskets (lower, bracketed) inspected in each week of the experiment.

		Pre-Treatment	**Treatment**				**Post-Treatment**
		Week 1	2	3	4	5	Week 6
Impact A	FA 1	2138 (33)	2630 (47)	1646 (33)	2233 (40)	2029 (63)	2139 (50)
	FA 2	2069 (39)	2599 (46)	2046 (39)	2415 (48)	2119 (45)	1999 (42)
Impact B	FB 1	2190 (37)	0 (0)	0 (0)	0 (0)	0 (0)	2235 (39)
	FB 2	2088 (40)	0 (0)	0 (0)	0 (0)	0 (0)	2056 (40)
Control	FC 1	2109 (36)	2128 (38)	1874 (37)	3010 (66)	2158 (41)	2006 (48)
	FC 2	2180 (36)	2721 (45)	1568 (25)	2081 (37)	2115 (40)	1966 (43)
TOTAL		12774 (221)	10078 (176)	7134 (134)	9739 (191)	8421 (189)	12401 (262)

Numbers of detected breaches were low in both treatment factories and control factories. Summing over all infringement categories, the numbers of infringements detected in the post-treatment week of the experiment were either comparable or less than numbers detected during pre-treatment and treatment weeks (Table 4.5). Levels of non-compliance were variable between treatments, and between replicates within treatments (Table 4.6). Significantly, Impact B factories, which were considered those with the highest potential to show increased levels of non-compliance, were in fact the factories with the lowest detected non-compliance during post-treatment monitoring. Note that 12 of the 20 undersize lobsters detected in week 1 at factory FA1 arose from a single fisher. The nature of this result is largely self-evident; given the observed variability in infringement rates, and the fact that virtually no illegal animals were detected at Impact B factories, it is reasonable to conclude that the experiment produced no discernable shift in levels of non-compliance after four weeks of reduced enforcement effort or non-issuing of infringement warnings and notices.

Table 4.5 Total number of illegal animals (sum of undersize, setose, oversize and tarspot) detected in each week of the experiment.

		Pre-Treatment	Treatment				Post-Treatment
		Week 1	2	3	4	5	Week 6
Impact A	FA 1	20	6	9	4	8	8
	FA 2	0	11	13	4	15	0
Impact B	FB 1	1	NA	NA	NA	NA	0
	FB 2	0	NA	NA	NA	NA	2
Control	FC 1	0	4	0	6	2	3
	FC 2	7	3	0	1	0	7

Table 4.6 Infringement rates based on total numbers of illegal animals detected (sum of undersize, setose, oversize and tarspot), expressed as percentages.

		Pre-Treatment	Treatment				Post-Treatment
		Week 1	2	3	4	5	Week 6
Impact A	FA 1	0.94	0.23	0.55	0.18	0.39	0.37
	FA 2	0	0.42	0.64	0.17	0.71	0
Impact B	FB 1	0.05	NA	NA	NA	NA	0
	FB 2	0	NA	NA	NA	NA	0.10
Control	FC 1	0	0.19	0	0.20	0.09	0.15
	FC 2	0.32	0.11	0	0.05	0	0.36

4.3.4 Discussion

Intuitively, a significant treatment effect from this study should be apparent provided a relationship between enforcement and compliance exists, and that any time lag between changes in enforcement effort and changes in non-compliant behaviour is less than four weeks. The absence of a treatment effect would indicate lack of a relationship between enforcement and compliance, or that the time lag for measurable effects to be detected is larger than four weeks, or that some unmeasured factor has influenced fishers' compliance behaviour. In other words, a positive treatment effect would have demonstrated a definite enforcement-compliance link, but unfortunately a negative result cannot discount such a link[8]. The lack of a clear result in this experiment suggests more questions than it provides answers, and I discuss these below.

Central to this experiment was the idea that changes in compliant behaviour could be detected within a six-week period. This is a relatively short time-frame, however anecdotal evidence from an *ad hoc* manipulation of enforcement effort previously conducted by Fisheries Officers indicated that time lags might be as small as 2-3 days (Fisheries Officer Joe Miller, personal communication). The reason for this is straightforward. Although fishers do not often visit processing factories (i.e. they consign catch to factory truck drivers at the point of landing), they have excellent sources of information about what is happening at factories. Factory staff provide regular feedback by telephone about the condition of catch, prices paid, and the activities of Fisheries Officers. Truck drivers also provide feedback on a regular basis. This information flow means that fishers are well informed about the activities of Fisheries Officers in factories, including the amount of catch being inspected and the types and severity of offences being detected. Any changes to the enforcement regime are likely to be viewed by fishers with great interest, such that compliance might actually *increase* if fishers were to suspect Fisheries Officers of conducting some sort of covert enforcement operation. Despite efforts to ameliorate such effects, it is possible that this occurred in the present study. Fisheries Officers involved in the experiment suspect that fishers were aware that some sort of "special compliance exercise" was taking place, and were more compliant as a result.

A second potentially limiting factor in the present study was the small number of factories involved. There are only a finite number of processing factories in the fishery, and only a subset operate in the Fremantle district. This effectively limited to seven the number of factories able to be sampled. The sampling design was further constrained in that particular factories had to be allocated to particular treatment groups in order to minimise potential confounding effects introduced by the proximity of certain factories to one another. Considering the small sample size, and non-random allocation of factories to treatments, it is possible that particularly compliant or non-compliant factories (with respect to their fishers) could have been assigned to particular treatment groups, perhaps causing the behaviour of their consigning fishers to be obscured.

It is encouraging that fishers appeared not to switch their consigning behaviour in order to deliver catch to those factories that had no enforcement effort for the treatment period. This cannot be known for certain, however, since Fisheries Officers only checked a small (and unknown) subset of the total catch consigned to

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[8] This is a general scientific principle – failure to establish evidence against a proposed hypothesis does not necessarily provide evidence for the status quo.

factories during the period of the experiment[9]. In any event, if "switching" behaviour occurred in order to consign illegal catch it would likely have only occurred among a small number of fishers, and given the scope of the experiment these may not have been detected[10].

While this study did not detect increased non-compliance with fishery rules as a result of decreased enforcement effort, it did highlight the difficulties involved in conducting manipulative experiments to measure illegal human behaviour. In the next section I examine an adaptive management approach that, while not without its own difficulties, aims to examine the enforcement-compliance relationship by avoiding some of the problems described in this section.

4.4 Adaptive Management: Extending the Factory Experiment

4.4.1 Introduction

Given the difficulties associated with the factory experiment described in the previous section, an adaptive management approach was considered as an alternative to determining the relationship between enforcement effort in rock lobster processing factories and compliance with fishery rules. The concept of adaptive management encourages management decisions to be viewed as experiments, and suggests they should be designed, where possible, to reduce uncertainty and increase knowledge about the system being considered. Hilborn and Walters (1992) distinguish between active and passive adaptive management. The former involves the experimental manipulation of a management system to test a range of alternate hypotheses in order to determine an optimum management model. In contrast, passive adaptive management relies on the choice of a single "best guess" management regime, and consequent changes to this system only occur if future assessments reveal deficiencies. A related idea is the concept of "natural experiments", or non-planned perturbations to management systems that have the potential to increase our knowledge of how systems work.

The concept of adaptive management is particularly useful in contexts where traditional experimentation may be difficult or not possible, and measuring enforcement-compliance relationships in fisheries provides one such example. Compliance programs in Australia have generally been developed by Fisheries Officers, management and industry representatives setting subjective levels of risk to different stages of the fishing process (passive adaptive management). Significant changes to a compliance strategy often only then occur after something goes awry in a fishery, or for government-driven budgetary reasons. Under an active management approach, however, standardised measures of compliance may be collected to examine how

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[9] Factory processors submit monthly returns to the Department of Fisheries WA about the amount of catch processed, however it is not possible to unambiguously determine the amount of catch processed in factories over the period of the experiment since this period spanned two calendar months.

levels of compliance change with varied levels of enforcement effort. That is, by systematically varying the frequency of inspection at different stages in the fishing process (and potentially between fisheries) it should be possible to measure consequent changes in levels of compliance.

There are few published studies examining the allocation of fisheries enforcement effort in order to maximise compliance. With limited success, Punt (1999) assessed the effect of alternative levels of observer coverage in the South East trawl fishery on alternate biological models of fishery behaviour. Other authors have used theoretical econometric approaches to examine relationships between enforcement and compliance (Anderson and Lee 1986, Sutinen and Andersen 1985, Milliman 1986). I know of no studies using active adaptive management techniques to optimise the allocation of enforcement effort, although many fishery enforcement programs are likely to unconsciously use passive adaptive management.

In this section I describe an adaptive management experiment conducted in the western rock lobster fishery. After careful consideration of the problems encountered in the pilot experiment described in Section 4.3 it was decided to adopt a "whole of fishery" approach to the reduction in enforcement effort. That is, rather than reducing enforcement effort in particular factories for short periods, or in particular areas of the fishery, effort directed toward factory inspections was reduced uniformly across the whole fishery for an entire season. In one sense this creates quite a "blunt" experimental instrument, since the absence of control groups and replication prohibits measured effects to be unambiguously attributed to changes in enforcement effort. The quality of inferences must therefore rely on the assumption that other factors thought to affect compliance rates (e.g. catch prices or pot lease prices) are approximately constant between periods being compared. Notwithstanding this limitation, there was merit in conducting a whole-of-fishery reduction of factory enforcement to assess if, all other things being equal, compliance rates changed. This was also a decision that was likely to be politically acceptable to the rock lobster industry – on average, no individual district would be (purposefully) checked more or less than others, and expenditure saved from reduced factory monitoring could be used to increase other enforcement activities. Additionally, compliance in the season prior to the planned reduction in effort had been measured to be high.

4.4.2 Methods

The 1998/1999 season represented the first year of complete data for factory-related rock lobster compliance inspections. During this season Fisheries Officers inspected 5% of the total catch consigned to processing factories, and data indicated that compliance rates were exceptionally high. Through internal deliberations among enforcement staff it was decided that effort in factories should be reduced for the 1999/2000 season, with resources diverted toward other compliance priorities. Careful monitoring in factories was to continue,

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[10] If indeed switching behaviour would be likely to occur at all – it is generally accepted that price and personal relationships with factory personnel are the main factors determining which factories a fisher will choose to allocate catch.

at a reduced level, and a re-evaluation of the strategy would take place at the end of the 1999/2000 season. The decision was taken to reduce inspection levels to 20% of the 1998/1999 figure, a level thought low enough to produce a significant change in compliance behaviour among fishers (if one was to occur at all), but high enough to ensure the sustainability of the resource was not put at threat.

In 1999/2000 Fisheries Officers continued to check factory catch in the same manner as previous years, but at the reduced level discussed above. Such a reduction in the presence of Officers in processing factories soon became well known among industry participants. This reduction in the level of inspection continued for the whole of the season.

Based on results from an analysis of 1998/1999 and 1999/2000 data, in the 2000/2001 season inspection levels in processing factories was increased to around 3% of the total catch, a level part-way between levels experienced in seasons 1998/1999 and 1999/2000. These results are also presented in the following section.

4.4.3 Results

During the 1998/1999 season Fisheries Officers inspected 5% of the total catch consigned to processing factories. This equated to almost 10,000 catch inspections, during which 26,500 baskets of catch, or 1.3 million lobsters, were examined. All vessels were inspected at least once, with most inspected 9-20 times (inter-quartile range) during the season. Over 90% of these inspections detected no illegal product, and around 75% of those inspections where illegal product was found detected 2 or fewer illegal animals. Pooling over all infringement categories (the majority of illegal animals were undersize) and considering just random inspections, this equates to around 1.1 illegal animals in every 1,000 lobsters checked, or equivalently 1 illegal animal in every 20 consigned baskets. Under certain assumptions about the average size of an illegal lobster, and utilising the known total commercial catch as determined from processing factory records, it is possible to estimate that around 14 tonnes of illegal lobster were consigned during the season. In the context of a total commercial catch of 13,000 tonnes, this level of compliance is commendable by any standard.

In 1999/2000 the inspection level in factories was reduced by 80% compared with the previous season, with Fisheries Officers inspecting around 1% of the total commercial catch. Around 95% of the fleet was inspected at least once, and 50% of all vessels were inspected 2-5 time during the season. There were a substantial number of vessels (25%) that were only inspected on one occasion. Combining all infringement categories, Officers detected 2.4 illegal animals in every 1,000 lobsters checked, or equivalently 2-3 illegal animals in every 20 baskets checked. Extending this rate to the 99% of catch that Fisheries Officers did not check, it is estimated that fishers consigned around 35 tonnes of illegal product during the 1999/2000 fishing season.

Despite the jump in non-compliance in the 1999/2000 season, an average infringement rate of 2-3 illegal (mainly undersize) animals in every 20 baskets of consigned catch was considered by the Department of Fisheries to be an excellent result. The consensus internal view was that inspections levels should remain at

1-2% of the commercial catch, but that careful monitoring should continue to ensure compliance rates were not climbing (e.g. on the shallow part of an exponentially increasing curve!). The commercial fishing industry did not view this result so favourably, however, and a decision was reached through the RLIAC process that inspection rates should be increased to around 3% of the total catch for the 2000/2001 season.

Results in 2000/2001 showed that, with an inspection rate of around 3%, all vessels were inspected at least once, and half of all vessels were inspected 2-11 during the season. Per-animal infringement rates decreased from the previous season to around 1.5 illegal animals in every 1,000 inspected, with a total estimated illegal catch processed through factories of around 16.5 tonnes. This represented a 50% decrease in the amount of illegal product removed from the fishery compared with the previous season. Per-animal non-compliance levels have thus far been presented in this section, however similar trends were apparent in both inspection-level and basket-level non-compliance rates (see also Tables Table 3.14, Table 3.16 and Table 3.18).

The difference between seasonal individual vessel compliance is worthy of comment (Figure 4.1). Results indicate that, for each season, vessels varied considerably in the number of baskets inspected, and high numbers of illegal animals were only detected among relatively few fishers. Per-animal compliance rates for individual vessels shows that an overwhelming majority of the rock lobster fleet manage to consign virtually no illegal animals in any one season (Figure 4.2).

The horizontal dotted line appearing at 0.1 in Figure 4.2 indicates twice the average per-animal infringement rate detected in the 1998/1999 season (i.e. 2 x 0.05 = 0.1, or 1 illegal animal in every 10 baskets checked), and is included to facilitate comparison between seasons. These results indicate that the vast majority of commercial vessels in both seasons consigned less than one illegal lobster in every 10 baskets of catch, and that most of these vessels consign no illegal catch whatsoever. The percentage of the fleet consigning greater than one illegal lobster in every 10 baskets increased from 15% in 1998/1999 to around 20% in seasons 1999/2000 and 2000/2001. This indicates that the number of fishers breaking rules under conditions of reduced factory enforcement effort increased by around 5% of the total fleet, or by 30% if just considering those fishers with detected infringement rates greater than 0.1 in the 1998/1999 season.

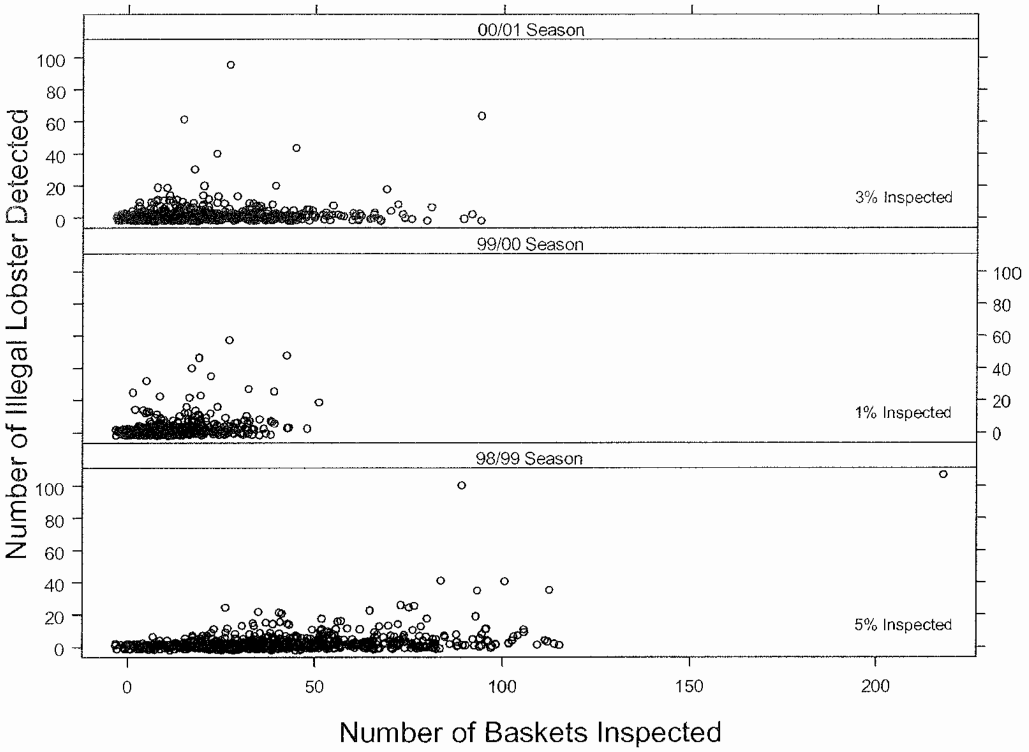

Figure 4.1 **Plot of individual vessels according to number of baskets inspected and number of illegal animals detected during seasons 1998/1999 – 2000/2001.**

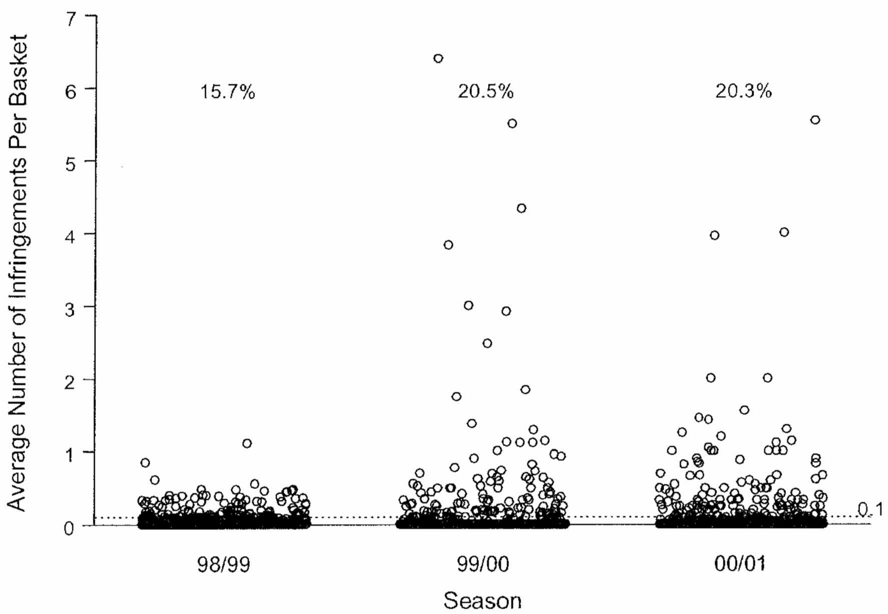

Figure 4.2 **Plot of average number of infringements per basket for individual vessels for seasons 1998/1999 – 2000/2001. The horizontal reference line at 0.1 indicates twice the average infringement rate observed in the 1998/1999 season. Percentages show the proportion of the fleet with infringement rates above 0.1. Random variation has been added in the x-direction to reduce over-plotting.**

Examining the degree of concordance between vessels with average infringement rates greater than 0.1 in different seasons, there are 26 vessels common to 98/99 and 99/00, 35 vessels common to 98/99 and 00/01, and 30 vessels common to 99/00 and 00/01. Finally, there are 14 vessels with infringement rates greater than 0.1 in all three seasons. Profiles of individual vessels with infringement rates in adjacent seasons greater than one illegal animal in every 10 baskets are instructive, since these are the vessels demonstrating infringement rates consistently greater than those measured for 80% of the fleet. In other words, it might be reasonable to surmise that these vessels would be most likely, compared with a majority of the fleet, to show an increase in infringement rates in response to lower inspection levels. Individual vessel profiles are variable, but generally show a consistent trend of an increase in non-compliance in 1999/2000, followed by a decrease in 2000/2001 (Figure 4.3). Note that a single vessel with an infringement rate of around 13 illegal lobsters per basket in 1999/2000 has been excluded from Figure 4.2 and Figure 4.3 in order that axes are not unduly stretched. Recall also that for seasons 98/99-99/00 in a), 99/00-00/01 in b), and all three seasons in c), 80% of the fleet in each season had infringement rates *below* 0.1.

Figure 4.3a) shows the profiles of vessels with infringement rates greater than 0.1 in seasons 1998/1999 and 1999/2000 (but excluding those vessels with rates greater than 0.1 in all three seasons, 1998/1999 – 2000/2001, which are shown in Figure 4.3c)). For these 11 vessels, with the exception of one vessel not checked during 2000/2001, infringement rates in 1999/2000 rose in response to decreased enforcement effort, then dropped to below 0.1 in 2000/2001, arguably due to sanctions imposed in 1999/2000 and the increased risk of detection in 2000/2001 when the inspection rate rose to 3% of the total catch.

Profiles for vessels with infringement rates greater than 0.1 in seasons 1999/2000 and 2000/2001 (but not in 1998/1999) show that most vessels (10 of 16) demonstrated increased infringement rates in 1999/2000 before declining in 2000/2001. However, six vessels increased their infringement rates over this period (Figure 4.3b), although it should be noted that two of these increases in the 2000/2001 season were calculated from only a small number of checked baskets.

For fishers demonstrating infringement rates greater than 0.1 in all three seasons (14 vessels), half showed an increase in infringement rate in 1999/2000 followed by a decrease in 2000/20001, while half showed an increasing trend over the period of the study (i.e. 1998/1999 < 1999/2000 < 2000/2001) (Figure 4.3c).

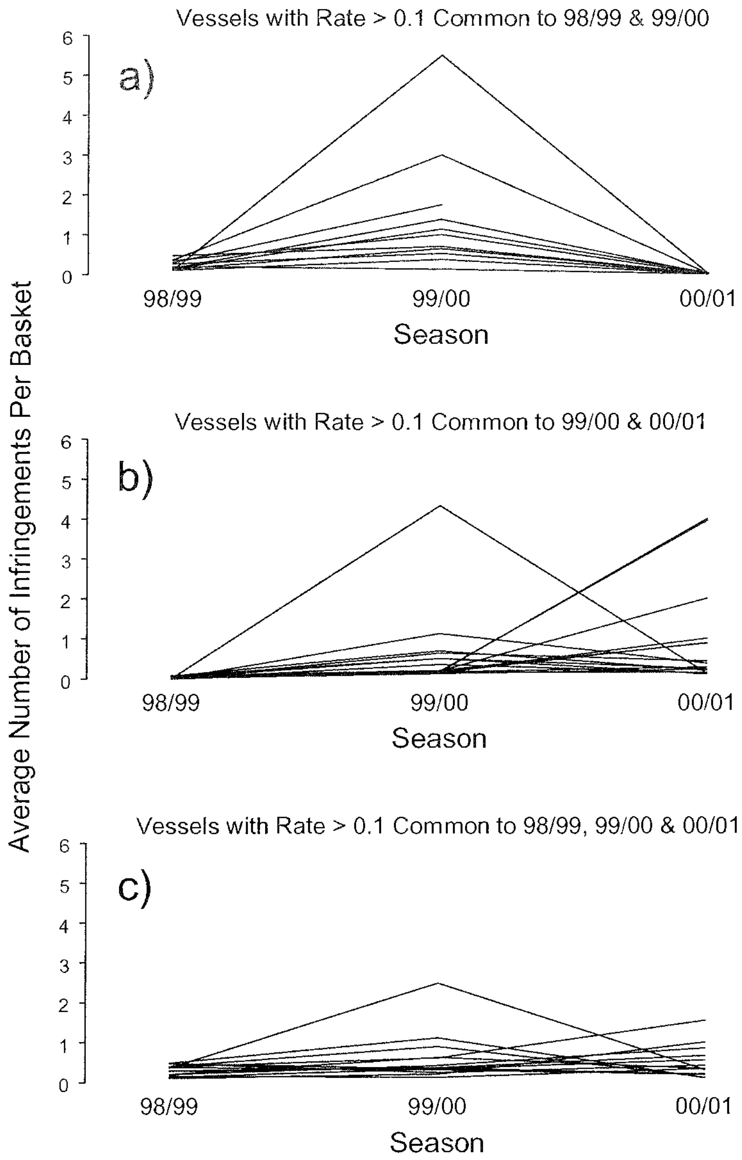

Figure 4.3 **Infringement profiles of individual vessels with infringement rates greater than 0.1 in: a) seasons 1998/1999 and 1999/2000; b) seasons 1999/2000 and 2000/2001; and, c) all three seasons.**

4.4.4 Discussion

Reducing enforcement effort in rock lobster processing factories in the 1999/2000 fishing season appeared to increase fisher non-compliance with catch-related rules, however this result is not entirely unambiguous. The adaptive management experiment under consideration did not include control groups, or suitable treatment replicates, and other, uncontrolled factors may have contributed to the observed increase in non-compliance. For example, the level of pot leasing (as opposed to pot ownership) among skippers is unknown but thought to be increasing in the fishery. Fishers using large numbers of leased pots are typically operating under tighter profit margins compared with owner-operators, such that small changes in catch rates can make the difference between making a profit or loss. Total catches were high in 1998/1999 and 1999/2000 (13,000 and 14,400 tonnes), but dropped in 2000/2001 (11,200 tonnes). It is possible that this (natural) fluctuation in total catch available to the fleet impacted heavily on some fishers, perhaps generating incentives to break regulations in order to maintain profitability.

Nevertheless, there are several results from this study that indicate increased non-compliance was largely attributable to decreased enforcement effort. Notably, the proportion of the fleet with infringement levels greater than 0.1 increased by around 5% (30 additional fishers) due to decreased enforcement effort, an effect that did not seem to diminish in 2000/2001 when the inspection level increased to 3% of the total catch. While the proportion of fishers with average infringement levels greater than 0.1 did not change appreciably between 1999/2000 and 2000/2001, individual vessel infringement rates did, with a majority of vessels showing a decrease in average infringement rates between these seasons. This indicates that those vessels with a propensity to break rules did so to a greater extent when inspection levels were low in the 1999/2000 season.

Perhaps less explicable is the increase in non-compliance among some individuals between 1999/2000 and 2000/2001, when inspection levels increased from 1% to 3% of the total catch. If a causal relationship between enforcement effort and compliance exists, then intuitively non-compliance should have dropped in 2000/2001, the year when enforcement effort was lifted to 3% of the total catch. While such a drop did occur for the overall mean compliance rate, the increase observed for some individuals is intriguing. There are several factors that might lead to such an increase. First, and perhaps least interesting, the increase for these fishers could have occurred simply due to sampling variation, since in these seasons only a relatively small proportion of the total catch was checked. Examining individual data, however, indicates this is not the case. For example, 10 of the 14 vessels displayed in Figure 4.3c had greater than 10 baskets checked in 2000/2001; of these 10, five vessels had more than 25 baskets checked. In fact, of those fishers demonstrating a marked rise in their 2000/2001 infringement rate, only one was determined from checking a relatively small amount of catch (four baskets). This would indicate that sampling variability played an unknown, but likely small, role in determining the upward trend in non-compliance observed for some vessels between 1999/2000 and 2000/2001.

A more likely explanation for the increase in non-compliance among some individuals observed between 1999/2000 and 2000/2001 is that an inspection level of 3% was insufficient to deter some fishers from consigning illegal animals. That is, if the probability of detection is low then the benefit of making continuing profits by consigning illegal animals may outweigh the risk of sanctions when a breach is finally detected. The decision to decrease or increase consignment of illegal animals is an individual one; generally, most fishers were observed to decrease their infringement rates between 1999/2000 and 2000/2001, however some fishers clearly made the decision that their infringement activity should continue, or even increase, in the 2000/2001 season, perhaps because they successfully consigned illegal product during 1999/2000. Such individual decisions are likely to be at least partly determined by external factors not considered in the present study, such as pot leasing arrangements, or levels of personal or business debt.

One of the most interesting aspects of this study was the reaction of the commercial rock lobster industry to the results. Most observers had anticipated that commercial fishers would judge an inspection rate of 1% of the total catch to be adequate, providing that observed non-compliance rates of around three illegal lobster in every 1,000 checked did not increase in subsequent years. This was not the case, however. Fishers instead expressed the wish that factory inspection levels should be lifted to 3-5% of the total catch. The reasons for this are twofold. First, as evident in Figure 4.2, most commercial fishers approach 100% compliance with catch consignment regulations. Most are proud of this fact, and are willing to pay (through the cost-recovery process) to ensure that their competitors have a reasonable chance of detection if they cheat. The second reason is that the infringement notice system for small breaches (akin to traffic tickets) in place in Western Australia acts as a form of process control for skippers and licence holders. By receiving a warning or small fine, fishing operators are alerted to problems in their catch as they occur, rather than being breached for a major offence once a problem becomes established. For example, crew who are paid as a proportion of the catch may be tempted to place illegal animals in with legitimate catch. If undetected by the skipper, and left unchecked by a low level of factory inspections, the practice may increase until finally a major breach is detected. Many licence-holders therefore view a rigorous factory inspection program as essential.

4.5 Conclusion

The nature of management arrangements in the western rock lobster fishery, and in particular the small number of processing factories licensed for overseas export, creates unique opportunities for examining the nature of the relationship between enforcement and compliance with fishery rules. Experiments such as those discussed in the present chapter will remain an important focus of compliance analyses in the fishery. Future experiments are planned to examine not only the frequency of inspection, but also the type of inspection conducted by Fisheries Officers. For example, would a different type of inspection regime allow the same amount of catch to be inspected, with the same likelihood of detecting illegal animals, but with less inspection effort? Another question of interest is whether different types of inspection strategies might be appropriate at different times of the season, or in particular areas of the fishery (e.g. according to the availability of illegal animals on the fishing grounds). It may also be desirable to stratify a proportion of factory inspection effort based on the known offence history of individual fishers or factories (this currently only occurs on an informal basis). Future experiments have the potential to increase our understanding of the enforcement/compliance relationship, and to increase the efficiency and effectiveness of processing factory inspections.

5. *Biological Sampling for Enforcement: The Problem of "Holding-Over"*

5.1 Overview

In this Chapter I examine the issue of fishers illegally "holding over" 76 mm lobster for several days prior to 1 February when the minimum size changes from 77 mm to 76 mm (known as the "gauge change"). Instead of immediately returning undersize lobsters to the water, fishers engaging in this activity retain 76 mm lobsters for typically 1-5 days prior to 1 February, after which they consign the lobsters as "legal" animals on or soon after the day of the size change. This practice provides enforcement staff with difficult problems to overcome in trying to apprehend fishers engaged in the activity, to the point that fishers must virtually be "caught in the act" for Fisheries Officers to gain a successful prosecution. Apprehensions are particularly difficult given the at-sea nature of the crime, and this chapter examines experimental approaches to detecting the practice after the illegal catch has been brought to shore.

I provide detail of two experiments conducted to assess methods of assisting Fisheries Officers to obtain successful prosecutions of fishers suspected of holding-over by using data-based evidence gathered from examining factory consigned catch. I first present a common introductory section, providing background to the problem of holding-over, after which I present each experiment separately, with distinct methods, results, and discussion sections.

Experiment 1 – Sampling to Determine Legitimate Proportions of 76mm Lobster in Catch

The first experiment involved a biological survey to determine the availability of 76 mm lobster in one particular area of the fishery over the period 27 January – 2 February 2001. A short, intensive survey to gather baseline data on the size-distribution of lobsters captured in pots from a defined operational area adjacent to Lancelin was conducted immediately prior to 1 February 2001. This data was then used to allow those fishers consigning held-over catch to factories on 1 February to be distinguished from those with legitimate catches.

Results demonstrated that, for fishers operating in the designated sampling area in the week prior to 1 February 2001, 30-60% of the total catch for individual vessels was between 76 mm and 77 mm. These 76 mm animals were typically in poorer condition than larger animals, with up to 7% in poor or very poor condition compared with less than 2% for larger size-classes. This difference is likely attributable to the increased handling of undersize animals in the weeks prior to 1 February (i.e. multiple catch and release).

Based on the size-distribution data collected prior to the rule change, it appeared most fishers checked post-1 February in processing factories were consigning legitimate numbers of 76 mm animals. However, on 1 February one fisher was discovered to be consigning a larger than expected number of 76 mm animals (almost 80% of the total catch), and a larger than expected proportion of these animals were in a poor or very poor condition (22%). One particular basket consigned on 1 February contained 100% 76 mm animals, and of these 45% were noted to be in poor or very poor condition. Based on the atypically high consignment of 76 mm lobster by the individual concerned, the poor condition of these lobsters, and by comparison with 40 comparable fishers operating in the same area, in the absence of additional explanatory information it would seem highly unlikely that the catch consigned by this vessel on 1 February 2001 was obtained wholly by legitimate means.

The method of sampling to determine legitimate proportions of 76 mm lobster in commercially consigned catch shows considerable promise in helping to detect, and perhaps prosecute, fishers suspected of holding-over 76 mm lobsters prior to the 1 February gauge change. Future work in this area is anticipated.

Experiment 2 – Haemolymph Sampling to Detect Stress

A study was conducted to assess whether haemolymph characteristics of rock lobster experimentally confined in a manner consistent with the practice of holding-over could be used to distinguish legitimate catch from catch held for several days prior to 1 February. Since stress identification by examining haemolymph characteristics is a new area of work for the Department of Fisheries WA, the study was considered a pilot to identify sources of variation in measured responses and define technical procedures for sampling and processing blood samples.

The study involved placing two groups of wild-caught lobsters in confined conditions for two days and four days, respectively. After the period of confined captivity, treatments groups and a control group of newly captured animals were transported to a processing factory where blood samples were extracted. Values of a known suitable stress indicator, prophenyl oxidase/ml/mg protein, were determined from biochemical analysis and compared between treatments using analysis of variance.

Results indicated significant differences between the control group and groups of animals experimentally confined, however no difference was apparent between lobsters held for two or four days. While results are encouraging, variability in individual lobster stress responses make the test of uncertain value. However, future refinements to the technique may help reduce variability observed in the present study, and further work in this area is continuing.

5.2 Introduction

Minimum sizes for the legal retention of fish are usually introduced to reduce exploitation and protect against the removal of fish from a stock before some have had an opportunity to breed. Lobsters in the western rock lobster fishery are measured for legal size by determining the linear distance from the front to the back of the head carapace; this is usually done by applying a precise, plastic or metal gauge to the head of the lobster (referred to as "gauging" the lobster). Minimum sizes in the fishery apply to both recreational and commercial fishers, such that lobster below the prescribed size must be returned to the water within 5 minutes of capture.

Current minimum sizes are a carapace length of at least 77mm between 15 November and 31 January, and 76mm between 1 February and 30 June, each fishing season. The "split" minimum size, introduced in the 1993/94 season, was one of a number of measures designed to boost egg production; the larger 77 mm minimum size at the beginning of the season allows 76mm lobsters an opportunity to join the breeding stock in deeper offshore water, where exploitation rates are considered to be lower, before they become available for capture by the fishery. The "split" also has the flow-on benefit of allowing animals normally caught as "whites" in the first half of the season to be captured as more valuable "reds" in the second half (Marec 1997).

While this rule has been effective in allowing increased escapement of juvenile animals to the breeding stock (Hall and Chubb 2001), with consequent increases in egg production, it has also created a compliance problem among certain commercial fishers. During normal fishing operations prior to 1 February, captured 76 mm lobsters should be immediately returned to the water. In the week leading up to 1 February, however, some fishers have adopted a practice of storing 76 mm animals in holding pots at sea until 1 February, at which time the lobster can be legally retained and consigned to processors. Holding pots may consist of one or more legal pots, or they may be specific, unmarked illegal pots. Often, fishers using such pots will obstruct pot escape gaps to ensure lobsters cannot exit the pots through mandatory escape gaps. Illegal lobsters placed in holding pots are lowered to the sea floor to be recovered at the time of the gauge change.

Animals that are consigned on 1 February after having been held captive for up to a week are generally in poor condition, showing signs of disease and substantial limb loss. While this problem does not present a threat to the sustainability of the fishery, the deterioration in product quality of lobsters consigned around the gauge change has caused industry (through the RLIAC process) to place a high priority on ensuring this practice is effectively policed. Non-compliance also raises important issues related to equity among fishers, since those fishers breaking rules secure higher catches immediately prior to the decrease in minimum size.

In practice, the offence of "holding-over" 76 mm animals is very difficult to detect. Apprehension of offenders requires Fisheries Officers to virtually catch people in the act, something that is almost impossible to do at sea when fishers are easily forewarned of the approach of Department of Fisheries vessels by the use of radar or satellite communications. Despite these difficulties the concerns expressed by industry require enforcement personnel to find solutions to minimise the problem of fishers "holding over" 76 mm rock lobster.

Perhaps the easiest way to eradicate the problem would be to make the minimum size uniform throughout the season, however industry representatives are reluctant to adopt this approach: to make the minimum size 76 mm all season would increase exploitation and inhibit the continuing recovery of the breeding stock; to make the minimum size 77 mm all season would unnecessarily reduce catches. Other approaches involving changes to management arrangements have been proposed (e.g. seasonally variable gauge change date), however to date none have been adopted. For the moment, at least, the split minimum size rule will remain in the fishery, and this poses problems for enforcement personnel since the practice is particularly difficult to police.

This chapter examines two separate approaches to obtaining evidence that might assist detect and obtain prosecutions of fishers engaged in the practice of holding-over. The first was conceived in late February 2000 when I was contacted by the Serious Offences Unit of the Department of Fisheries W.A. to assist in developing some data-based evidence against a rock lobster fisher suspected of holding-over 76 mm lobster prior to the rule change on 1 February 2000. On 1 and 2 February 2000 Fisheries Officers checked the catch consigned to rock lobster processing factories by around 70 commercial rock lobster vessels. Some of these checks were specifically targeted toward fishers suspected of holding over 76 mm lobsters, while other fishers were chosen for inspection on a random basis. Some fishers, both targeted and non-targeted, were found to have consigned substantial numbers of 76 mm animals over this two day period. Many of these 76 mm lobster were in poor condition (e.g. diseased, physically damaged, or dead) indicating they may have been held for several days prior to 1 February.

Analysis of the data obtained in the operation described above provided some indication that a number of fishers may be engaging in "holding over" lobsters, however without independent knowledge of the number of 76 mm lobsters that might be expected to be legitimately landed it was not possible to determine which fishers had broken the rules. If information on the expected proportion of 76 mm animals in catches around the time of the rule change were known it would provide a basis for comparing the size-distribution of consigned catches to the actual size-distribution of lobster available for capture in the water. With such data it should be possible to compare the ratio of 76 mm to 77+ mm lobsters in fishers' factory consigned catch with known legitimate ratios[11]. Those fishers with unusually high ratios of 76:77+ mm animals should be subject to careful scrutiny, and in conjunction with other information (such as the condition of the catch) this data might contribute substantially to an over-all case for prosecution.

The first approach, therefore, was to engage in an "on-the-water" data collection exercise designed to gather information suitable for determining the usual ratio of 76:77+ mm animals immediately prior to 1 February 2001. This data was then used to assess which, if any, vessels consigned unusually large numbers of 76 mm animals compared with other fishers operating within the survey area both before and after the 1 February rule change. Vessels with significantly higher post-1 February consignments of 76 mm lobsters compared with the known size-composition should be subject to close scrutiny for possibly holding-over undersized lobsters prior to 1 February 2001.

The second approach detailed in this chapter involved examining the blood biochemical characteristics of lobsters experimentally confined around the time of the gauge change. This work was to determine if particular haemolymph characteristics could be considered symptomatic of lobsters being held in confined conditions (ie. similar to those conditions experienced when lobster are "held-over" by commercial fishers). The rationale is that if holding-over produces blood characteristics indicative of confinement, held-over lobsters consigned to factories immediately after 1 February might be sampled to provide additional evidence in cases for prosecution against fishers suspected of the practice. While such evidence by itself is unlikely to be sufficient to obtain a successful conviction, it could contribute substantially to an overall case.

Since stress identification by examining haemolymph characteristics is expensive, and a new area of work for the Department of Fisheries WA, the present study was considered a pilot to identify sources of variation in measured responses and technical difficulties associated with the sampling and processing of blood samples. It is anticipated that results will help to determine the requirements for future experiments examining the holding-over problem in the rock lobster fishery, and may assist in designing experiments to investigate illegal harvesting in other crustacean fisheries.

5.3 Experiment 1: Determining Legitimate Proportions of 76mm Lobster in Catch

5.3.1 Methods

Data collection was divided into two distinct phases. Phase 1 involved Fisheries Officers travelling aboard commercial vessels during the period 27-30 January 2001 and measuring the sizes of rock lobsters as they were brought aboard as part of the vessel's normal fishing operation. Phase 2 involved Fisheries Officers sampling commercial catch consigned to licensed rock lobster processing factories on 1-3 February 2001.

Area of Operation and Choice of Sample Vessels

Fisheries Officers identified an area of coast between the towns of Seabird and Lancelin, up to 5 nm offshore (Figure 5.1), as suitable for the purposes of the operation (hereafter referred to as the *operational area*). This area was chosen for a number of reasons, including:

i) The area contained the usual fishing grounds for a particular vessel suspected of illegally holding over 76 mm animals prior to 1 February in the previous fishing season.

ii) The area provided good accessibility to a sufficient number of commercial fishing vessels to provide an adequate sample size for determining the size-distribution of (catchable) lobsters in the water.

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[11] A note on terminology: 76 to 77+ mm or 76:77+ mm is the notation used to describe the ratio of the number 76 mm carapace length animals to the number of animals that have carapace length 77 mm or above.

iii) The area was sufficiently small, and similar in bottom type, to be assumed reasonably homogenous over the range of the operational area.

On 26 January 2001 the Patrol Vessel Walcott took a census of fishing gear set within the operational area in order to identify and select a suitable subset of vessels on which to conduct onboard sampling. Five vessels randomly chosen from this list were sampled on 27 January 2001. While on board measuring catch from these vessels, Fisheries Officers noted the presence of any additional vessels fishing in the operational area that did not appear on the original list. Vessels sampled on subsequent days were randomly chosen in a similar fashion, with the list of vessels available for sampling updated appropriately each day. No vessel was sampled more than once during the at-seas sampling phase of the operation.

Fisheries Officers sampled catch from 21 randomly selected vessels for one full fishing day during the period 27-30 January 2001 (Table 5.1). For reasons of confidentiality, a randomly assigned vessel identification number is used to label all sample vessels in subsequent tables and figures.

Table 5.1 Vessels attended by Fisheries Officers during Phase 1 On-The-Water Sampling for 27-30 January 2001. The column NL records the number of lobster measured aboard each vessel.

27 January	NL	28 January	NL	29 January	NL	30 January	NL
Vessel Id. 6	126	Vessel Id. 3	122	Vessel Id. 2	229	Vessel Id. 1	95
Vessel Id. 11	167	Vessel Id. 8	256	Vessel Id. 7	213	Vessel Id. 4	139
Vessel Id. 14	227	Vessel Id. 12	44	Vessel Id. 9	140	Vessel Id. 5	131
Vessel Id. 18	238	Vessel Id. 13	177	Vessel Id. 10	228	Vessel Id. 15	344
Vessel Id. 21	225	Vessel Id. 17	67	Vessel Id. 19	264	Vessel Id. 16	124
						Vessel Id. 20	147

On 31 January, after four days of onboard sampling and the day before the minimum-size change, the PV Walcott again conducted a search of the area and found 31 vessels fishing with a majority of their gear within the boundaries of the operational area. Due to the logistical constraints associated with conducting comprehensive pot-counts, it was not possible for the master of the PV Walcott to state that these 31 vessels had all their lobster pots in the designated sampling area, but rather could only ascertain those vessels with a majority of their gear within the area.

Onboard Sampling

Fisheries Officers boarded designated commercial vessels without the vessel having prior knowledge that an Officer would be attending for the days fishing. Officers measured the carapace length of all lobster with carapace length 76 mm and above brought aboard during the fishing trip.

Since many factors may affect catches, size-distribution sampling was timed to take place as close to the date of the minimum size change (1 February) as possible. For example, catch rates may be affected by lunar cycle, with higher catches recorded around new moons. A new moon occurred on 24 January so catch rates could be expected to remain reasonably high for the week immediately prior to the change-over date. Other variables that might influence catch rates were measured, and include:

i) Latitude and longitude (by Global Positioning System) of the beginning of each line of rock lobster pots in the water.

ii) Type of pot type used – either batten, stick, or plastic.

iii) Water depth in metres for each line of pots.

iv) Bait type used in pots.

v) Substrate type for each line of gear.

vi) Number of days between pot-pulls.

vii) Sea conditions on the sampling day.

viii) Condition of each lobster on a 1-4 rating scale (described below).

Fisheries Officers were instructed to tell fishers they were conducting a compliance operation, but to provide no detail about what the operation involved. Officers recorded the lobster measurements and other data on personal audio micro-recorders, later transcribing this information onto predefined data recording sheets at the end of each day.

The crew were asked to measure all lobster brought aboard using a 76 mm gauge, to return all lobster less than 76 mm to the water immediately, and to pass all animals 76 mm or greater to the attendant Fisheries Officer(s). The Fisheries Officer then measured all retained animals with vernier measuring callipers to within 0.1 mm. After measurement the animals were passed back to the crew to be measured for legal size (using a 77 mm gauge), at which time undersize animals (less than 77 mm) were returned to the water.

In addition to recording lobster size, Fisheries Officers also subjectively graded each lobster according to a 1-4 "condition scale" designed to provide an index of lobster health. Rankings of individual animals were determined by referring to the number of appendages each animal had missing[12], the smell of the animal, indications of disease, and the mobility of the animal. Condition grades were determined as:

1 = Excellent condition – most appendages attached (1 or none missing), lively (tail flick), no smell.

2 = Good condition – 2-4 appendages missing, no smell, no evidence of disease, lively (tail flick).

3 = Poor condition – 5 or more appendages missing, little or no movement, slight decaying smell, evidence of disease.

4 = Very poor condition – strong decaying smell, no movement, dead or near dead.

Since lobsters may loose appendages through the normal handling process when they are caught, Fisheries Officers were instructed to give more weight to factors other than limb-loss when determining the condition score of a lobster. For this reason lobsters that had 2-4 appendages missing were still considered to be in good condition. Lobsters that had obviously died due to natural mortality (eg. from predation by octopus) were noted, but were excluded from analyses. Data were forwarded to the Western Australian Marine Research Laboratories where it was validated and entered into electronic format for analysis.

Factory Sampling

The second phase of the operation involved inspecting factory consigned commercial catch during the period 1-2 February 2001. Factories from the Lancelin and the Perth metropolitan areas were chosen for inspection on the basis that they would be receiving catch from vessels fishing within the designated operational area immediately prior to 1 February 2001. Of the 21 vessels sampled at sea, 6 were subsequently sampled in a processing factory on both 1 and 2 February, 3 were sampled on 1 February only, and 1 was sampled on 2 February only. The remaining 11 boats sampled prior to 1 February 2001 consigned their catch to factories other than those chosen for inspection by Fisheries Officers[13].

In addition to those 10 vessels previously sampled at sea, Officers also inspected catch from a further 20 vessels that had also fished within the operational area in the days immediately preceding 1 February 2001 (but who had not been involved in onboard sampling at sea). Of these 20 vessels, 7 were sampled on 1 and 2 February, 9 were sampled on 1 February only, and 4 were sampled on 2 February only. In summary, 10 of the 21 pre-February sample vessels had their catch inspected in a processing factory on 1 or 2 February, and 20 non-sample vessels that had also fished within the operational area had their catch inspected over this

[12] A rock lobster normally has 12 appendages (10 legs and 2 antennae).

[13] In order to obtain the best price for their product, fishers may transport catch to processing factories that are considerably distant from the point of landing. It was recognised that it would not be possible to predict to which factories catch from the 21 sample vessels would be consigned, therefore Fisheries Officers chose for inspection those factories with a high probability of receiving catch from sampled vessels.

period. Lobster measurements and data recording occurred in the same manner as described for the onboard sampling that occurred prior to 1 February.

In the event that a consignment contained large numbers of 76 mm animals, or animals that appeared to be in poor condition, then the consignment was kept in a live tank[14] until such time as the catch could be filmed using a video camera. Once the video camera was filming, each animal was individually measured, inspected, and graded according to the 4-point condition scale. From those vessels sampled, Fisheries Officers determined only one fisher to have consigned unusually large numbers of 76 mm lobster, a conclusion that was later independently confirmed from an analysis of the data supplied by Officers.

5.3.2 Results

On-the-Water Sampling

Over the four day period 27-30 January 2001, Fisheries Officers attended aboard 21 commercial fishing vessels. These fishers operated a total of 150 lines[15] of fishing gear within the designated sampling area, with an average of 10 pots per line. The distribution of sampled lines within the operational area is shown in Figure 5.1, along with approximate depth contours calculated from depth measurements undertaken while sampling. This shows that sampling generally took place in depths of 5-20 m, the only notable exceptions occurring toward the South-western corner of the area where three lines occurred in depths of 25-30 m.

Fisheries Officers also measured a number of other variables that may affect catches, including weather condition on sampling day, bait type used in pots, pot type, and the number of days between pot-pulls. There appeared to be no appreciable effect from these variables on catch rates; in fact, results for most vessels over the sampling period were quite homogenous in respect to these variables. Weather conditions over the period were uniformly calm, with Officers recording seas and swell to 1.0 metres. Almost all fishers utilised batten-type pots, the exception being Vessel 17 that used the stick/cane pot type. Fishers used a variety of bait types in their pots (noted in Figure 5.3), but the type of bait used did not appear to affect the ratio of 76 mm to 77+ mm lobsters captured in pots. All sampled fishers pulled their pots once every day.

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[14] A live tank is a sea-water holding facility inside a processing factory designed to store live lobster.

[15] A "line of gear" refers to a number of rock lobster pots that are placed in a group on the ocean floor, often in an approximate linear fashion, thereby making them easier to re-locate and recover. A particular type of float, referred to as a header float, usually distinguishes the first and last pot in a line.

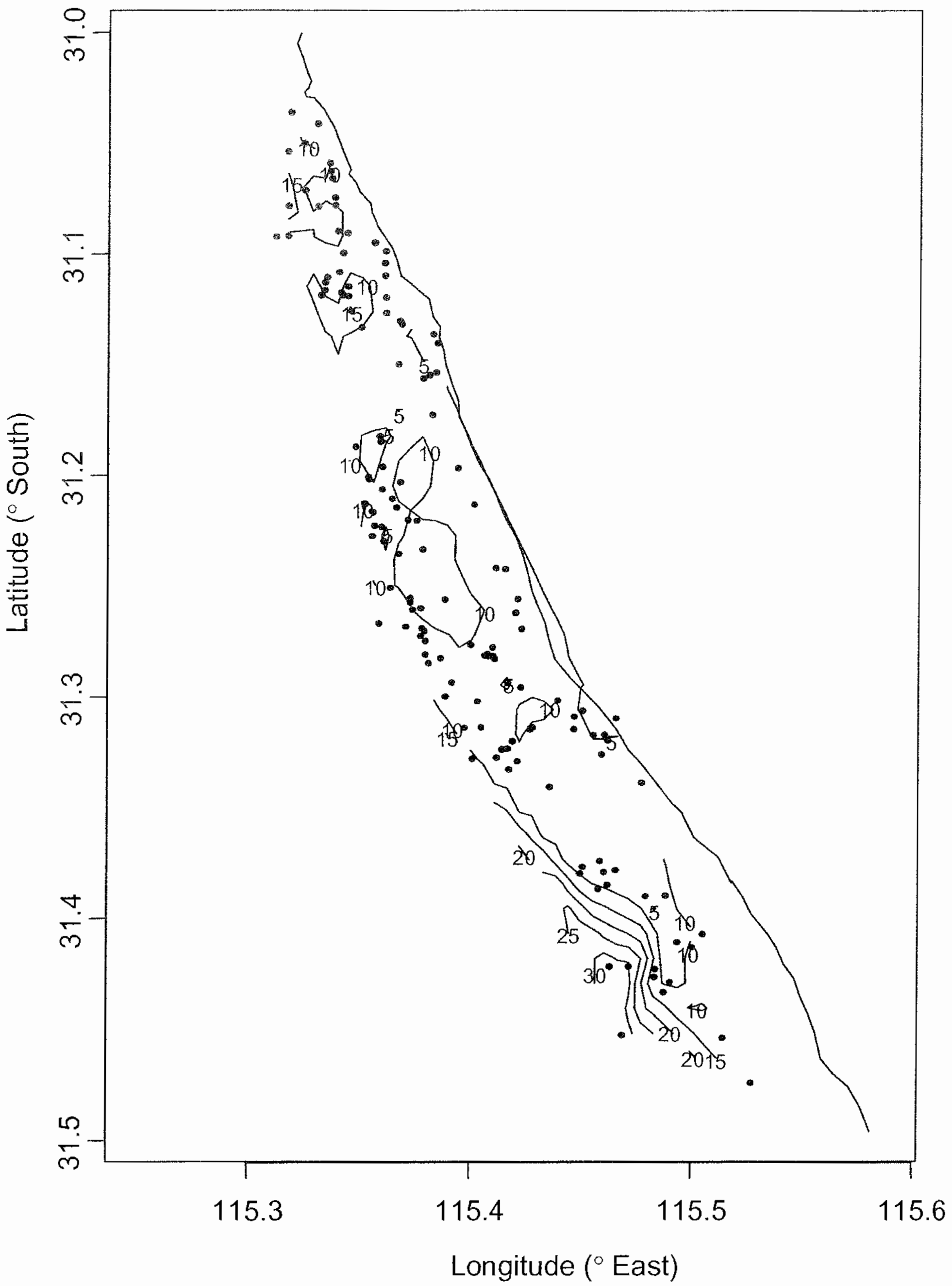


Figure 5.1 Map of operational area indicating the position of header floats from 150 lines of sampled fishing gear from 21 vessels. Contour lines indicate depth in metres.

Table 5.2 shows a summary of the condition level of each lobster captured during sampling, noting that condition levels 3 and 4 (poor and very poor) have been pooled due to low numbers. A Chi-squared homogeneity test was used to determine if animals of different sizes were of similar condition. This showed that wild-captured 76 mm animals were more likely to be of poorer condition (condition levels 2 or 3/4) than larger sized lobster ($\chi_2 = 200.52$, df = 10, $p < 0.001$). Almost 7% of all 76 mm sampled rock lobster were found to be in poor or very poor condition, compared with 2% or less of animals from larger size classes. This result accords with the anecdotal evidence of fishers and Fisheries Officers, who both recognise that

76 mm lobster are generally in poorer condition than other size classes around the 1 February size change because of increased handling (multiple captures and releases) prior to this date. Note that a larger proportion of 77 mm animals were observed to be in "good" condition (14%), rather than "excellent", compared with larger size-classes (less than 10%), presumably due to increased handling of these animals in the months prior to reaching 77 mm.

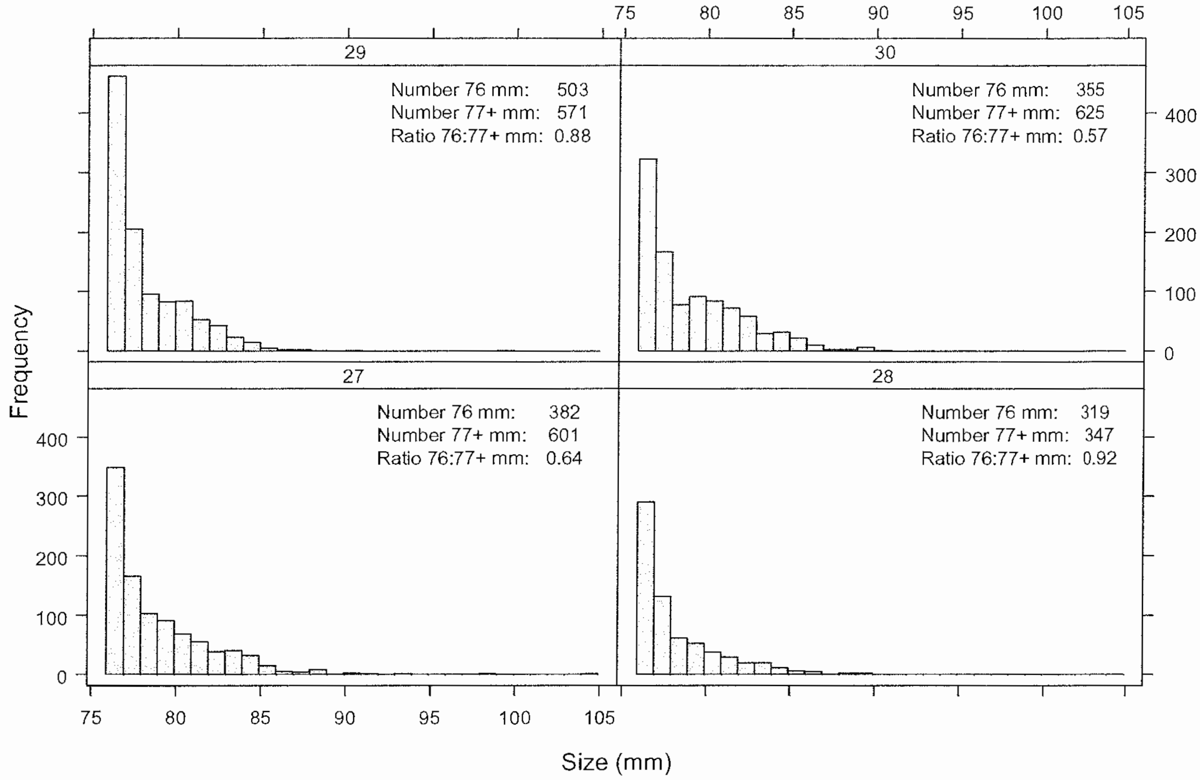


Figure 5.2 **Rock lobster size distribution from on-the-water sampling conducted 27-30 January 2001. Individual panels represent a single day's sampling. Panel insets indicate the number of 76 mm lobster measured, the number of lobster with carapace length 77 mm or greater (labelled 77+), and the ratio of 76:77+ mm.**

Table 5.2 Frequency of pre-1 February sampled rock lobster categorised by three condition levels (1=Excellent, 2=Good, 3/4=poor/very poor) and six size-class categories. Condition levels 3 and 4, and size-classes 81-105, have been combined due to the relatively low occurrence of sampled animals in some of these size-class/condition level combinations. Bracketed numbers provide the column-wise percentages.

		Carapace Length (mm)						
		76	77	78	79	80	81-105	Total
Condition Level	1	1119 (71.8)	483 (84.3)	291 (88.7)	289 (91.2)	240 (91.6)	601 (90.5)	**3023**
	2	333 (21.4)	81 (14.1)	30 (9.2)	21 (6.6)	19 (7.3)	57 (8.6)	**541**
	3/4	107 (6.8)	9 (1.6)	7 (2.1)	7 (2.2)	3 (1.1)	6 (0.9)	**139**
	Total	**1559**	**573**	**328**	**317**	**262**	**664**	**3703**

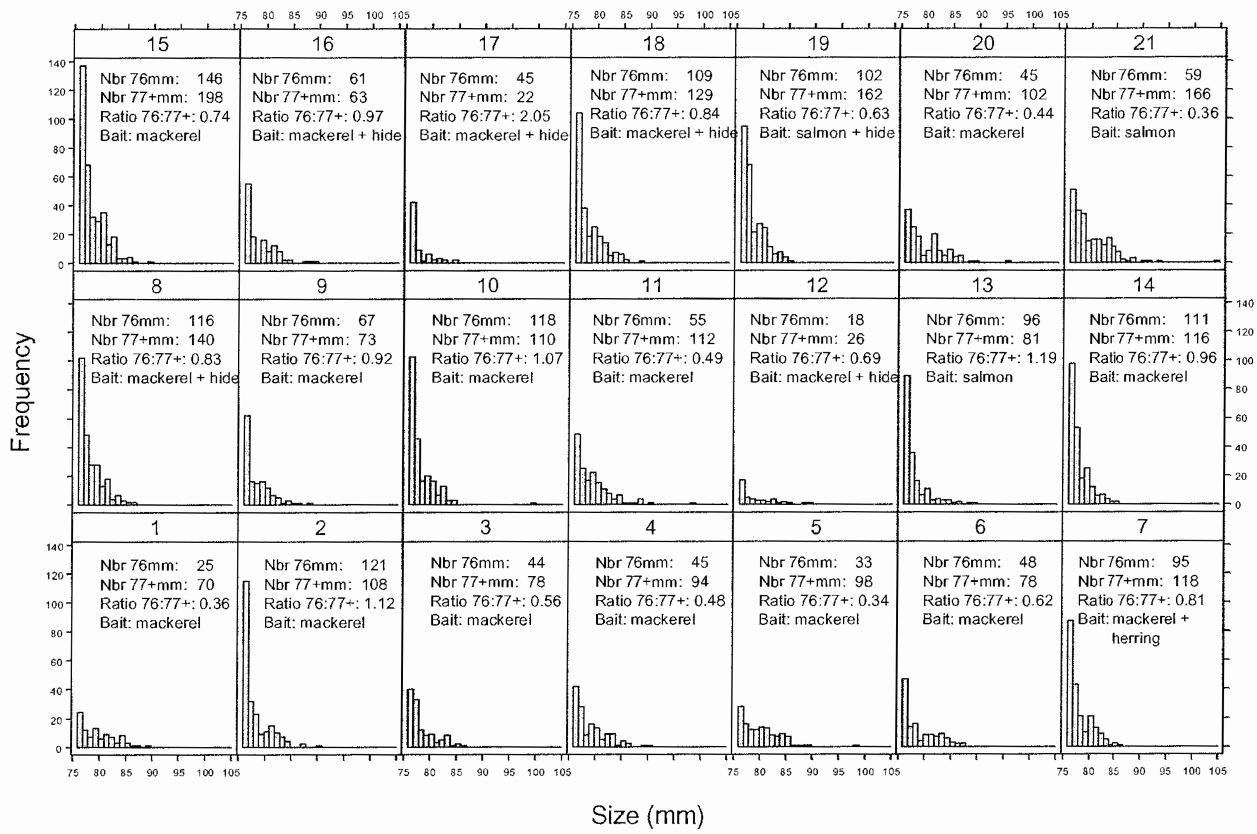


Figure 5.3 Rock lobster size-distribution from on-the-water sampling conducted 27-30 January 2001. Each panel represents a single sample vessel. Panel insets indicate the number of 76 mm lobster measured, the number of lobster with carapace length 77 mm or greater (labelled 77+), the ratio of 76:77+ mm, and the bait type used.

Factory Sampling

A total of 5796 lobsters from nine processing factories were measured on 1 and 2 February. These samples arose from 30 commercial fishing vessels, 10 of which were attended by Fisheries Officers as part of the pre-1 February on-the-water sampling operation described previously. Of these 30 vessels, 13 had catch sampled in factories on both 1 and 2 February, 12 had catch sampled on 1 February only, and 5 had catch sampled on 2 February only. Licensed fishing boat ***XYZ***[16] was one of the 30 vessels sampled, but data arising from this boat are not included in results presented in this section. This is because ***XYZ***'s catch values, due to their unusual nature, tend to distort any depiction of the size-distribution of the remaining 29 vessels. Results for ***XYZ*** are treated separately in the next section.

The size-distributions of lobsters measured in processing factories on 1 and 2 February 2001 are presented in Figure 5.4. On 1 February, Fisheries Officers measured 1643 animals with carapace length greater than or equal to 76 mm but less than 77 mm, and 1651 animals with a carapace length 77 mm or greater, resulting in a ratio of 76:77+ mm animals of 0.995. This indicates there were approximately equal numbers of 76 mm lobster and 77+ mm lobster consigned on 1 February. On 2 February this ratio dropped to 0.723, indicating that for every seven 76 mm animals consigned there were around ten animals 77 mm or greater consigned. The ratio observed for 2 February was exactly the same as the average for sample vessels observed prior to 1 February, indicating that the apparent drop observed between 1 and 2 February provides an estimate of the numbers of 76 mm animals held-over and consigned to factories on 1 February. That is, if 1651 77+ mm animals were consigned on 1 February, and the expected ratio of 76:77+ was 0.723, it follows that 1194 76 mm animals should have been consigned on 1 February, not the 1643 animals as observed. It is therefore possible to estimate that approximately 27% of all 76 mm lobsters consigned by sampled fishers on 1 February were held over prior to the date of the minimum size change.

Turning to the condition level of factory sampled rock lobster, Table 5.3 shows the frequency of different sized animals in each of four condition levels. A Chi-squared homogeneity test showed that 76 mm animals were more likely to be of poorer condition (condition levels 2 or 3/4) than larger sized lobster ($\chi_2 = 263.10$, $df = 10$, $p < 0.001$). Around 8% of all 76 mm sampled rock lobster were found to be in poor or very poor condition, compared with 5% of 77 mm animals and about 2% of animals from larger size classes (Table 5.3). This result shows that the condition of consigned rock lobsters from different size categories on 1 and 2 February was not substantively different from that measured during on-the-water sampling prior to 1 February 2001 (refer Table 5.2 for comparison).

[16] Identification omitted for reasons of confidentiality.

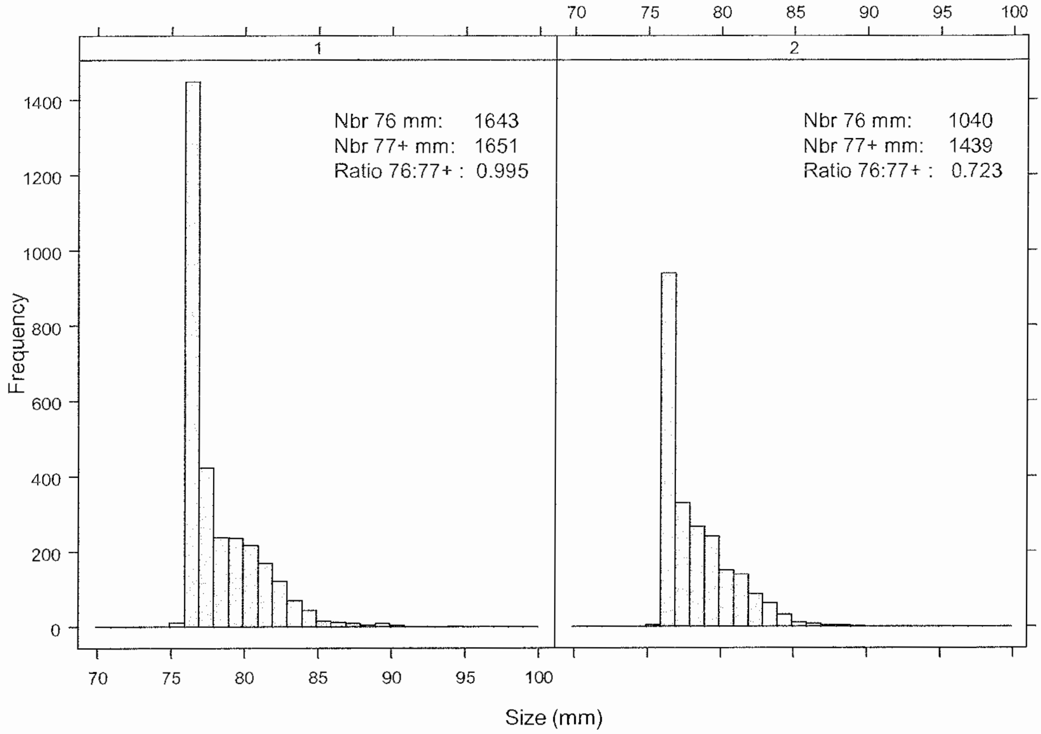


Figure 5.4 **Rock lobster size distribution from factory sampling conducted 1 February (left panel) and 2 February (right panel) 2001. Panel insets indicate the number of 76 mm lobster measured, the number of lobster with carapace length 77 mm or greater (labelled 77+), and the ratio of 76:77+ mm. Note that there are 18 lobsters measurements greater than 100 mm not displayed for purposes of graph readability.**

Table 5.3 **Frequency of rock lobster sampled in processing factories on 1 and 2 February 2001 categorised by three condition levels (1=Excellent, 2=Good, 3/4=poor/very poor) and six size-class categories. Condition levels 3 and 4, and size-classes 81-180, have been combined due to the relatively low occurrence of sampled animals in some of these size-class/condition level combinations. Bracketed numbers provide the column-wise percentages.**

		Carapace Length (mm)						
		76	77	78	79	80	81-180	Total
Condition Level	1	1426 (65.4)	598 (79.5)	426 (84.7)	410 (86.3)	315 (85.6)	713 (85.7)	3888
	2	571 (26.2)	116 (15.4)	68 (13.5)	55 (11.6)	45 (12.2)	105 (12.6)	960
	3/4	182 (8.4)	38 (5.1)	9 (1.8)	10 (2.1)	8 (2.2)	14 (1.7)	261
	Total	2179	752	503	475	368	832	5109

Assessment of Vessel *XYZ*

While undertaking factory sampling on 1 February 2001, Fisheries Officers identified vessel *XYZ* as having an unusually large proportion of 76 mm lobsters in its catch, many of which were in very poor condition. This led Officers to believe that *XYZ* may have been illegally storing 76 mm lobster prior to the rule change on 1 February 2001. The skipper of *XYZ* claimed that he had been fishing with all his pots in the operational area on 31 January 2001. It was requested that I examine the catch statistics of *XYZ* in relation to other vessels that had been fishing within the operational area on the dates 27-30 January 2001.

It is pertinent at this stage to note that the fishing operation of ***XYZ*** is not dissimilar to the majority of those vessels who were sampled over the period 27-30 January 2001 – ***XYZ*** fishes with batten pots, was reportedly fishing in relatively shallow water immediately prior to 1 February, and used similar bait[17] to other vessels fishing the area.

Fisheries Officers inspected factory consigned catch from ***XYZ*** on both 1 and 2 February 2001. On 1 February Officers checked 258 lobster in 4 baskets and found 199 animals with carapace length greater than 76 mm but less than 77 mm, and 59 animals with carapace length 77 mm or greater. This results in a 76:77+ ratio of 3.37. On 2 February Officers checked 203 lobsters in 3 baskets and found 102 lobsters with carapace length greater than 76 mm but less than 77 mm, and 101 lobsters with carapace length 77 mm or greater, with a resultant ratio of 1.01. For comparison purposes, the ratios for ***XYZ*** are plotted against those calculated for the 21 sample vessels examined over the period 27-30 January 2001 (Figure 5.5). This shows that the ratio for ***XYZ*** on 1 February was over 3 times higher than all sampled vessels bar one, but that this ratio dropped dramatically on 2 February down to levels typically shown by sample vessels. The ratio of 2 shown by vessel 17 arose from a catch of only 67 lobsters, and so is less precisely estimated than the ratios for most other vessels. The ratios for ***XYZ*** arose from over 200 lobsters on each day.

The results for ***XYZ*** are consistent with what might be expected for a vessel that, after illegally accumulating 76 mm lobsters prior to 1 February, consigned all this illegal catch on the day of 1 February. On 2 February the catch ratio of this fisher's consignment dropped to 1.01, a level clearly comparable to the majority of other fishers who were fishing within the operational area prior to 1 February 2001.

[17] Fisheries Officers ascertained bait type for ***XYZ*** by checking bait sales records.

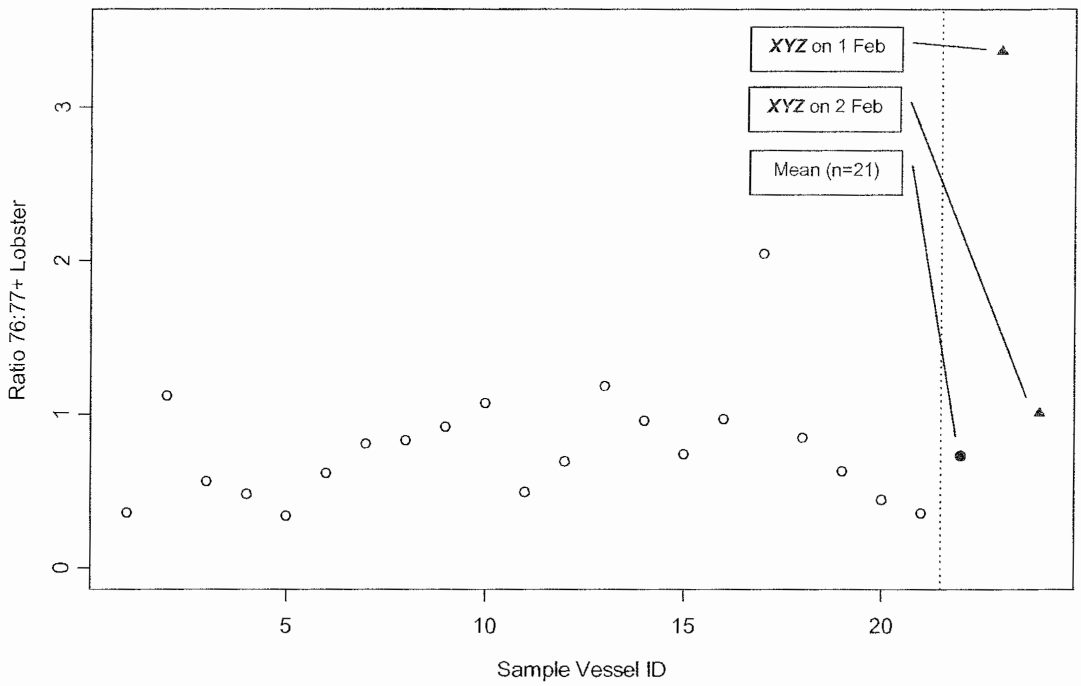


Figure 5.5 Plot of the ratio of 76:77+ mm rock lobster catches for each of the 21 vessels sampled over the period 27-30 January 2001 (open circles). Also shown is the overall mean ratio for these vessels (solid circle), and the ratio for the factory consigned catch of vessel *XYZ* on 1 and 2 February 2001 (solid triangles).

Fisheries Officers also recorded the condition level of lobsters examined for vessel ***XYZ***. This revealed that 22.6% of all 76 mm lobster consigned on 1 February by ***XYZ*** were in poor or very poor condition; this compares with 7% from pre-1 February on-the-water sampled vessels, and 8% from examination of factory consigned catch from other vessels on 1 and 2 February 2001.

Information regarding observed ratios of 76:77+ lobsters is summarised in Figure 5.6. This shows the ratio of 76 mm animals to larger size classes for each vessel contacted during the operation. Different symbols are used to indicate at what point of the operation vessels were sampled. For example, some vessels have three ratios displayed, indicating they were sampled on-the-water while fishing, and in processing factories on both 1 and 2 February 2001.

These results clearly show that the majority of vessels, independently of where sampling took place (ie. on-the-water or in factories), displayed ratios of the number of 76:77+ mm lobsters between 0.5 and 1.5. Excluding ***XYZ***, three vessels scored ratios in excess of 1.5; vessel 32 scored around 1.75, and vessels 2 and 17 scored just more than 2. However, with a score of 3.3 vessel ***XYZ*** was clearly atypical with respect to the number of 76 mm lobsters consigned to processing factories, despite there being no apparent differences in the fishing process between that vessel and other vessels fishing the same area.

It is also instructive to examine the proportion of 76 mm animals in each individual basket of lobsters consigned to factories over the period 1-2 February 2001. In the course of a normal fishing operation it would be usual to expect each consigned basket to contain a number of 76 mm lobsters and a number of 77+ mm lobsters. That is, lobsters are placed in baskets as they are landed from the water, and are not usually sorted into different baskets according to lobster size. Senior enforcement staff conveyed to me that, when questioned, the skipper of ***XYZ*** stated he had been fishing in his usual manner immediately prior to 1 February 2001 and had not been sorting lobsters according to size.

A plot of the ratio of 76:77+ mm lobsters for each individual basket consigned from the 30 vessels sampled in factories during the period 1-2 February 2001 shows that most vessels displayed ratios between 0 and 3 (Figure 5.7). The three highest-ratio baskets were observed for vessel ***XYZ***, with the most extreme arising from a single basket containing 46 lobsters with a carapace length of 76 mm (but less than 77 mm) and zero lobsters with carapace length 77 mm or greater. Note that ratios displayed in Figure 5.7 were calculated as the number of 76 mm lobster divided by the number of 77+ mm lobster plus one in order to avoid a division by zero error that arises for the basket of only 76 mm lobster consigned by ***XYZ*** (to the far right in the plot).

These results show that, based on 101 baskets from 30 vessels sampled in factories on 1 and 2 February 2001, it is extremely unlikely that a fisher could legitimately consign a basket with 100% 76 mm lobster. That is, if the size characteristics of the catch sampled in factories on 1 and 2 February can be assumed representative of the true size distribution of animals in the water (excluding catch from ***XYZ***), then the probability of consecutively removing 46 lobsters of 76 mm or greater carapace length, but less than 77 mm carapace length, is effectively zero.

It should also be noted that 45% of the animals contained in this "unusual" basket were rated as being in poor or very poor condition. As discussed previously, this compares with 7% from pre-1 February on-the-water sampled vessels, and 8% from examination of factory consigned catch from other vessels on 1 and 2 February 2001.

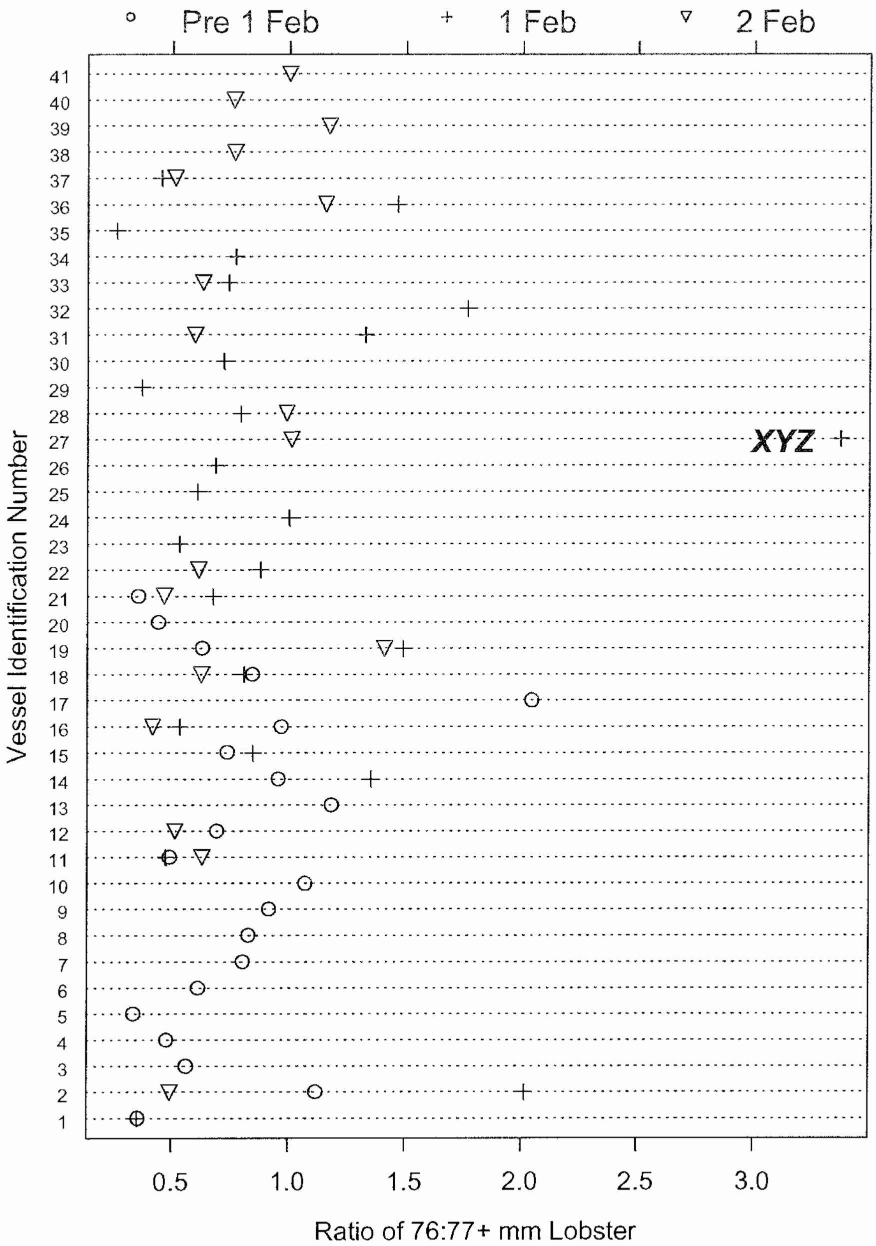


Figure 5.6 **Plot of the ratio of 76:77+ mm lobsters for all vessels sampled, indicating the time of sampling by symbol type. Circles indicate those vessels accompanied by Fisheries Officers for on-board sampling of catch during 27-30 January 2001 (vessels 1-21). Crosses and diamonds indicate catch examined in processing factories on 1 and 2 February 2001.**

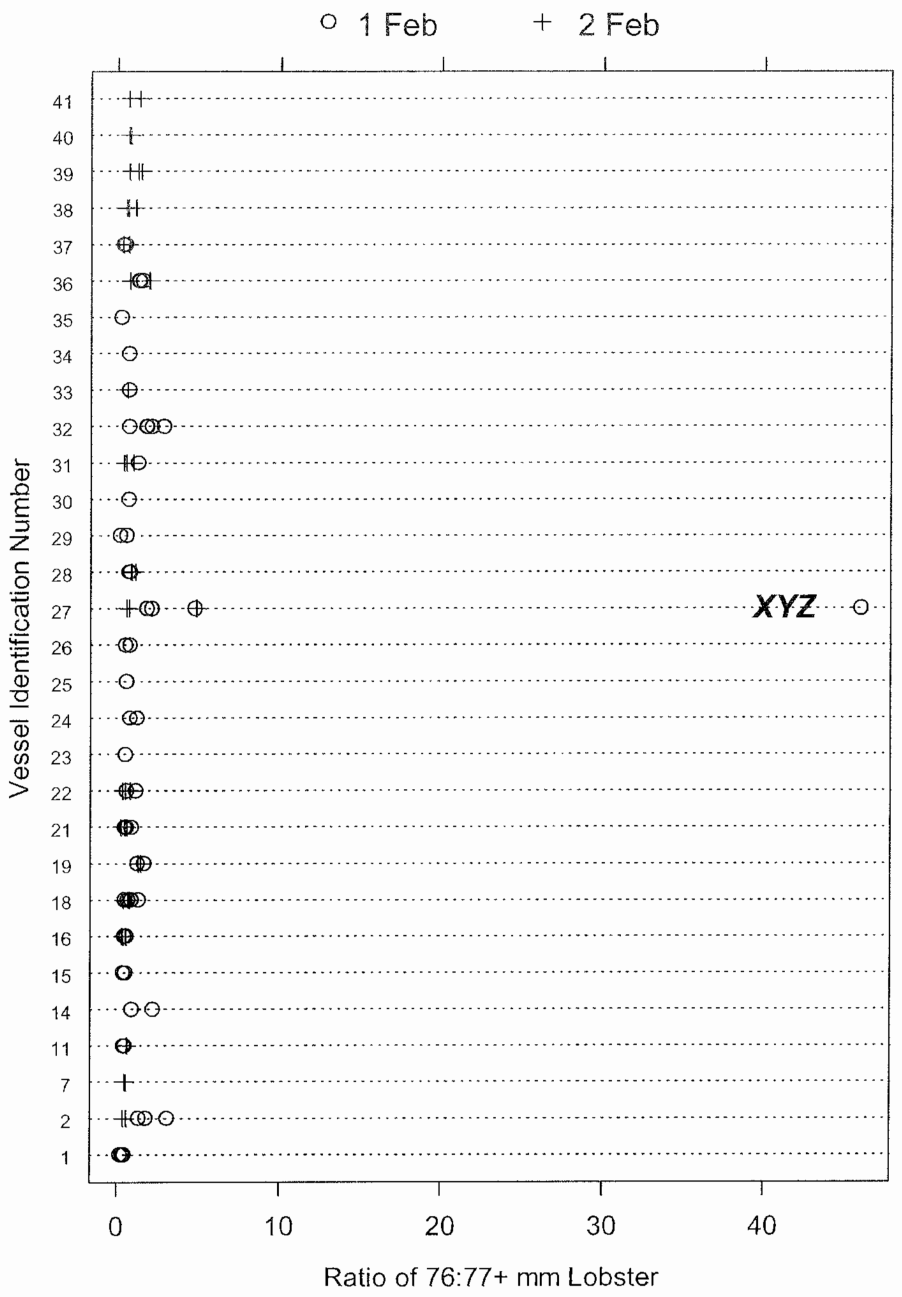


Figure 5.7 Plot of the ratio of 76:77+ mm lobsters for all consigned baskets from 30 vessels sampled during the factory-sampling phase of the operation. Individual symbols indicate a single basket, and symbol type indicates the date in February 2001 when sampling occurred.

5.3.3 Discussion

The compliance operation discussed in this section set out to do two things: i) to determine the usual size-composition of commercial catches from a pre-defined area of the fishery immediately prior to 1 February 2001, and ii) to check commercial catches consigned to processing factories immediately after the rule-change on 1 February in order to detect fishers, by virtue of their catch composition and condition, who may be breaking the minimum size rule by "holding over" 76 mm lobster prior to the rule change.

Analysis of these data has shown that, around the time of the rule change, 30-60% of the total catch of most fishers is comprised of 76 mm lobsters (ie. a catch ratio of 76:77+ mm lobsters in the range 0.5 – 1.5). This ratio is observed to drop slightly from 1 to 2 February, as a large proportion of 76 mm lobsters available to the fishery are caught and consigned on 1 February. Typically 7-8% of the captured 76 mm lobsters are in poor or very poor condition around this time, compared with less than 2% in poor condition for larger size classes. The difference in condition of 76 mm animals is due to repeated capture, handling, and return to the water of 76 mm lobsters in the weeks prior to the gauge change date.

Results obtained from sampling in processing factories on 1 and 2 February were very similar to results obtained from attending aboard fishers' vessels on 27-30 January, indicating that, at least for the 2000/2001 season in the area sampled, most fishers were unlikely to be holding over significant numbers of 76 mm lobsters prior to the rule change on 1 February. It must be recognised, however, that the highly visible presence of Officers during the sampling period would undoubtedly introduce a deterrent effect, and likely discourage fishers who might normally hold-over 76 mm lobster from engaging in the practice.

Vessel ***XYZ*** was found to have consigned far greater numbers of 76 mm lobsters than might reasonably occur based on sample data, and many of these lobsters were in unusually poor condition. Furthermore, the ratio of 76:77+ mm lobsters for ***XYZ*** dropped substantially, and to a much greater degree than other sampled fishers, between 1 and 2 February. All this information is consistent with the proposition that ***XYZ*** held-over 76 mm lobsters for several days prior to consignment on 1 February.

One might reasonably question why ***XYZ*** would consign illegally held-over animals when most other fishers in the area were aware Fisheries Officers were conducting an enforcement operation. Discussion with Fisheries Officers and fishers reveal two possible reasons: i) vessel ***XYZ*** only commenced fishing in the operational area immediately prior to 1 February, and was not present for the majority of the period when Officers were conducting sampling aboard commercial vessels; and, ii) the skipper of ***XYZ*** was considered to be of questionable character by his fishing peers, who in turn were unlikely to "do him any favours" by alerting him to the compliance operation.

A primary aim of the study was to gather base-line data against which suspected offenders might be profiled to aid in obtaining successful prosecutions. While the operation described in this section was generally considered a success for this purpose, larger sample sizes are desirable if statistical evidence is to be used in cases for prosecution. In the present study, only 21 fishers were sampled prior to 1 February, with an additional 20 vessels sampled 1-2 February. Collecting these data cost an equivalent of around 40 Officer-days, a significant cost by any measure. Obtaining larger sample sizes for any individual operation would involve considerable expense, since personnel requirements would necessitate Fisheries Officers to be relocated from other parts of the State. In order to increase sample sizes, it is possible that the at-sea component of the current study could be repeated in future seasons in other parts of the fishery. If subsequent at-sea sampling showed consistency in time and space in relation to the size distribution of animals available for capture, then a reasonable argument could be mounted that data from several seasons could be used to increase the effective sample size for comparing factory consigned catch on 1 and 2 February each season. It should also be noted that the resources for the current study did not allow for individual vessels to be sampled more than once during the on-the-water phase of sampling, so it was not possible to obtain measures of intra-vessel variability.

Notwithstanding the cost-constraints on obtaining larger sample sizes, the type of work described in this section has been of considerable benefit. Assuming that the size-distributions of animals available to the fishery does not change appreciably year-to-year, examining factory consigned catch on 1 and 2 February allows those fishers with unusually high numbers of 76 mm lobster to be objectively identified. While such information may be insufficient as sole evidence in a case for prosecution, the process of identifying fishers engaging in the practice has a significant deterrent effect. In other words, fishers are now aware that Fisheries Officers can and do detect the practice of holding-over, and that they will be under surveillance in subsequent years even if they are not successfully prosecuted in the year they are first detected engaging in the practice. This makes good sense in terms of cost-effectiveness, since Fisheries Officers are provided with a sound basis for targeting limited enforcement resources toward those fishers who are highly likely to be engaging in the practice.

5.4 Experiment 2: Haemolymph Sampling to Detect Stress

In January 2002 a study measuring the blood characteristics of experimentally confined lobsters was conducted to explore stress responses as a method for identifying lobster illegally held-over around the time of the minimum size change. The aim of the experiment was to hold wild-caught lobster captive in confined conditions over a number of days in order to examine changes in blood chemistry occurring due to stress. If present, such changes could provide an indicator that could be measured in commercially consigned catch around the time of the gauge change, and provide evidence of the practice of holding-over.

Note that in the following sections I focus on the methodology and results of the experiment, not of the biochemical analyses *per se*. For the latter I relied on the expertise of the Department of Fisheries WA fish pathologist, Dr B. Jones, and the advice that prophenyl oxidase/ml/mg protein is a suitable indicator of stress, with lower values indicating higher stress responses. Standardised measures of prophenyl oxidase as a measure of lobster stress is a new application of existing stress recognition techniques developed for other crustacea (e.g. Hauton *et al.* 1997, Moullac and Haffner 2000). Readers interested in the biochemical analyses undertaken in the present study are invited to contact Dr. Jones directly at the Department of Fisheries, Western Australia.

5.4.1 Methods

Experimental Design

The experiment was designed to simulate the conditions that lobsters would experience if illegally held-over for a number of days by a commercial fisher prior to the gauge change.

A number of factors were considered when designing the experiment:

a) Those commercial fishers engaging in holding-over retain lobsters whose carapace length is greater than or equal 76 mm, but less than 77 mm, for several days before 1 February. Due to the limited catching capabilities of the Department of Fisheries patrol vessel responsible for catching experimental animals, it was not possible to limit experimental animals to this strict size range. Instead, lobsters in the range 69 mm – 84 mm (mean 75 mm) were retained, since these animals were considered to be of sufficiently similar sizes and would be expected to show comparable stress responses to illegally held animals.

b) Commercial fishers engaging in holding-over typically retain lobsters 1-5 days prior to 1 February. Experimental conditions were therefore designed to hold groups of lobsters for periods of 2 and 4 days during the period 3-9 January 2002. It was important to conduct the experiment close to 1 February since developmental characteristics of the animals (e.g. moult-stage) and environmental conditions may influence stress responses.

c) Lobsters landed as part of the normal catching process may show a stress response attributable to removal from the water and/or transportation to a processing factory. Since the objective of the experiment was to determine if animals could be tested in factories to establish if they have been held-over, stresses introduced by the capture and transportation process must be accounted for in any analysis. Measuring the blood characteristics of a number of newly captured animals on the Department of Fisheries patrol vessel tested this possibility.

During the period 3-9 January 2002, the Department of Fisheries patrol vessels Baudin and Walcott fished for lobsters using 24 baited batten-type rock lobster pots in a manner consistent with commercial fishing operations. Sample sizes were largely dependent on the number of animals captured, and were necessarily small due to the lower than average catches experienced in the 2001/2002 season. A total of 128 animals (69-84 mm) were captured during the period of experimental fishing. Of these, 40 were stored in a single holding-pot for 4 days, 51 were held in a single holding-pot for 2 days, and 37 were wild-caught on the last day of the experiment and were not held prior to transportation to a processing factory.

All animals were removed from the water on the final day of the experiment and transported to a processing factory in a manner similar to that experienced by commercially consigned catch. Blood was sampled from a number of animals from each group prior to transportation (see below). Once animals arrived at the processing factory they were measured (carapace length) to the nearest 0.1 mm, sexed, and haemolymph samples were extracted.

Haemolymph Sampling

All blood sampling took place on the last day of the experiment, and proceeded in the following manner. While still on the patrol vessel, 2 mL of haemolymph was removed from: a) 11 non-confined, freshly caught animals; b) 10 animals held for 2 days; and, c) 10 animals held for 4 days. Syringes used for sampling were preloaded with 4 ml of anticoagulant (pH 7.3). Of the freshly caught animals, 10 of the 11 were sampled a second time using syringes without anticoagulant in order to determine the effect of anticoagulant presence/absence on stress measurements. The sampled animals were then replaced amongst the other (as yet non-sampled) lobsters for transport to a processing factory, and haemolymph samples were placed on ice pending analysis. Once the lobsters arrived at the factory all animals were haemolymph sampled in the manner described above.

5.4.2 Results

Sample Sizes and Valid Cases

Due to problems encountered with haemolymph sampling and preservation, results for some animals were not usable (Table 5.4). In addition one of the fresh lobsters sampled on the boat came from a pot with an octopus present and was excluded since it was likely to be severely stressed.

Recall from Section 5.4.1 that on the last day of the experiment a number of lobsters from each treatment had haemolymph removed on the vessel immediately prior to transportation to a processing factory, and that freshly caught lobsters ("Not Held" treatment) were double-sampled, with and without anticoagulant present in the syringe. Haemolymph results for some of these samples were not usable, particularly among those samples obtained in the absence of anticoagulant (Table 5.5). All subsequent results make use of replicates noted in the "Effective Sample Size" columns of Table 5.4 and Table 5.5.

Table 5.4 Original sample sizes and effective sample sizes after haemolymph processing for each of three experimental treatments.

Treatment	Original Sample Size	Effective Sample size
Not Held	37	23
Held 2 Days	51	14
Held 4 Days	40	25
Total	**128**	**62**

Table 5.5 Original sample sizes and effective sample sizes after haemolymph processing for vessel-based samples for each of three experimental treatments. Note that freshly caught animals were double-sampled, once with anticoagulant present and once with anticoagulant absent.

	Anticoagulant Present		Anticoagulant Absent	
Treatment	**Original Sample Size**	**Effective Sample Size**	**Original Sample Size**	**Effective Sample Size**
Not Held	11	9	10	6
Held 2 Days	10	10	NA	NA
Held 4 Days	10	9	NA	NA
Total	**31**	**28**	**10**	**6**

Effect of Anti-coagulant on Stress Response Results

In order to preserve blood samples for biochemical analyses, it is necessary to introduce an anti-coagulant agent to the syringe used to extract blood from each lobster. In order to ascertain any effect on stress measurements due to the introduction of anti-coagulant, 11 fresh-caught animals (ie. captured on last day of sampling and not subject to experimental confinement) were double-sampled, once with anti-coagulant present in the syringe and once without. Samples were taken from animals sequentially, and randomised with respect to the presence or absence of anti-coagulant. Table 5.5 shows effective sample sizes after haemolymph processing of 9 and 6 for samples taken with and without anticoagulant present. Unfortunately, valid results did not always occur across paired readings for individual animals, leaving only 4 lobsters with valid results for both measurements (Figure 5.8).

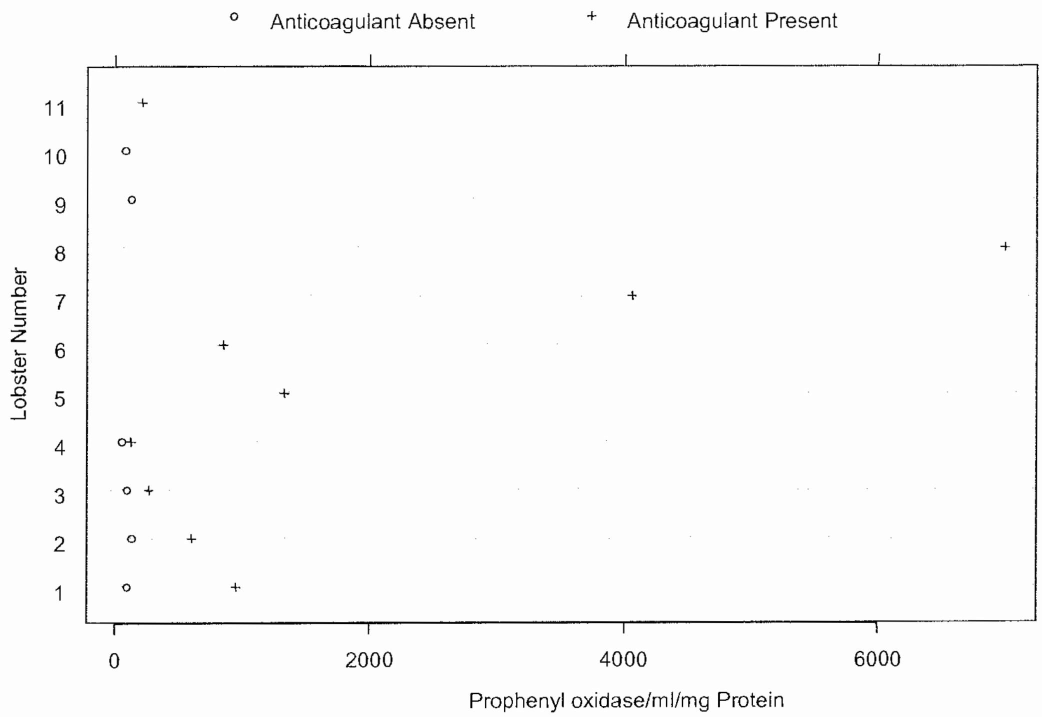


Figure 5.8 Plot of prophenyl oxidase/ml/mg protein in blood samples of 11 fresh-caught lobsters sampled aboard the patrol vessel prior to transport to a processing factory.

Although there is an insufficient number of replicates for analysis, the following observations may be made. High values of prophenyl oxidase/ml/mg protein in blood samples are indicative of good condition, however the two extreme values of around 4,000 and 7,000 are unreasonably high and likely indicative of some failure in the process of haemolymph analysis (B.Jones, pers. comm.). Even discounting these values, responses for samples with anticoagulant present appear inherently variable, a feature likely to obscure discrimination of stressed animals. Unfortunately, those animals (six) sampled without anticoagulant returned prophenyl oxidase/ml/mg protein values close to zero, and unsuitable for determining differences between stressed and unstressed lobsters. The conclusion is that samples must be taken with anticoagulant present in order to prevent clotting and allow prophenyl oxidase/ml/mg protein levels to be measured.

For haemolymph samples from factory sampled lobsters, analysis of variance using a square-root transformed response (to stabilise within group variance) showed significant differences in prophenyl oxidase/ml/mg protein values between treatment groups ($F_{2,59} = 6.10$, $p < 0.01$). Examination of individual data revealed several potential (and unexplained) outliers, and the analysis was repeated removing response values greater than 2,000 (Figure 5.9 group c, showing non-transformed response). Removal of these points increased significance levels, however interpretations did not change and additional ANOVA results are not presented. Mean prophenyl oxidase/ml/mg protein responses were highest in those animals not confined, and approximately double the mean values observed for groups of animals confined for 2 and 4 days. Animals confined for 2 or 4 days showed no appreciable difference in response. This shows that the level of prophenyl oxidase/ml/mg protein in haemolymph is indeed an indicator of lobster stress, but is unlikely to be of use as a diagnostic tool for enforcement purposes due to apparent variability in this measure ($R^2 = 0.17$).

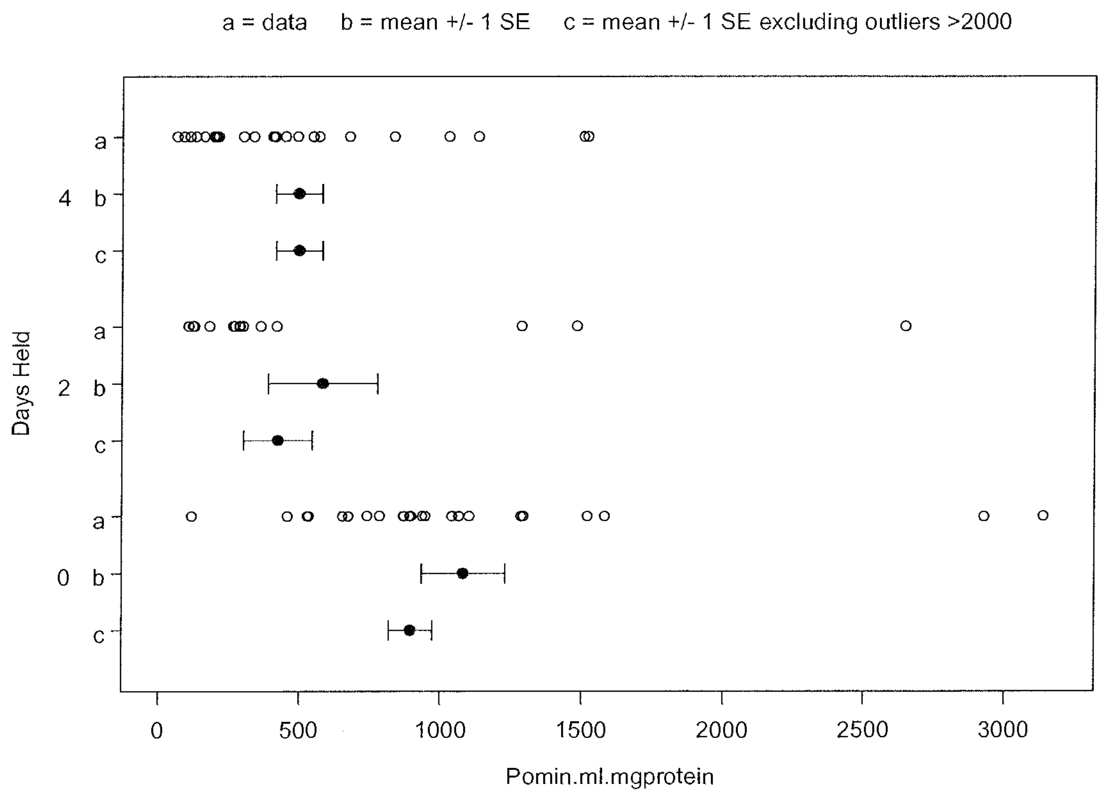


Figure 5.9 Plot of prophenyl oxidase/ml/mg protein in blood samples of factory sampled animals, showing for each treatment: a) individual lobster measurements; b) means and SEs; and, c) means and SEs excluding outlying values greater than 2000.

5.4.3 Discussion

The purpose of examining stress responses in experimentally confined rock lobster was to determine an appropriate diagnostic measure that might be used to assess if commercial catch consignments had been subjected to high levels of stress prior to consignment. It was anticipated that such a measure might be used, in conjunction with other evidence, to help obtain successful prosecutions of commercial operators illegally holding-over catch immediately prior to the gauge-change on 1 February each season.

Unfortunately, while significant differences in responses were evident between lobsters not held and lobsters held for 2/4 days, individual variation in lobster responses renders such a test unsuitable for evidentiary purposes. In essence, substantial overlap in prophenyl oxidase/ml/mg protein values between groups indicates that evidence would have to rely on an appeal to the central limit theorem, and it is questionable whether a magistrate would accept mean differences as indicative of the practice of holding-over given the overlap in individual response values between groups. Furthermore, sampling of commercial catches would have to take place on a large scale to obtain samples from a sufficient number of fishers, and a sufficient sample of individual lobsters per fisher. Sub-sampling a small number of lobsters from a range of fishers would likely be insufficient to prove a case of holding-over based on prophenyl oxidase/ml/mg protein values, and obtaining large samples would be a costly exercise.

There are also several unusually large (or small) response values present in each treatment group, and at the present time the cause for these values remains unexplained. Problems were encountered in extracting and preserving haemolymph samples, and it became clear that the amount of anticoagulant needed to prevent clotting was a critical factor. While it was necessary to exclude several obviously unreliable haemolymph samples (Table 5.4) prior to biochemical processing, it is not possible to state with complete certainty that all included samples were of sufficient quality.

This pilot study was a useful exercise to identify likely levels of variation in prophenyl oxidase/ml/mg protein values, and to develop the techniques for haemolymph sampling and biochemical analysis. Work to refine these techniques continues, however results from the current study suggest that significant improvements in the current measure, or alternate diagnostic measures, are required before such tests might be useful for evidentiary purposes.

5.5 Conclusion

Fisheries Officers have been aware for several years that a small number of fishers illegally hold-over 76 mm lobster prior to the minimum-size change on 1 February. Some of these fishers are immediately identifiable due to the poor condition of their catch and/or the high numbers of 76 mm animals in their catch when inspected on 1-2 February. Those fishers with high numbers of 76 mm animals, but whose catch is not in poor condition, are much more difficult to identify with any certainty. The studies described in this section provide two data-based tools to help identify fishers engaging in the practice. Neither method provided a prescriptive solution, and while each may help identify fishers likely to be guilty of holding-over, further refinements would be needed to use the data as the sole basis for securing a prosecution. It would be useful to test such evidence in a legal context by proceeding with a case for prosecution in which the suspected fisher had a high proportion of 76 mm animals and a high percentage of those animals in poor condition.

The studies described in this section provided Fisheries Officers with an understanding that careful collection and analysis of data can be directly beneficial to the job of "catching the crooks". The benefit of encouraging Fisheries Officers to make use of data, and to think creatively about how data might be used to identify non-compliant fishers, should not be underestimated. Notwithstanding this observation, it is questionable in the present case whether the costs involved in gathering data are outweighed by consequent benefits to the enforcement program. While the prevalence of fishers engaging in holding-over remains low, and the practice continues to pose only a minor threat to the sustainability of the fishery, continued experimentation at this time is judged unwarranted. However, periodic, intense sampling of the kind described in this study may be beneficial in both attempting to subjectively monitor the proportion of the fleet engaged in the activity, and in presenting a credible deterrent presence on the water around the period of the minimum size change.

6. *Commercial Attitudinal Survey*

6.1 Overview

At the beginning of the 1999/2000 fishing season a mail survey was provided to all people involved in the catching sector of the commercial western rock lobster fishery, including skippers, licence-holders and crew. The survey asked fishers to provide their views on a range of issues relevant to enforcement and compliance during the 1998/1999 season. The response rate for skippers was high (approaching 50%), with lower response rates for non-fishing licensees and crew.

Results demonstrated considerable diversity in fisher views about the enforcement program, perceptions about the risks of infringing, and attitudes toward other commercial and recreational fishers. Generally, most fishers were satisfied with the performance of the enforcement program, and with compliance by their peers. Most recognised that a small number of fishers will break fishing rules, but that most commercial fishers follow regulations most of the time. Many fishers felt that monetary penalties or periods of suspension should be increased for serious offences such as over-potting.

Most respondents thought recreational fishers complied with most catch-related rules, but that substantial numbers of recreational fishers sell or barter their catch. This perception is at variance with the view held by Fisheries Officers, a majority of whom feel recreational fishers are compliant with fishery rules most of the time. While Officers do, from time to time, detect small numbers of recreational fishers selling catch, several large-scale enforcement operations have to date only uncovered low levels of this type of activity.

A significant number of respondents (up to 30% in some zones) expressed dissatisfaction with some fishery rules, such as the protection of oversize females and the split minimum size rule. It would appear that some fishers, despite the success of these rules in helping to rebuild and maintain breeding stocks, still feel aggrieved by their introduction in the 1993/1994 management package.

Most respondents felt that monetary gain was the primary motivating factor for fishers breaking regulations, although small numbers of fishers are thought to be motivated by competition for catch or because of financial hardship.

6.2 Introduction

Regulatory management of renewable resources is primarily concerned with managing the people who utilise a resource, and ensuring that resource exploitation does not exceed the capacity of the resource to self-replenish. In fisheries this is typically achieved by State regulation designed to limit catches directly through quota allocation to fishery participants, or indirectly through limits on fishing effort, or both. Compliance by fishers with regulations is important if management objectives relating to sustainability are to be attained. Achieving high compliance has, however, proven difficult in many high-value fisheries around the world (e.g. Hauck and Sweijd 1999), especially when potential profits are high and the probability of detection and/or monetary penalties are low (Sutinen and Gauvin 1989a, Sutinen *et al.* 1990).

Traditional studies of enforcement programs and fisher compliance have focused on econometric approaches to design management policies or regulatory instruments to optimise levels of compliance given restrictions on costly and often imperfect enforcement (Anderson and Lee 1986, Milliman 1986). Such studies are often predicated on an assumption that individuals will break rules when the profit to be gained by undertaking illegal activity outweighs the costs that might be incurred if detected and apprehended (Sutinen and Andersen 1985). Although this concept almost certainly applies to a greater or lesser extent among non-compliant fishers, recent research has indicated that perceptions of legitimacy of regulations and management authorities, and social norms, can greatly influence an individual's decision to violate (Kuperan and Sutinen 1998, Hatcher *et al.* 1998, Hønneland 2000, Jentoft 1989). In turn, there has been an emerging awareness among fisheries managers of the need to assess and respond to fisher attitudes and perceptions, and to involve fishers in the development of rules and fisheries policy.

Many fishing regulatory bodies have adopted social research techniques for gathering information on fisher attitudes toward management (Wilde *et al.* 1996, Matlock 1991). Most methodologies involve surveys – personal interviews, phone interviews, or written self-response questionnaires – to solicit information from resource users. Such surveys have a well-established history in estimating catch and effort in recreational fisheries (Pollock *et al.* 1994, Grambsch and Fisher 1991, Wilde *et al.* 1996). Although survey techniques may be subject to inherent and often unmeasurable biases (Fisher 1996, Brown 1991), they do provide a useful mechanism for gauging the attitudes and perceptions of fishers toward management, levels of compliance and enforcement (Matlock 1991). In turn, this information may be important to assess enforcement programs, and to effectively target educative campaigns designed to improve fisher understanding and acceptance of regulations.

Enforcement and compliance in the western rock lobster fishery is a subject that attracts much interest from fishery participants for a diversity of reasons, including:

- The rock lobster enforcement budget accounts for a large proportion of total management costs recovered from the rock lobster commercial fishing industry.
- Although most fishers demonstrate high compliance with rules, a small number do engage in illegal activities, and there is often considerable antipathy expressed by compliant fishers toward their non-compliant peers.
- In some shallow water areas of the fishery there may be considerable overlap and competition between the commercial and recreational sectors.
- Increasing efficiency, the rising level of leased pots in operation, and a move in the fishery toward contract skippers help to fuel competition between commercial fishers.
- Some rules are difficult for enforcement staff to police, while others are difficult for fishers to comply with.

All these factors contribute in varying degrees toward fisher interest in the effectiveness of the Department of Fisheries enforcement program, and in levels of compliance. In order to assess fishers' attitudes and perceptions relating to enforcement and compliance, a mail survey of all commercial fishers was conducted in late 1999. The broad objectives of the survey were to determine fisher attitudes toward various rules, and their perceptions about the levels of illegal activity occurring in the fishery. The deterrent effect of various rules was also examined by asking fishers about the size of fines they thought courts would impose for certain rule breaches, and the probability of detection by Fisheries Officers.

This is the first survey of its kind in the rock lobster fishery, and it is likely that similar surveys will be conducted periodically to assess changes in perceptions and attitudes through time.

6.3 Methods

6.3.1 Survey Design

A written questionnaire was developed in conjunction with Department of Fisheries WA research, fishery participants and enforcement personnel. Personal interviews and telephone surveys were rejected as potential methods of collecting information due to resource limitations and the sensitive nature of many of the questions. Once near completion, commercial industry representatives[18] were asked to trial the survey and provide comments about ambiguities and the use of potentially inflammatory terminology. This input

[18] Industry members of the Compliance Subcommittee of RLIAC

contributed substantially to improving the content and format of the survey, and, despite the survey's length, participants agreed it was pertinent and comprehensive, and would likely be well-received by industry.

Surveys that ask respondents to self-report illegal behaviour are well known to produce results that are often biased toward socially acceptable conduct (Wyner 1980, Schill and Kline 1995). That is, respondents may tend to down-play their involvement in illegal activities and provide answers closer to (their perception of) socially accepted behaviour. For this reason, many of the questions about illegal fishing behaviour presented to fishers in this survey were framed in the third person. For example, I ask respondents about "fishers you know" or "fishers operating in your usual fishing area". While this approach is unlikely to totally eliminate an aversion to self-incriminate, it is thought likely to elicit more honest responses to sensitive issues than questions framed in the first person. To further encourage honest reporting, surveys were unmarked and confidential, and a written covering letter assured participants that information received would only be presented in aggregated form to enforcement personnel.

6.3.2 Distribution and Return

At the beginning of each fishing season, Fisheries Officers usually attempt to make contact with the skippers of all boats within their districts. This afforded an opportunity to distribute surveys and provide fishers with a "face-to-face" explanation of what the survey was about and how the results would be used. At the beginning of the 1999/2000 season, Fisheries Officers personally distributed a survey form to all skippers and crew working in the commercial rock lobster fleet. Over subsequent weeks Fisheries Officers were also in a position to gently remind fishers about the surveys as they contacted them during the normal course of their work.

In addition to skippers and crew, the catching sector of the commercial fishery also comprises licence-holders that do not fish whatsoever. Since certain penalties (such as black marks) are recorded against the fishing licence, it was of interest to obtain the views of all licence-holders, not only those actively involved in fishing. Therefore, additional surveys were posted to all registered licence-holders in the fishery; these were printed on coloured paper to distinguish them from the white surveys distributed to boats. Those fishers who own licences and also skipper vessels received two surveys, but were asked in the covering letter to only complete one and discard the other.

The objective was therefore to provide all skippers, licence-holders and crew the opportunity to participate in the survey. Survey forms were return postage-paid and constructed in such a way that they could be folded and self-sealed for posting.

6.3.3 Presentation of Results

Some rules in the western rock lobster fishery, and in particular those relating to at-sea fisher behaviour, are difficult for Fisheries Officers to police, and compliance levels for some rules are largely unknown. It is equally difficult for fishers to observe some kinds of illegal behaviour, and this means that for many interesting questions – for example, questions relating to observed illegal activity – response rates can be quite low. As "the devil is in the detail", and the fact that percentages can be misleading in cases of low sample size, I have chosen to present tabular and graphical results as counts of respondents. Percentages are easily calculated from most results, however, and where appropriate I refer to percentages.

I present many results split according to fishing zone and employment status, where the latter is defined by fisher responses to Question 7. Where appropriate, however, I have either aggregated or subset data according to the relevance of particular employment types to certain questions. For example, the category "Licence-Holder but not Skipper" is often omitted for questions that specifically relate to on-the-water activities. Similarly, the category "Crew" is often only displayed when the proportionate responses of crew differ appreciably from views expressed by skippers.

Results for questions are largely presented in the order in which they appear in the survey (Appendix 3), with the exception of information relating to response rates. Important features of particular tables and graphs are noted in "dot point" format immediately below the appropriate graphic or table.

The presentation of results for Question 59a-u is noteworthy. These results would conventionally be displayed in tabular format, however I have adopted a graphical approach to assist assimilate the large volume of information. In particular, the rating-scale responses for "Impact on Sustainability" and "Probability of Detection" have been plotted in a 4x4 grid, adding a small amount of random noise so as to separate points. Each point represents an individual response, so that the density of points indicates response levels for that position on the grid.

6.4 Results

6.4.1 Response Rates

A total of 437 completed surveys were returned. Response rates were generally high, perhaps reflecting the high level of interest within the fishery on matters relating to enforcement and compliance. Skippers accounted for 59% of all respondents, a representation of almost half the total number of skippers in the fleet (Table 6.1). Significantly fewer crew (105 respondents) and licence-holders not actively fishing (61) replied. The number of crew and non-fishing licence-holders in the fleet is unknown, but since vessels may have between one and four crew (most have around two) it is safe to surmise that only a small (5-10%) proportion of crew in the total fleet replied. Of the eight respondents indicating category "Other" for employment status (see Question 7), most indicated they did not fish in the 1998/1999 season. Pooled across employment Status, 24% of respondents fish in Zone A, 33% in Zone B, and 41% in Zone C, which compares with around 25%, 25% and 50% of the fleet known to fish in each zone.

Table 6.1 Numbers of respondents returning completed survey forms categorised by Zone, and Employment Status.

		Zone A	Zone B	Zone C	Missing	Total
Employment Status	**Employed Skipper**	11	17	24	0	**52**
	Lease-holder and skipper	6	15	11	0	**32**
	Licence-holder and skipper	49	44	78	3	**174**
	Licence-holder, not skipper	13	26	21	1	**61**
	Crew	23	36	38	8	**105**
	Other	1	2	4	1	**8**
	Missing	0	3	1	1	**5**
	Total	**103**	**143**	**177**	**14**	**437**

6.4.2 Sample Demographics

Q1. How many years have you been involved in the rock lobster fishery?

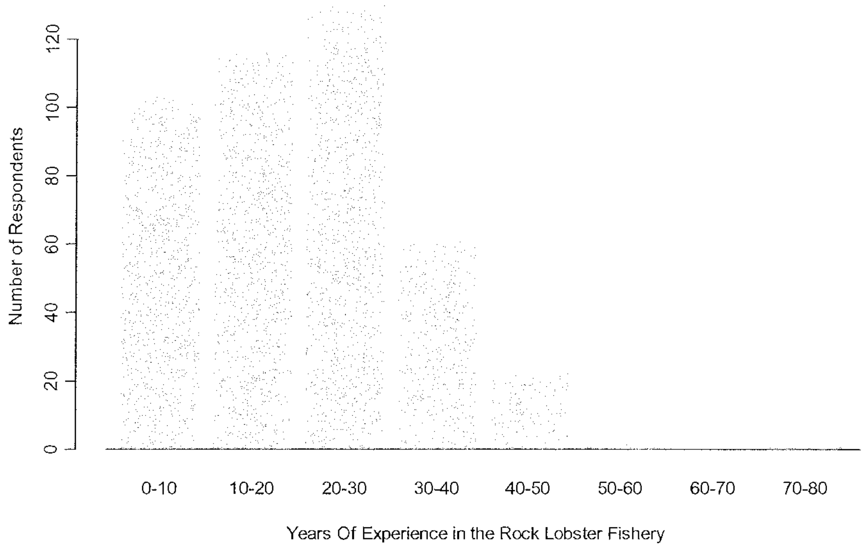


Figure 6.1 Barchart showing years of experience in the western rock lobster fishery.

- Most respondents had between 10 and 30 years experience in the fishery (Figure 6.1).
- Examining years of experience split by Zone and Employment Status (Figure 6.2) shows that crew, and to some extent licence-holders who do not fish and employed skippers, have less experience compared with skippers who own their licence.
- Many licence-holders who are also skippers have considerable (> 40 years) experience.

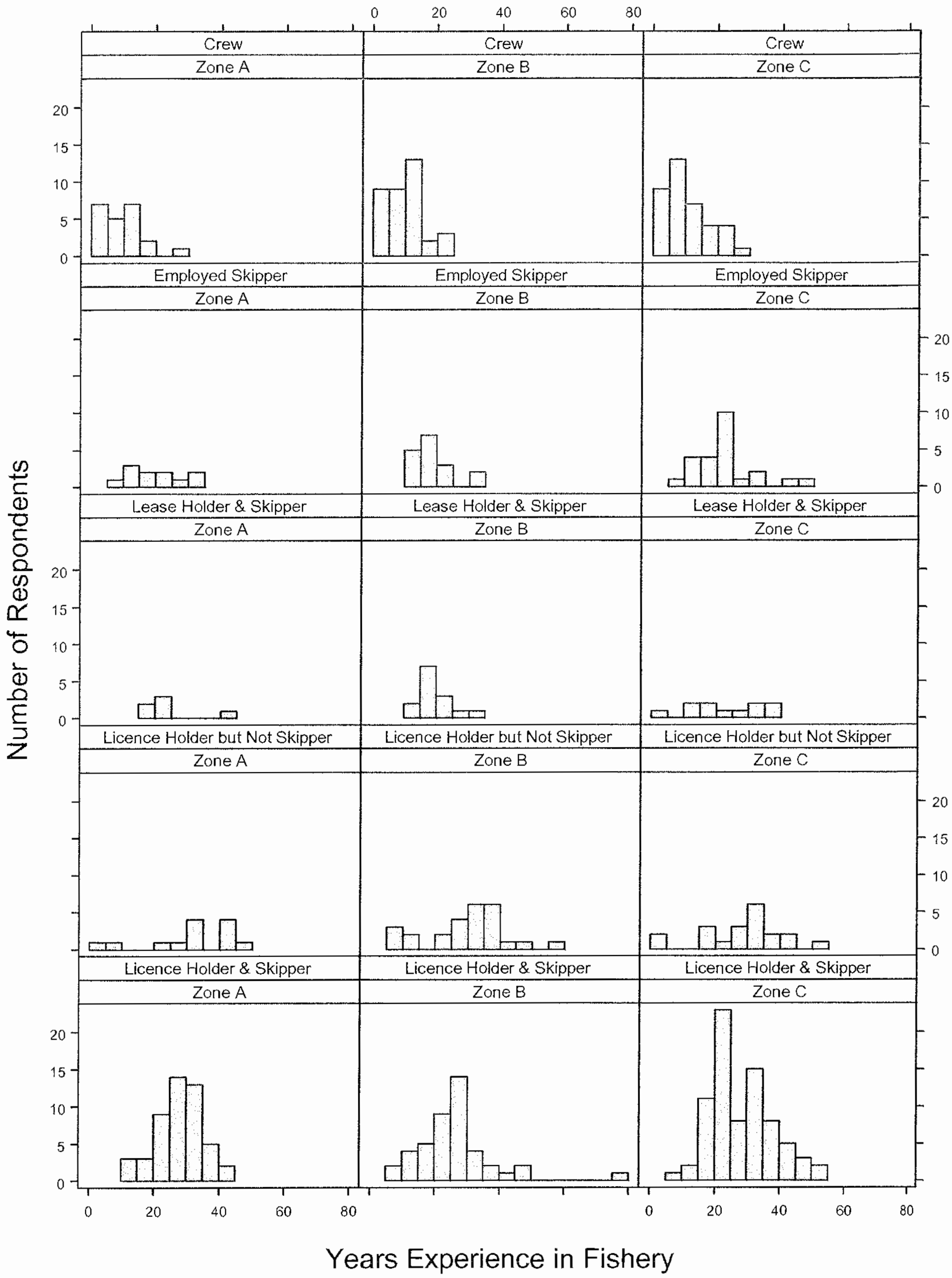


Figure 6.2 Histograms of years of experience in the fishery, categorised by Zone and Employment Status.

Q2. What is length of your boat? (metres)

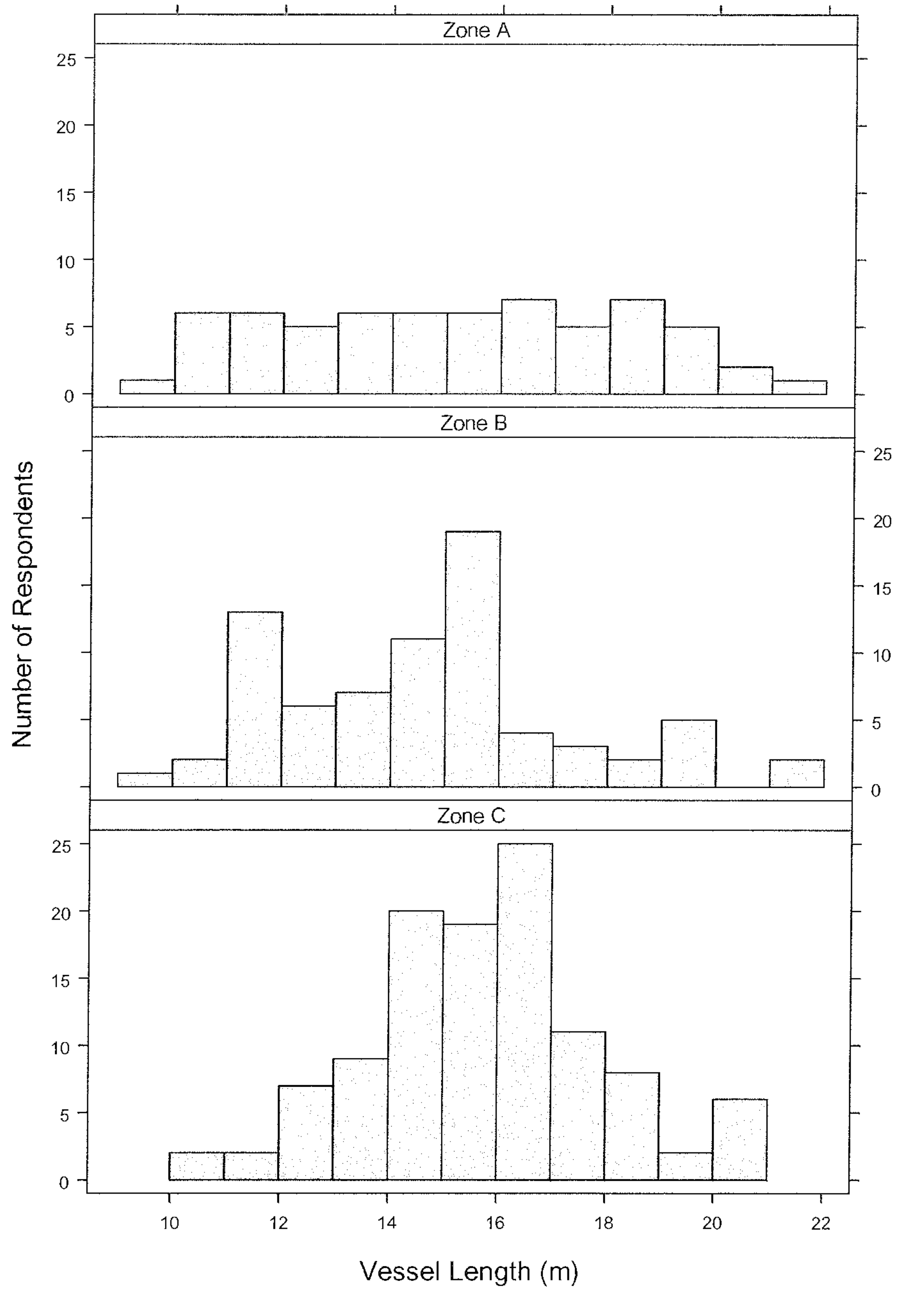


Figure 6.3 Histogram of respondent vessel length, categorised by Zone and restricted to skipper responses only.

- Respondent vessel lengths typically range between 12 and 20 metres.
- Zone A respondents fish with proportionately small vessels compared with Zones B and C.

Q3. What is the main language spoken at home?

Table 6.2 Main language spoke at home, categorised by Zone.

		Zone				
		A	**B**	**C**	**Missing**	**Total**
Main Language	**English**	103	140	169	13	**425**
	Italian	0	0	3	0	**3**
	Other	0	0	2	1	**3**
	Missing	0	3	3	1	**7**
	Total	**103**	**143**	**177**	**15**	**438**

- Most fishers indicated English as the main language spoken at home.
- One respondent in category "Other" indicated his main language as "Fowl" (his spelling, not mine)!

Q4. What is your country of birth?

Table 6.3 Respondent country of birth, categorised by Zone.

		Zone				Total
		A	B	C	Missing	
Country of Birth	Australia	96	137	154	13	**400**
	Germany	0	1	0	0	**1**
	England	4	1	5	0	**10**
	Scotland	1	1	1	0	**3**
	Italy	0	0	6	0	**6**
	Wales	0	0	1	0	**1**
	New Zealand	1	0	1	0	**2**
	Other	1	2	7	1	**11**
	Missing	0	1	2	0	**3**
	Total	**103**	**143**	**177**	**14**	**437**

- Most respondents were born in Australia, with only minor representation from respondents born in other countries.

Q5. Does your family have a tradition in the rock lobster fishery? If you answered yes, how many years?

Table 6.4 Respondents with a family tradition in the rock lobster fishery, categorised by Zone and Employment Status (Y=yes, N=no).

	Zone	A		B		C		Missing		Total	
	Tradition	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
Employment Status	**Employed Skipper**	8	3	10	7	13	11	0	0	**31**	**21**
	Lease-Holder and Skipper	5	1	6	9	8	3	0	0	**19**	**13**
	Licence-holder and Skipper	31	18	27	17	50	28	3	0	**111**	**63**
	Licence-holder, not skipper	2	11	17	9	8	13	1	0	**28**	**33**
	Crew	9	14	7	29	19	19	1	7	**36**	**69**
	Other	1	0	1	1	0	4	0	1	**2**	**6**
	Missing	0	0	1	2	1	0	1	0	**3**	**2**
	Total	**56**	**47**	**69**	**74**	**99**	**78**	**6**	**8**	**230**	**207**

- Of all respondents, 230 (53%) indicated they had a family tradition of fishing for rock lobster.
- Typically, 40%-70% of skippers (all types) had a family tradition.
- Non-fishing licence-holders in Zone A and C predominantly did not have a family tradition.
- Crew in Zone A and B predominantly did not have a family tradition.

Table 6.5 Years of family tradition in the rock lobster fishery, categorised by Employment Status.

		Years of Family Tradition				Total
		1-10	11-20	21-40	+40	
Employment Status	Employed Skipper	0	3	15	13	**31**
	Lease-Holder and Skipper	0	0	11	8	**19**
	Licence-holder and Skipper	0	2	48	55	**105**
	Licence-holder, not skipper	0	2	17	10	**29**
	Crew	2	2	18	10	**32**
	Other	0	1	0	1	**2**
	Missing	0	1	0	1	**2**
	Total	**2**	**11**	**109**	**98**	**220**

- Of those respondents with a family tradition, most had families involved in fishing in excess of 20 years.
- Of all skippers with a family tradition, 49% had families involved in fishing for more than 40 years.

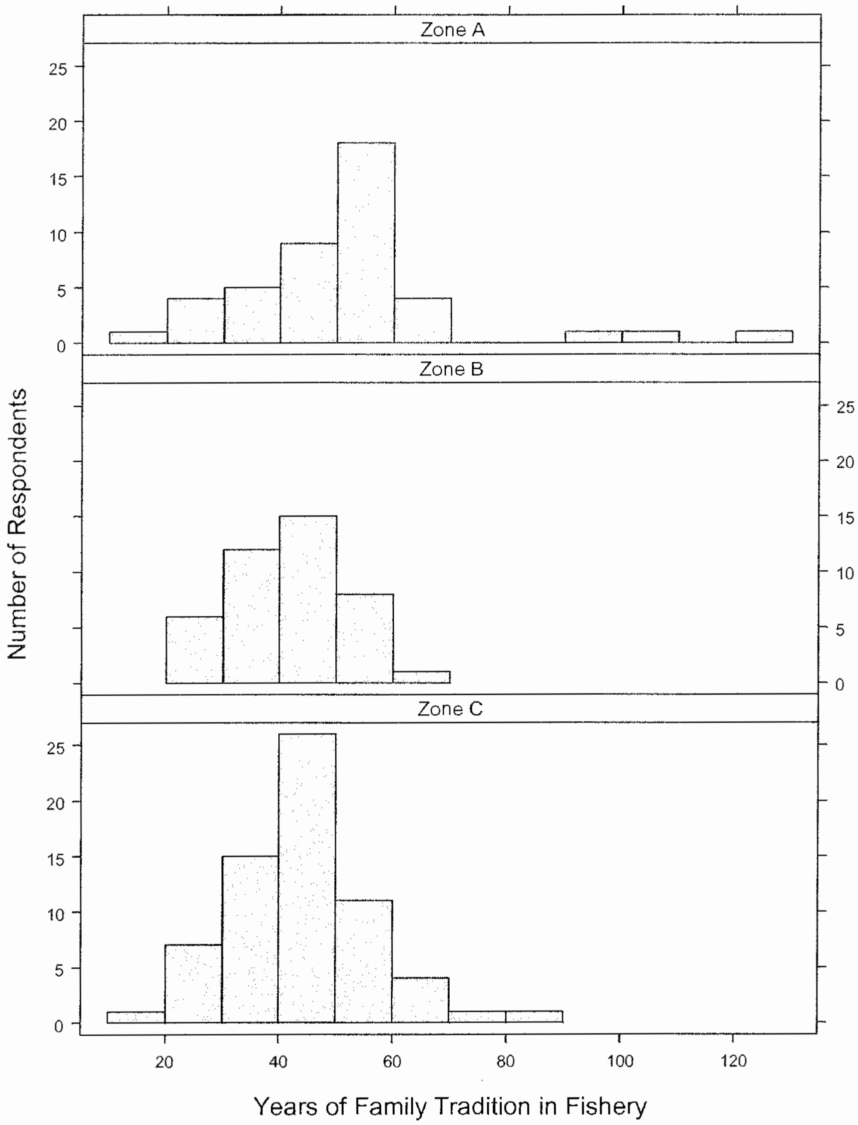


Figure 6.4 Histogram of years of family experience in the fishery, categorised by Zone and restricted to skipper responses only.

- Distributions of family experience for skippers show that a many respondents come from multi-generational fishing families, with a small number having as many as 100 years experience in the fishery.

Q6. How many crew (including the skipper) worked your boat in the 1998/1999 season?

Table 6.6 Number of crew working aboard respondents' vessels, categorised Zone and restricted to skipper responses only.

		Zone A	Zone B	Zone C	Missing	Total
Number of Crew	**1**	0	1	2	0	**3**
	2	25	37	15	1	**78**
	3	35	34	83	2	**154**
	4	5	4	11	0	**20**
	Missing	1	0	2	0	**3**
	Total	**66**	**76**	**113**	**3**	**258**

- Most respondent's vessels fished using two or three crew members (excluding skippers).
- In Zone C, proportionately more vessels fished with three crew members compared with vessels from other zones.

Q7. In the 1998/1999 season, are you the: (circle one)

a) **Licence-holder (or stake-holder) and skipper**
b) **Licence-holder but not skipper**
c) **Lease-holder and skipper**
d) **Employed skipper (neither a lease-holder nor a licence-holder)**
e) **Crew**
f) **Other (please specify) ___________________________**

For this information refer to Table 6.1 in Section 6.4.1.

Q8. If you work as part of the crew, how are you paid for your work? (circle one)

a) **Flat rate of pay (hourly or daily)**
b) **Paid as a proportion of the value of the catch**
c) **Paid a flat rate + a proportion of the value of the catch**
d) **Other (please specify): ____________________________**
e) **Not part of the crew**

Table 6.7 Method of crew payment, categorised by Zone and Employment Status.

		Zone				Total
	CREW	**A**	**B**	**C**	**Missing**	
Crew Payment	**Flat Rate**	1	3	0	1	**5**
	Proportion of value of catch	20	33	37	5	**95**
	Flat rate + proportion of catch	2	0	1	1	**4**
	Missing	0	0	0	0	**0**
	Total	**23**	**36**	**38**	7	**104**
	SKIPPERS	**A**	**B**	**C**	**Missing**	
Crew Payment	**Flat Rate**	3	6	2	0	**11**
	Proportion of value of catch	10	17	53	1	**81**
	Flat rate + proportion of catch	4	2	1	0	**7**
	Not part of crew	47	41	53	2	**143**
	Missing	2	10	4	0	**16**
	Total	**66**	**76**	**113**	**3**	**258**

- Although this question asked only crew to respond, a large number of skippers also provided an answer. It is not clear, however, whether skippers were responding about their own method of receiving pay, or in relation to the crew working aboard their vessels.
- Most crew are paid as a proportion of the value of the catch.
- A majority of employed skippers (results not separated) are paid as a proportion of the value of the catch.

Q9. What is the full pot entitlement (excluding the 18% reduction) of your fishing boat?

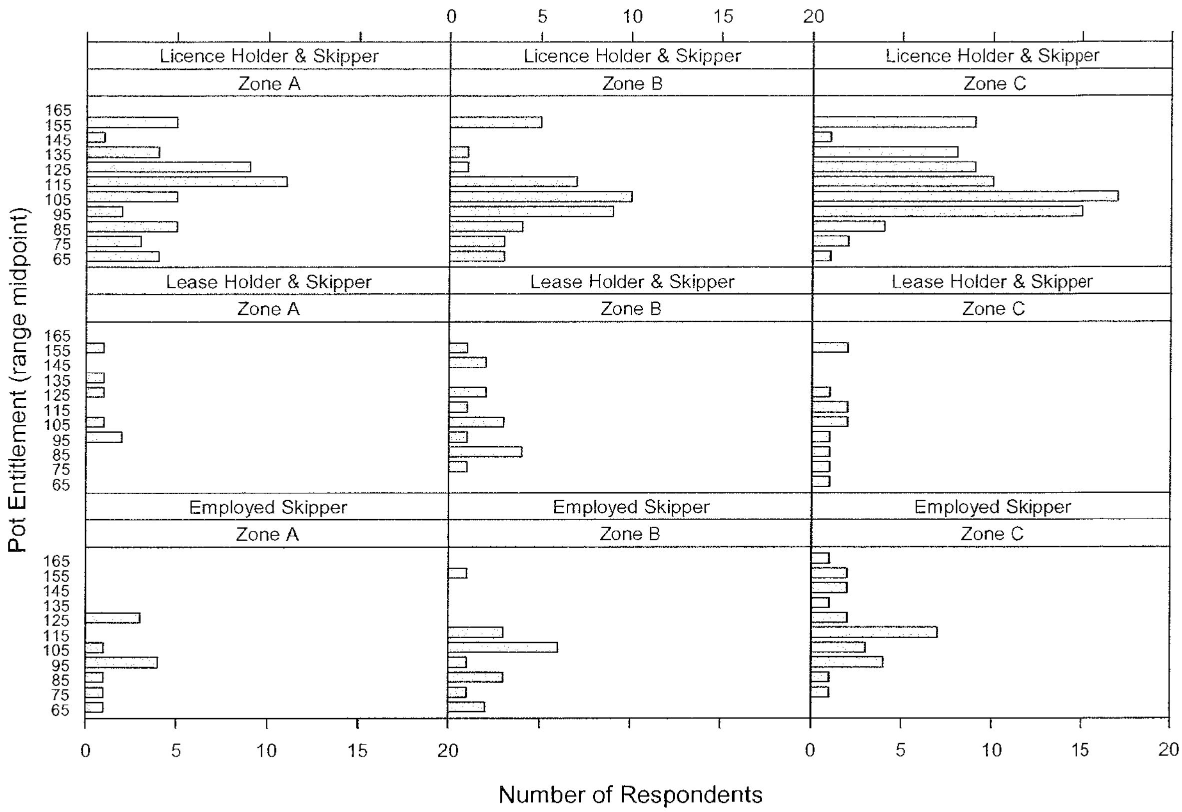


Figure 6.5 Pot entitlement of respondents' vessel, categorised by Zone and Employment Status (skippers only).

- Most vessels fished 80-130 pots during the 1998/1999 season.
- Employed skippers in Zone A and B typically fished fewer pots than respondents belonging to other categories of Zone and Employment Status (samples sizes are small, however).

Q10. Do you lease pots from any other fishing operations as investments? If you answered yes, how many pots?

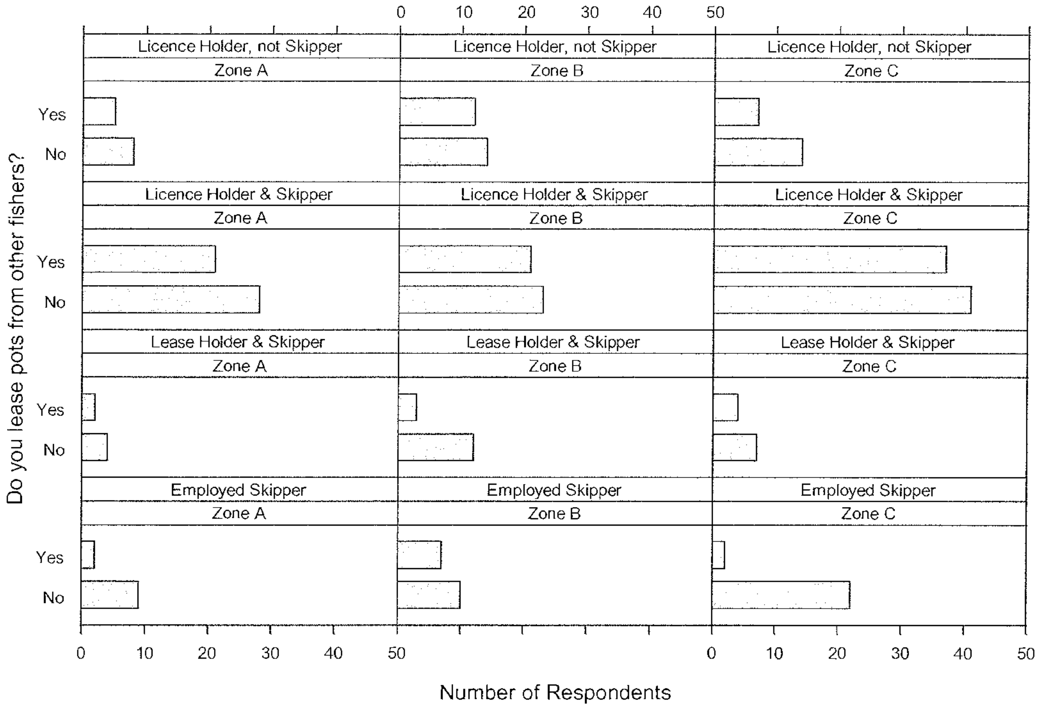


Figure 6.6 Number of respondents leasing pots, categorised by Zone and Employment Status.

- A large proportion (30-40%) of licence-holders in all zones lease additional pots.
- Employed skippers, with the exception of Zone B respondents, appear to enter into leasing arrangements less often than licensees.

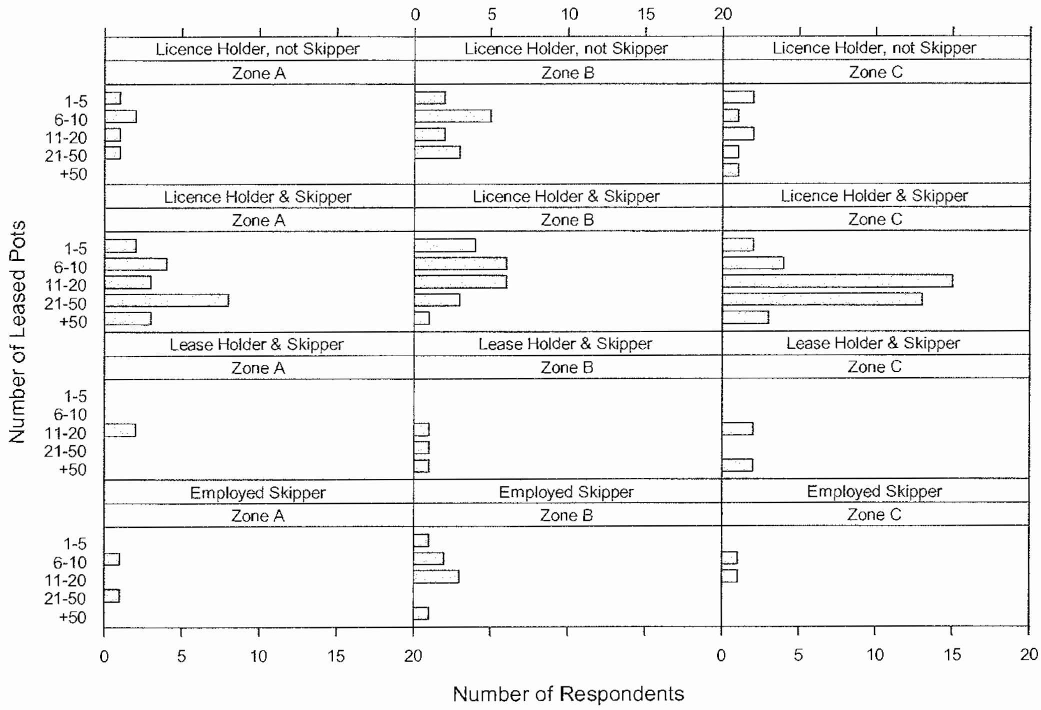


Figure 6.7 **Number of pots leased by respondents, categorised by Zone and Employment Status and restricted to skipper and licence-holder responses only.**

- Of those fishers leasing pots, most lease 11-50.
- Highest levels of leasing occur among licence-holders who are also skippers.

Q11. What percentage of your gross income comes from fishing?

a) **0- 20%**
b) **21- 40%**
c) **41- 60%**
d) **61- 80%**
e) **81- 100%**

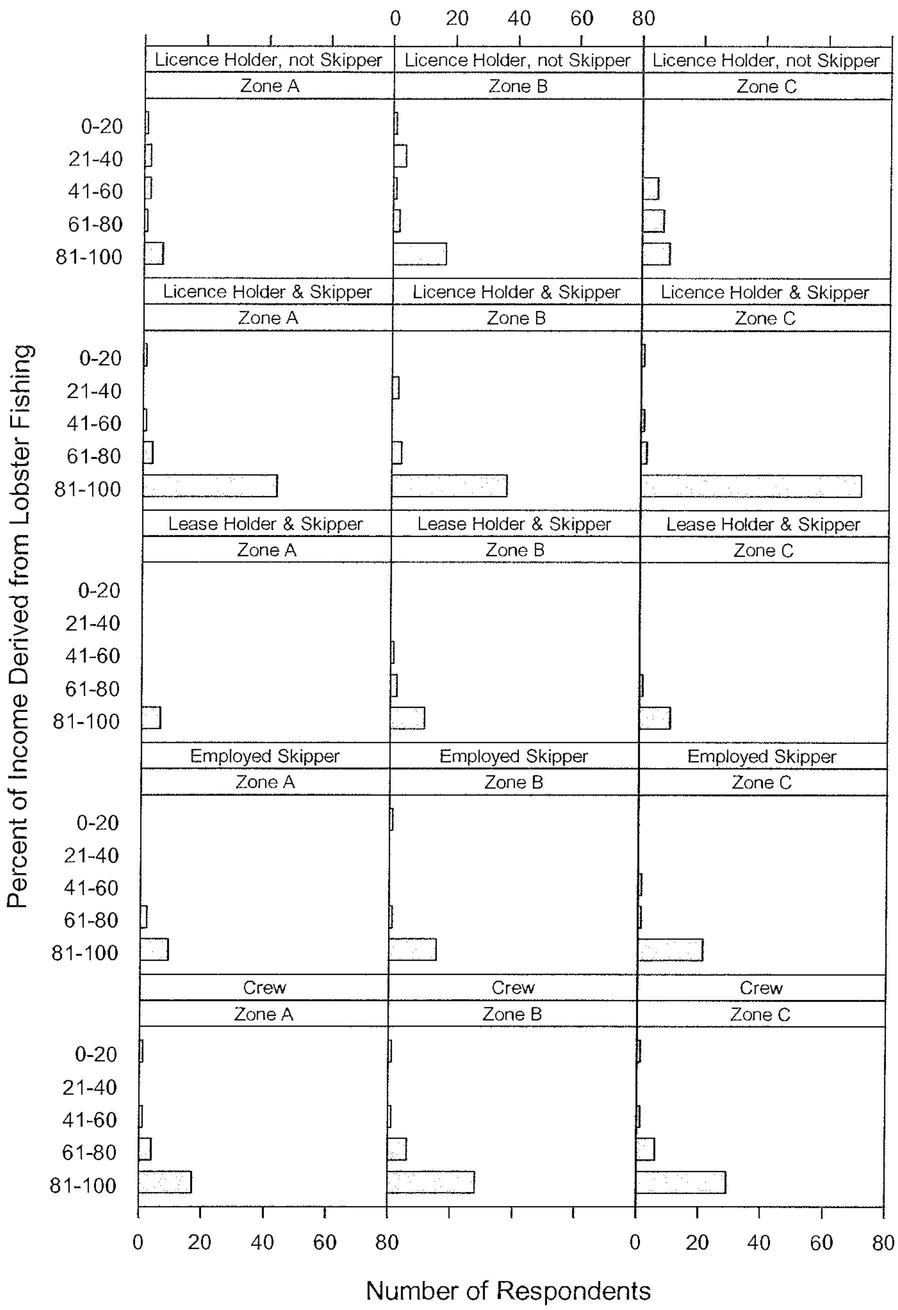


Figure 6.8 Percent of respondent income derived from rock lobster fishing, categorised by Zone and Employment Status.

- Most employment types in most zones derive a majority of their income from fishing.
- Respondents who work as crew are a consistent exception across zones, with a small but significant proportion deriving 20-40% of their income from other sources (presumably during the 4.5 month closed season).

Q12. What zone is your vessel licensed to fish?

a) **Zone A**
b) **Zone B**
c) **Zone C**

For this information refer to Table 6.1 in Section 6.4.1.

Q13. Please list the 3 main landing points where you unload rock lobster during the fishing season.

Table 6.8 Respondent's main landing point (only) for catch, categorised by Employment Status.

	Employed Skipper	Lease Holder & Skipper	Licence Holder & Skipper	Licence Holder, not Skipper	Crew	Other & Missing	Total
Abrolhos	0	1	5	2	5	0	**13**
Cervantes	3	2	9	0	6	0	**20**
Dongara	5	4	21	4	8	0	**42**
Geraldton	16	8	30	15	22	6	**97**
Jurien	7	1	19	5	13	1	**46**
Kalbarri	3	0	13	4	4	2	**26**
Lancelin	3	5	10	8	6	2	**34**
Ledge Pt	4	4	8	4	7	0	**27**
Leeman	1	0	12	2	4	0	**19**
Mandurah	0	1	4	1	1	0	**7**
Mindarie	3	1	7	1	4	0	**16**
Missing	1	1	7	2	6	0	**17**
Perth Metro	1	2	8	7	6	0	**24**
Port Denison	1	1	5	2	3	2	**14**
Port Gregory	0	0	6	2	2	0	**10**
Two Rocks	4	1	10	2	8	0	**25**
Total	**52**	**32**	**174**	**61**	**105**	**13**	**437**

- Unlike the general categorisation of fishing zone, a fisher's main landing point provides an indication of the spread of respondents along the length of the fishery. This shows that the full length of the coast is represented, with higher concentrations of responses arising from larger fishing ports such as Dongara, Geraldton, Jurien, Lancelin and the Perth Metro area.
- Fremantle, which is included as part of Perth Metro, is perhaps proportionately under-represented given the number of fishers operating from the port.

6.4.3 Perceptions about Enforcement and Compliance

Q14. Have you ever called the Fishwatch 1800 phone number to report illegal recreational fishing activity?

Table 6.9 Number of respondents calling the Fishwatch 1800 telephone number (illegal fishing "hotline") to report illegal recreational fishing, categorised by Zone and Employment Status.

		Zone A		Zone B		Zone C		Missing	
		Y	N	Y	N	Y	N	Y	N
Employment Status	Employed Skipper	0	11	0	17	2	22	0	0
	Lease-holder and skipper	0	6	1	14	1	10	0	0
	Licence-holder and skipper	4	45	1	43	7	71	0	3
	Licence-holder, not skipper	1	12	2	24	1	20	0	1
	Crew	1	22	0	5	0	5	1	7
	Other & Missing	0	1	1	35	1	37	0	1
	Total	**6**	**97**	**5**	**138**	**12**	**165**	**1**	**12**

- 6%, 3% and 7% of respondents from Zones A-C have, at some stage of their fishing careers, called the Fishwatch hotline to report illegal recreational activity.
- Most Fishwatch calls arise from skippers, although interestingly four non-fishing licence-holders have at some stage (perhaps when previously fishing) called about illegal recreational activity.

Q15. Have you ever called the Fishwatch 1800 phone number to report illegal commercial fishing activity?

Table 6.10 Number of respondents calling the Fishwatch 1800 telephone number (illegal fishing "hotline") to report illegal commercial fishing, categorised by Zone and Employment Status.

		Zone A		Zone B		Zone C		Missing	
		Y	N	Y	N	Y	N	Y	N
Employment Status	**Employed Skipper**	0	11	0	17	1	23	0	0
	Lease-holder and skipper	0	6	1	14	2	9	0	0
	Licence-holder and skipper	3	46	2	42	8	70	0	3
	Licence-holder, not skipper	1	12	1	25	1	20	0	1
	Crew	1	22	0	36	0	38	0	2
	Other & Missing	0	1	0	5	0	5	0	8
	Total	**5**	**98**	**4**	**139**	**12**	**165**	**0**	**14**

- A small percentage of fishers (6%, 3% and 7% in Zones A-C) indicated they had previously called the Fishwatch hotline to report illegal commercial fishing activity.
- Although the proportions of fishers who had previously used the Fishwatch service was similar depending on whether reporting commercial or recreational illegal fishing activity, examining the degree of concordance between fishers shown in Table 6.9 and Table 6.10 shows that only about half of all respondents reporting illegal activity have done so for *both* commercial and recreational fishers.

Q16. Consider a fisher who is to have their licence suspended for an over-potting offence. What do you consider the minimum number of pots that warrants a suspension, and for what period?

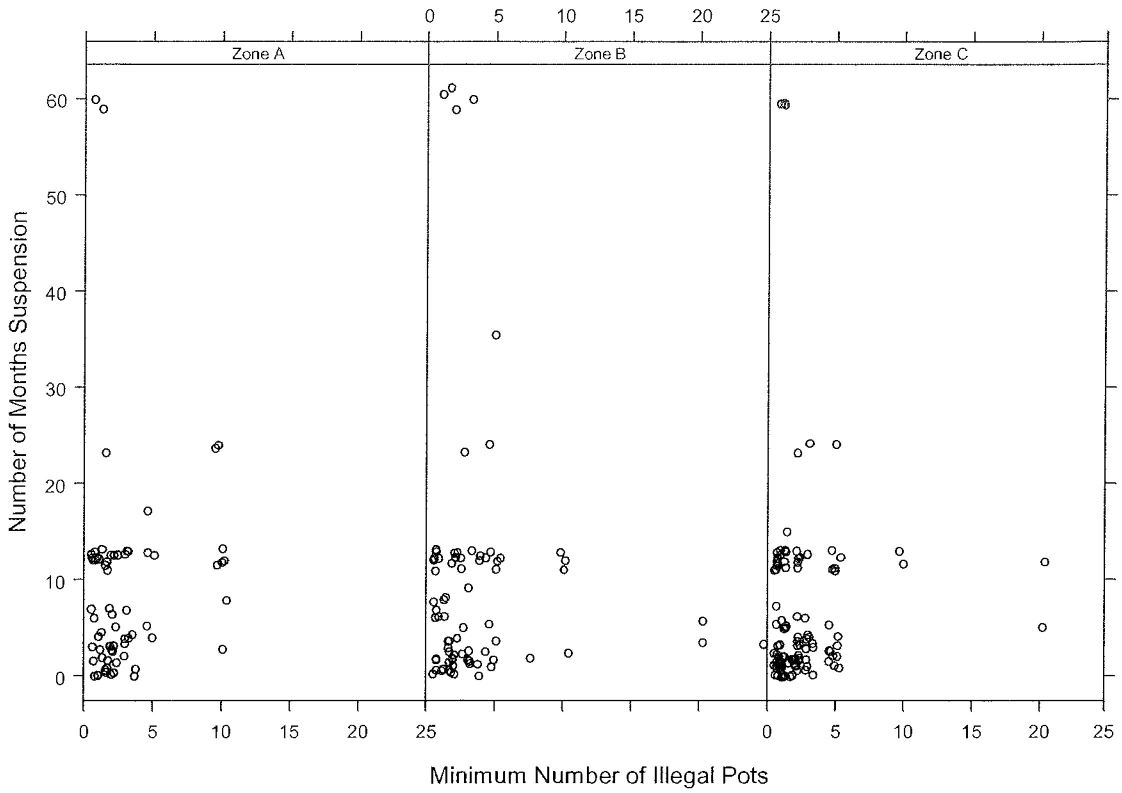


Figure 6.9 Plot of respondent opinion (skippers and licence-holders only) of the number of illegally fished pots warranting a licence suspension, and for what period. A small amount of random noise has been added to data in order to reduce over-plotting of points.

- Most fisher responses fell into two groups. First, many fishers considered a short (< 6 month) licence suspension was warranted for using even a small (< 5) number of illegal pots. A second group of respondents indicated that at least a 12 month suspension was warranted for a small (< 5) number of illegal pots.
- 14 fishers (8, 4 and 2 in Zones A-C) felt that suspension was not warranted until a fisher was discovered to be over-potting by at least 10 pots, at which time they should be given a suspension of between 12-24 months.
- Perhaps of concern, four fishers (2 in Zone B and 2 in Zone C) indicated a suspension should not be imposed unless a fisher was caught fishing 20 pots over entitlement, and that the resulting suspension should be for a relatively short period (12 months or less).
- Finally, a small group of fishers in each zone suggested a five year (60 month) suspension for fishing a few pots over entitlement.

Q17. In your experience, do Fisheries Officers deal with similar infringements and offences in a consistent manner? As far as you know, do they treat people:(circle one)

a) **Always consistently**
b) **Usually consistently**
c) **Often inconsistently**
d) **Don't know, no contact with Fisheries Officers**

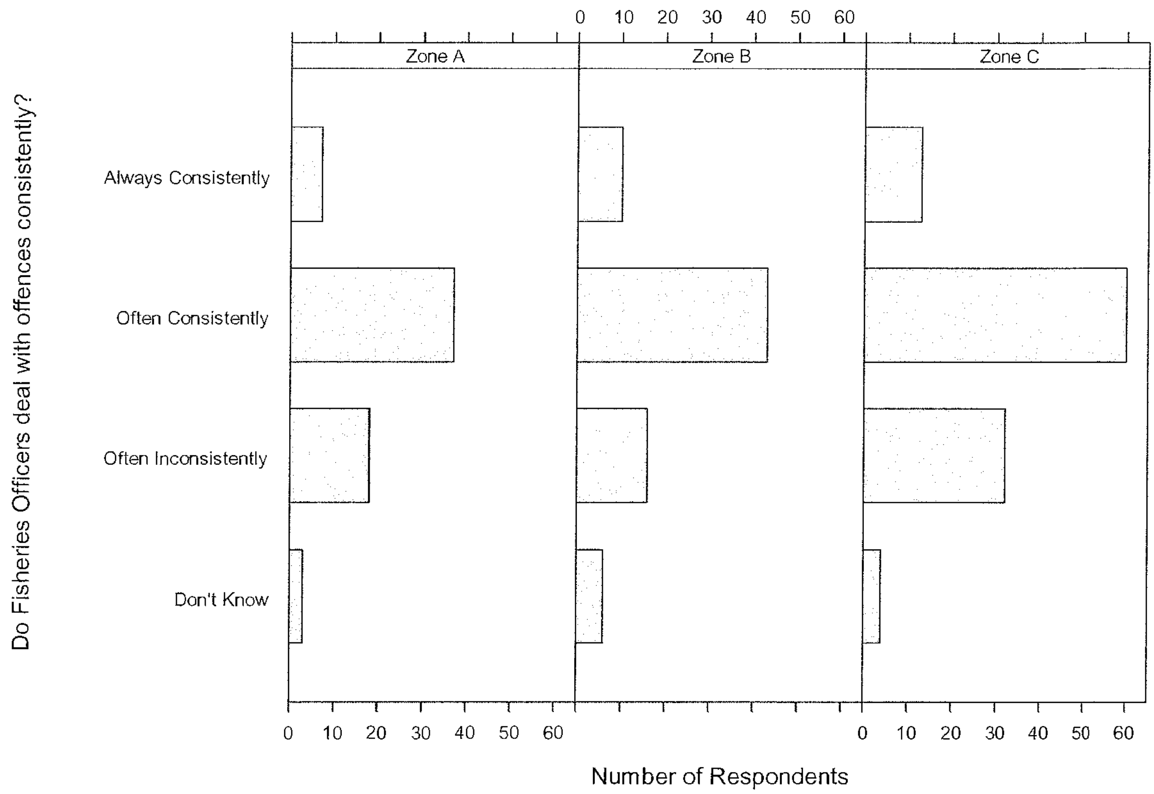


Figure 6.10 Respondent opinion on whether Fisheries Officer deal with similar infringements in a consistent manner, categorised by Zone and restricted to skipper responses only.

- Most respondents, and the pattern was consistent across zones, thought that Fisheries Officers were always consistent (8-13%) or often consistent (49-53%) in the way they deal with similar offences.
- However, a significant number of respondents (25%) in each zone thought that Officers treated fishers inconsistently in respect of similar offences.
- This pattern was consistent across different Employment Status types.

Q18. In your experience, when different people are prosecuted for similar offences, do you think the legal system deals with them in a consistent manner? As far as you know, does the legal system treat people:

a) **Always consistently**
b) **Usually consistently**
c) **Often inconsistently**
d) **Don't know, no contact with the legal process**

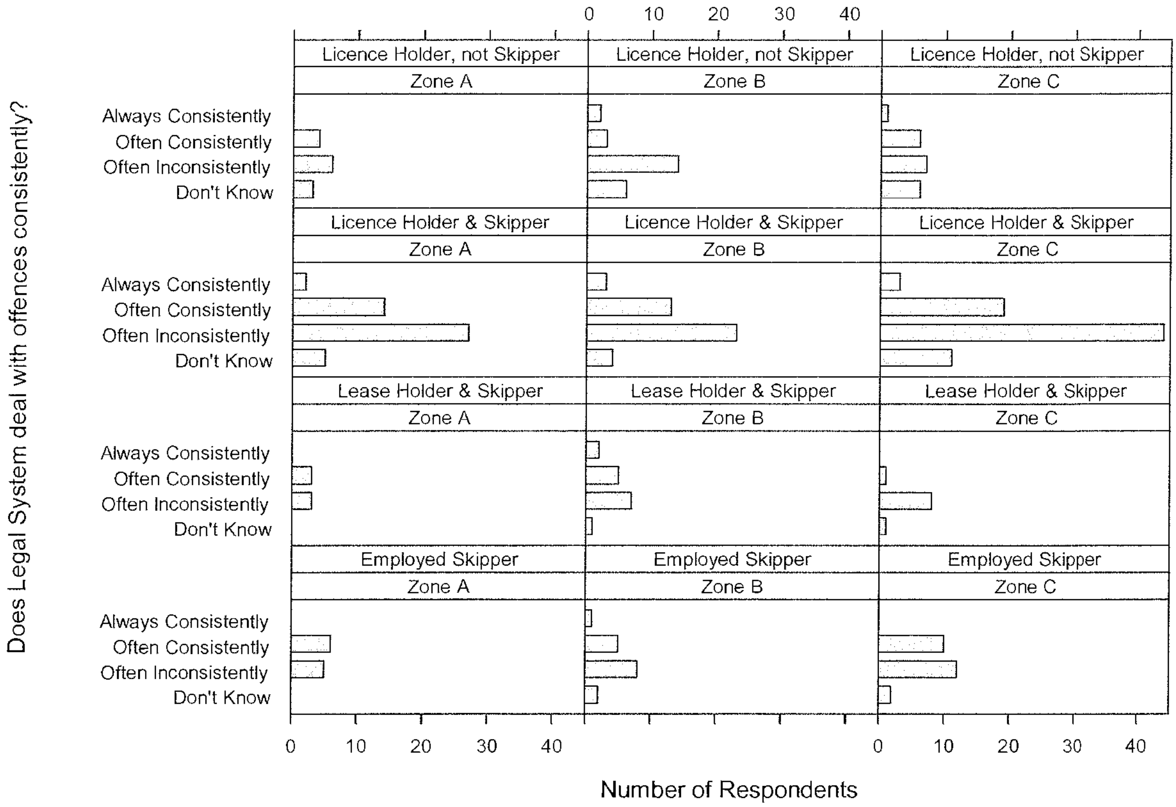


Figure 6.11 Respondent opinion on whether the legal system deals with similar offences in a consistent manner, categorised by Zone and Employment Status (skippers and licence-holders only).

- Most respondents expressed the view that the legal system often dealt with similar offences inconsistently. For example, 52-56% of skippers who are also licence-holders felt outcomes were often inconsistent.

Q19. In your usual fishing area, what percentage of factory consignments of rock lobster do you think would contain undersized lobster? (circle one)

a) 0-5%
b) 5-10%
c) 10-20%
d) 20-30%
e) More than 30%
f) If you answered e), please write percentage ____________

Table 6.11 Respondent opinion on the percentage of factory consigned catch containing undersized rock lobster, categorised by Zone.

		Zone				Total
		A	B	C	Missing	
Percent of Factory Consignments Undersize	0 – 5	90	126	157	10	**383**
	6 – 10	5	5	6	1	**17**
	11 – 20	0	2	2	0	**4**
	21 – 30	1	0	0	1	**2**
	Missing	7	10	12	2	**31**
	Total	**103**	**143**	**177**	**14**	**437**

- Most fishers were of the view that less than 5% of factory consigned catch contained undersized rock lobster, a view supported by results of factory inspected catch presented in Chapter 3.
- No respondent answered e), more than 30%.

Q20. Consider a fisher trading in illegal lobster in your usual fishing area (eg black market sales of undersize or setose lobsters). What chance does a Fisheries Officer have of detecting the activity?

a) Very low chance of detection
b) Low chance of detection
c) Good chance of detection
d) High chance of detection
e) Don't know

Table 6.12 Respondent opinion on the likelihood of Fisheries Officers detecting trading in illegal lobster, categorised by Zone.

		Zone			
		A	B	C	Missing
Chance of Fisheries Officer detecting trade in illegal lobster	Very low chance of detection	14	21	27	2
	Low chance of detection	31	44	56	3
	Good chance of detection	34	55	53	5
	High chance of detection	7	8	13	0
	Don't Know	14	12	22	3
	Missing	3	3	6	1
	Total	**103**	**143**	177	**14**

- Results were remarkably consistent between zones on the opinion of the likelihood of Fisheries Officers detecting trade in illegal lobsters, with a majority of fishers in each zone stating Officers had only a low chance (30-32%) or very low chance (14-15%) of detecting the crime.
- Only 6-7% of respondents thought Fisheries Officers had a high chance of detecting illegal trading in lobsters.

Q21. Consider the following statement: "Commercial rock lobster fishers generally abide by fisheries regulations". Do you: (circle one)

a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

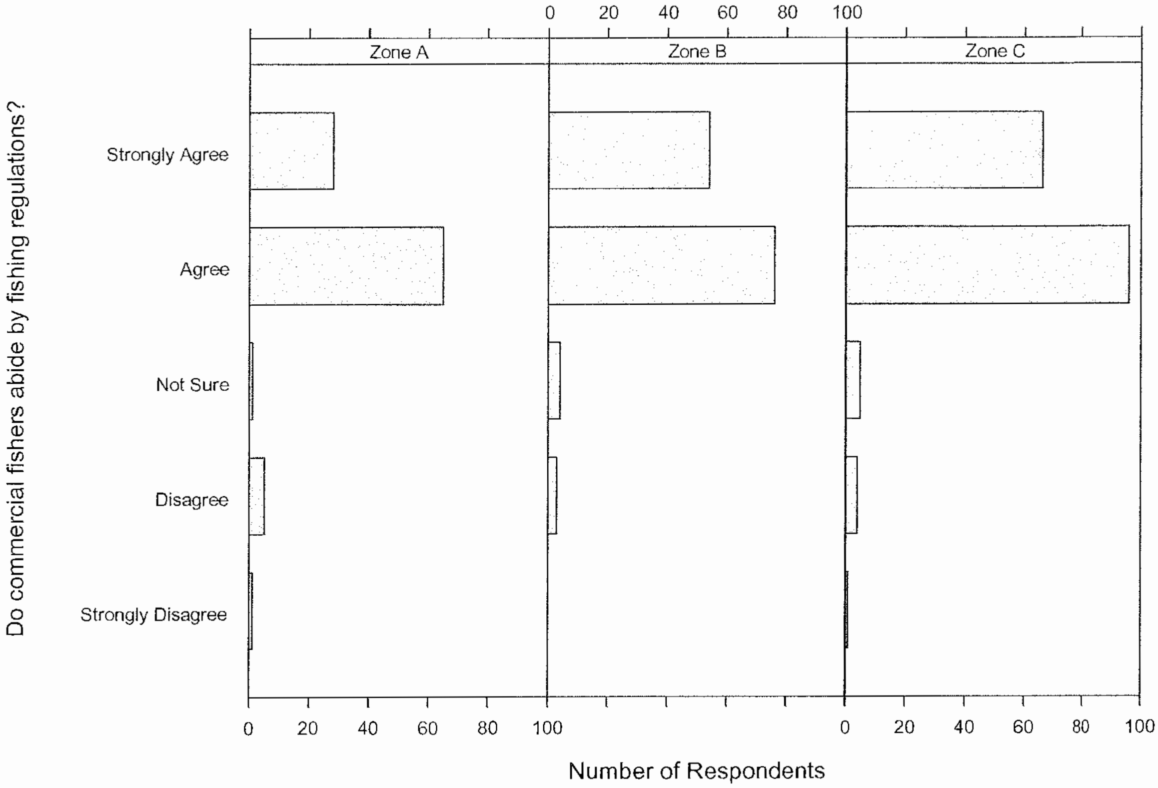


Figure 6.12 Respondent opinion on whether commercial rock lobster fishers generally abide by fishing regulations, categorised by Zone.

- Most respondents in all zones either agreed (55-63%) or strongly agreed (27-38%) that commercial fishers generally abide by regulations. Interestingly, more people were inclined to agree, rather than strongly agree.
- A small number of fishers disagreed that commercial fishers generally abide by regulations, particularly those fishing in Zone A (5% in Zone A compared with 2% in Zone B and C).
- No differences in response profiles were apparent for different Employment Status types, and in particularly no differences existed between crew and skippers.

Q22. Consider the following statement: "Recreational rock lobster fishers generally abide by fisheries regulations". Do you: (circle one)

a) **Strongly agree**
b) **Agree**
c) **Not sure**
d) **Disagree**
e) **Strongly disagree**

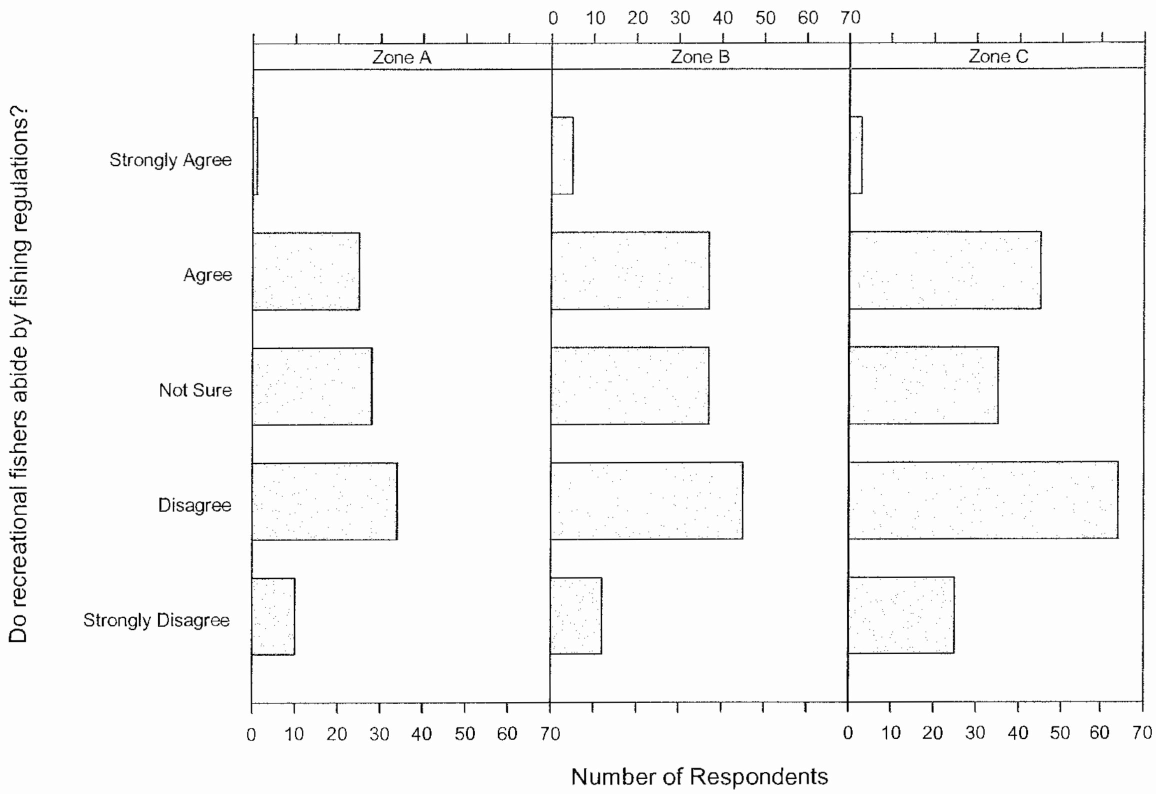


Figure 6.13 Respondent opinion on whether recreational rock lobster fishers generally abide by fishing regulations, categorised by Zone.

- In contrast to the question about whether commercial fishers obey fishing rules (Figure 6.12), perhaps predictably many respondents (41-51% between zones) stated they did not think that recreational fishers generally abide by fishery rules (this phenomenon was also apparent in recreational survey results regarding recreational fishers' opinion of commercial compliance).
- A large proportion of people responded that they were not sure, likely indicating they have little contact with recreational fishers.
- 15 people did not answer question this question.

Q23. If you saw a commercial rock lobster fisher breaking fishing regulations, would you report their actions to Fisheries staff? (circle one)

a) Yes, depending on who it was
b) Yes, depending on the offence
c) Yes, irrespective of who or what offence
d) No. If "No", why not? _____________

Table 6.13 Respondent view on reporting illegal commercial fishing activity, categorised by Zone.

		Zone			
		A	**B**	**C**	**Missing**
If commercial fisher is breaking rules, would you report to Fisheries	**Yes, depending on who it was**	6	6	14	2
	Yes, depending on offence	44	73	72	5
	Yes, irrespective of who or what offence	44	55	73	6
	No	4	4	7	0
	Missing	5	5	11	1
	Total	**103**	**143**	**177**	**14**

- Most respondents indicated they would either report people depending on the offence involved (41-51% across zones) or irrespective of the offence or person involved (38-43% across zones).
- Only a small number of fishers (15 respondents) stated they would not report illegal activities to the Department of Fisheries.
- Of those fishers responding that they would not report illegal activity, two people stated that reporting would have no useful effect, four people listed fear of repercussions, six people stated that it was not their problem or none of their business, and three people stated that they wouldn't ever report anyone.

Q24. Please indicate the number of times your vessel/gear was inspected by Fisheries Officers last season: (circle one, but if greater than 2 inspections please write number)

a) None
b) Inspected once
c) Inspected twice
d) Inspected more than twice
(please specify) _ _ _ _ _
e) Don't know

Table 6.14 Number of times respondents thought their gear/vessel had been checked in the previous season, categorised by Zone and restricted to skipper and/or licence-holder responses only.

		Zone			
		A	B	C	Missing
How many times was your gear inspected last season?	0	27	18	21	1
	1	30	36	53	0
	2	10	22	26	1
	3-5	0	2	5	0
	Don't Know	9	16	19	2
	Missing	2	5	6	0
	Total	**78**	**99**	**130**	**4**

- 40% of respondents in Zone A thought their gear had not been inspected in the previous season, compared with 20% and 23% in Zones B and C.
- Around half of all respondents (45-50%) in each zone thought their gear had been inspected once in the previous season.

Q25. Please indicate the number of times your vessel/gear has been inspected by Fisheries Officers in the last 5 years: (circle one, but if greater than 2 inspections please write number)

a) None
b) Inspected once
c) Inspected twice
d) Inspected more than twice
(please specify)_ _ _ _ _
e) Don't know

Table 6.15 Number of times respondents thought their gear/vessel had been checked in the previous five seasons, categorised by Zone and restricted to skipper and/or licence-holder responses only.

		Zone			
		A	**B**	**C**	**Missing**
How many times has your gear been inspected in the last 5 Years?	**0**	9	7	4	0
	1	11	18	17	0
	2	23	12	27	2
	3-5	12	18	27	0
	6-9	3	2	9	0
	10-15	2	2	5	0
	Don't Know	9	22	24	1
	Missing	4	5	7	0
	Total	**73**	**86**	**120**	**3**

- Fisher perceptions about the number of times their gear has been inspected in the last five years varied considerably between zones. Generally, 60-90% of respondents from each zone thought their gear had been examined between 1 and 5 times in the last five years.
- Only 4% of respondents in Zone C thought their gear had not been inspected in the last five years, compared with 12% and 15% in Zones B and C.

Q26. Opinions regarding licence cancellations, periods of suspension, and court imposed fines.

Question 26 asked fishers to specify, for a range of offences, whether license cancellation was warranted, for what period, and the types of fines a court would impose, and should impose. Unfortunately, most fishers did not complete this question in the manner intended, with many people writing textual answers concerning permanent removal of pots from licences, and fines associated with some multiplier of the number of pots concerned and the cost of pots. The wide range and manner of responses did not provide a sound basis for establishing consistent groups of responses of sufficient sample size, and this question is not reported further.

Q27. Do you think that current penalties for illegal rock lobster fishing are generally: (circle one)

a) Too harsh
b) About right
c) Not harsh enough
d) Don't know

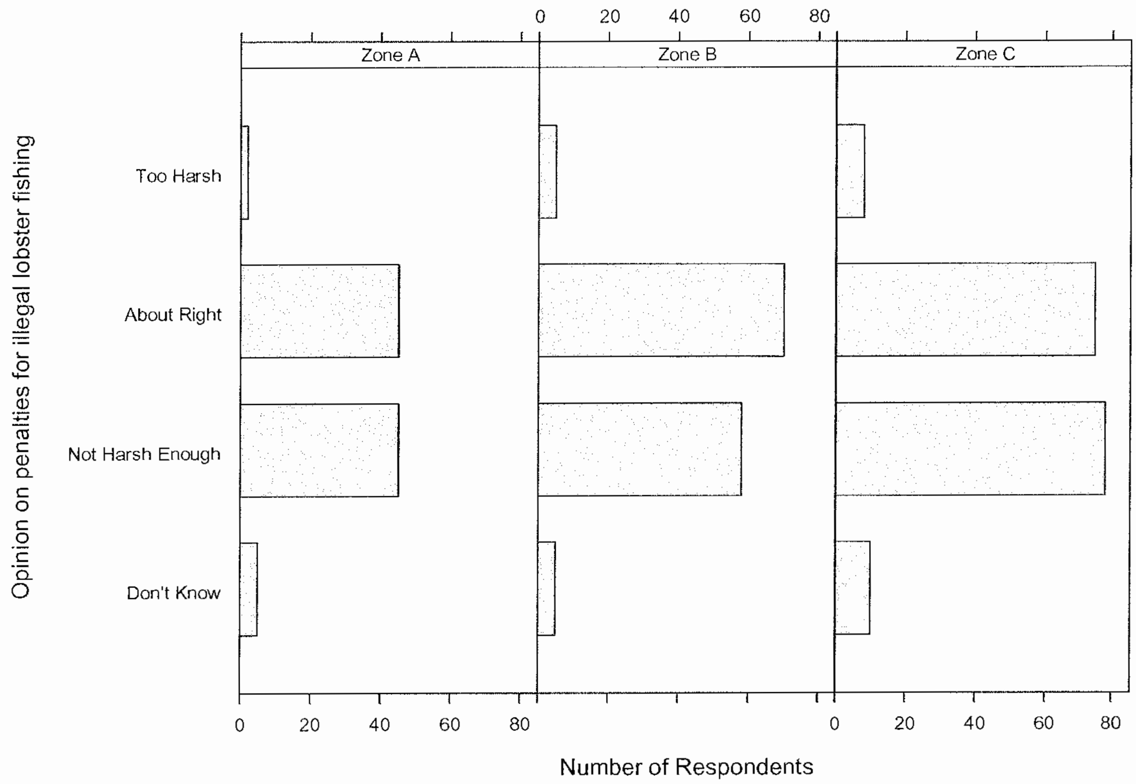


Figure 6.14 Respondent opinion about penalties for illegal rock lobster fishing, categorised by Zone.

- Opinions about the current penalties for illegal rock lobster fishing were equally split across zones between those who thought penalties were about right (42-49%), and those who thought penalties were not harsh enough (41-44%).
- Only a small number of fishers (2-5%) from each zone thought that current penalties were too harsh.

Q28. How do you think recreational rock lobster fishers should be able to catch lobster: (tick more than 1 answer if appropriate)

Free-diving	SCUBA	Pots
Hookah	Spear	Loops
Shepherd's crook	Other (please specify)	______________

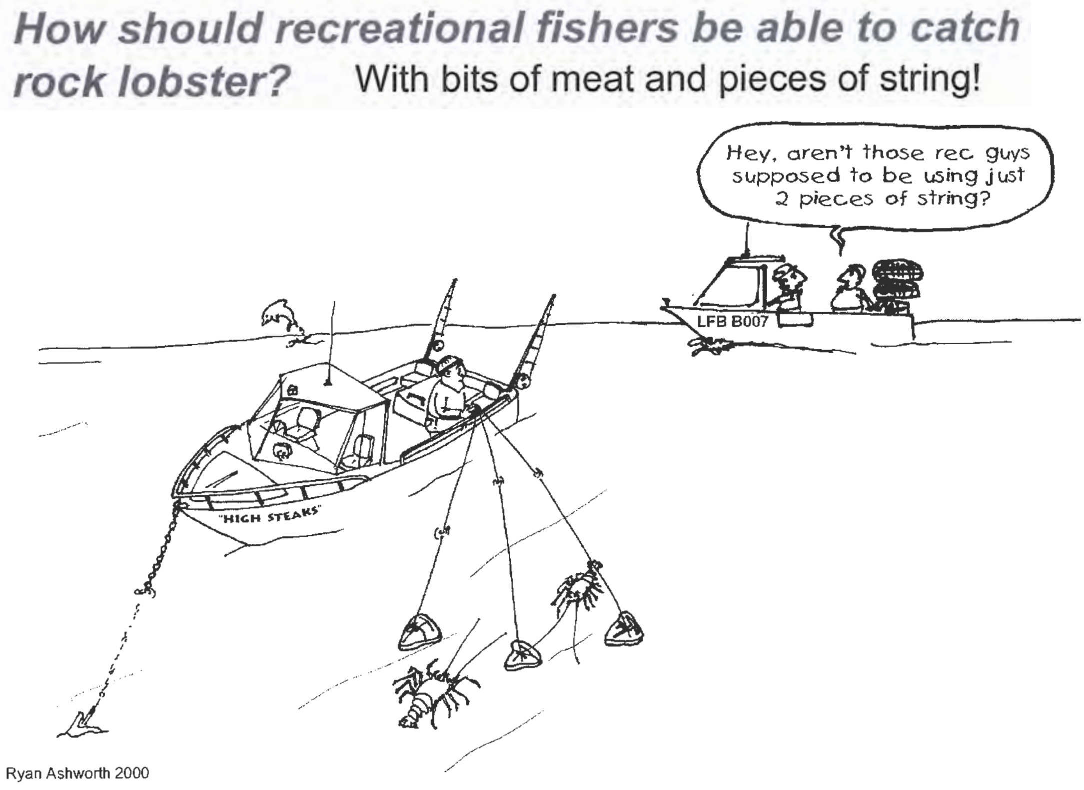
Table 6.16 Respondents view on how recreational fishers should be allowed to catch rock lobster, categorised by Zone. Table entries represent percentages calculated from within zone sample sizes of 103 (A), 143 (B) and 177 (C), excluding entries for missing values which are recorded as numbers of respondents (n). Note that fishers were able to answer with more than one choice.

		Zone				
		A	B	C	Missing	
		Yes (%)	Yes (%)	Yes (%)	Yes (n)	No (n)
How should recreational fishers be allowed to catch lobsters?	Free-diving	37	43	40	2	12
	SCUBA	16	22	27	2	12
	Pots	91	93	92	14	0
	Hookah	7	13	10	1	13
	Spear	0	2	0	0	14
	Loops	23	20	33	2	12
	Shepard's Crook	7	7	12	0	14

- 37-43% of all respondents thought recreational fishers should be allowed to fish for lobster by free-diving, however only 16-27% felt recreational fishers should be able to dive to catch lobster using SCUBA. Only a small proportion of respondents (7-13%) felt diving using hookah (surface-fed compressed air) was an appropriate way for amateur fishers to take lobster.
- Most respondents (> 90%) thought that recreational fishers should be able to take rock lobster using pots.

- Spears, loops and shepard's crooks are devices used by divers to assist capturing lobster; and commercial fishers were generally of the opinion that recreational fishers should not be able to use these apparatus. An exception was the use of loops (acceptable to 20-33% of respondents), perhaps because commercial fishers consider these to be the least destructive mechanical device available to divers.
- This question provided respondents with space to indicate "Other" methods they thought should be available recreational fishers to capture lobster. Many respondents wrote that recreational fishers should not be allowed to catch lobsters by any other means. From Zones A-C, 77 (75%), 97 (68%) and 130 (73%) respondents answered in this way.

Amongst the many serious survey responses received, I occasionally discovered lighter moments from wags within the fishing industry. While perhaps not particularly generous to the recreational sector, one respondent suggested recreational fishers should only be able to catch lobsters using pieces of meat on bits of string! (the graphic was developed for use on the annual rock lobster tour when presenting results to stakeholders).



Q29. If you see a recreational fisher breaking the rules, what do you do? (circle more than 1 answer if appropriate)

a) Do nothing about it
b) Report the illegal activity to Fisheries WA
c) Talk to the person directly
d) Tell other fishers about what you witnessed
e) Don't know
f) Other (please specify) _____________________

Table 6.17 Respondent view on the action they would take after observing a recreational fisher breaking regulations, categorised by Zone. Column totals exclude "Other" responses*.

		Zone				Total
		A	B	C	Missing	
If you see a recreational fisher breaking rules, what do you do?	a) Do Nothing	2	6	7	0	**15**
	b) Report to Fisheries	46	67	71	8	**192**
	c) Talk Directly to Person	7	16	17	0	**40**
	d) Tell Other Fishers	10	15	13	0	**38**
	b) and c)	11	10	19	1	**41**
	b), c) and d)	4	5	16	2	**27**
	b) and d)	12	16	18	1	**47**
	c) and d)	2	4	6	1	**13**
	e) Don't Know	4	2	7	1	**14**
	Other – cut offenders floats off	43	51	58	3	**155**
	Other – do nothing, waste of time	19	25	23	3	**70**
	Other – monitor before reporting	20	31	62	4	**117**
	Missing	5	2	3	0	**10**
	Total*	**103**	**143**	**177**	**14**	**437**

- Most respondents indicated they would report observed incidences of illegal activity to enforcement personnel, but might also talk directly to the person or tell other fishers about the incident.

- Perhaps of concern, a substantial number of fishers (42%, 36%, 33% in Zones A-C) indicated they would take direct action against an offending fisher by cutting the floats off the offender's pots.
- A significant number of people suggested they would monitor any observed activity to determine if it was an ongoing problem before deciding to take action.

Q30. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who trade (sell or barter) in oversized female lobster? Would they think the practice is: (circle one)

a) Very wrong
b) Basically wrong, but OK if it's not too many
c) Fine if you can get away with it
d) Not sure

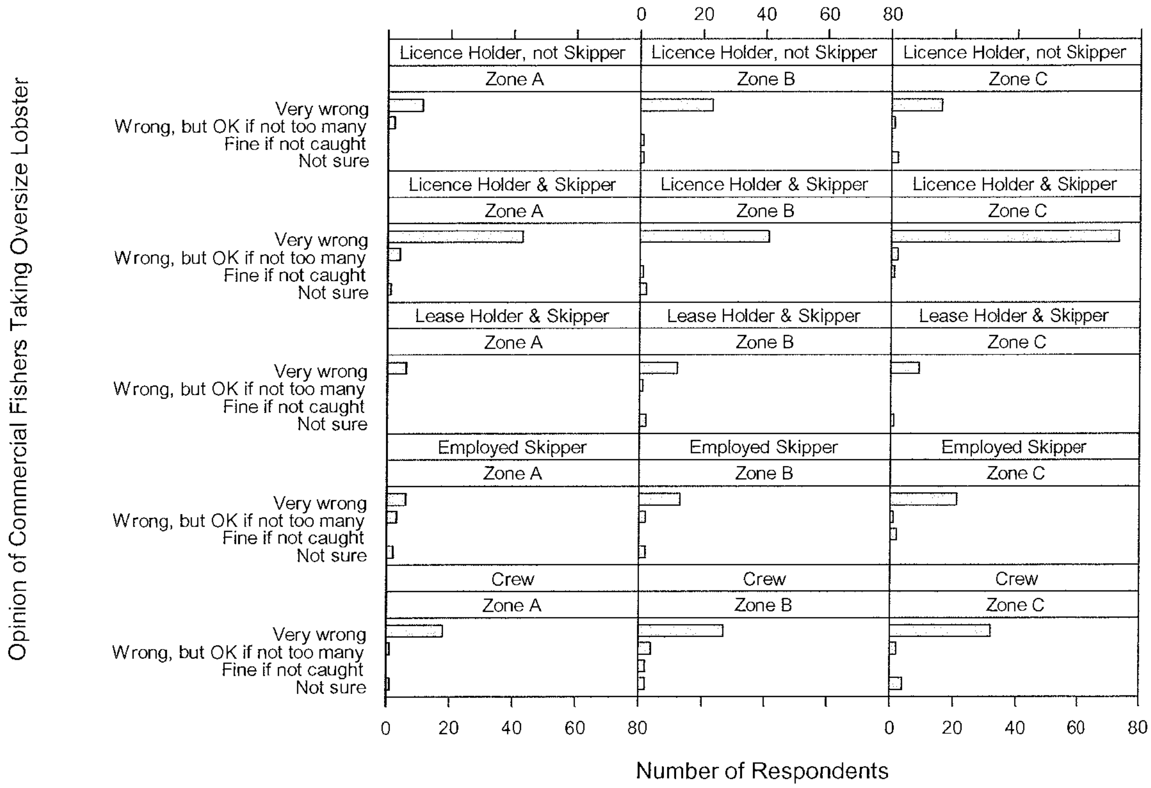


Figure 6.15 Respondent view on the attitude of commercial fishers towards those who trade in oversize female lobster, categorised by Zone and Employment Status.

- The overwhelming majority of respondents indicated that a majority of commercial fishers they knew considered it very wrong to trade in oversize female rock lobster.

- Less encouragingly, a small number of fishers from each zone thought that some commercial fishers thought it was acceptable to deal in oversize female lobster. Although absolute numbers are low, employed skippers were over-represented compared with other employment types.

Q31. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who trade in undersized lobster? Would they think the practice is: (circle one)

a) **Very wrong**
b) **Not sure**
c) **Fine so long as it's not too many**
d) **Fine if you can get away with it**
e) **Basically wrong, but OK depending on circumstances**

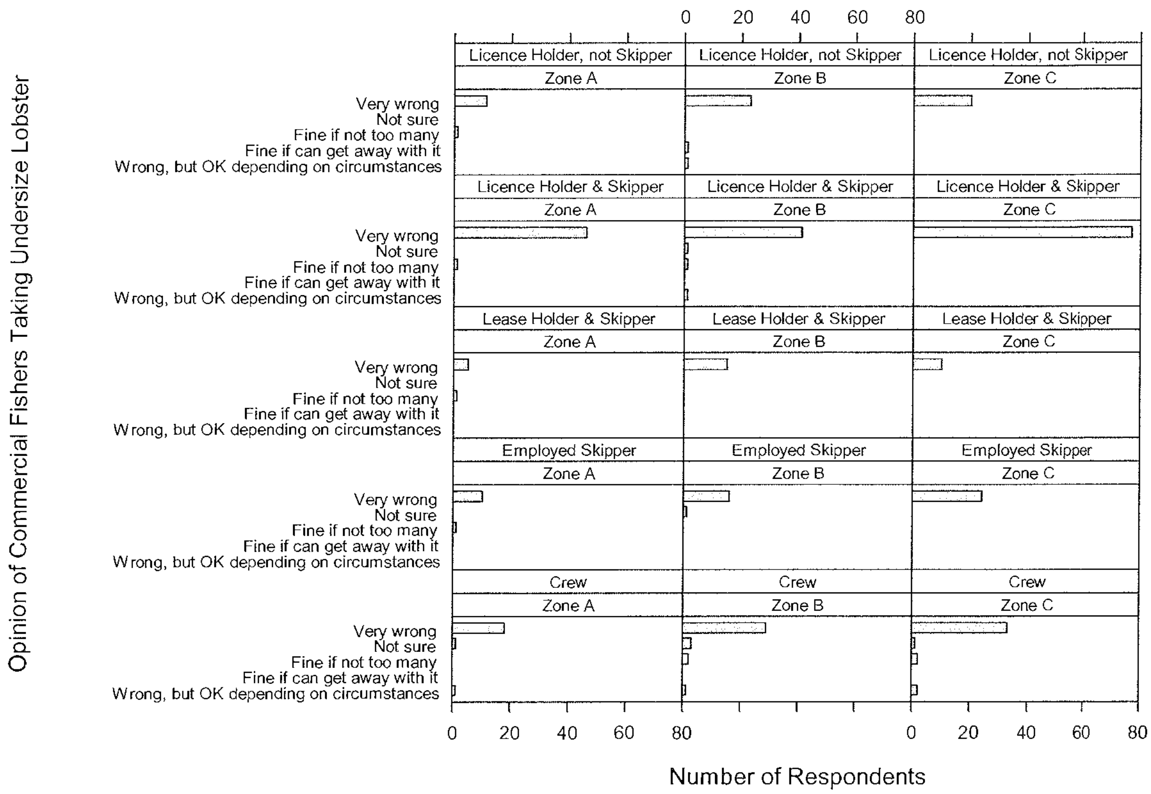


Figure 6.16 Respondent view on the attitude of commercial fishers towards those who trade in undersize lobster, categorised by Zone and Employment Status.

- The overwhelming majority of respondents indicated that a majority of commercial fishers they knew considered it very wrong to trade in undersized rock lobster, although a small number did indicate that some commercial fishers thought it acceptable depending on circumstances.

Q32. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who interfere with other fishers' pots? Would they think the practice is: (circle one)

a) **Very wrong**
b) **Fine if you can get away with it**
c) **Not sure**
d) **Basically wrong, but OK depending on circumstances**
If you answered d), in what circumstances is it OK? ____________________

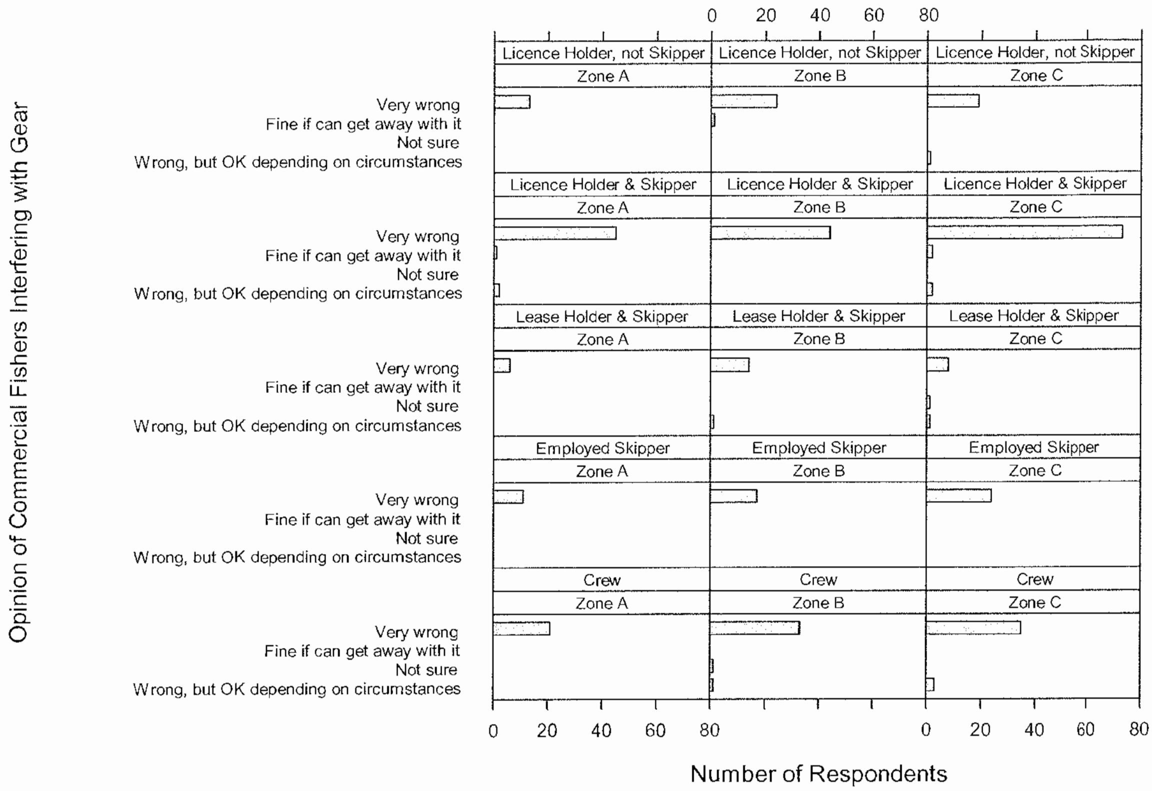


Figure 6.17 Respondent view on the attitude of commercial fishers towards those who interfere with other fishers' pots, categorised by Zone and Employment Status.

- A majority of respondents indicated that most commercial fishers they knew considered it very wrong to interfere with another fisher's gear.

A substantial number of fishers provided circumstances in which they thought interfering with another fisher's gear was acceptable, even though they did not indicate response *d) Wrong, but OK Depending on Circumstances* for the question. Most of these fishers indicated response a), "Very wrong", before proceeding to record a specific situation where gear interference is considered acceptable (Table 6.18). Presumably, these respondents thought other's interfering with their gear was "very wrong", but that circumstances could exist that would legitimise them interfering with someone else's gear!

Table 6.18 Circumstance in which commercial fishers feel it is justifiable to interfere with another fisher's gear.

Circumstances when acceptable to interfere with another's gear?		Zone				Total
		A	B	C	Missing	
	a) Revenge	24	33	43	3	**103**
	b) Another's pot tangled with own	5	3	6	1	**15**
	c) Return pot with missing float	0	5	4	2	**11**
	d) If being "bombed"	20	18	12	4	**54**
	e) Cut off float by accident	0	1	1	0	**2**
	f) Over-potting	21	35	47	2	**105**
	g) Return misplaced gear	4	6	20	1	**31**
	Missing	29	42	44	1	**116**
	Total	**103**	**143**	**177**	**14**	**437**

- Around 24% of respondents from each zone thought that revenge was an acceptable reason for interfering with another fisher's pots.
- Similarly, 19%, 13%, and 7% of fishers from Zones A-C thought that being "bombed" justified interfering with other people's gear. "Bombing" refers to the practice of placing pots in immediate proximity to another fisher's pots, creating the potential for a dispute over fishing territory or gear entanglement.
- For Zones A-C, 20%, 24% and 27% of respondents considered it reasonable to interfere with another fisher's gear if that fisher was thought to be over-potting.

Q33. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who fish with more than their pot entitlement (overpot)? Would they think the practice is: (circle one)

a) **Very wrong**
b) **Basically wrong, but OK provided it's only a few pots**
c) **Fine if you can get away with it**
d) **Not sure**

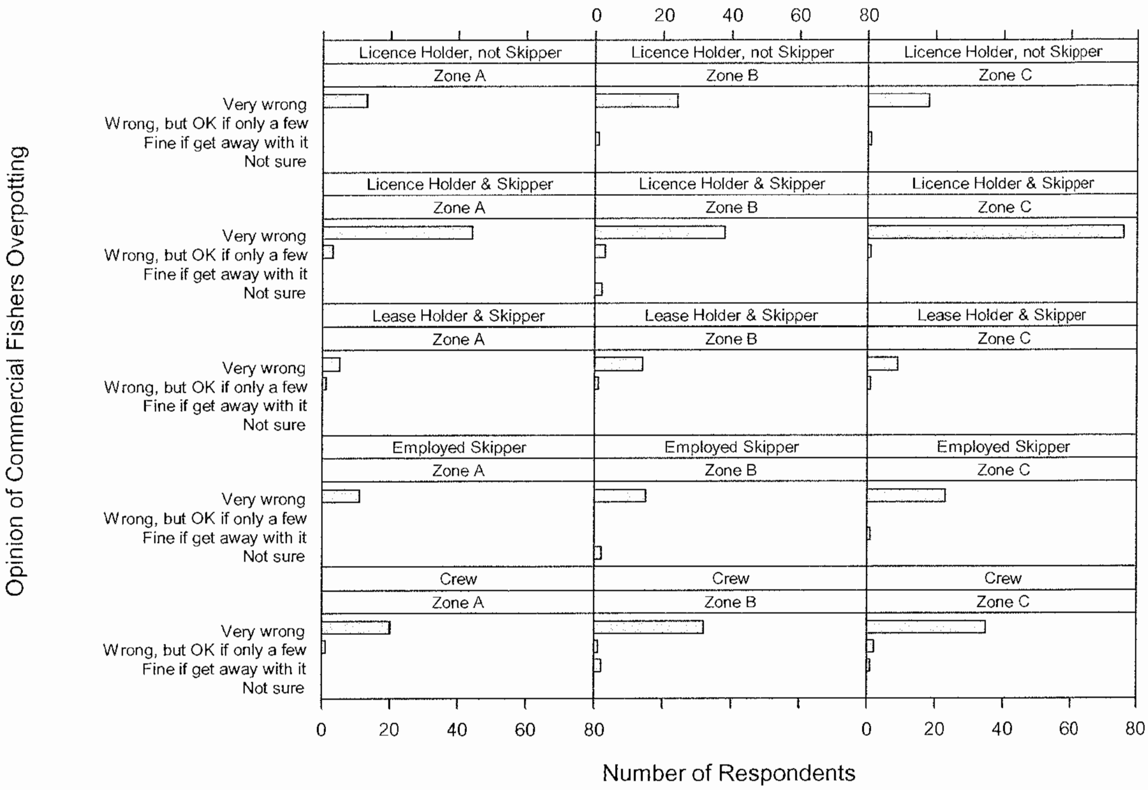


Figure 6.18 Respondent view on the attitude of commercial fishers towards those who fish with more pots than their entitlement allows, categorised by Zone and Employment Status.

- A majority of respondents indicated that most commercial fishers they knew considered it very wrong to fish with more pots than an entitlement allows.
- A small number of respondents indicated that some commercial fishers they knew considered over-potting basically wrong, but acceptable if only using a few pots in excess of entitlement. For example, from Zones A-C, four, four and two licensees who are also skippers indicated that over-potting is essentially an acceptable practice.
- Interestingly, two non-fishing licence-holders (one from each of Zone B and C) indicated that over-potting is acceptable providing it is remains undetected, a view hopefully not held by their skippers.

Q34. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who trade (sell or barter) in setose lobster? Would they think the practice is: (circle one)

a) Very wrong
b) Basically wrong, but OK if it's not too many
c) Not sure
d) Fine if you can get away with it

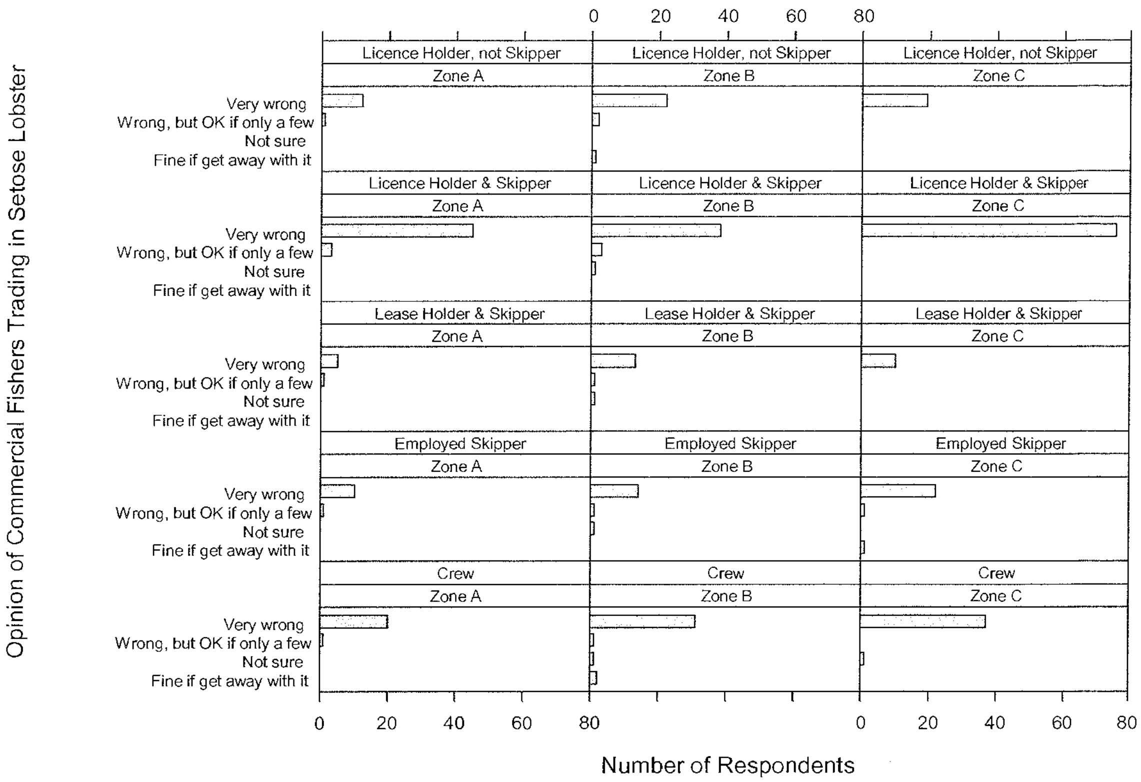


Figure 6.19 Respondent view on the attitude of commercial fishers towards those who trade in setose lobster, categorised by Zone and Employment Status.

- Most respondents were firmly of the opinion that a commercial operator trading in setose lobsters was very wrong.
- Notably, in Zones A and B a small number of licence-holders who are also skippers indicated that, among commercial fishers they know, they thought trading in setose lobsters was basically wrong, but acceptable if not on a large scale. This pattern was not evident in Zone C, where all respondents indicated the practice was very wrong.

Q35. Consider the statement: "You are likely to be caught by Fisheries Officers if you occasionally include a small number of illegal animals in a factory consignment of catch". Do you: (circle one)

a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

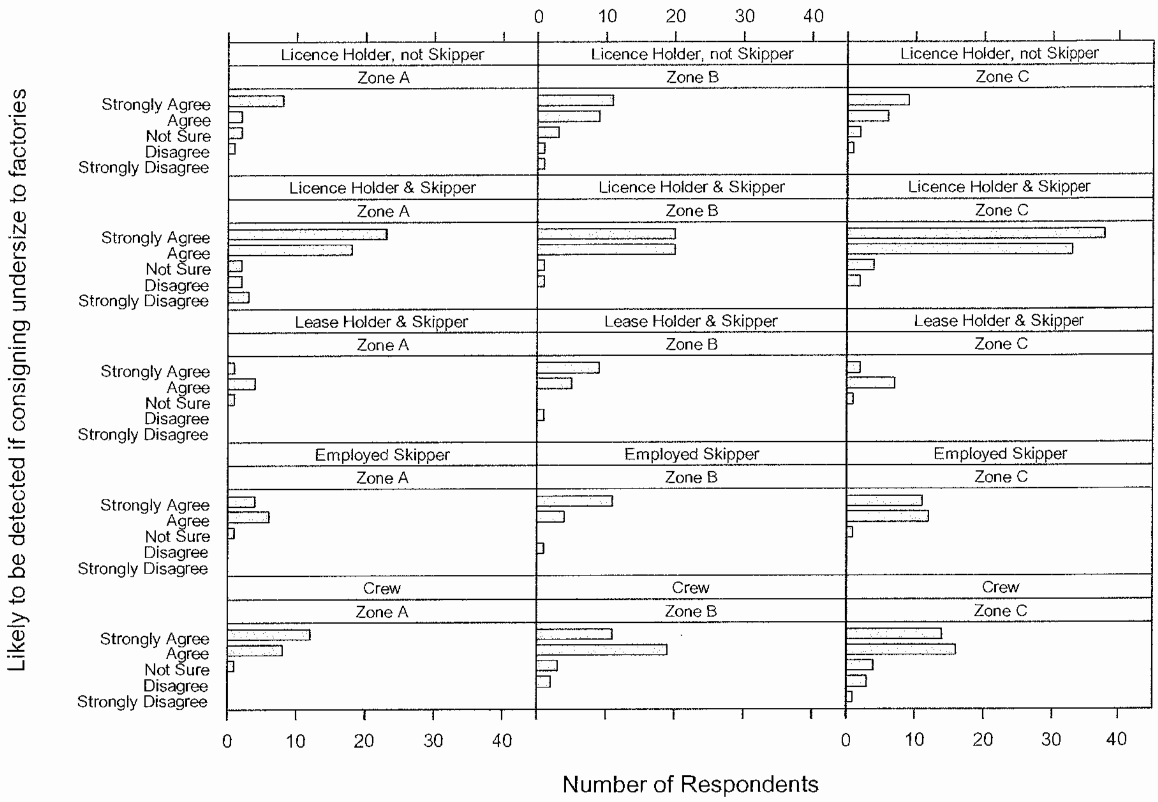


Figure 6.20 Respondent view on the likelihood of being detected if consigning small numbers of illegal animals amongst legal catch, categorised by Zone and Employment Status.

- A majority of fishers were of the opinion that Fisheries Officers would detect a fisher occasionally consigning a small number of illegal animals in factory consigned catch, however a small number disagreed with this assertion. Summed across zones, 15 respondents disagreed that Officers currently detect people occasionally consigning illegal animals, and 5 fishers strongly disagreed.

Q36. Fishers tell us that the following issues are considered important in the commercial rock lobster fishery. Please number these according to the priority you think Fisheries Officers should give each issue (1 for highest priority, 10 for lowest priority - please use each number only once)

Issue	Number
Education of commercial fishers about fishing regulations	
Commercial fishers trading in undersize lobsters	
Illegal pot-pulling of commercial pots by recreational fishers	
Commercial fishers trading in oversize female lobster	
Commercial fishers using more pots than their entitlement	
Recreational divers poaching rock lobster from pots	
Commercial fishers trading in mature female lobster (setose, berried)	
Enforcing recreational fisher bag limits	
Commercial fishers poaching lobster from other commercial fishers pots	
Commercial fishers interfering with other commercial fishers' pots (eg dragging away from their fishing grounds, cutting floats, etc.)	

Despite clear instructions, many fishers did not complete this question correctly, likely because they were not willing to uniquely rank particular issues they felt were equally important. Many felt that several of the issues listed should be afforded a high priority by enforcement staff; for example, some respondents marked "1" against three or four of the issues, and "2" against all others. Of the 392 people responding to the question, 294 (75%) answered in the correct manner. I have included all responses in results, however, since those fishers who answered incorrectly in the way described above still provided meaningful information, albeit that they provided tied rankings for particular issues.

The following dot points refer to Figure 6.21 (Issues 1-5) and Figure 6.22 (Issues 6-10):

- Many results appear mixed, not providing the discrimination between issues that had been hoped when designing the survey. This is likely due to the diversity of opinion in the industry regarding the importance of different issues.
- Two results are clear: i) the primary issue of significance to respondents was the problem of commercial fishers poaching lobster from other commercial pots; and ii) the problem of least significance to respondents was the issue of educating commercial fishers (although a significant number of respondents did indicate education to be their primary concern).
- Recreational fishers pulling commercial pots, and recreational divers poaching from commercial pots, are regarded as higher priority issues in Zone C than in other zones.

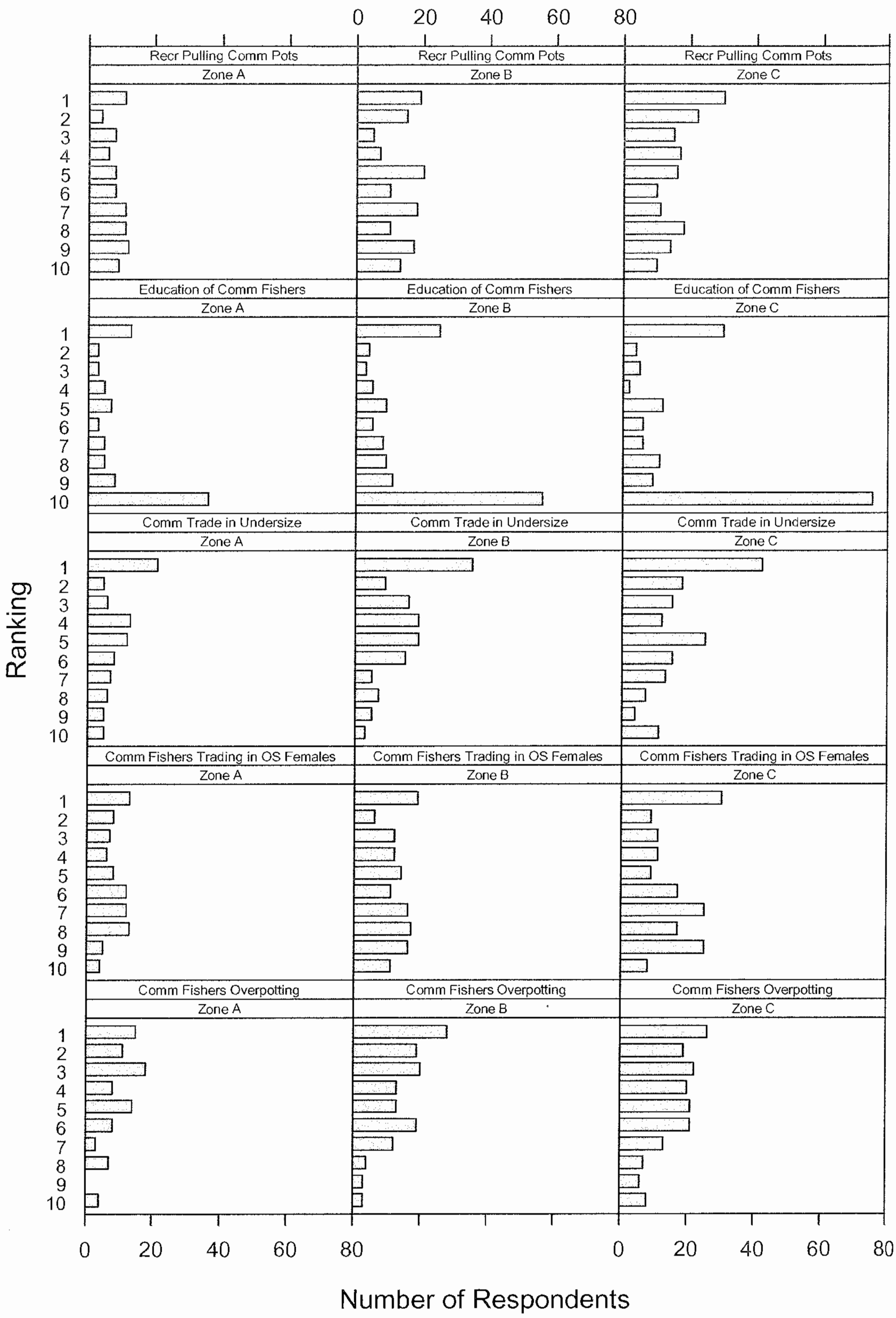


Figure 6.21 Fisher views on priorities for enforcement for issues 1-5 (Q36), categorised by Zone.

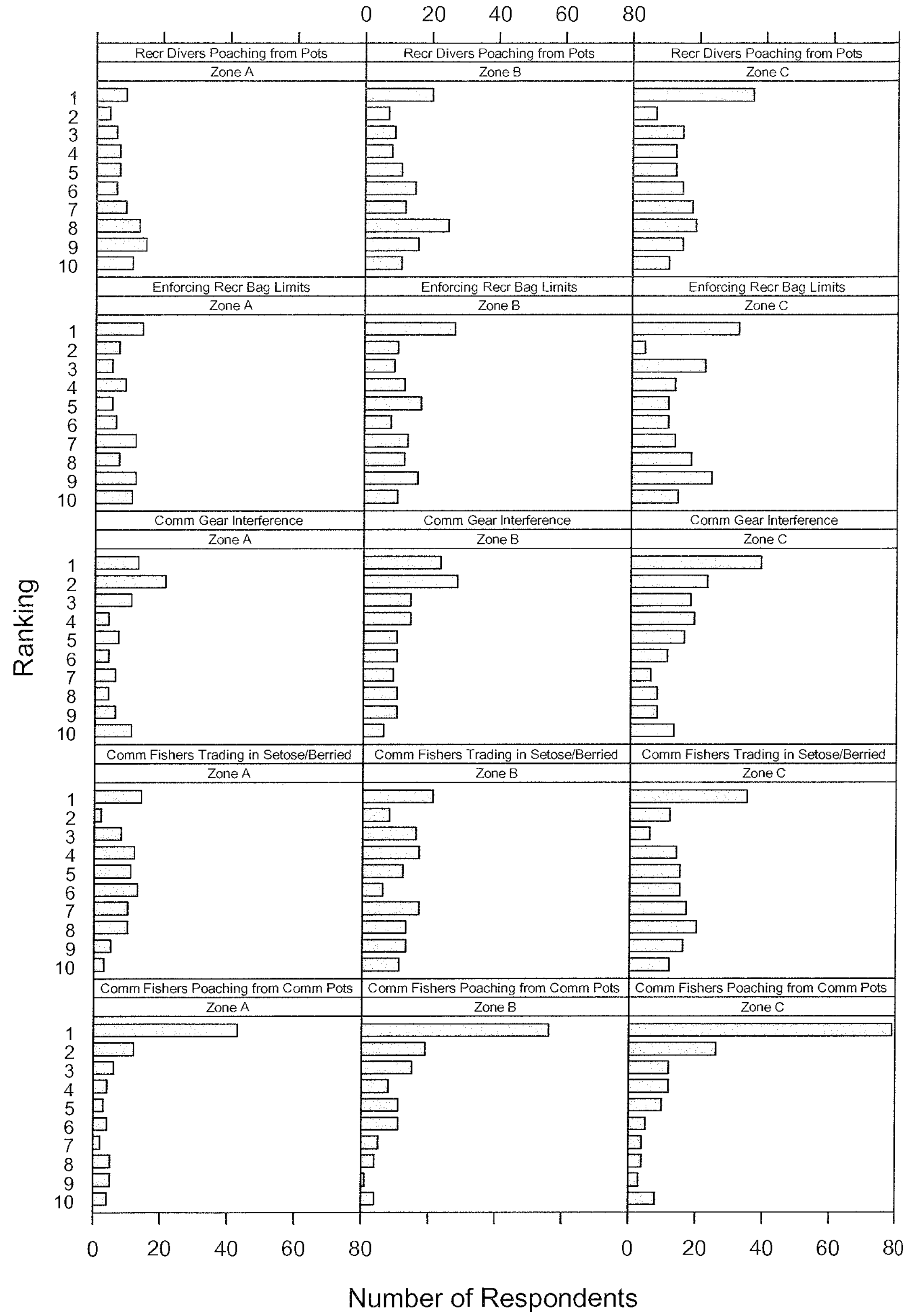


Figure 6.22 Fisher views on priorities for enforcement for issues 6-10 (Q36), categorised by Zone.

Q37. Are there any issues you feel are important which were not listed in Q36?

Table 6.19 Enforcement issues, additional to those listed in Q36, considered important to commercial fishers, categorised by Zone.

		Zone		
		A	B	C
Other issues considered important	a) Gauging lobster straight away	3	0	2
	b) Illegal Zone Fishing	2	5	0
	c) Sale of lobster by recr fishers	1	3	6
	d) Education of recr fishers	1	3	1

A number of respondents noted issues additional to those listed as part of Question 36. Table 6.19 lists those issues mentioned by at least five respondents. Other issues with responses less than five included (bracketed numbers indicate number of responses):

> Fishers taking undersize lobster home to eat themselves (2), Teaching Fisheries Officers to handle lobster properly (4), Boats working other boats gear without a break-down agreement (1), Stretching of lobsters to fit the gauge (2), Pulling pots before starting time (1), Stealing pots and fishing gear (3), Illegal pot-pulling of recreational pots by commercial fishers (2), Trawlers trawling over coral at the Abrohlos Island (2), Ensuring recreational fishers only use two pots (3), Safety (1), Keeping 76's mm lobster in holding pots prior to change of minimum size (2), Recreational divers storing lobsters in illegal pots (1), Recreational fishers interfering with commercial fishers' pots (1), Pollution/ocean littering (1), Recreational fishers spearing undersize lobster (1), and Recreational divers diving too close to commercial pots (1).

Q38. Consider the maximum legal size rules for female western rock lobster. Do you think: (circle one)

a) **Maximum size should be larger**
b) **Maximum size is about right**
c) **Maximum size should be smaller**
d) **Shouldn't be a maximum limit at all**
e) **Don't know**

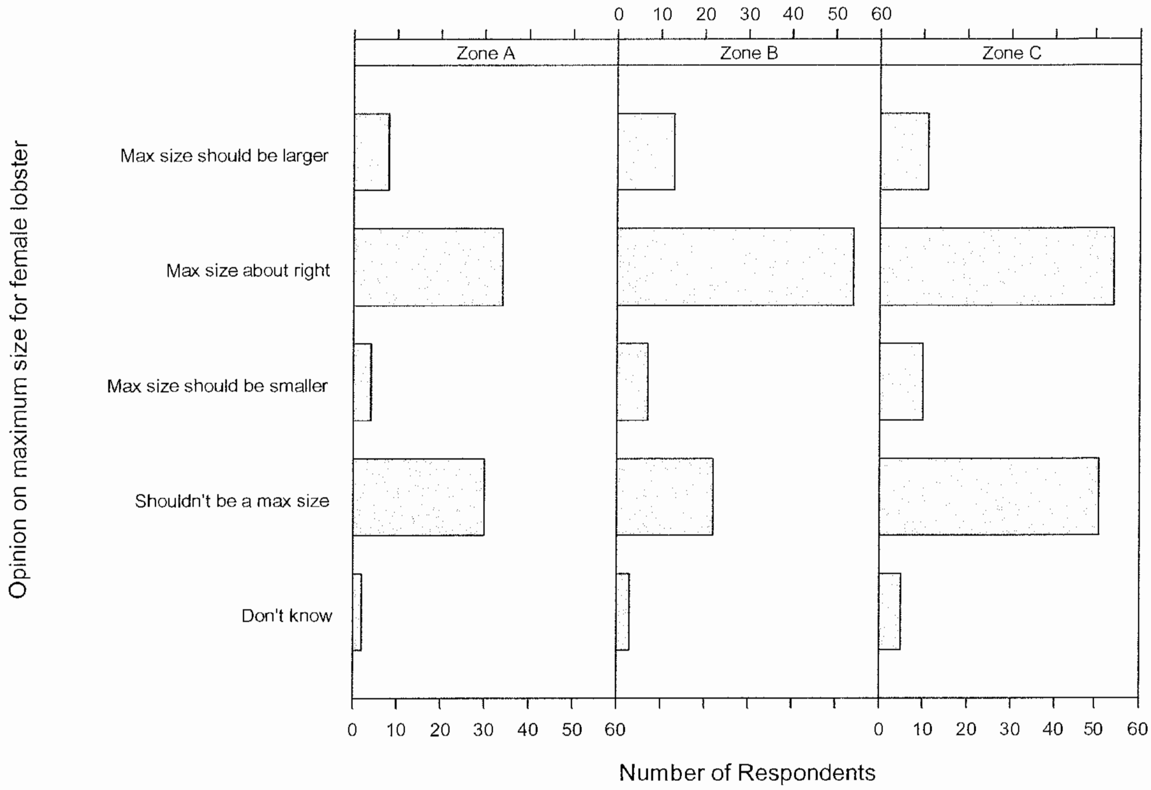


Figure 6.23 Respondent view on maximum size rule for female lobster, categorised by Zone and restricted to skipper and/or licence-holder responses only.

- Generally, respondents were split between the opinion that the maximum size for female lobster was "About right" (45%) and "Shouldn't be a maximum size" (35%). This effect was particularly apparent for Zones A and C. Zone B differed, however, with over 50% of respondents feeling the maximum size is about right, and only 20% thought there shouldn't be a maximum size.

Q39. Consider the rules restricting the start-times for pulling lobster pots. Do you think: (circle one)

a) **Start-times are OK**
b) **Start-times should be earlier**
c) **Start-times should be later**
d) **Shouldn't be a restriction on start-times**
e) **Start times should be restricted to daylight hours**
f) **Don't know**

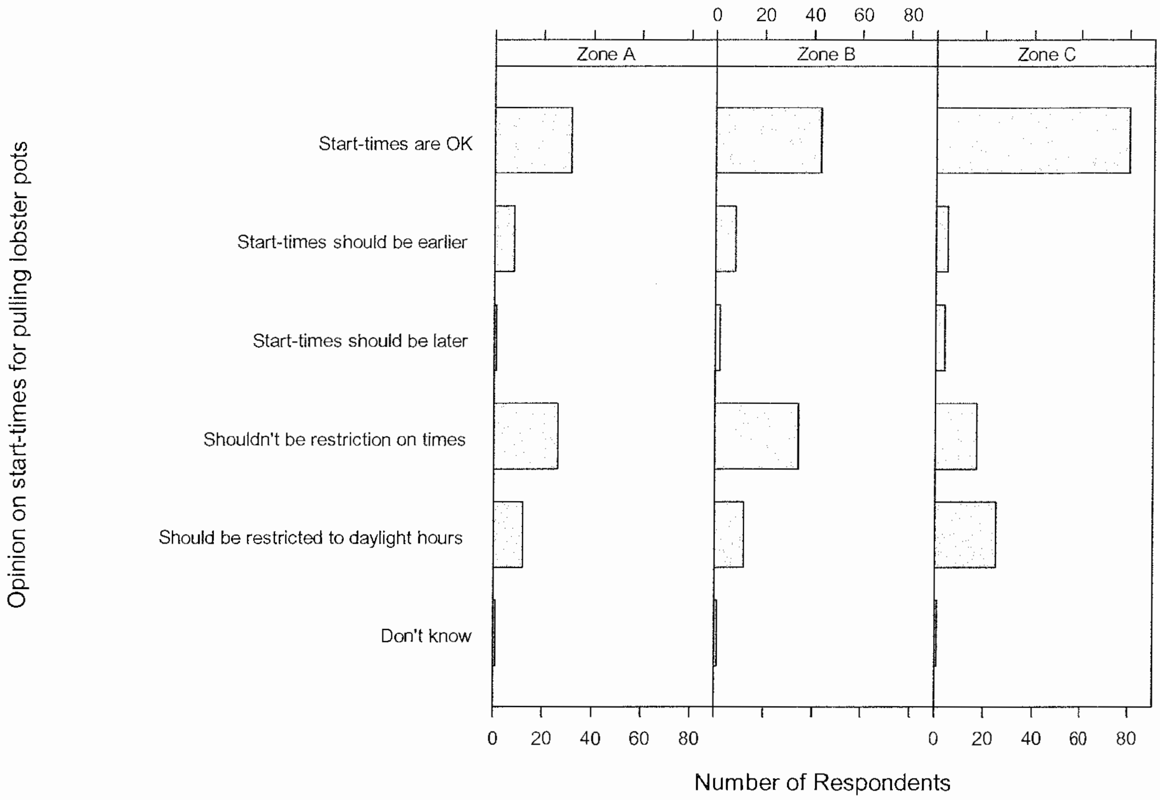


Figure 6.24 Respondent opinion on rules restricting start-times for pulling pots, categorised by Zone and restricted to licensees and/or skippers only.

- Most respondents (45-60%) thought current start-times for pulling pots are acceptable, although there are evidently some divergent views among industry members. Significant numbers of fishers in Zones A and B (around 30%) thought there should not be any restriction on start-times for working fishing gear, compared with only 13% of respondents holding this view in Zone C.

Q40. In your experience, what percentage of recreational fishers do you think illegally take lobsters from commercial fishers' pots? (circle one)

a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%, write percentage: _________
f) Don't know

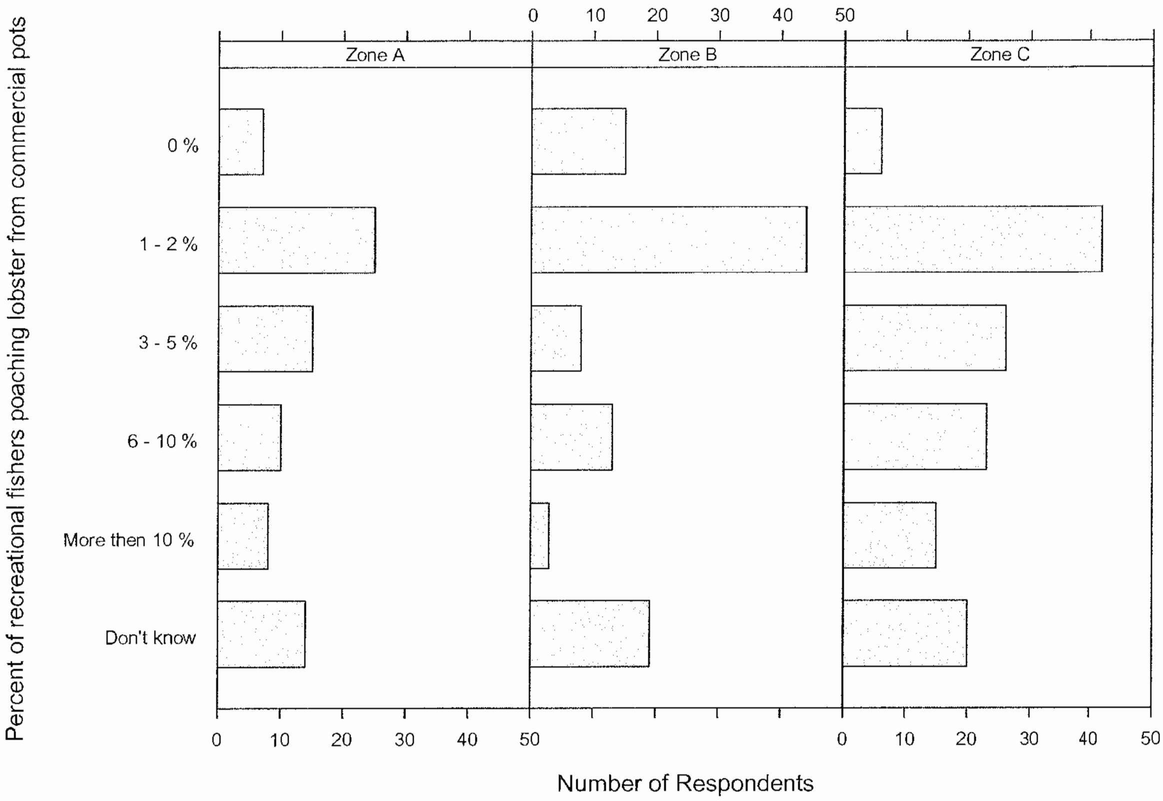


Figure 6.25 Respondent opinion about the percentage of recreational fishers that illegally take lobster from commercial pots, categorised by Zone and restricted to licensees and/or skippers only.

- Commercial fishers generally indicated an opinion that 1-2% of recreational fishers illegally pull commercial fishing gear, although significant numbers indicate they think a higher percentage is more likely.
- Of those fishers who indicated more than 10%, 17 people said 11-25%, and 10 people said 26-50%.

<u>Q41. In your experience, what percentage of recreational fishers do you think interfere with commercial fishers' pots (move or cut floats)? (circle one)</u>

a) **0%**
b) **1-2%**
c) **3-5%**
d) **6-10%**
e) **If more than 10%, write percentage: _ _ _ _ _ _ _ _ _**
f) **Don't know**

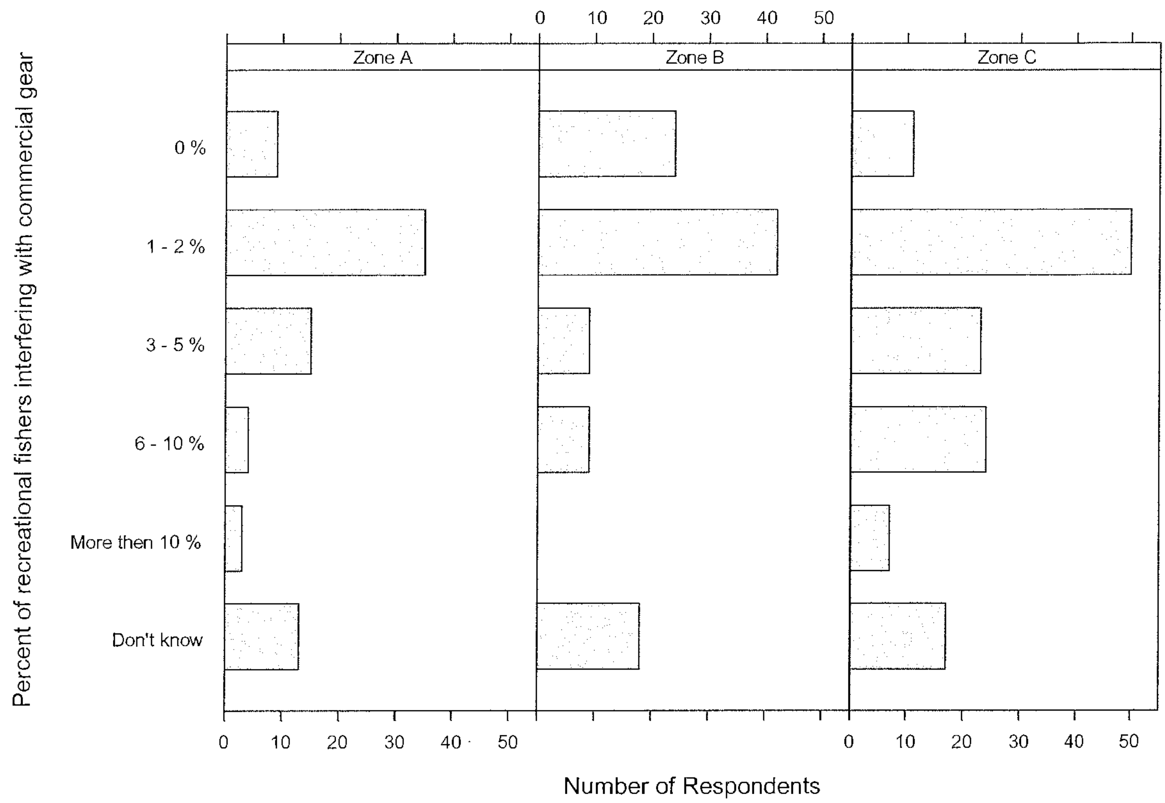


Figure 6.26 Respondent opinion about the percentage of recreational fishers that interfere with commercial pots, categorised by Zone and restricted to licensees and/or skippers only.

- Around 40% of respondents from each zone considered that 1-2% of recreational fishers typically interfere with commercial pots.
- Of those respondents indicating "More than 10%", five people said 11-25%, and two people said 26-50%.

Q42. In your experience, what percentage of recreational fishers do you think regularly sell or barter some or all of their catch? (circle one)

a) **0%**
b) **1-2%**
c) **3-5%**
d) **6-10%**
e) **If more than 10%, write percentage: _________**
f) **Don't know**

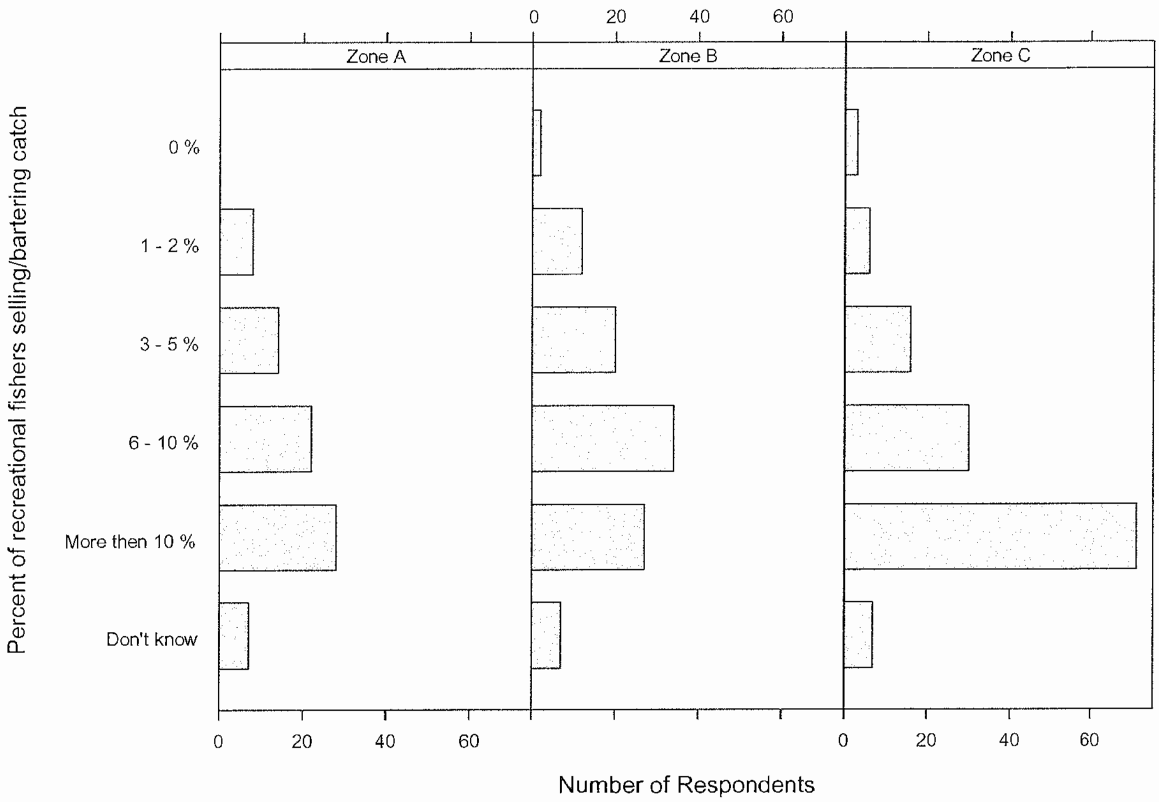


Figure 6.27 Respondent opinion about the percentage of recreational fishers that regularly sell or barter their catch, categorised by Zone and restricted to licensees and/or skippers only.

- There is a clear perception among commercial fishers that many in the recreational sector regularly sell or barter their catch, with 34%, 27% and 50% of respondents in Zones A-C indicating that more than 10% of recreational fishers engage in the activity.
- Of those people who indicated the percentage to be more than 10%, 53 people said 11-25%, 74 people said 26-50%, and 23 indicated greater than 50%.

Q43. Consider the minimum legal size rules for western rock lobster (77 mm 15 Nov-31 Jan; 76 mm 1 Feb-30 Jun). Do you think: (circle one)

a) **Minimum size should be a larger**
b) **Minimum size is about right**
c) **Minimum size should be smaller**
d) **Shouldn't be a minimum limit at all**
e) **Make the minimum limit 76mm all season**
f) **Make the minimum limit 77mm all season**
g) **Don't know**

- Opinion among commercial fishers appeared divided between those who thought the legal minimum size was about right (58%, 45%, 59% for Zones A-C), and those who thought the split legal minimum size (see Chapter 5) should be changed to be uniformly 76 mm for the whole of the season (29-43% across zones, pooled over Employment Status) (Figure 6.28).
- A small number of licence-holders who are also skippers considered fishing rules should be more conservative. Particularly in Zone A, they suggested that the minimum size should be revised to be 77 mm all season.
- No respondents suggested there should be no minimum size.

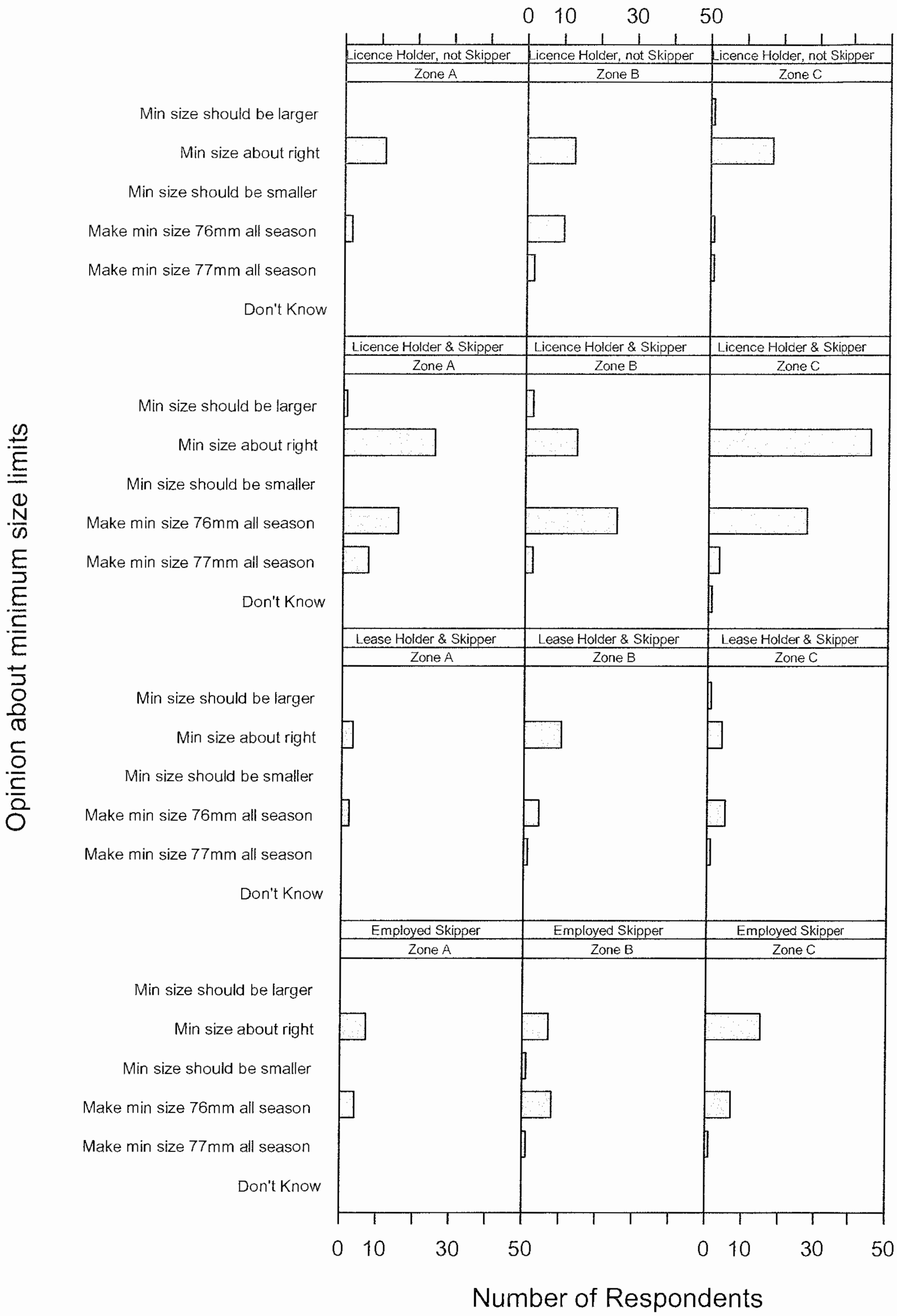


Figure 6.28 Respondent opinion about the minimum size rule for western rock lobster, categorised by Zone and Employment Status (licensees and/or skippers only).

Q44. In your experience, what percentage of commercial fishers do you think illegally take lobsters from recreational fishers' pots? (circle one)

a) **0%**
b) **1-2%**
c) **3-5%**
d) **6-10%**
e) **If more than 10%, write percentage: _ _ _ _ _ _ _ _**
f) **Don't know**

- Most respondents (typically 35-50% across employment types) considered 1-2% of commercial fishers illegally remove lobsters from recreational fishers' pots.
- A small number of respondents thought that either 3-5% or 6-10% of commercial fishers illegally remove lobsters from recreational fishers' pots. Although sample sizes are low, this perception seemed disproportionately prevalent among crew members, particularly those working in Zones B and C.
- For response category "More than 10%", one person indicated 15% (crew), and one person indicated 20% (employment type not specified).

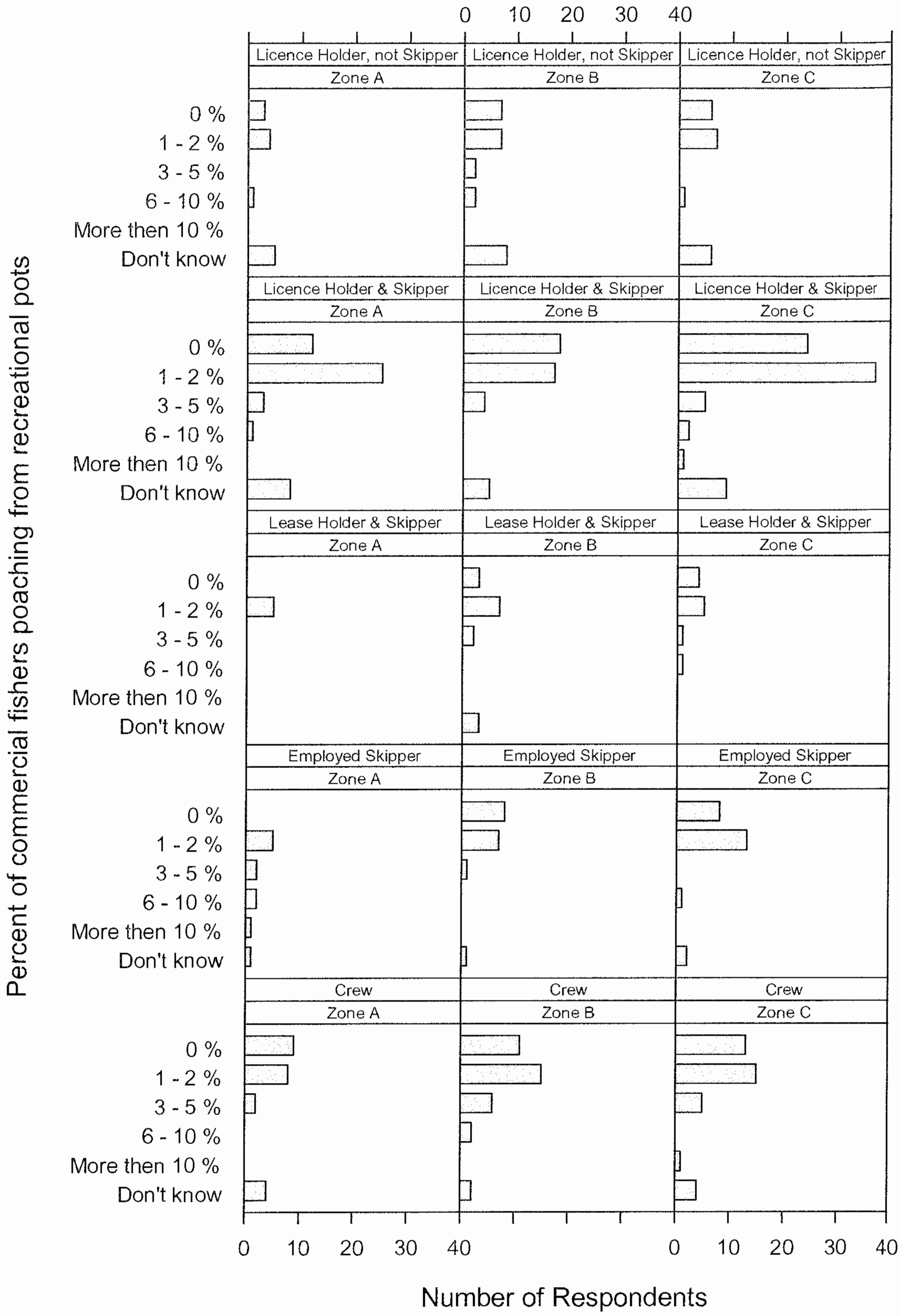


Figure 6.29 Respondent opinion about the percentage of commercial fishers that illegally take lobster from recreational pots, categorised by Zone and Employment Status.

Q45. In your experience, what percentage of commercial fishers do you think interfere with recreational fishers' pots (move or cut floats)? (circle one)

a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) **If more than 10%,write percentage: _ _ _ _ _ _ _ _**
f) **Don't know**

- Around 50% of licence-holders who are also skippers consider 1-2% of commercial fishers interfere with recreational fishers' pots. This perception was also observed among those licence-holders who are not skippers, however for these respondents only 30-35% of people considered 1-2% of commercial fishers interfere with recreational fishing gear.
- A small number of respondents thought that either 3-5% or 6-10% of commercial fishers illegally interfere with recreational gear, with this perception appearing disproportionately prevalent among crew members.
- For response category "More than 10%", one person indicated 20% (crew), and one person indicated 25% (employment types were not specified).

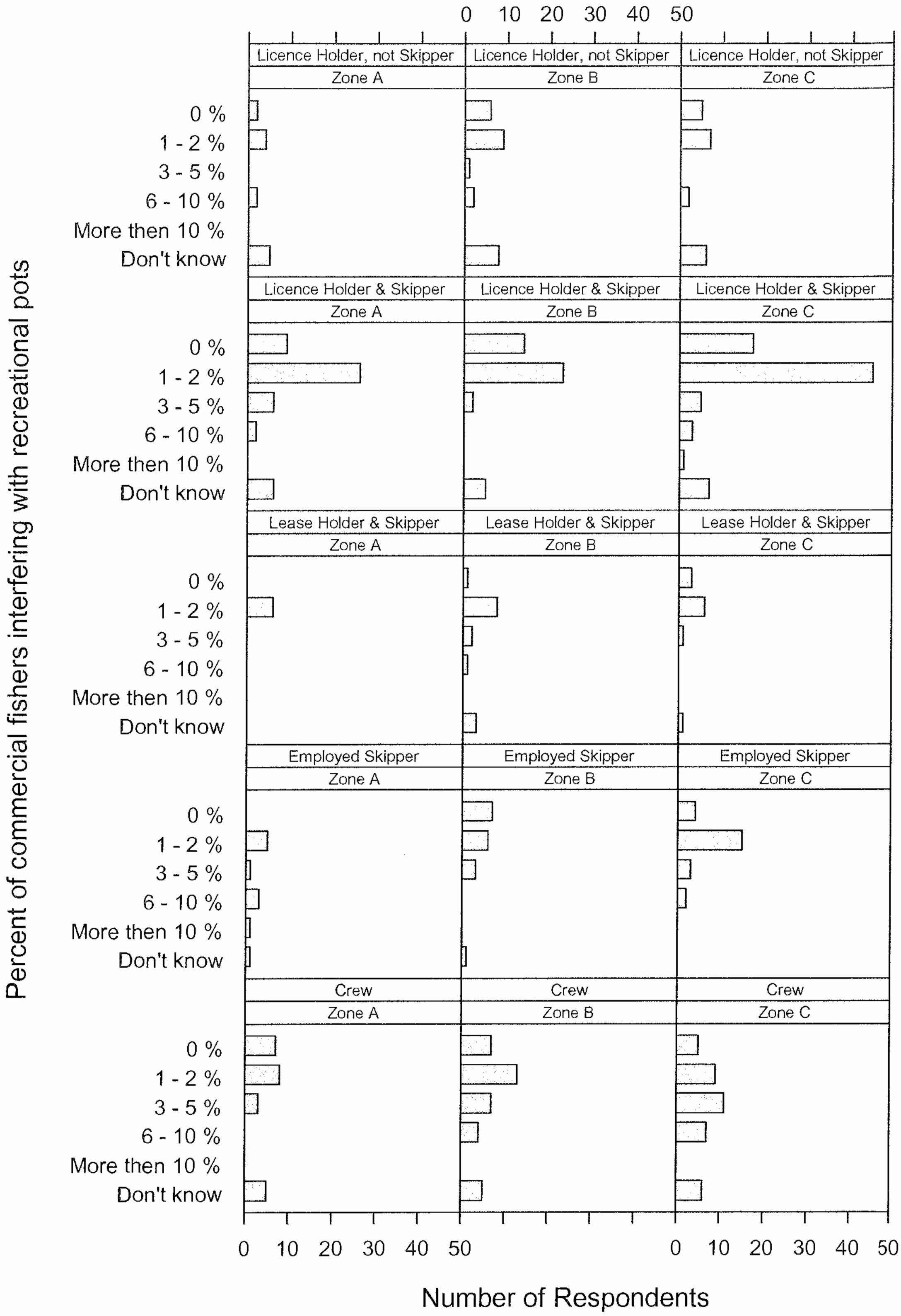


Figure 6.30 Respondent opinion about the percentage of commercial fishers that interfere with recreational pots, categorised by Zone and Employment Status.

Q46. In your experience, what percentage of commercial fishers do you think illegally take lobsters from other commercial fishers' pots? (circle one)

a) **0%**
b) **1-2%**
c) **3-5%**
d) **6-10%**
e) **If more than 10%, write percentage: _ _ _ _ _ _ _ _**
f) **Don't know**

- Most respondents considered 1-2% of commercial fishers illegally remove lobster from other commercial fishers' pots, however significant numbers of respondents thought this practice occurred among 3-5% or 6-10% of fishers.
- Of those people who indicated response category "More than 10%", most provided answers in the range 15-25%.

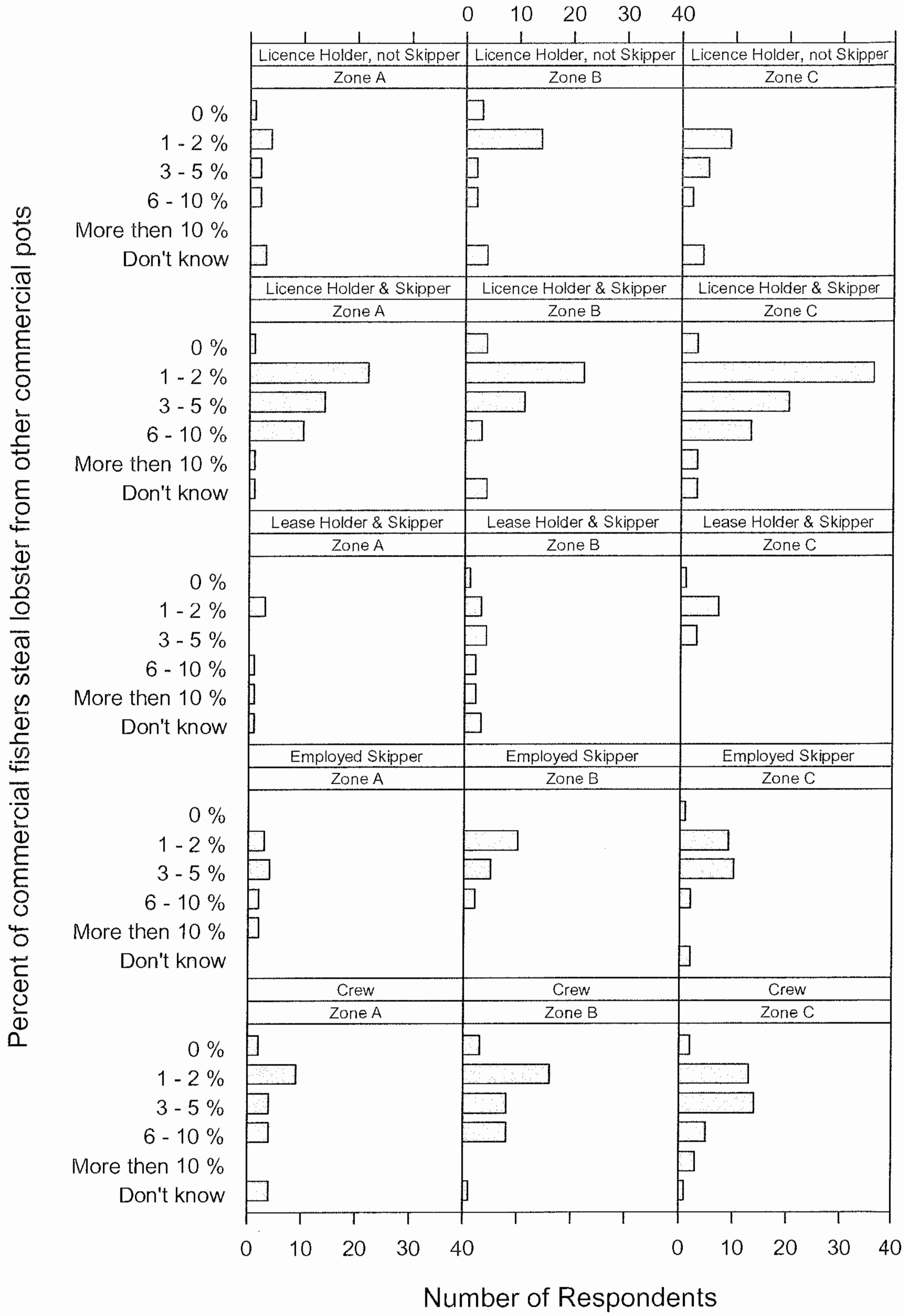


Figure 6.31 Respondent opinion about the percentage of commercial fishers that illegally take lobster from commercial pots, categorised by Zone and Employment Status.

Q47. In your experience, what percentage of commercial fishers do you think interfere with commercial fishers' pots (move or cut floats)? (circle one)

a) **0%**
b) **1-2%**
c) **3-5%**
d) **6-10%**
e) **If more than 10%, write percentage: _ _ _ _ _ _ _ _**
f) **Don't know**

- Among the largest Employment Status group, licence-holders who are also skippers, around 50% of respondents thought 1-2% of commercial fishers interfere with other commercial fishers' pots, 25% thought this behaviour was prevalent among 3-5% of fishers, and 9-20% (depending on zone) thought the activity was practiced by 6-10% of fishers.
- For those respondents who thought 6-10% of fishers engaged in interference, the perception generally appeared most common among Zone A fishers.
- Crew and employed skippers thought that commercial gear interference was generally more prevalent among commercial fishery participants compared with other Employment Status categories.
- Of the 14 people indicating response category "More than 10%", most indicated 15-25%. However three respondents (licence-holders and skippers) from Zone C indicated they thought the practice occurred among 30-50% of skippers.

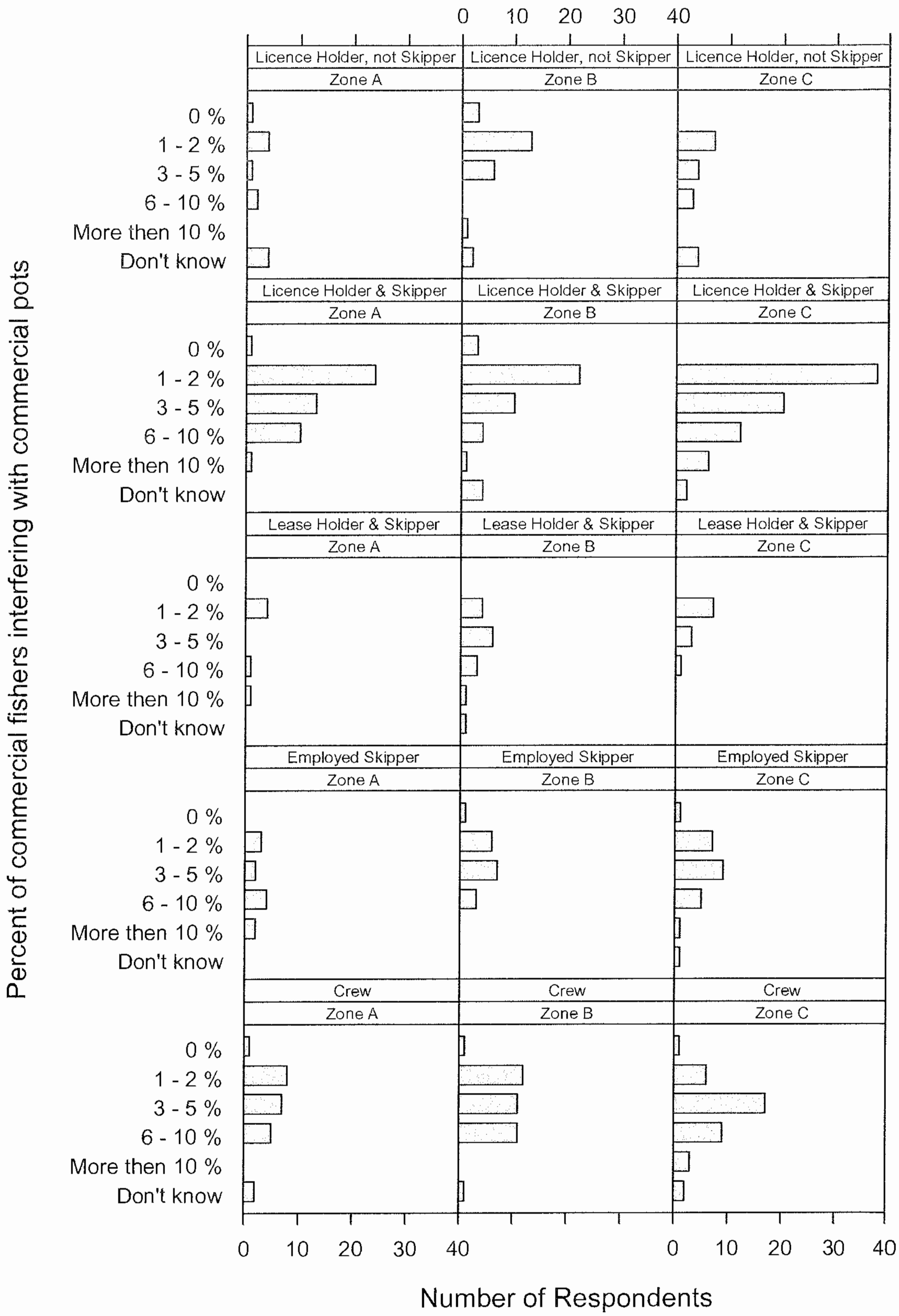


Figure 6.32 Respondent opinion about the percentage of commercial fishers that interfere with commercial pots, categorised by Zone and Employment Status.

Q48. What evidence have you seen of illegal pot pulling among commercial rock lobster fishers? (circle more than 1 answer if appropriate)

a) None
b) Have heard rumours it occurs (reliability of information unknown)
c) Have heard rumours it occurs (very reliable information)
d) Occasionally witnessed it
e) Regularly witnessed it occurring

Table 6.20 Degree of evidence respondents have with respect to perceptions of illegal pot-pulling among commercial fishers, categorised by Zone and restricted to licensees and/or skippers only.

		Zone			
		A	**B**	**C**	**Missing**
What evidence have you seen of illegal pot-pulling among commercial fishers?	**a) None**	2	9	5	1
	b) Heard rumours (reliability unknown)	13	15	25	0
	c) Heard rumours (reliable)	29	33	48	2
	d) Occasionally witnessed it	8	9	18	0
	e) Regularly witness it	4	1	0	0
	b) and c)	2	2	1	0
	b), c) and d)	2	1	0	0
	c) and d)	6	5	16	2
	Missing	0	1	0	0
	Total	**66**	**76**	**113**	**5**

- A majority of respondents (42-44% across Zones A-C) had heard reliable rumours of commercial fishers engaging in illegal pot-pulling, while a relatively large number of respondents (12-16% across zones) occasionally witness the activity.
- Conversations with fishers suggest that illegal pot-pulling is often an occasional crime, and is typically very difficult to directly observe. This observation is reflected in survey responses, with only five respondents indicating that they regularly witness illegal pot-pulling by commercial fishers.

Q49. What evidence have you seen of illegal pot pulling among recreational rock lobster fishers? (circle more than 1 answer if appropriate)

a) None
b) Have heard rumours it occurs (reliability of information unknown)
c) Have heard rumours it occurs (very reliable information)
d) Occasionally witnessed it
e) Regularly witnessed it occurring

Table 6.21 Degree of evidence respondents have with respect to perceptions of illegal pot-pulling among recreational fishers, categorised by Zone and restricted to licensees and/or skippers only.

		Zone			
		A	B	C	Missing
What evidence have you seen of illegal pot-pulling among recreational fishers?	a) None	20	20	19	1
	b) Heard rumours (reliability unknown)	22	26	35	1
	c) Heard rumours (reliable)	15	16	36	1
	d) Occasionally witnessed it	8	8	11	0
	e) Regularly witness it	1	3	4	0
	b) and c)	0	2	0	0
	c) and d)	0	1	6	0
	Missing	0	0	1	0
	Total	**66**	**76**	**112**	**3**

- 20-30% of respondents indicated they had heard reliable rumours about recreational fishers illegally pulling lobster pots, with 10-12% of respondents specifying they occasionally witnessed the activity.
- Only eight respondents indicated that they regularly witness recreational fisher illegally pulling pots.

Q50. If you see a commercial fisher breaking the rules, what do you do? (circle more than 1 answer if appropriate)

a) Do nothing about it
b) Report the illegal activity to Fisheries WA
c) Talk to the person directly
d) Tell other fishers about what you witnessed
e) Don't know
f) Other (please specify) _ _ _ _ _ _ _ _ _ _ _ _ _

Table 6.22 Respondent reaction to witnessing illegal commercial fishing activity, categorised by Zone.

		Zone			
		A	B	C	Missing
If you see a commercial fisher breaking rules, what do you do?	a) Do Nothing	1	1	5	0
	b) Report to Fisheries	43	65	76	6
	c) Talk Directly to Person	8	10	11	1
	d) Tell Other Fishers	18	23	23	2
	b) and c)	2	3	7	0
	b), c) and d)	11	9	16	3
	b) and d)	12	21	21	0
	c) and d)	1	3	8	0
	e) Don't Know	2	7	8	1
	Other – report if illegal pot-pulling	9	20	15	0
	Other – monitor before reporting	7	2	0	0
	Missing	3	0	2	0
	Total	**117**	**164**	**192**	**13**

- Encouragingly, 60% of respondents in each zone indicated they would report observed illegal activity to enforcement personnel (percentage includes multiple-response answers containing selection *b) Report to Fisheries*).
- Very few fishers indicated they would take no action.

- Most fishers in all zones indicated they would tell other fishers about illegal activities they observed.
- A surprisingly large number of fishers (15-22% across zones) indicated they would choose to talk directly to the offending fisher.
- Fishers were asked to specify if there was any other action they might take after observing illegal activity by their peers. Across Zones A-C, 9, 20 and 15 people indicated they would only report illegal activity if it involved fishers illegally pulling other fishers' pots.

Q51. Some fishers claim that they are unwilling to report the illegal behaviour of other commercial fishers because they may be harassed or victimised (eg. gear interference, or physical violence). Do you think: (circle one)

a) This is often a real danger if reporting illegal activity
b) This is occasionally a danger, depending on the people involved
c) This is rarely a concern when reporting illegal activity
d) I don't report illegal activity, so this is never a concern
e) I would report illegal activity, the risk doesn't concern me
f) Don't know

- Respondents were split between those who thought that reporting illegal behaviour is occasionally dangerous, depending on who is involved, and those who expressed the opinion that they would report illegal behaviour irrespective of any perceived or real risk of retaliation.
- Crew members, in particular, considered that reporting illegal behaviour could involve risk of harassment or victimisation depending on the identity of the offending fisher.
- Only eight respondents (five from Zone C) indicated they would not report illegal activity.
- Typically 7-12% of respondents (but up to 20% for crew) indicated that reporting illegal activity represented a real danger to the informant.

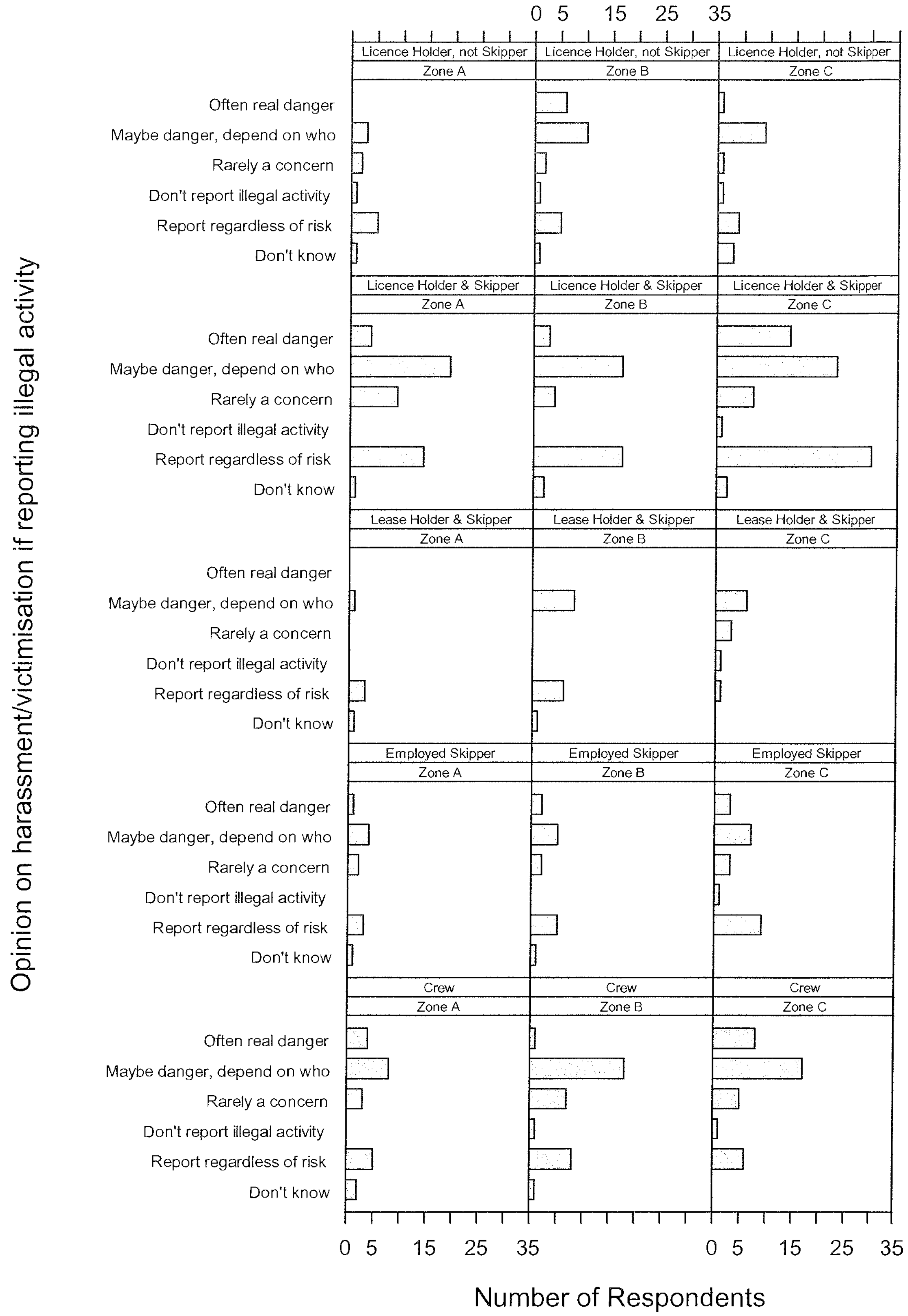


Figure 6.33 Respondent perceptions about possible harassment or victimisation after reporting illegal commercial fishing, categorised by Zone and Employment Status.

Q52. What do you think about the amount of compliance inspections Fisheries Officers carry out at sea (eg. gear checks and pot counts)? Do you think: (circle one)

a) **There are too many at-sea inspections**
b) **There are about the right number of at-sea inspections**
c) **There are too few at-sea inspections**
d) **Don't know**
e) **Comment: ___________________**

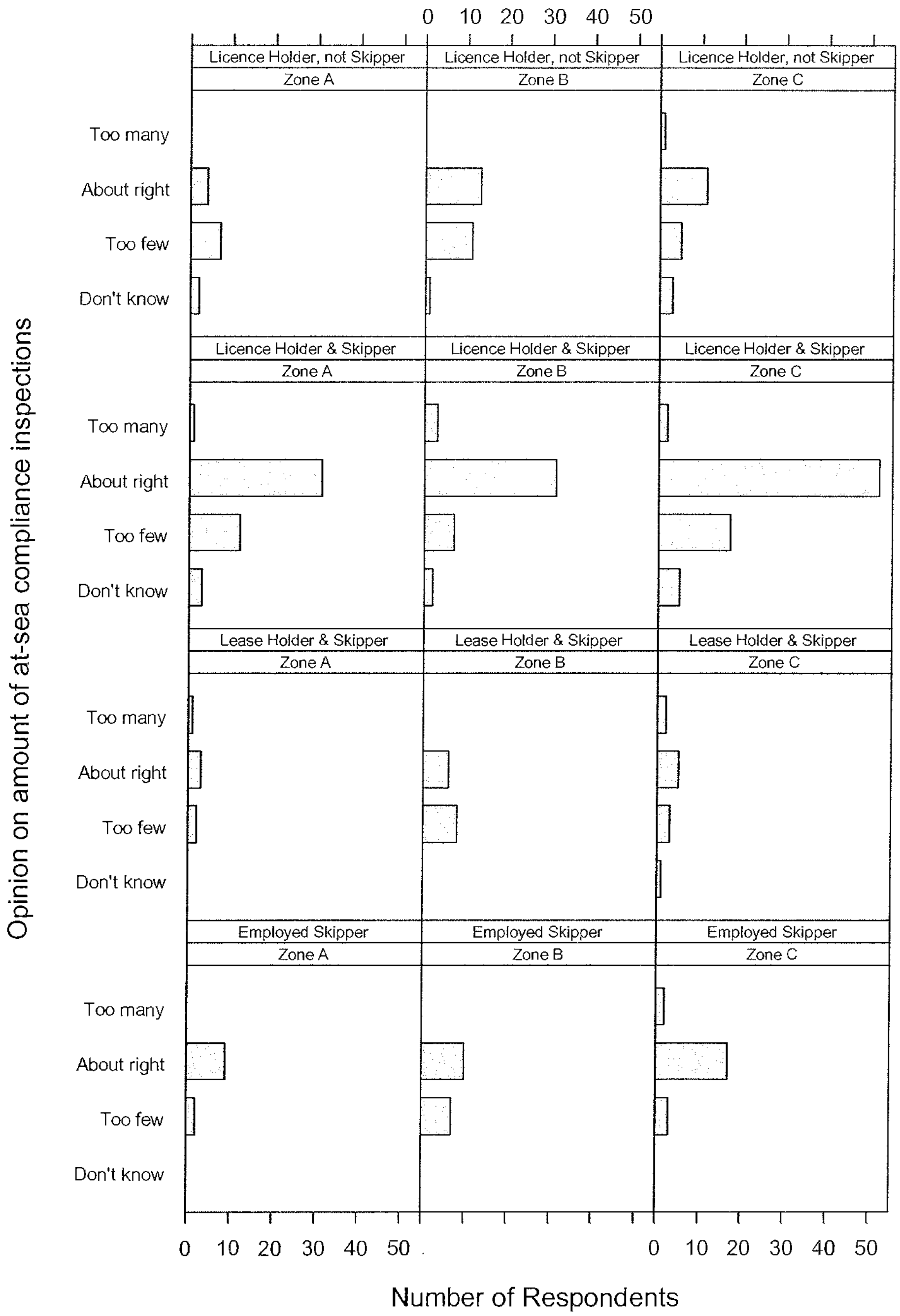


Figure 6.34 Respondent opinion about the amount of at-sea compliance inspections, categorised by Zone and Employment Status (licensees and/or skippers only).

- Most respondents (typically 50-70% among different Employment Status types) thought that the level of at-sea compliance was acceptable, and did not need to change.
- However, significant number of respondents (typically 20-40% depending on Employment Status) thought that the level of at-sea enforcement was not adequate, and should be increased. Zone A and B non-fishing licence-holders, in particular, felt there were too few at-sea inspections.
- Very few respondents (15 in total) thought that the level of at-sea inspection should be reduced.
- 10 missing responses are not indicated in results.

A large number of written comments were received from licensees and skippers regarding the amount of at-sea compliance activities undertaken by the Department. Comments received were, where possible, categorised into main themes and are summarised below. Bracketed numbers indicate numbers of respondents according to Zone.

- All fishers should be checked the same number of times (A 17; B 17; C 34).
- Boats convicted of serious regulation breaches should be required to carry on-board observers for specific periods of time (A 5; B 5; C 4).
- Fisheries Officers should let boat-owners know when they inspect gear – should tag gear so fishers know it has been checked (A 5; B 8; C 13).
- Do not want pots moved after setting them – Fisheries Officers generally don't put them back in the same spot (A 7; B 14; C 9).
- Should board and check more suspect vessels, rather than checking gear at random and upsetting pots (A 5; B 3; C 9).
- Inspections are a waste of time, money and manpower - fishers have too much to lose to break the rules (A 11; B 11; C 13)

Q53. What do you think about the amount of compliance inspections in processing factories that Fisheries Officers carry out (eg checking for totally protected animals)? Do you think: (circle one)

a) **Should increase the number of factory inspections**
b) **The amount of factory inspections is about right**
c) **Should decrease the number of factory inspections**
d) **Don't know**
e) **Comment:** _

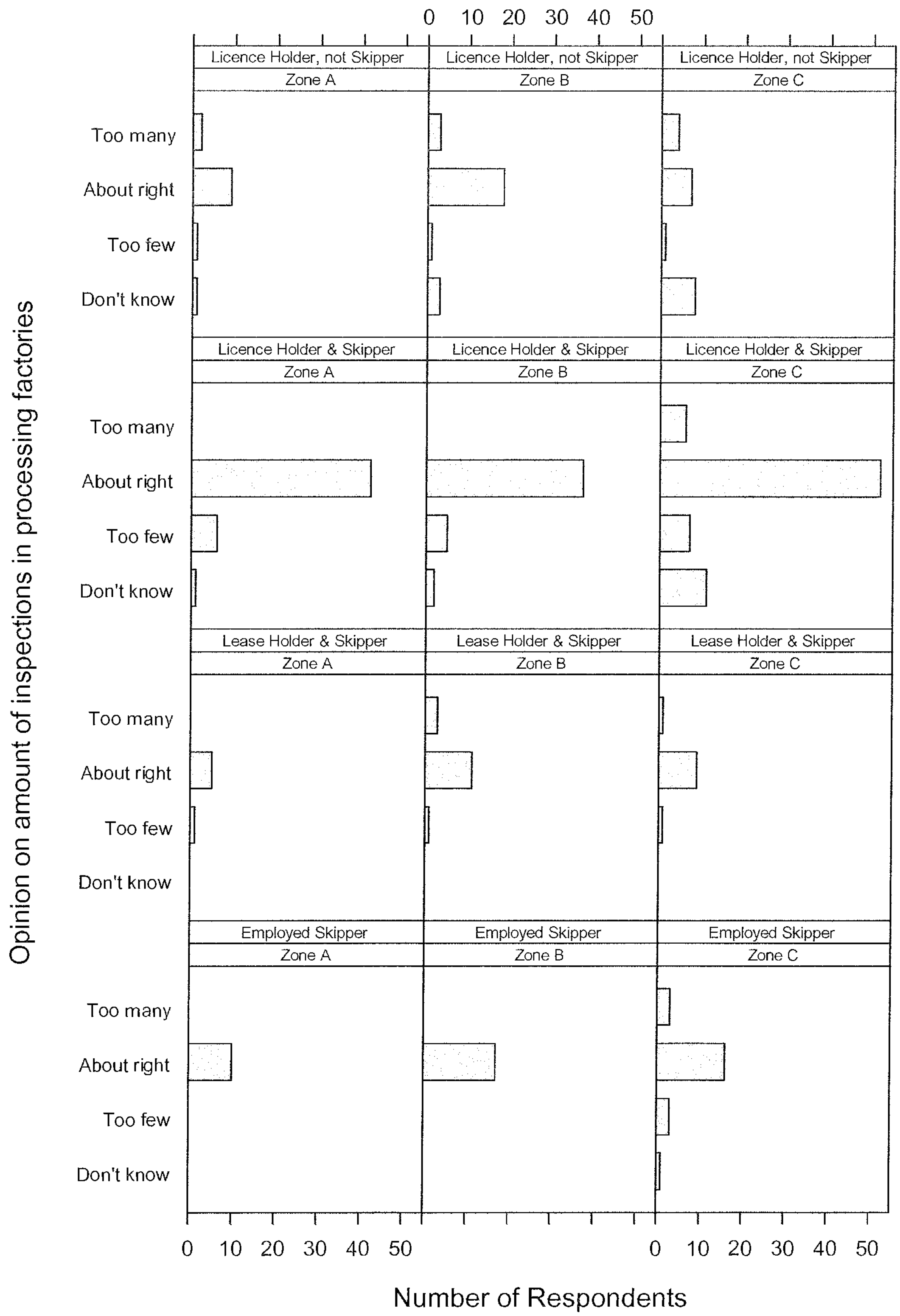


Figure 6.35 Respondent opinion about the amount of factory catch inspections conducted by Fisheries Officers, categorised by Zone and Employment Status (licensees and/or skippers only).

- Typically, 70-85% of all respondents of different Employment Status considered the level of factory inspections to be about right. Note that the survey was conducted immediately following the 1998/1999 season, in which it is estimated 5% of the total catch was inspected in processing factories.
- A small, but significant, groups of respondents (typically 5-15% dependent on Employment Status) thought that the level of factory inspection was too low, and should be increased.
- Six missing responses are not indicated in results.

Written comments received from licensees and skippers regarding the amount of factory catch inspections were, where possible, categorised into main themes and are summarised below. Bracketed numbers indicate numbers of respondents according to Zone.

- If only a couple of protected animals are found in a catch, then these are genuine mistakes, due to rough weather or hurried gauging. Inspectors should allow some margin of error (A 5; B 13; C 10).
- No idea how many inspections are carried out – lack of publicity needs to be addressed (A 22; B 30; C 40).
- Too much handling of lobsters is not good for quality – should not re-check lobsters that have already been checked in coastal towns (A 8; B 18; C 15).
- Too many inspections are carried out in small towns with only one factory (A 15; B 12; C 7).
- Should increase the number of late-night inspections at processing factories (A 5; B 8; C 13).
- Should only inspect catch while skipper is present when catch is weighed in – not later on as catch could be interfered with in-between (A 2; B 3; C 12).

Q54. What do you think about the amount of compliance inspections in retail outlets that Fisheries Officers carry out (eg checking restaurants for totally protected animals)? Do you think: (circle one)

a) Should increase the number of retail inspections
b) The amount of retail inspections is about right
c) Should decrease the number of retail inspections
d) Don't know
e) Comment: ________________________

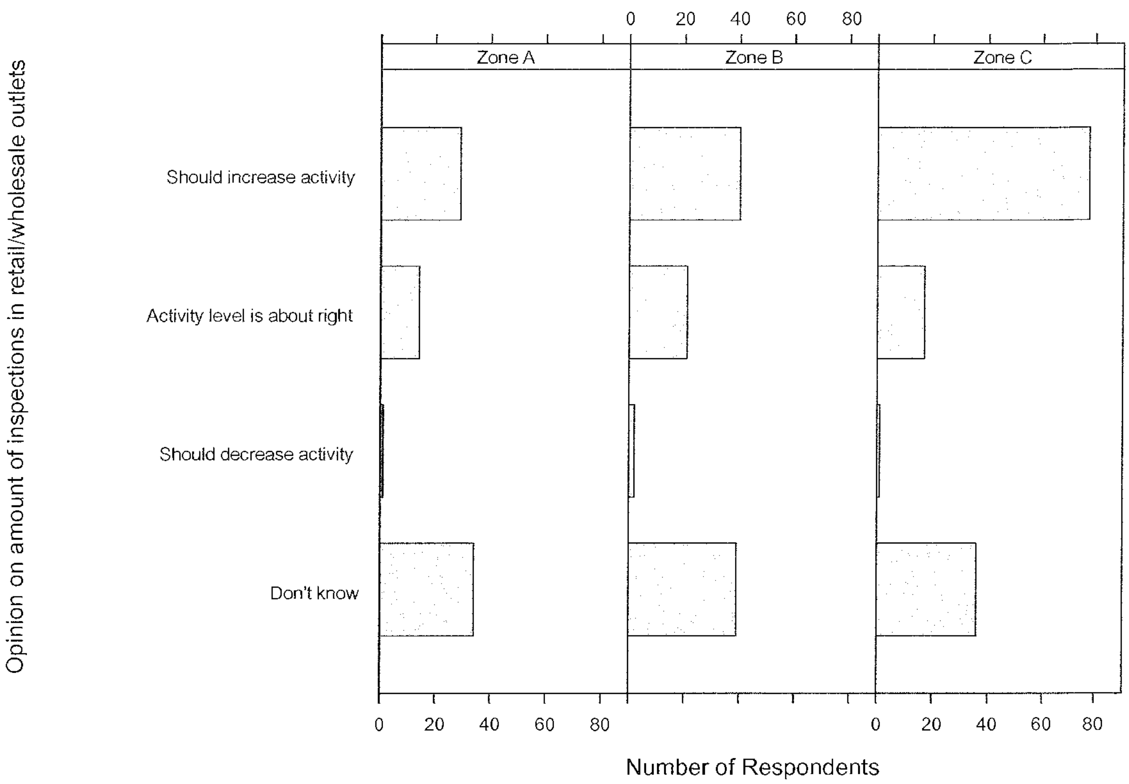


Figure 6.36 Respondent opinion about the amount of retail/wholesale inspections conducted by Fisheries Officers, categorised by Zone and restricted to licensees and/or skippers only.

- Most respondents indicated either that enforcement checks of wholesale/retail outlets should be increased, or that they couldn't offer an opinion about the level of inspection (see comments below).
- Virtually no-one suggested that the level of wholesale/retail enforcement should be reduced.

Written comments received from licensees and skippers regarding the amount of wholesale/retail inspections were, where possible, categorised into main themes and are summarised below. Bracketed numbers indicate numbers of respondents according to Zone.

- No idea how many inspections are carried out, lack of publicity needs to be addressed (A 48; B 54; C 66).
- All retailers should be checked regularly (A 15; B 14; C 25).
- Should focus more on the small outlets, e.g. fish & chip shops (A 3; B 6; C 6).

Q55. Do you think Fisheries Officers spend enough time investigating allegations of fishers interfering with fishing gear (eg dragging gear or cutting floats)? (circle one)

a) **Should increase the time spent investigating gear interference**
b) **The amount of time spent investigating gear interference is about right**
c) **Should decrease the time spent investigating gear interference**
d) **Don't know**
e) **Comment: _______________________**

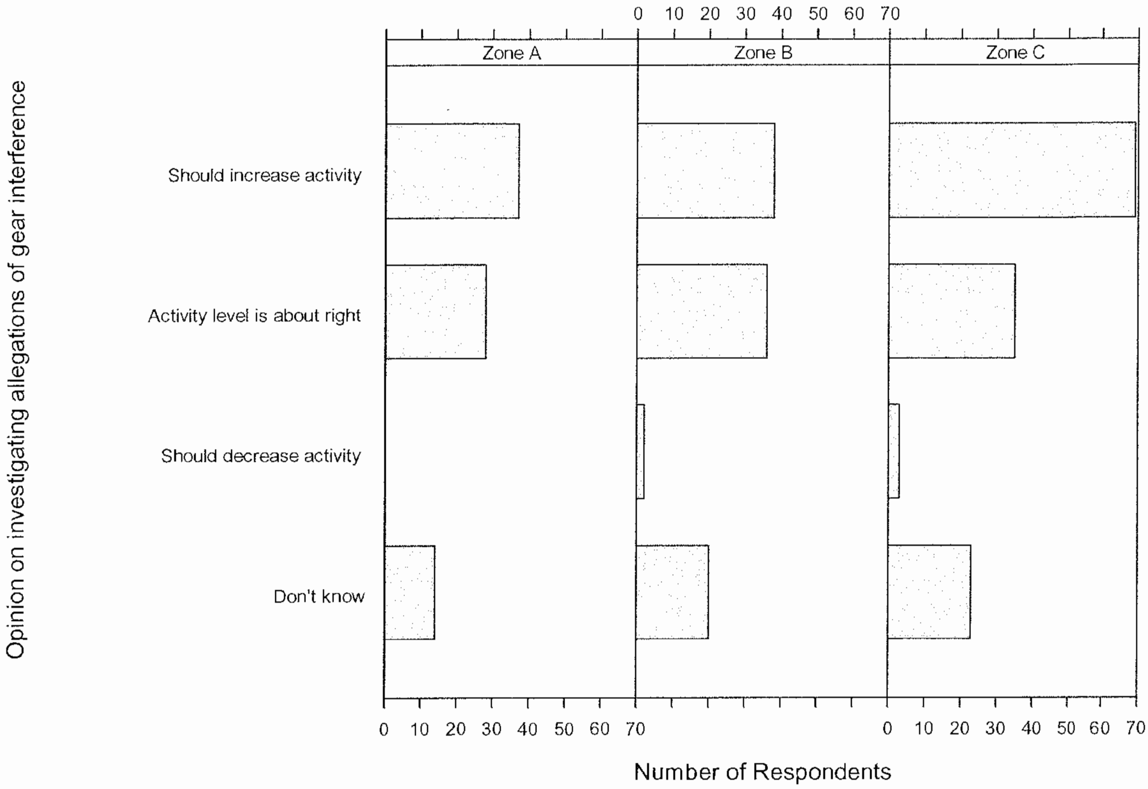


Figure 6.37 Respondent opinion about the degree to which Fisheries Officers conduct investigations into allegations of gear interference, categorised by Zone and restricted to licensees and/or skippers only.

- A majority of respondents in Zone A and C (47% and 51%) thought that investigations into allegations of gear interference should be increased. In Zone B, fisher opinions were equally divided between those who thought activity in this area was acceptable (35%), and those who thought activity needed to increase (37%).

Written comments received from licensees and skippers regarding investigations into gear interference were, where possible, categorised into main themes and are summarised below. Bracketed numbers indicate numbers of respondents according to Zone.

- Interference generally done by same, small number of offenders – Fisheries Officers know who the offenders are, but they are very hard to catch (A 47; B 55; C 54).
- No idea how much time is spent investigating allegations – lack of publicity needs to be addressed (A 9; B 11; C 15).
- Illegal pot-pulling is mainly done by the overnighters (i.e. those that stay at sea overnight) and those who leave early to pull their gear (A 3; B 2; C 4).
- The fishers can sort it out between themselves (A 0; B 4; C 5).
- Most gear interference is accidental (A 1; B 3; C 6).

Q56. Consider the statement: "The overall enforcement program in the western rock lobster fishery is better than it was 5 years ago". Do you: (circle one)

a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree
f) Comment: ______________________

- A majority of respondents, across all Employment Status types, agreed or strongly agreed that the enforcement program in the rock lobster fishery had improved over the previous five years. Combining across Employment Status types, 62%, 76% and 67% of respondents in each of Zones A-C were of this view.
- Not all agreed the enforcement program had improved, however, with 14%, 6% and 13% of respondents in Zones A-C indicating they thought the current enforcement program was not better than it had been five years ago.

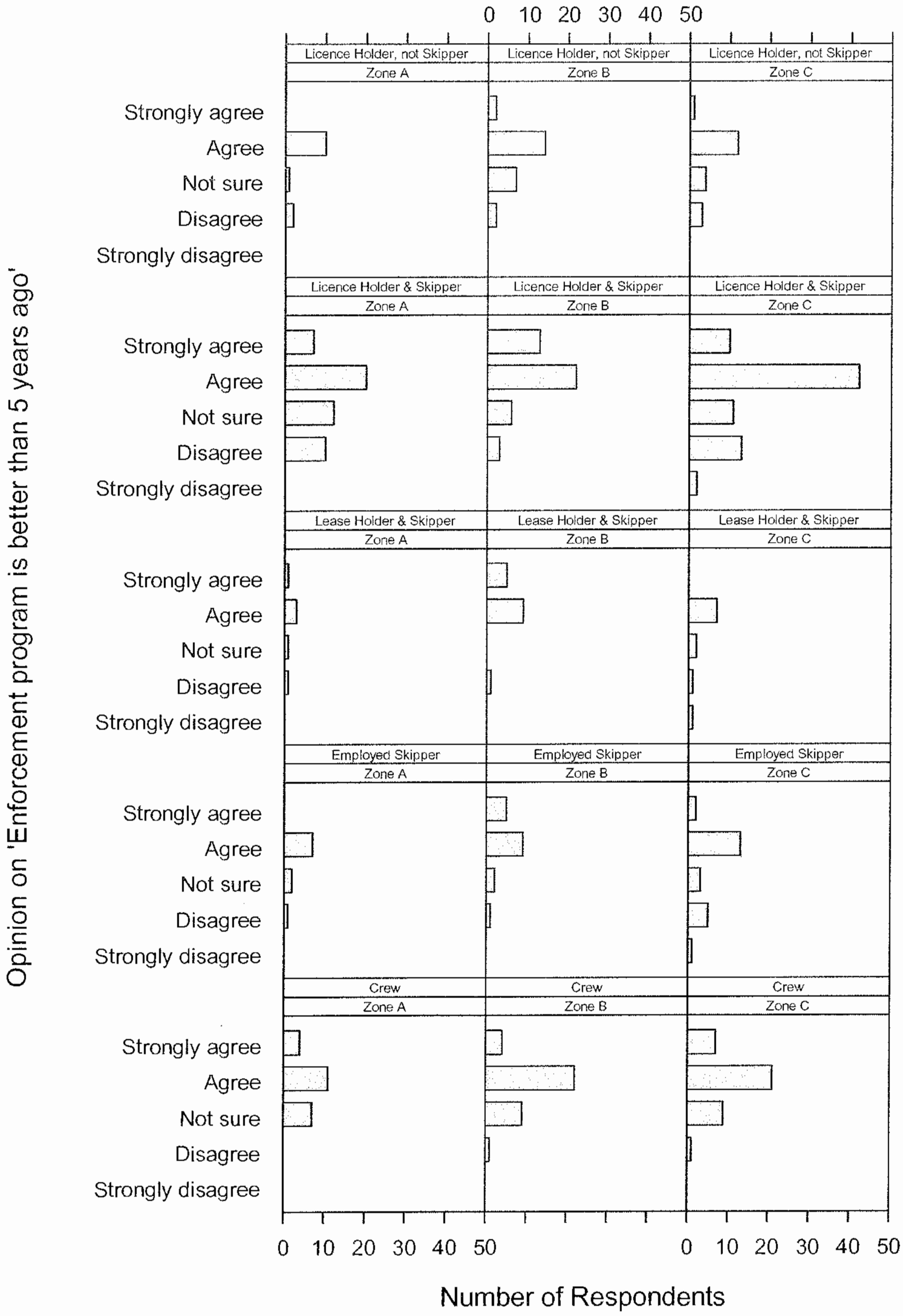


Figure 6.38 Respondent opinion on whether the enforcement program in the western rock lobster fishery has improved over the last five years, categorised by Zone and Employment Status.

Written comments on the quality of the enforcement program were, where possible, categorised into main themes and are summarised below. Bracketed numbers indicate numbers of respondents according to Zone.

- Need for consistency in enforcement of setose regulations throughout all of WA – setose measurement is different with each individual Fishery Officer up and down the coast (A 11; B 21; C 49).
- Recently employed Fisheries personnel have qualifications, but not the required knowledge of the industry (A 7; B 14; C 12).
- Enforcement program has improved due to cost recovery (A 21; B 17; C 9).
- Fines have increased and are more effective (A 6; B 3; C 2).
- A lot of time is wasted checking licences (A 5; B 8; C 13).

<u>Q57. Consider the statement: "Overall, compliance with fisheries regulations in the western rock lobster fishery is better than it was 5 years ago". Do you: (circle one)</u>

a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree
f) Comment: _________________________

- Most respondents agreed or strongly agreed that compliance in the western rock lobster fishery had improved in the previous five years (pooling responses, typically 60-80% across all Employment Status types).
- Virtually no respondents strongly disagreed with the proposition that compliance in the western rock lobster fishery had improved in the previous five years, however 5-15% (depending on Employment Status) disagreed with the statement.

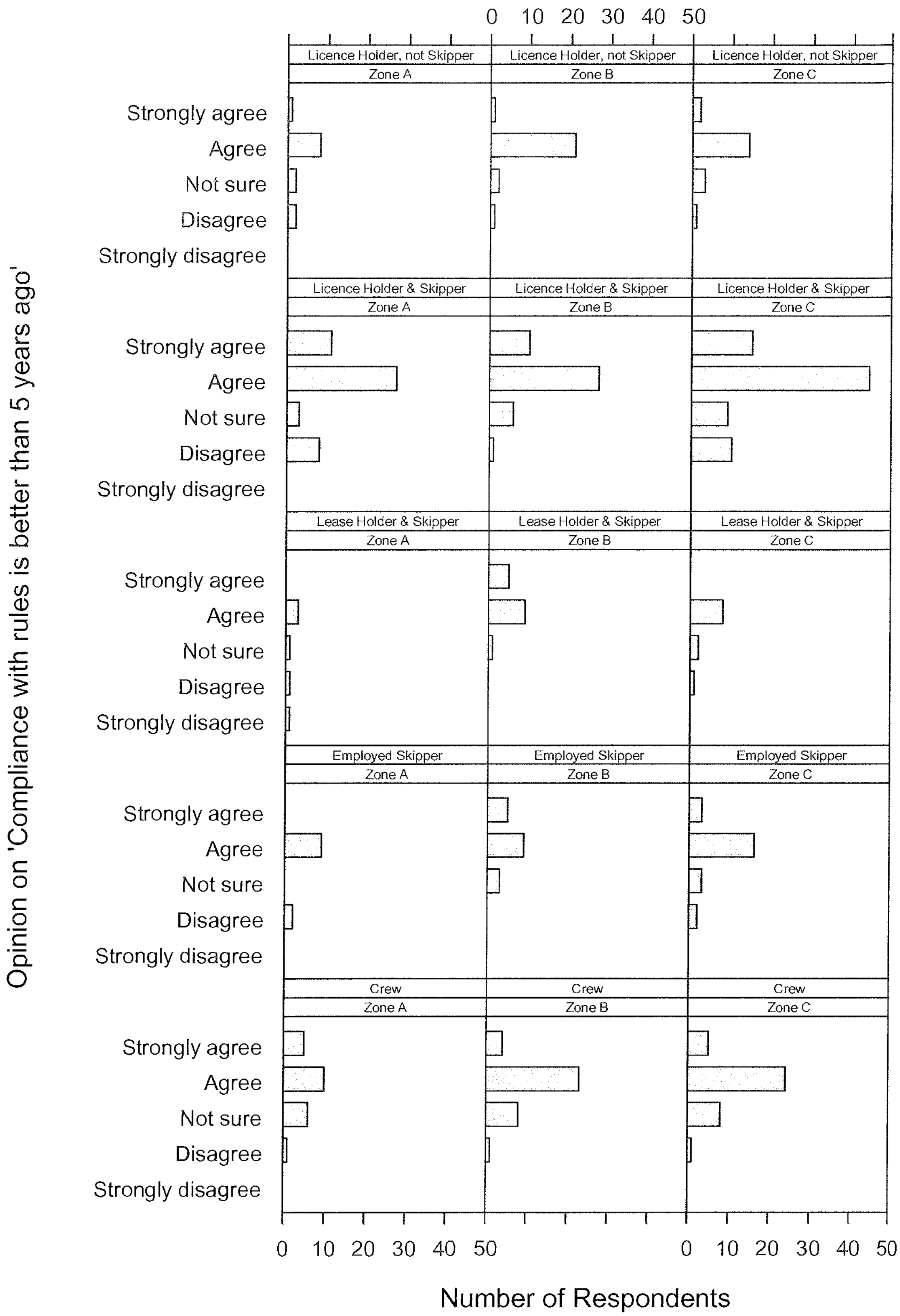


Figure 6.39 Respondent opinion on whether compliance with fishery rules in the western rock lobster fishery has improved over the last five years, categorised by Zone and Employment Status.

Written comments on compliance in the rock lobster fishery were, where possible, categorised into main themes and are summarised below. Bracketed numbers indicate numbers of respondents according to Zone.

- More gear interference occurs these days (A 19; B 24; C 38).
- Compliance is the same as it was 5 years ago (A 4; B 5; C 16).
- Recreational fishers' compliance is still bad, or even worse (A 7; B 16; C 18).
- The introduction of higher fines and licence cancellation has been effective in cutting down on certain practices (e.g. selling undersize crays / overpotting / lobster stretching) (A 16; B 17; C 22).
- Repeat offenders are still getting away with breaking regulations (A 9; B 17; C 15).
- Most commercial fishers will not break rules due to the risk of losing their licence (A 21; B 17; C 8).

Q58. In your experience, what is the main reason you think fishers break fishing regulations? (circle one)

a) Fishers do not know the fisheries regulations.
b) Fishers do not believe in the fisheries regulations.
c) Fishers believe in the rules, but are willing to break them for personal gain.
d) There is an existing culture of non-compliance with regulations.
e) Fishers are suffering financial hardship.
f) Competition between fishers.
g) Other (please specify) ___________________

Despite being asked to specify the *main* reason, 44 fishers responded with more than one answer. For the purpose of Figure 6.40 these answers are excluded, however most indicated "personal gain" along with "financial hardship" and/or "competition between fishers".

- A majority of respondents indicated that personal gain was the main motivation for fishers breaking fishing regulations (50-75% of respondents, depending on Employment Status and Zone).
- "Competition" as a motivation for non-compliance ranked second highest among most Employment Status types, followed by "financial hardship" and an "existing culture of non-compliance".

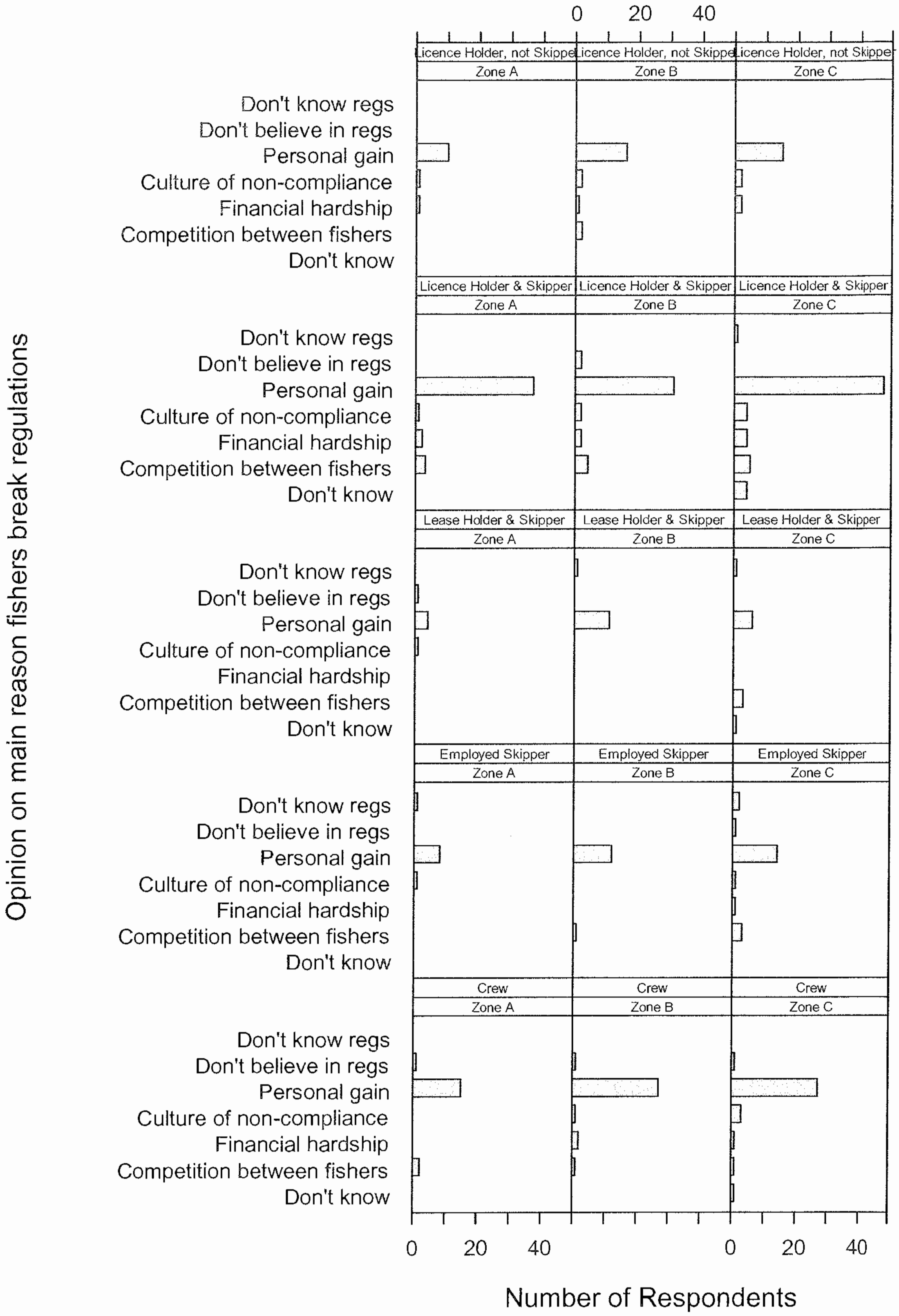


Figure 6.40 Respondent opinion about the main reason that fishers choose to break fishing regulations, categorised by Zone and Employment Status.

Written comments on why non-compliant rock lobster fishers choose to break rules were, where possible, categorised into main themes and are summarised below. Bracketed numbers indicate numbers of respondents according to Zone.

- Accidental error (human error/weather conditions/hurried sorting/extra pots to replace lost pots, which are later recovered) (A 57; B 67; C 89).
- The potential gain outweighs the penalty (A 8; B 10; C 19).
- Pressure for results from owners and investors (A 8; B 19; C 22).
- Fishers know how to bend the rules without being fined or suspended (A 15; B 15; C 21).

Q59 Please consider the following activities relating to illegal rock lobster fishing. For each line of the table, indicate your assessment of the activity's impact on sustainability of the fishery, it's prevalence among fishers, and the probability of a fisher being apprehended if they engage in the activity.

Figure 6.41-Figure 6.61 correspond to Question 59, parts a-u. Data for these graphics are drawn from skipper and licence-holder responses only. For each fisher providing valid data, answers on the rating-scale "None-Low-Medium-High" for *Impact on Sustainability* and *Probability of Detection* have been plotted in a 4x4 grid, adding a small amount of random noise so as to separate points. Each point represents an individual response, so that the density of points indicates response levels for that position on the grid.

Note that *n* and *missing* (including category "Don't know") are provided for the scatter-plot of *Probability of Detection* against *Impact on Sustainability*, but do not relate to the histograms of fisher opinions about the percentage of fishers engaging in the activity (the two are often similar, but not the same since some fishers answered that they "Didn't know" what percent of fishers were engaging in the activity).

Main features of the results are provided in dot-point format under each graphic, using the abbreviations IOS to indicate *Impact on Sustainability*, and POD to represent *Probability of Detection*.

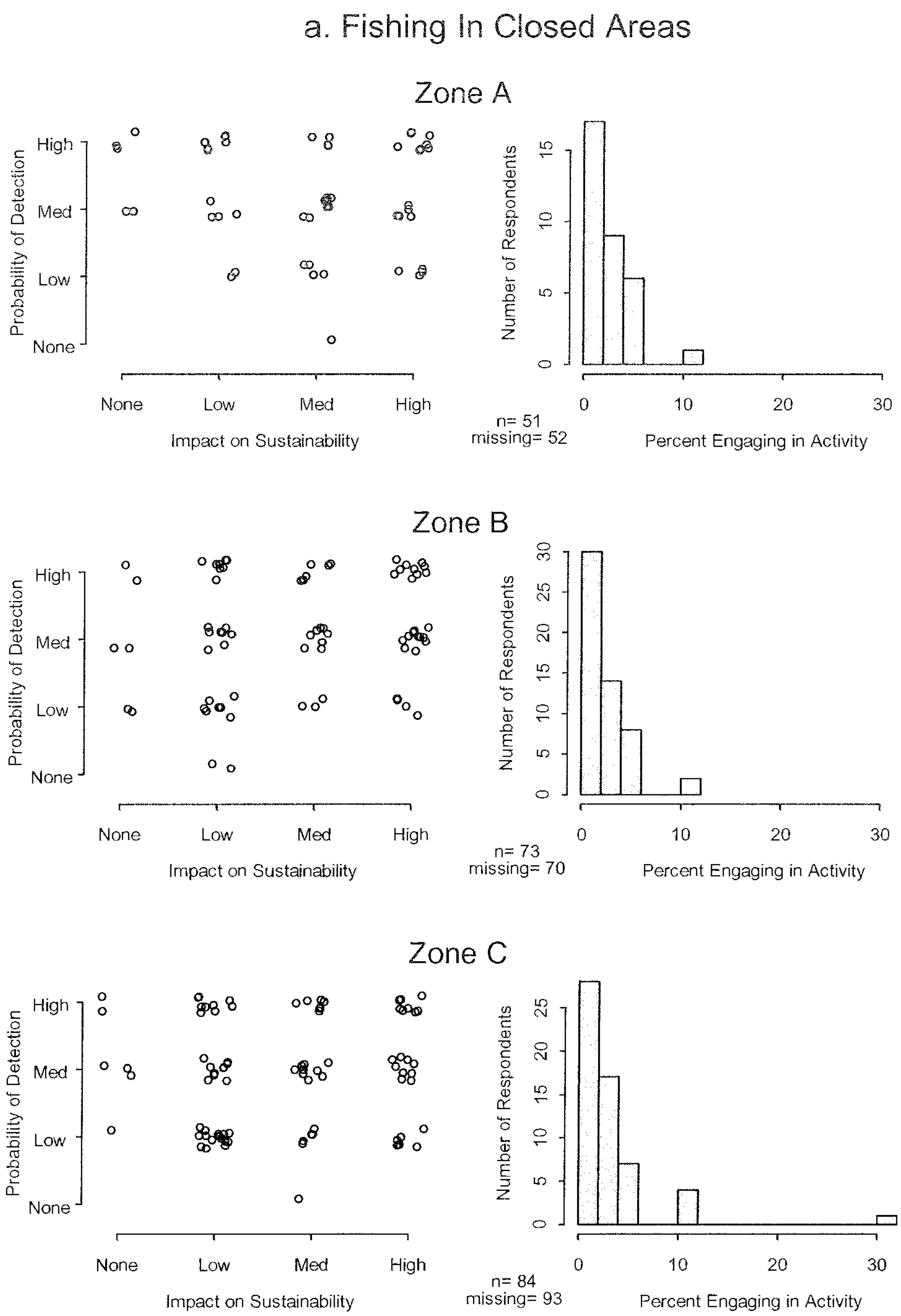


Figure 6.41 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *fishing in closed areas (Q59a)*, categorised by Zone.

- In general, Zone A fishers were more likely to think the effect of fishing in closed areas would have greater IOS, and there is a greater POD, compared with fishers from Zone B or C.
- Very few fishers (all zones) considered there was no probability of detection when fishing in closed areas.
- Most respondents from all zones considered 0-5% of fishers to be engaged in closed-area fishing.

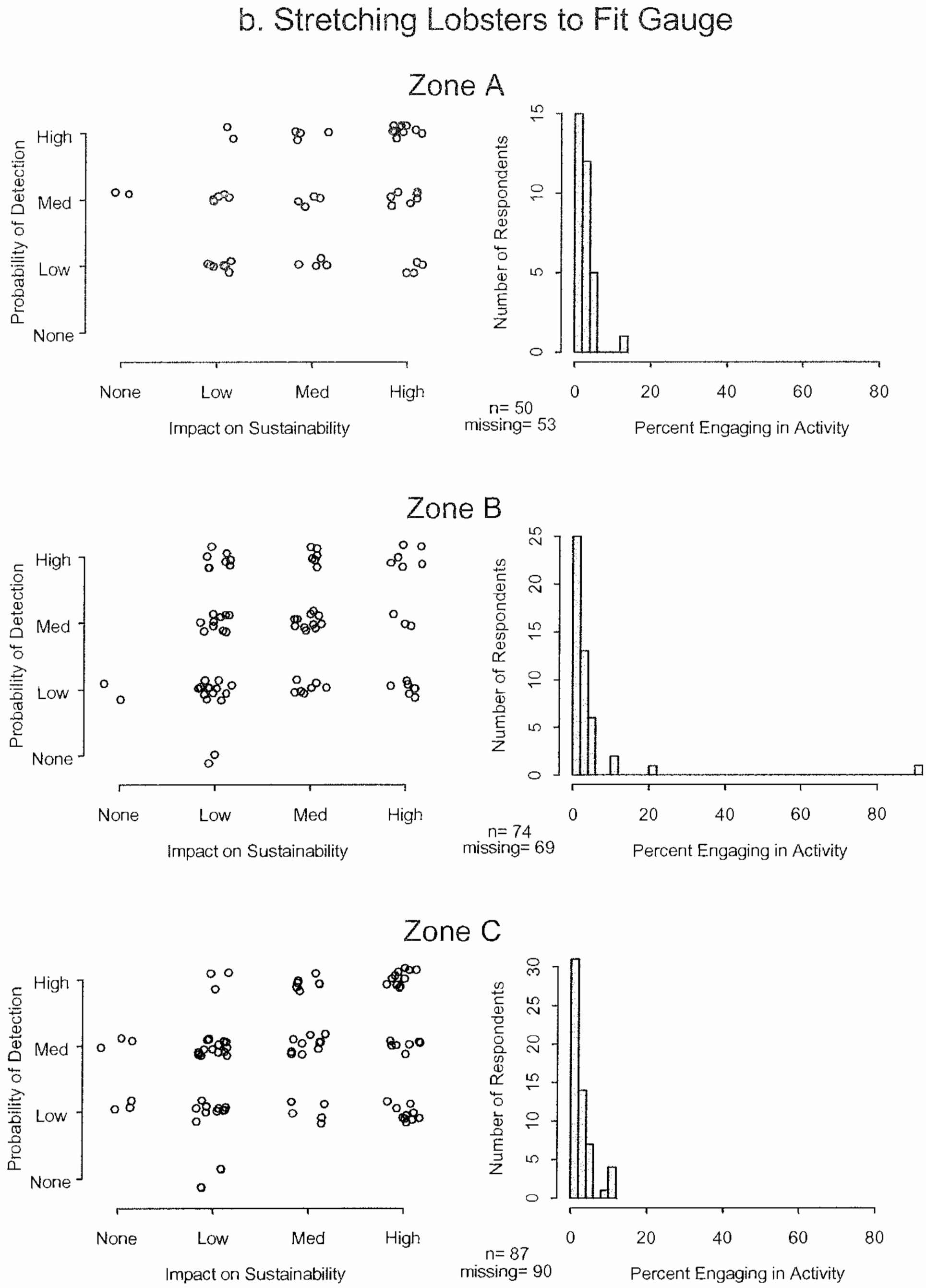


Figure 6.42 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *fishers stretching lobsters to fit the minimum size gauge (Q59b)*, categorised by Zone.

- A substantial number of Zone B and Zone C fishers considered stretching undersize lobsters to fit the minimum-size gauge to have only a low or medium IOS.
- A large proportion of Zone B fishers felt the POD is low for fishers stretching lobsters.
- Most fishers from all zones considered 0-5% of fishers to be engaged in stretching lobsters, however a small number of fishers in Zone C thought up to 10% engaged in the activity.

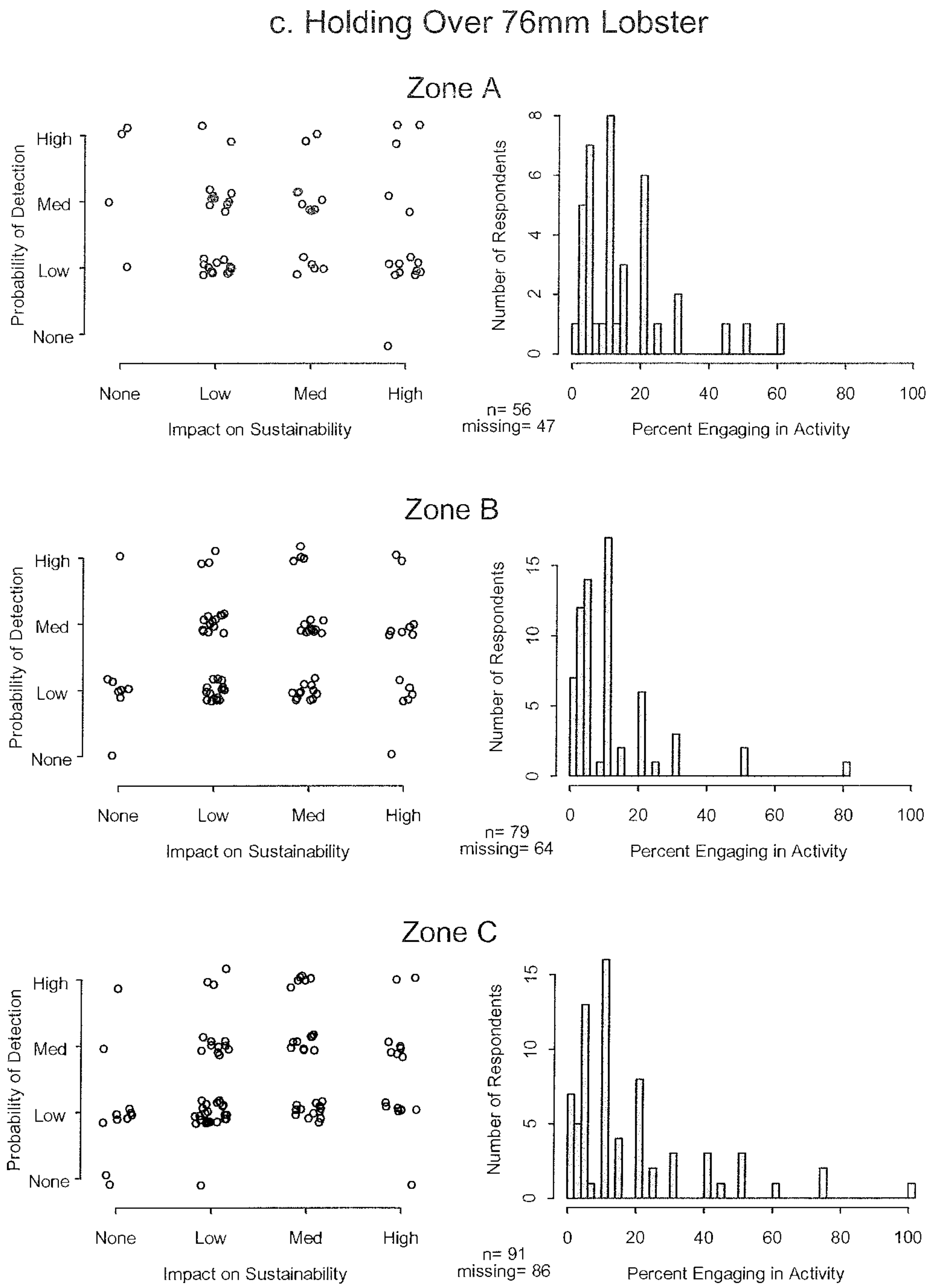


Figure 6.43 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *fishers holding-over 76mm lobster prior to the gauge change (Q59c)*, categorised by Zone.

- A majority of fishers from all zones considered the practice of holding over undersized lobsters prior to the 1 February gauge change had a low-medium IOS and a low-medium POD.
- Perhaps of concern to enforcement officers, a considerable number of respondents from each zone considered the practice to be widespread among fishers.

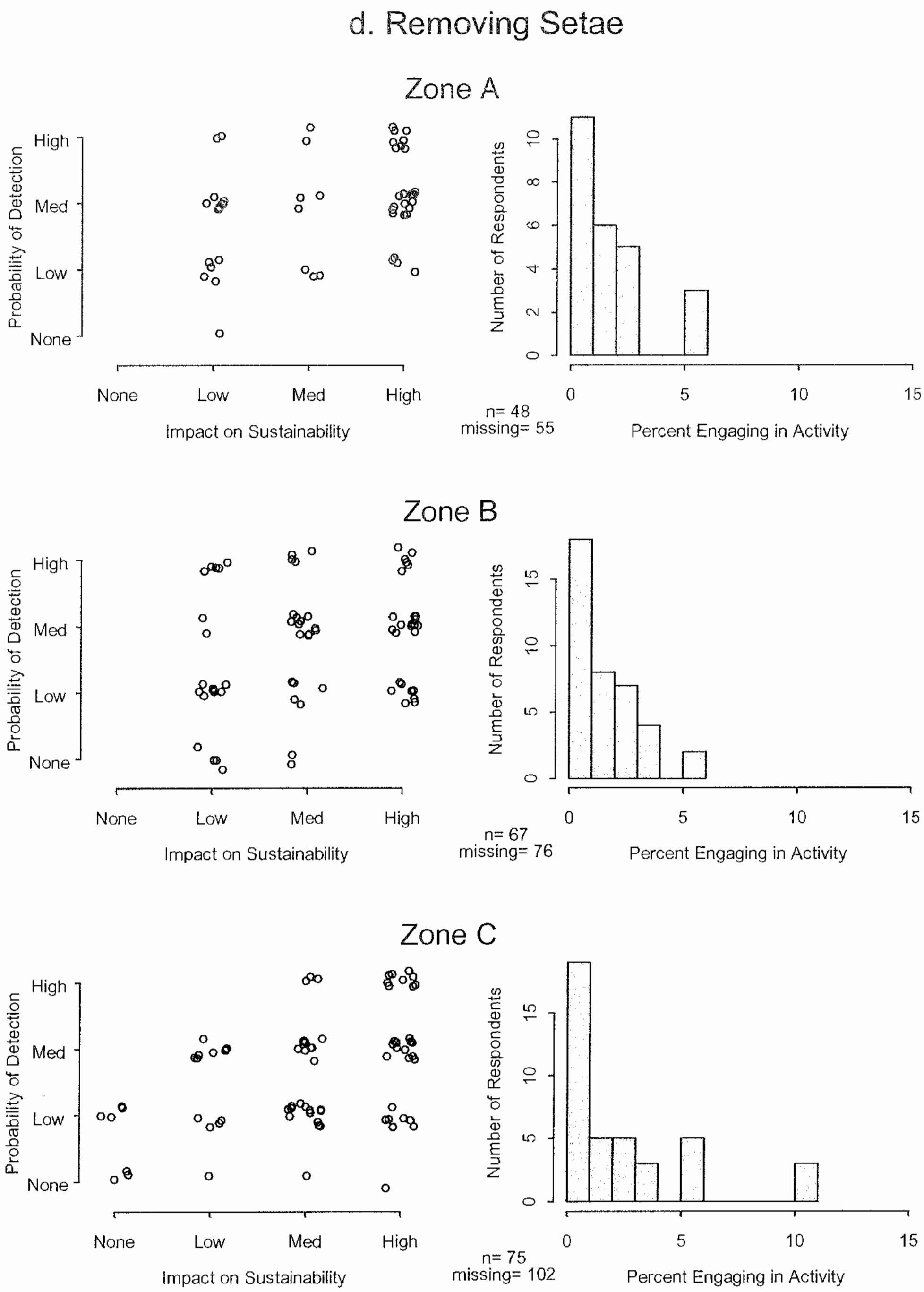


Figure 6.44 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *fishers removing setae from rock lobster (Q59d)*, categorised by Zone.

- Most fishers though that removing setae from mature female lobster had a high IOS, however several fishers from each zone (and especially Zone C) thought the practice had a negligible IOS.
- Most respondents in each zone thought 0-3% of fishers engaged in the practice of removing setae from mature lobster.

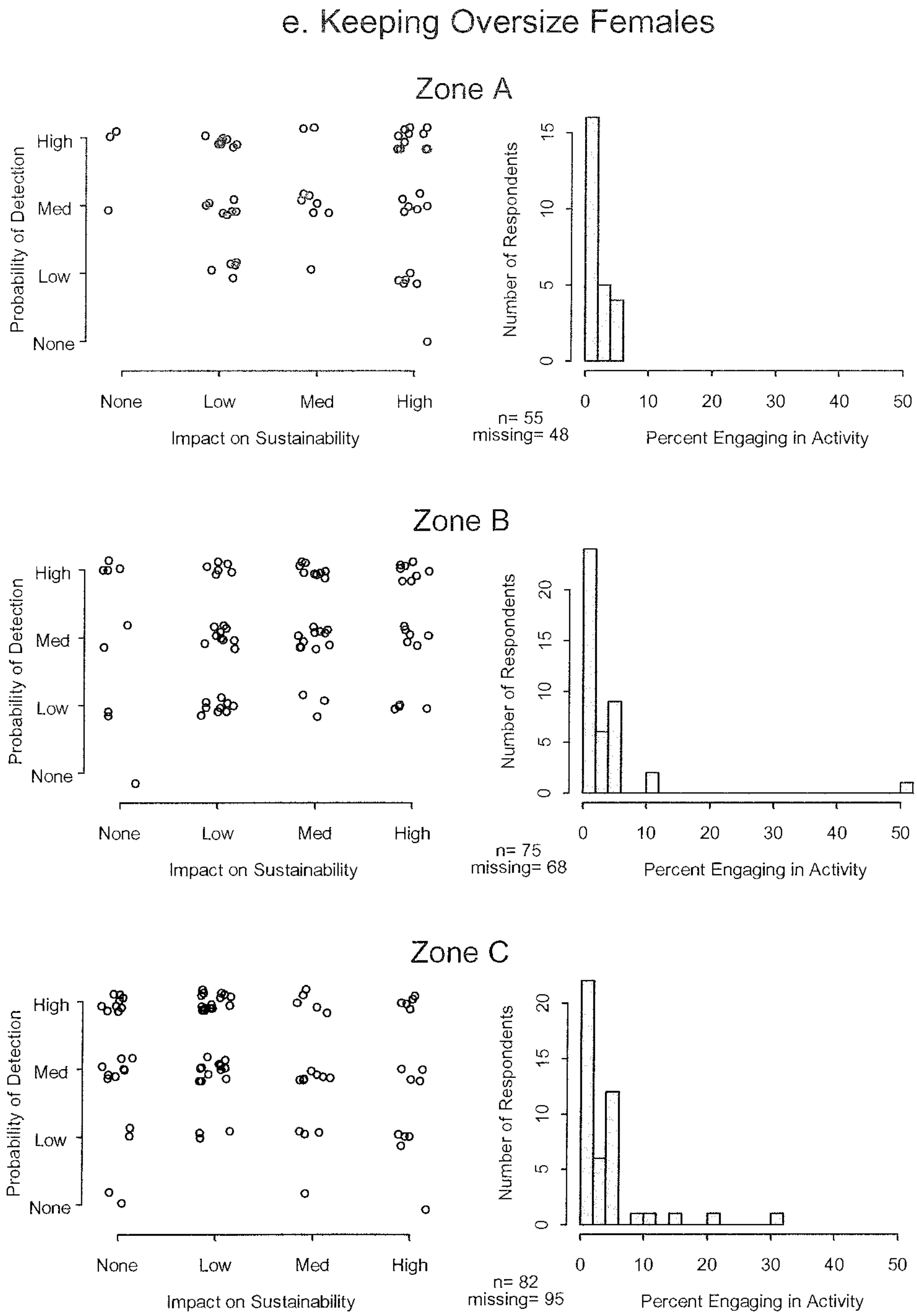


Figure 6.45 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *fishers keeping oversize female lobster (Q59e)*, categorised by Zone.

- A significant number of fishers in Zone C thought keeping oversize females had no or low IOS, however most considered the POD to be medium or high.
- The percent of fishers retaining oversize female lobsters was estimated in the range 0-5% for all zones, although several Zone C fishers thought 10-30% of fishers could be engaging in the practice.

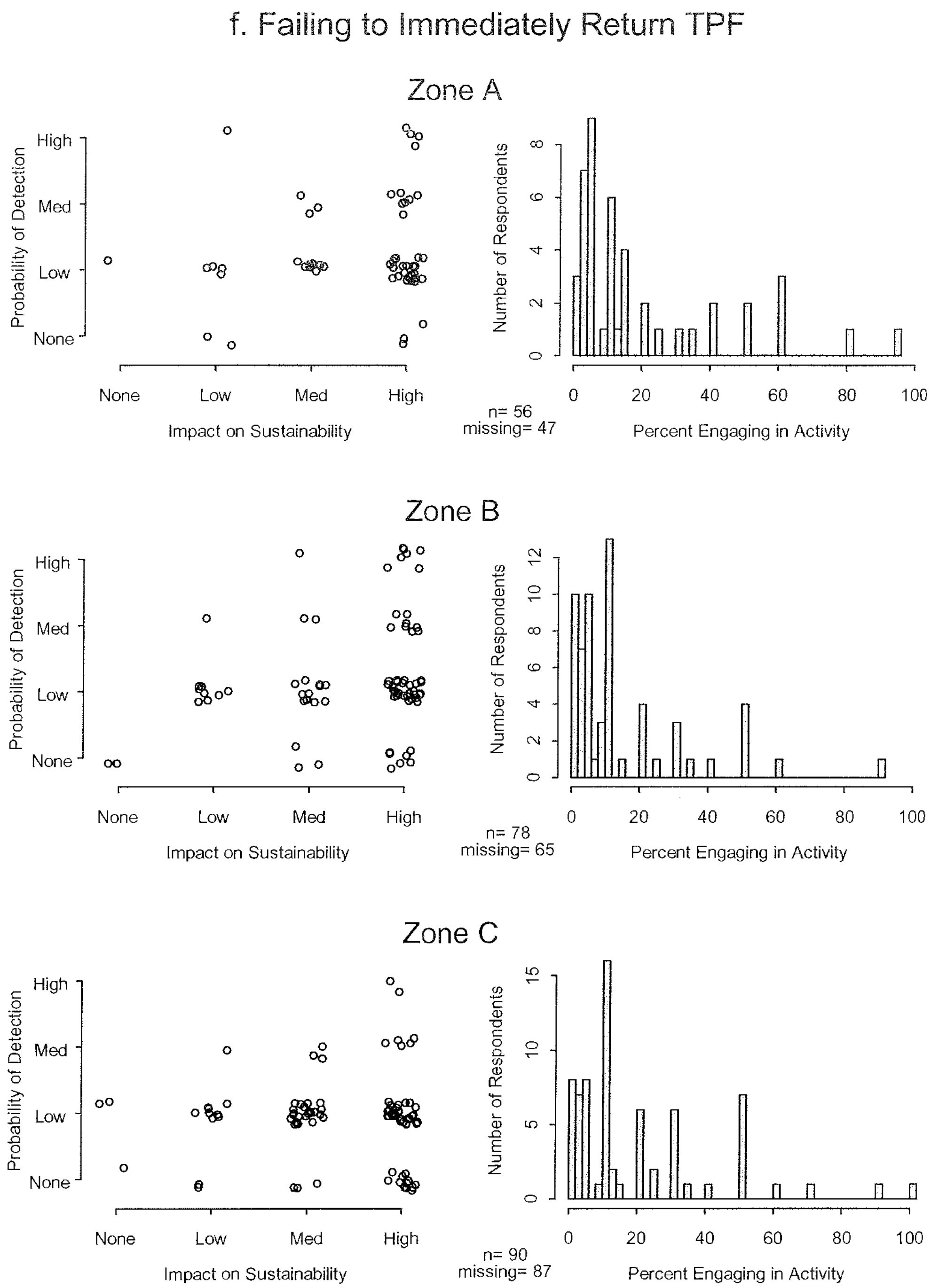


Figure 6.46 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *fishers failing to return TPF to the water after each pot-pull (Q59f)*, categorised by Zone.

- Results clearly indicate that most respondents think failing to immediately return totally protected fish (TPF) to the water has a high IOS, but that the POD is low.
- Many fishers were of the view that the practice may be widespread in the fishery.

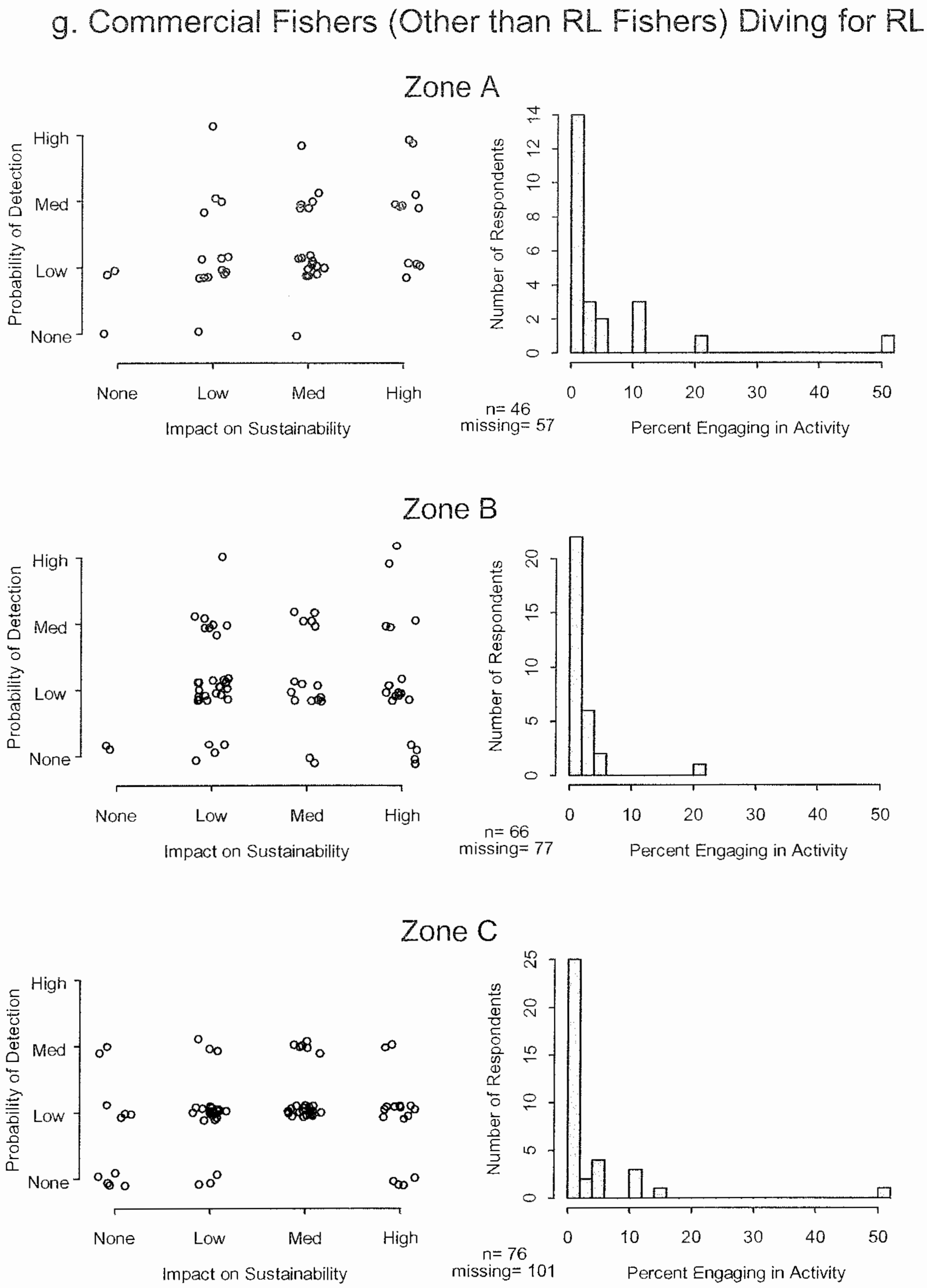


Figure 6.47 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *commercial fishers (other than rock lobster fishers) diving for rock lobster (Q59g)*, categorised by Zone.

- A majority of respondents considered commercial fishers diving for rock lobster to have a low POD, and a low-medium IOS.
- Respondents considered 0-5% of commercial fishers (not rock lobster fishers) to possibly be engaging in the activity, except in Zone A where a small number of respondents thought the figure might be 10% or more.

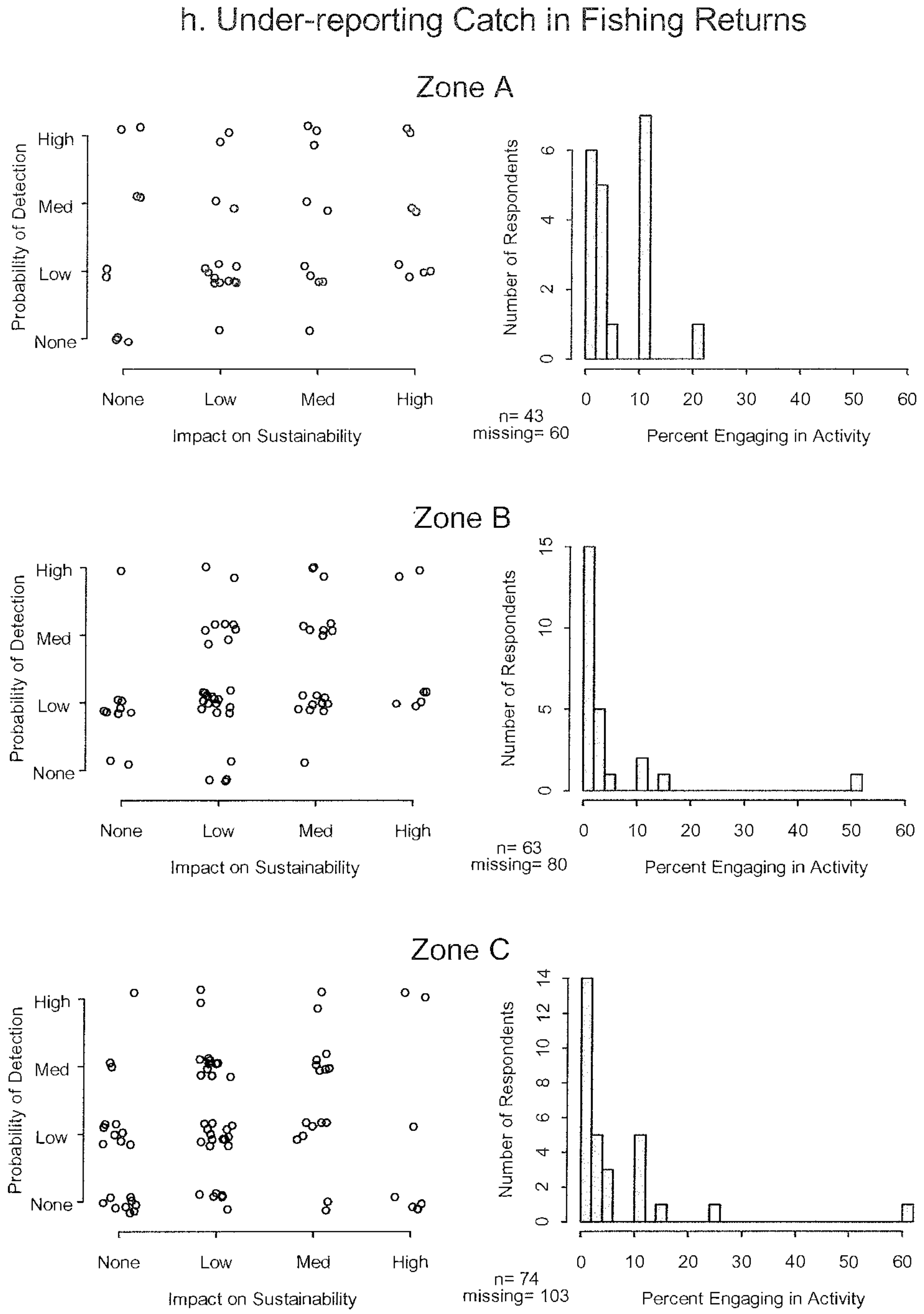


Figure 6.48 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *fishers under-reporting catch in fishing returns (Q59h)*, categorised by Zone.

- Of note, a small but substantial number of Zone C fishers consider under-reporting catch to have no IOS.
- Generally, most fishers considered the POD for misreporting catch to be low.
- Most respondents thought the prevalence of misreporting was low (0-5%), although several indicated that up to 10% of fishers may engage in the practice.

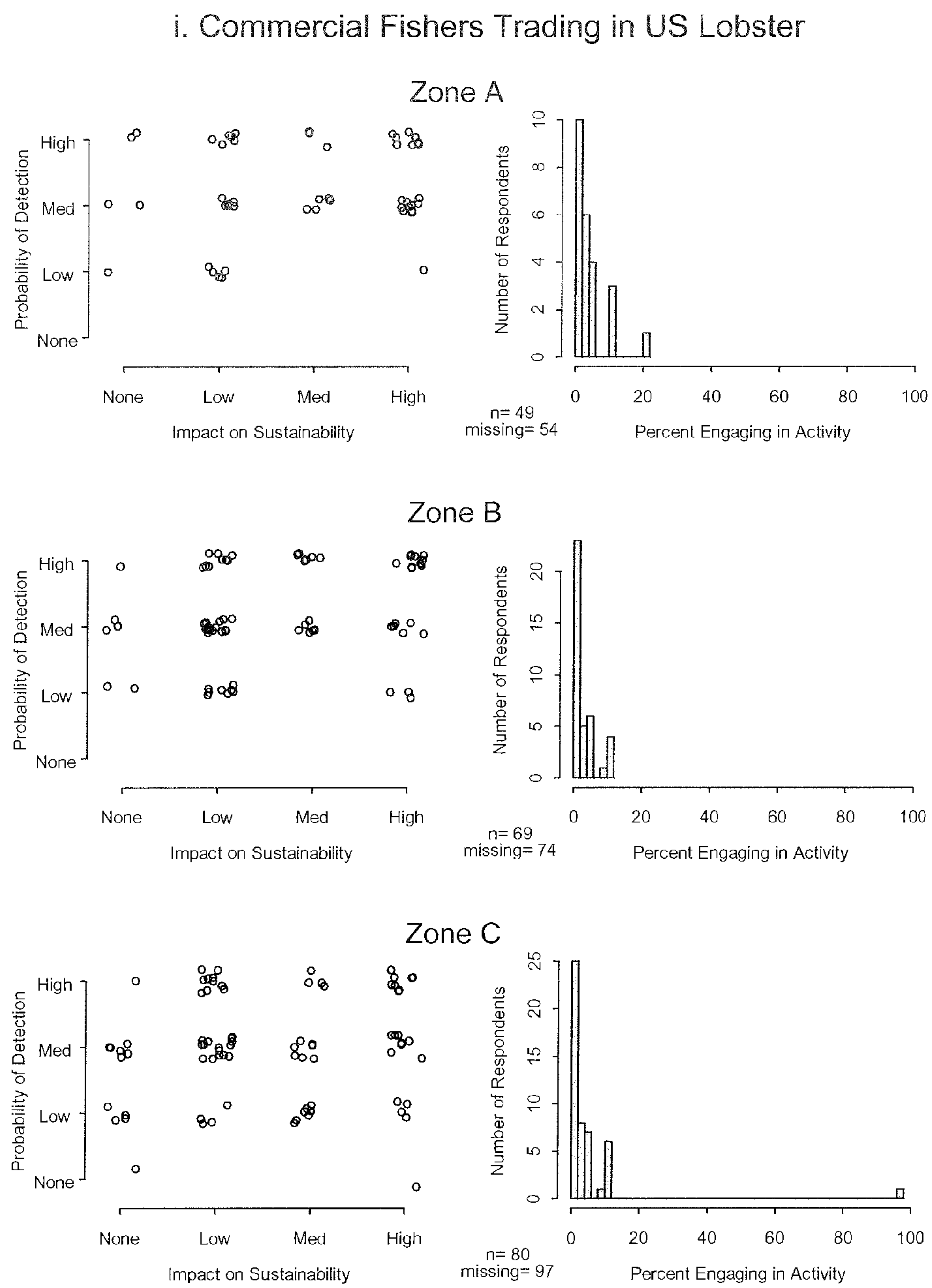


Figure 6.49 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *commercial fishers trading in undersize lobster (Q59i)*, categorised by Zone.

- Opinion seemed divided between those respondents who thought trading in undersized lobster had a low IOS, and those who though the impact was high.
- Respondents were generally of the opinion that the POD was medium-high.
- The percent of fishers trading in undersized lobster was generally estimated in the range 0-5%.

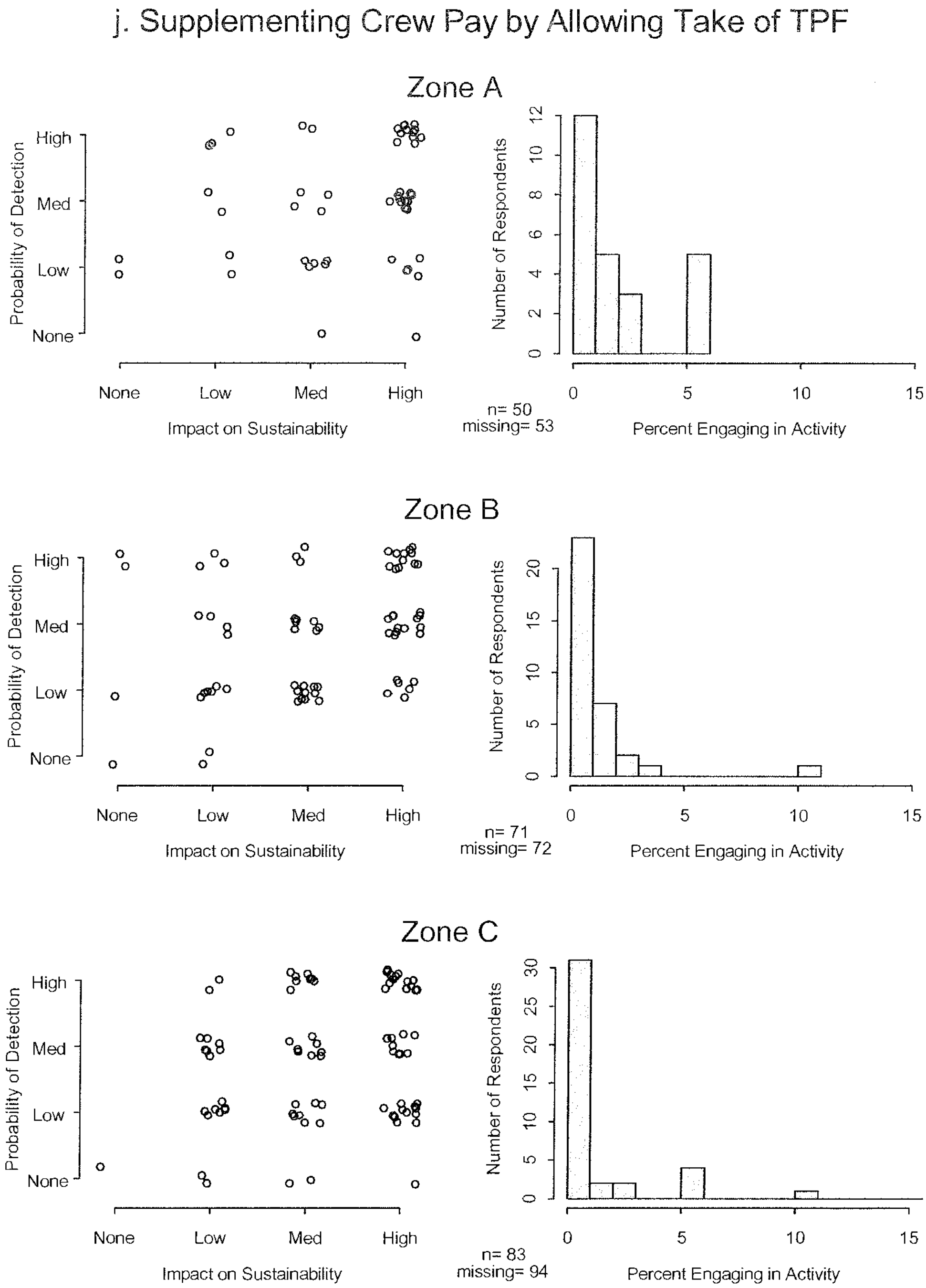


Figure 6.50 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *commercial fishers supplementing crews' pay by allowing them to take home illegal lobster (Q59j)*, categorised by Zone.

- A large proportion of respondents indicated the practice of providing crew with totally protected fish had a high IOS.
- A low but significant number of people thought that the probability of Fisheries Officer detecting the practice was low.
- Most fishers thought that only 0-1% of fishers supplemented crew pay by providing TPF.

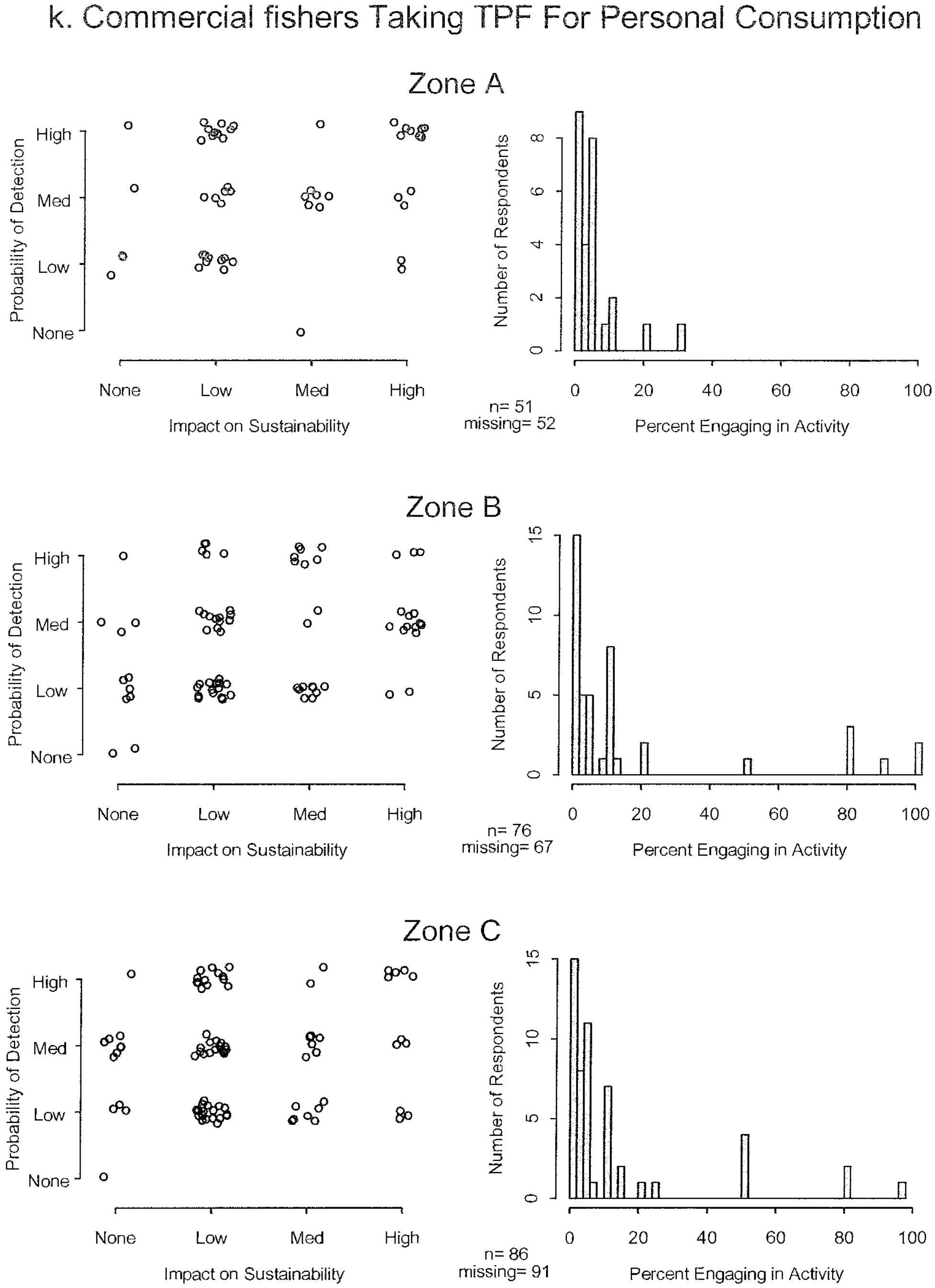


Figure 6.51 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *commercial fishers taking home protected rock lobster for personal consumption (Q59k)*, categorised by Zone.

- In contrast to results for providing crew with TPF, many respondents (skipper and licence-holders) thought that taking protected fish home for their own consumption had only a low IOS.
- Most fishers, with perhaps the exception of Zone A respondents, thought that the POD for the offence was low-medium.
- Overall prevalence among fishers was estimated between 0-5%, but with many exceptions.

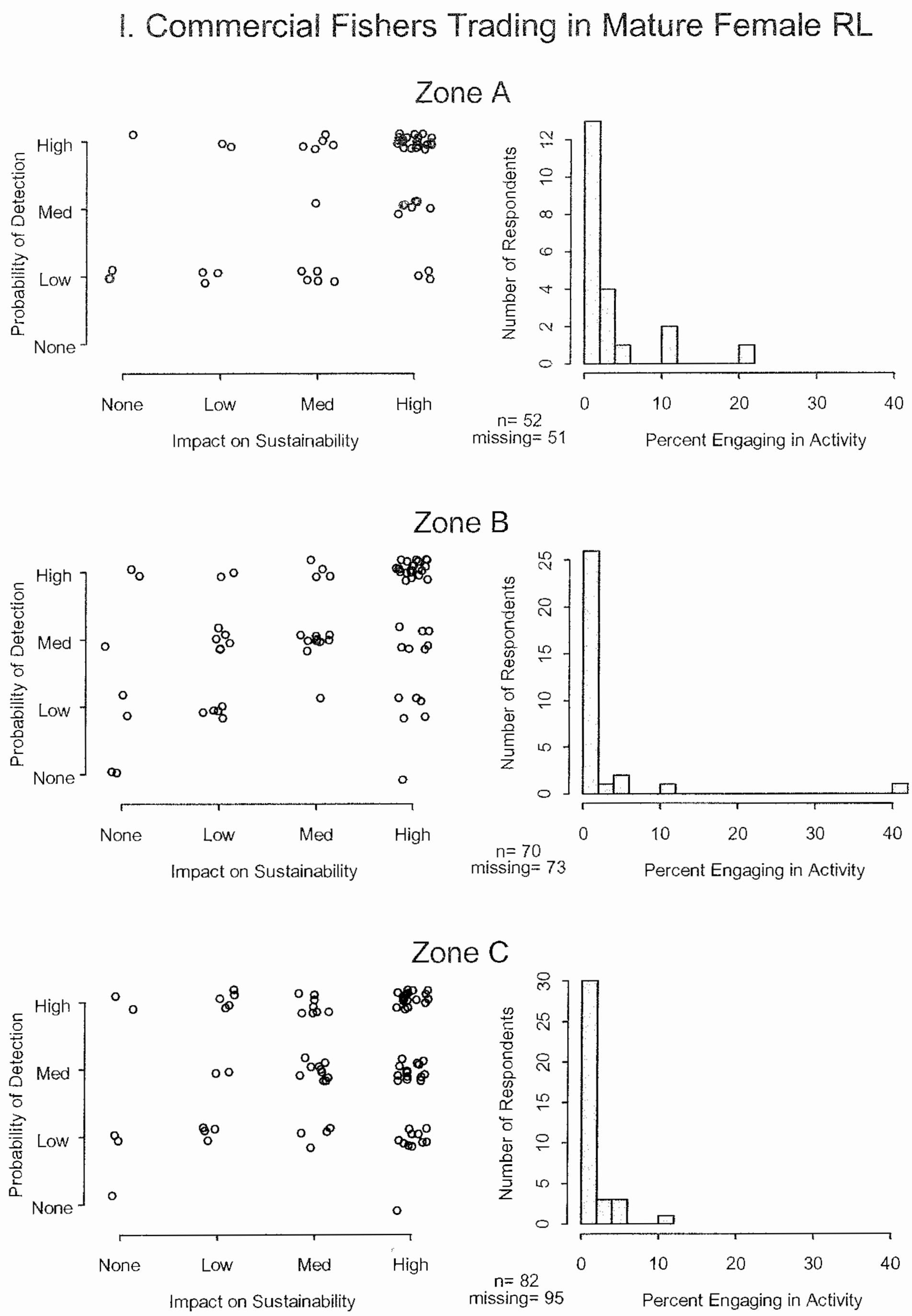


Figure 6.52 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *commercial fishers trading in mature female lobster (Q59l)*, categorised by Zone.

- Fishers generally considered the IOS of trading in mature female lobster to be high, with a correspondingly high POD.
- Most respondents were of the opinion that only 0-2% of fishers engaged in trade of mature female lobster.

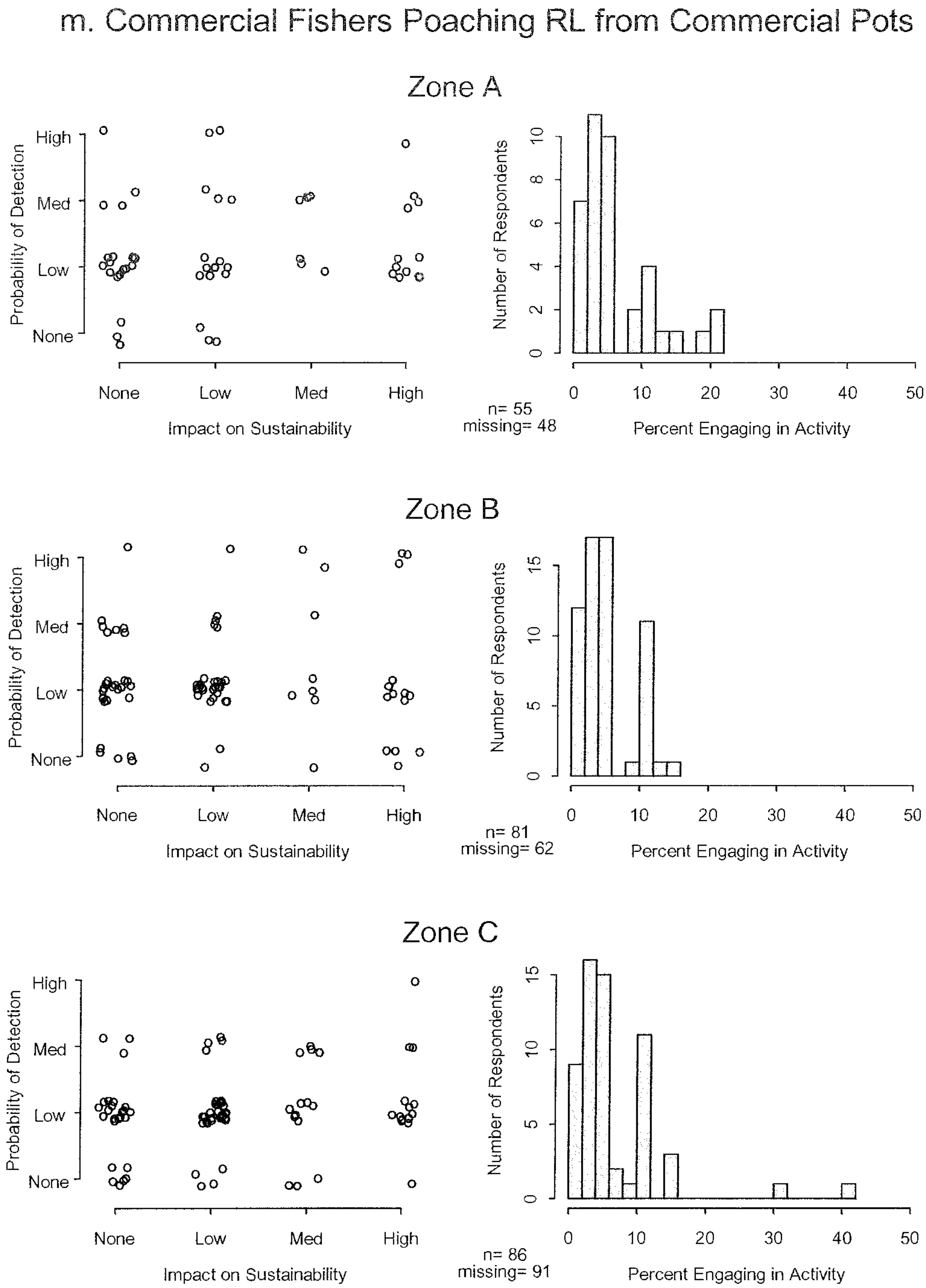


Figure 6.53 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of *commercial fishers poaching lobster from other fishers' pots (Q59m)*, categorised by Zone.

- Respondent views were divided between a majority who felt commercial pot-poaching occurred in 0-5% of the fleet, and those who felt the practice was more widespread (10% or more).
- IOS was considered low or negligible by most fishers, and most agreed that it was a difficult offence for Fisheries Officers to detect.

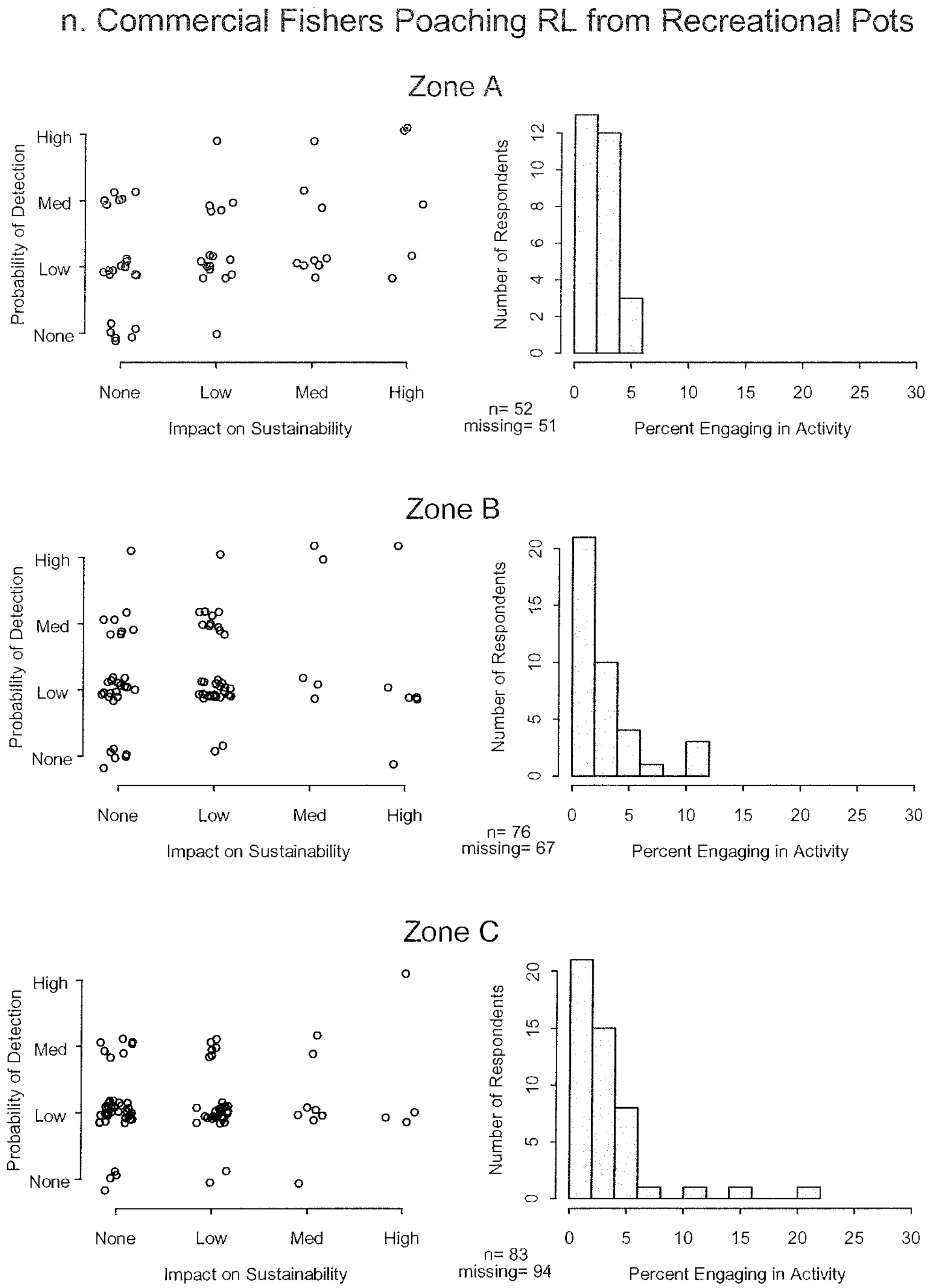


Figure 6.54 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *commercial fishers poaching lobster from recreational pots (Q59n)*, categorised by Zone.

- Like commercial pot-poaching, most respondents thought poaching from recreational pots to have a low IOS, and a low POD.
- Most respondents thought only a small proportion of fishers (0-5%) engage in the practice.

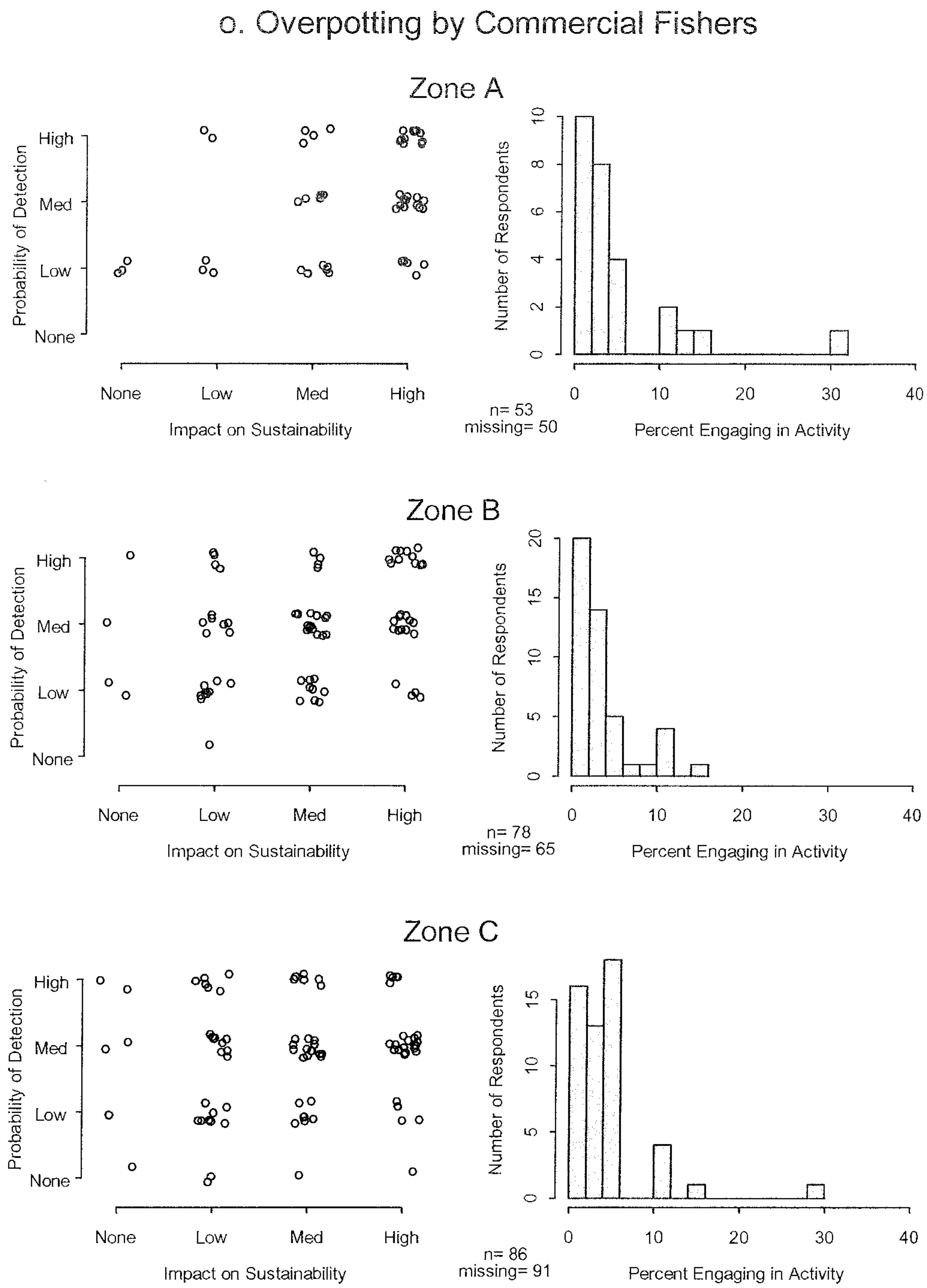


Figure 6.55 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *over-potting by commercial fishers (Q59o)*, categorised by Zone.

- Respondents typically indicated that over-potting has a medium-high IOS, and a medium POD.
- Most respondents indicated they thought 0-5% of fishers used more pots than their entitlement to fish allowed, although several individuals considered the practice more prevalent (10% or more).

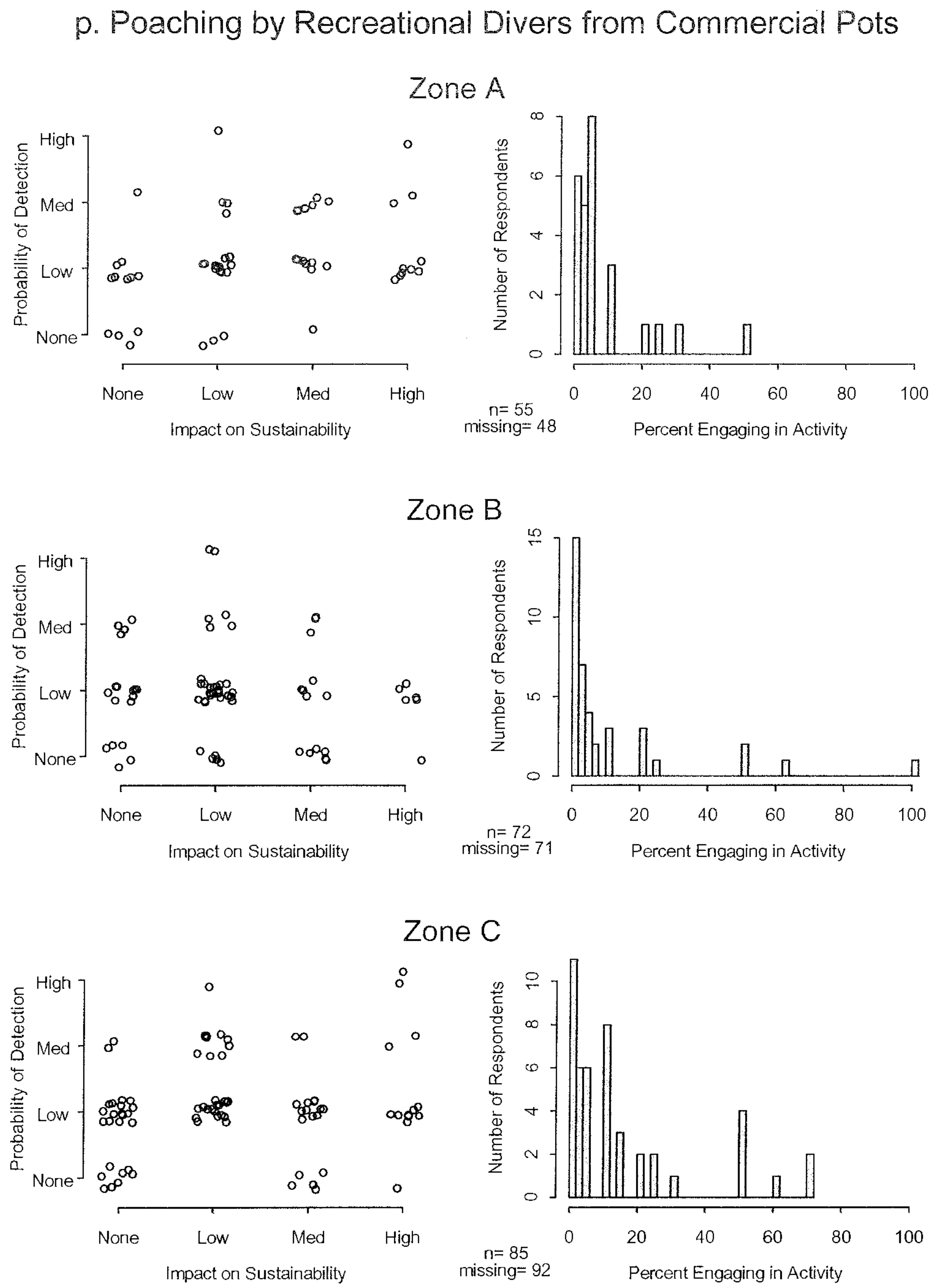


Figure 6.56 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *poaching by recreational divers from commercial pots (Q59p)*, categorised by Zone.

- Survey participants generally considered recreational divers stealing lobster from commercial pots to have only a small IOS. Most considered the POD to be low.
- Although many fishers estimated the prevalence of the activity among recreational fishers to be 0-5%, many individuals considered the practice to be much more widespread.

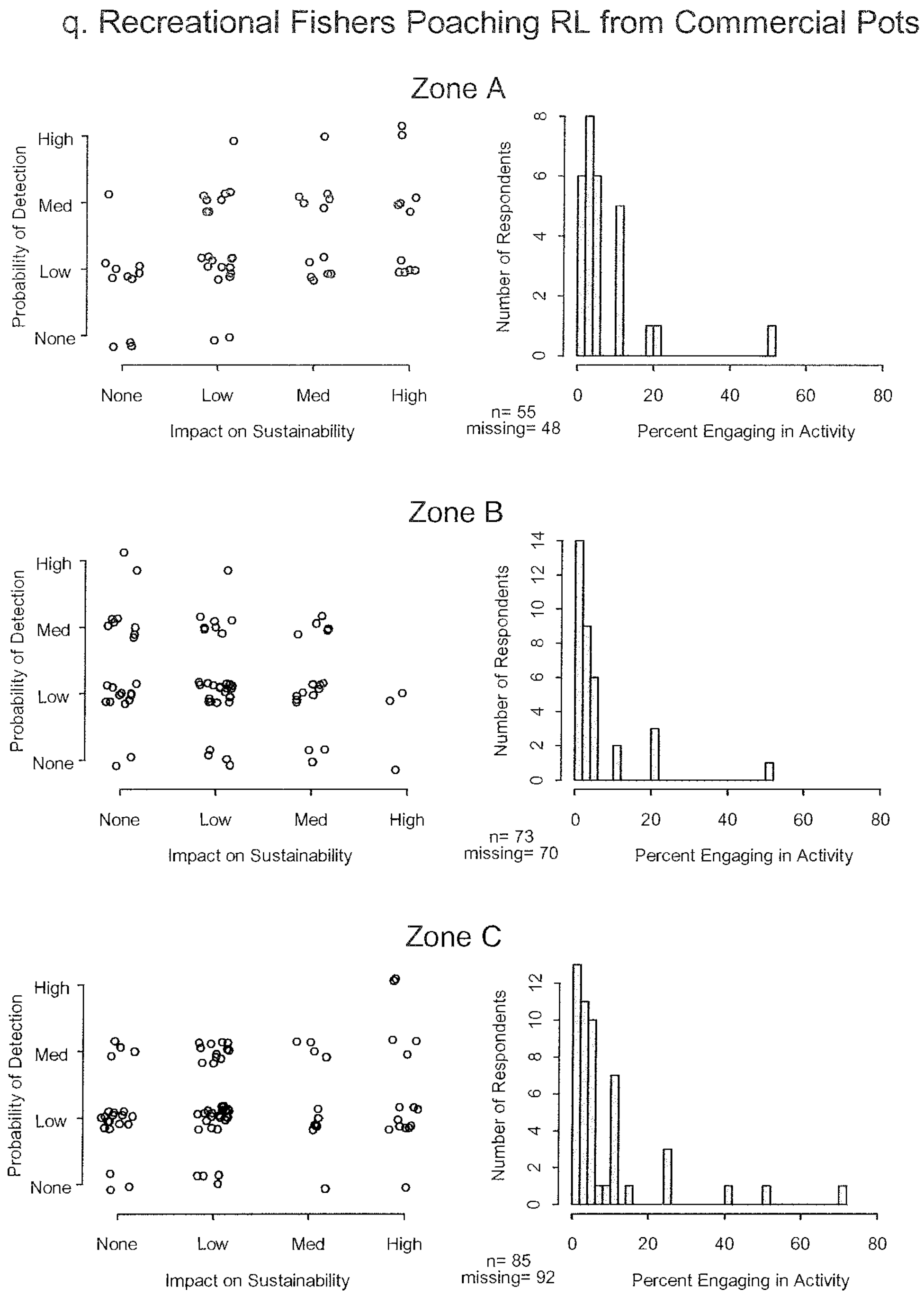


Figure 6.57 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *recreational fishers poaching from commercial pots (Q59q)*, categorised by Zone.

- Commercial fishers generally thought that only a small number (0-5%) of recreational fishers steal lobsters from commercial pots.
- A majority of respondents thought both the IOS and POD to be low.

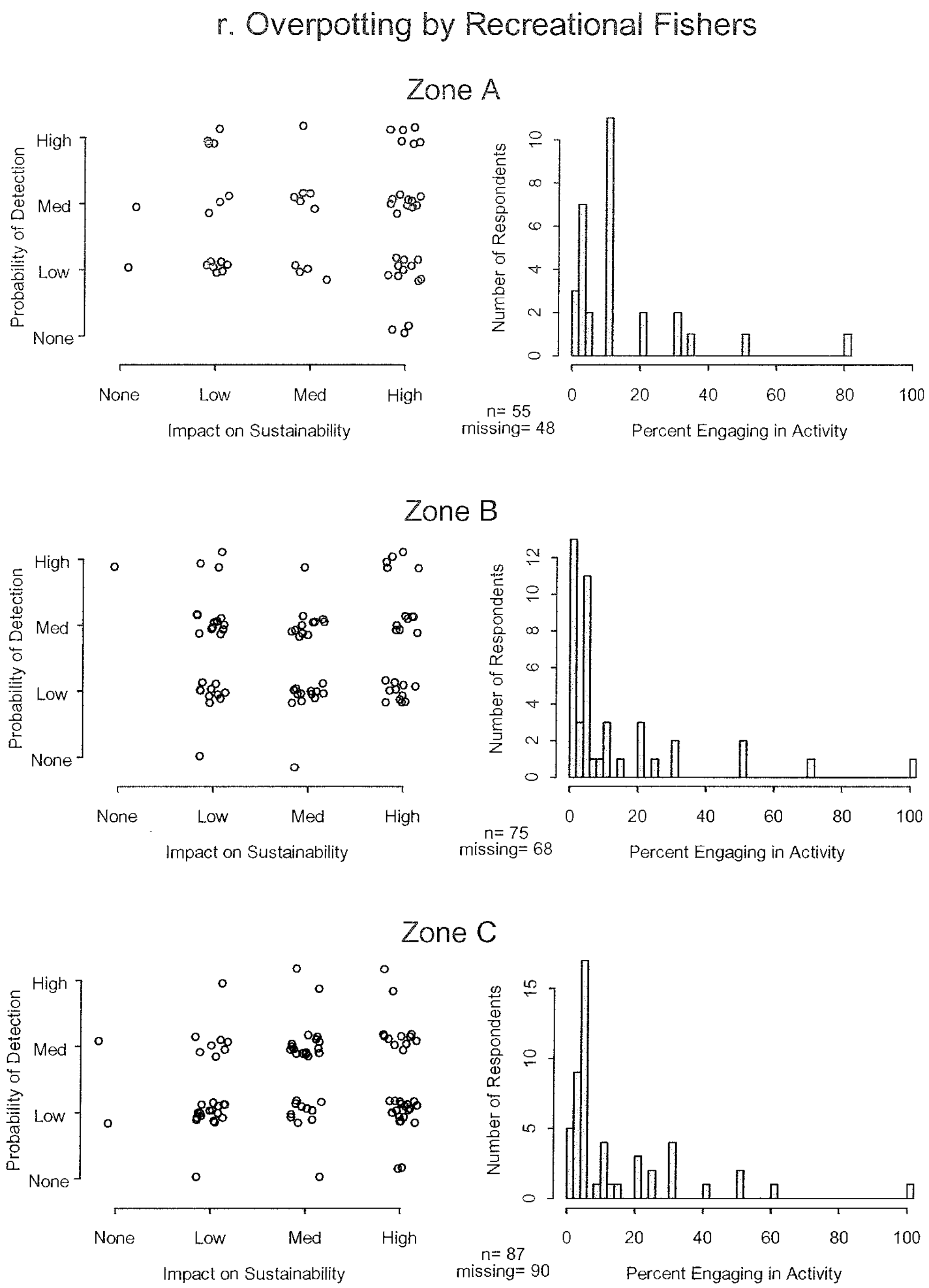


Figure 6.58 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *over-potting by recreational fishers (Q59r)*, categorised by Zone.

- Survey respondents generally thought there was a low-medium chance of Fisheries Officers detecting of recreational fishers using more than two pots. Opinion about the IOS appeared split between low, medium and high.
- A majority of respondents thought 0-10% of recreational participants fished using more than two pots, however several individuals indicated they thought the practice was more common.

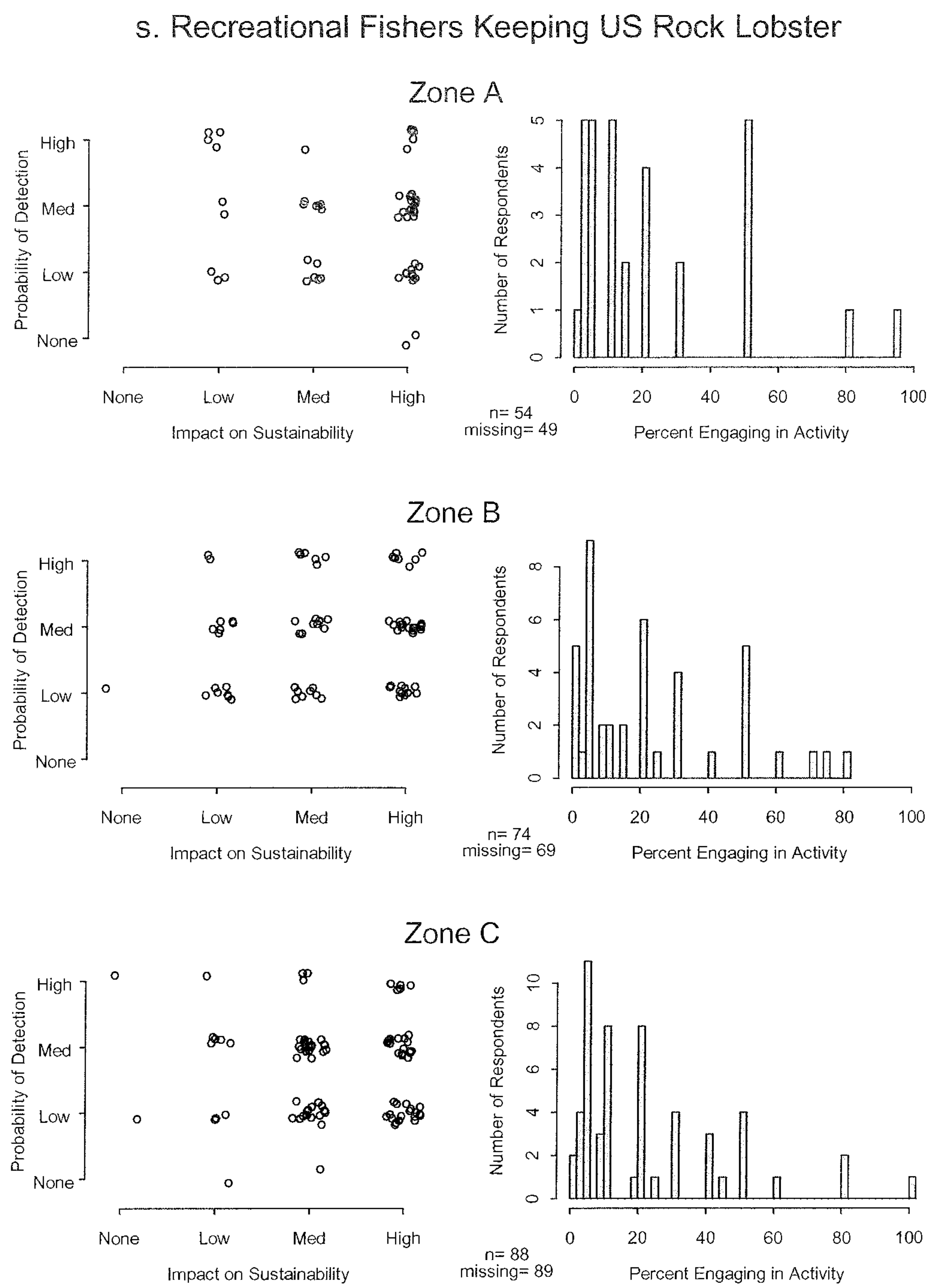


Figure 6.59 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *recreational fishers keeping undersized rock lobster (Q59s)*, categorised by Zone.

- Many commercial fishers were of the opinion that a large proportion of recreational fishers keep undersized rock lobster.
- Opinion among respondents was divided over the POD, but nearly all indicated they thought the IOS to be low or medium.

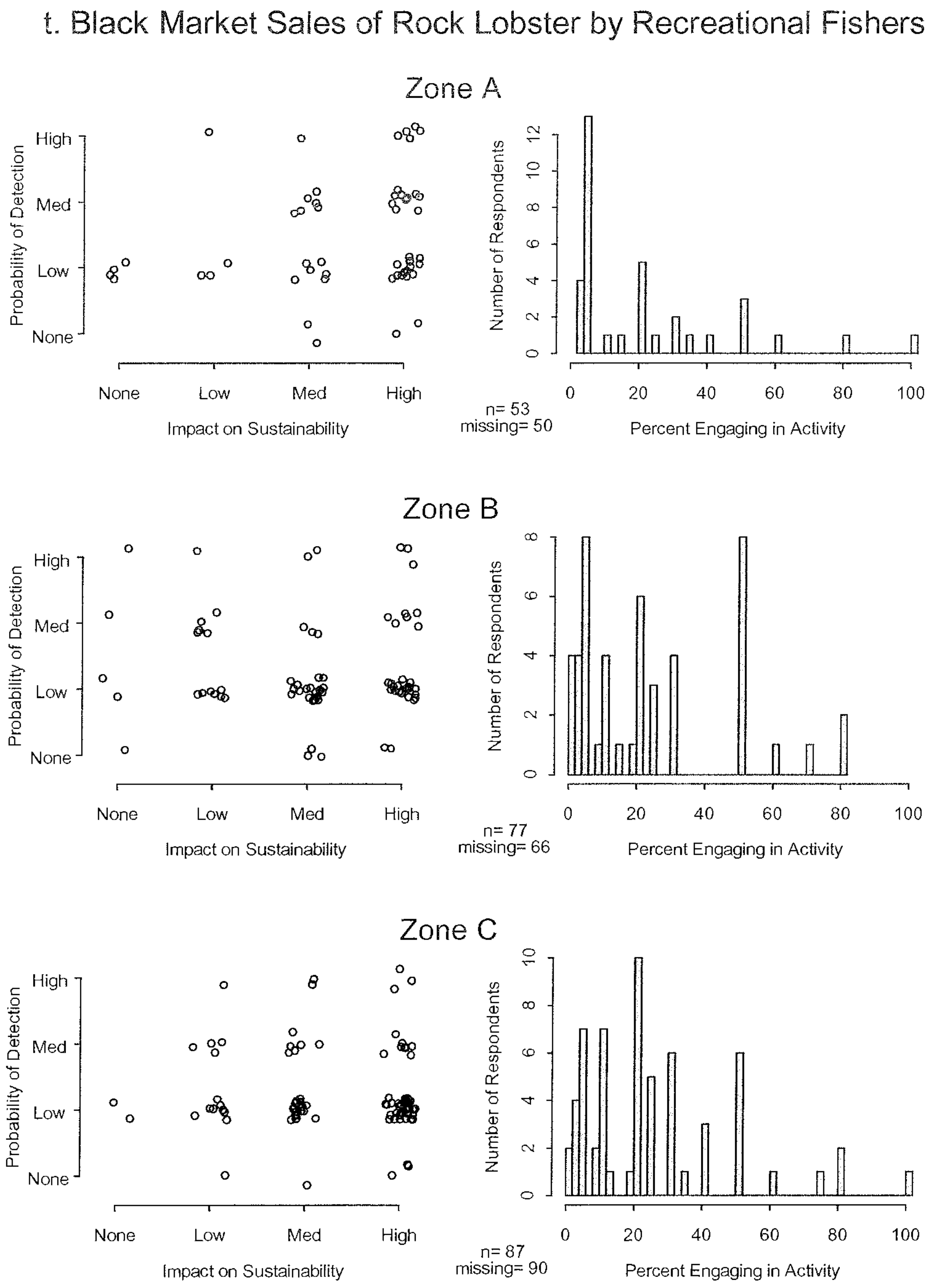


Figure 6.60 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *black market sales by recreational fishers (Q59t)*, categorised by Zone.

- A majority of respondents, with the exception of perhaps Zone A, thought the probability of Fisheries Officers detecting black market sales of lobsters was low. Most were agreed that the IOS was medium-high.
- Estimates of prevalence of the activity in the fishery varied, but generally fell within the range 0-50%. Fishers in Zone C felt the activity was more prevalent than respondents in Zones A and B.

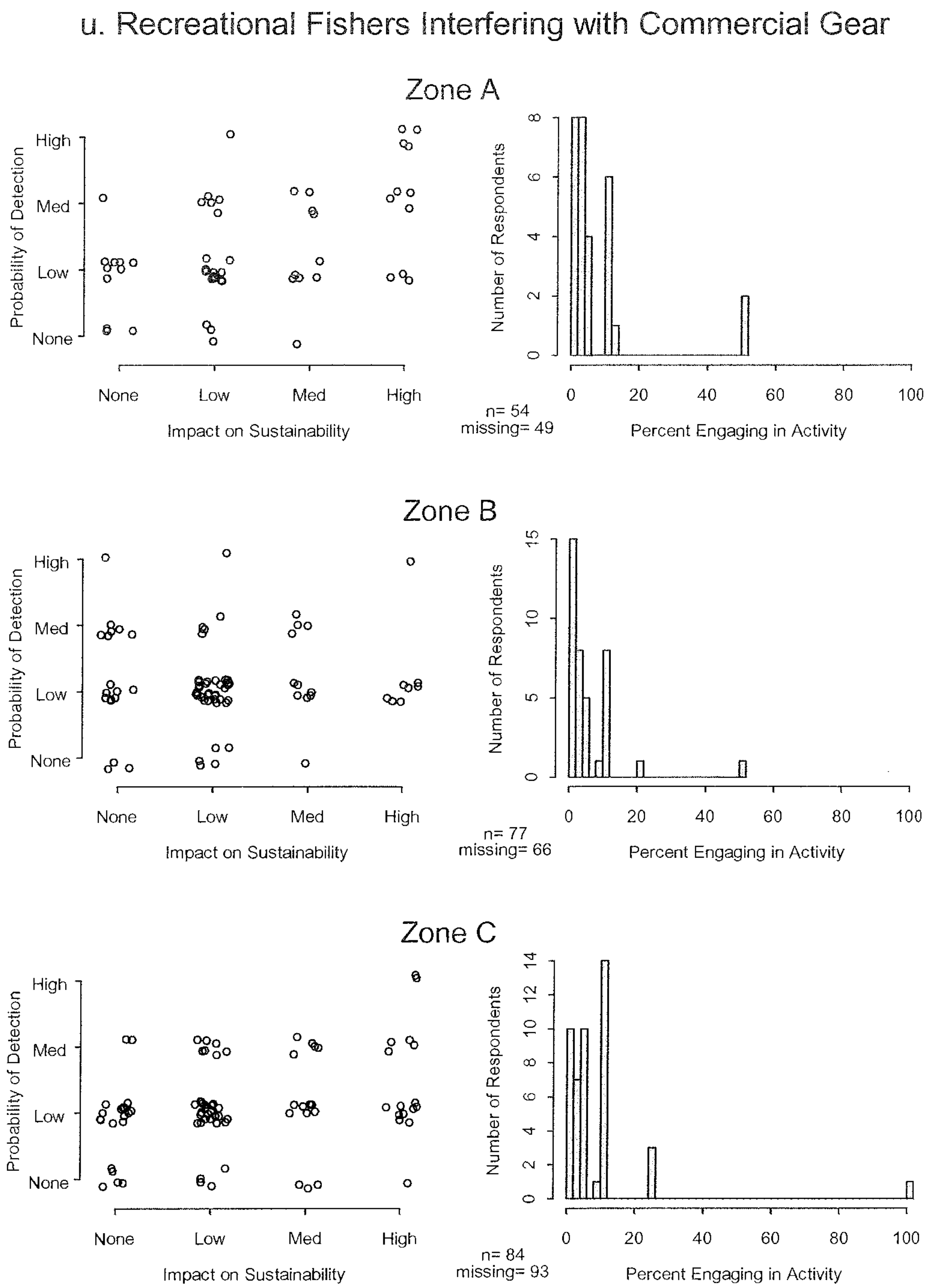


Figure 6.61 Respondent opinion about impact on sustainability, prevalence among fishers, and probability of detection of *recreational fishers interfering with commercial fishers' gear (Q59u)*, categorised by Zone.

- Respondents indicated that, generally, the IOS and POD for recreational fishers interfering with commercial gear was low.
- Estimates of prevalence among recreational fishers was bimodal, with peaks at 0-5% and 10%.

Q60. Please indicate which fisher organisations you are member.

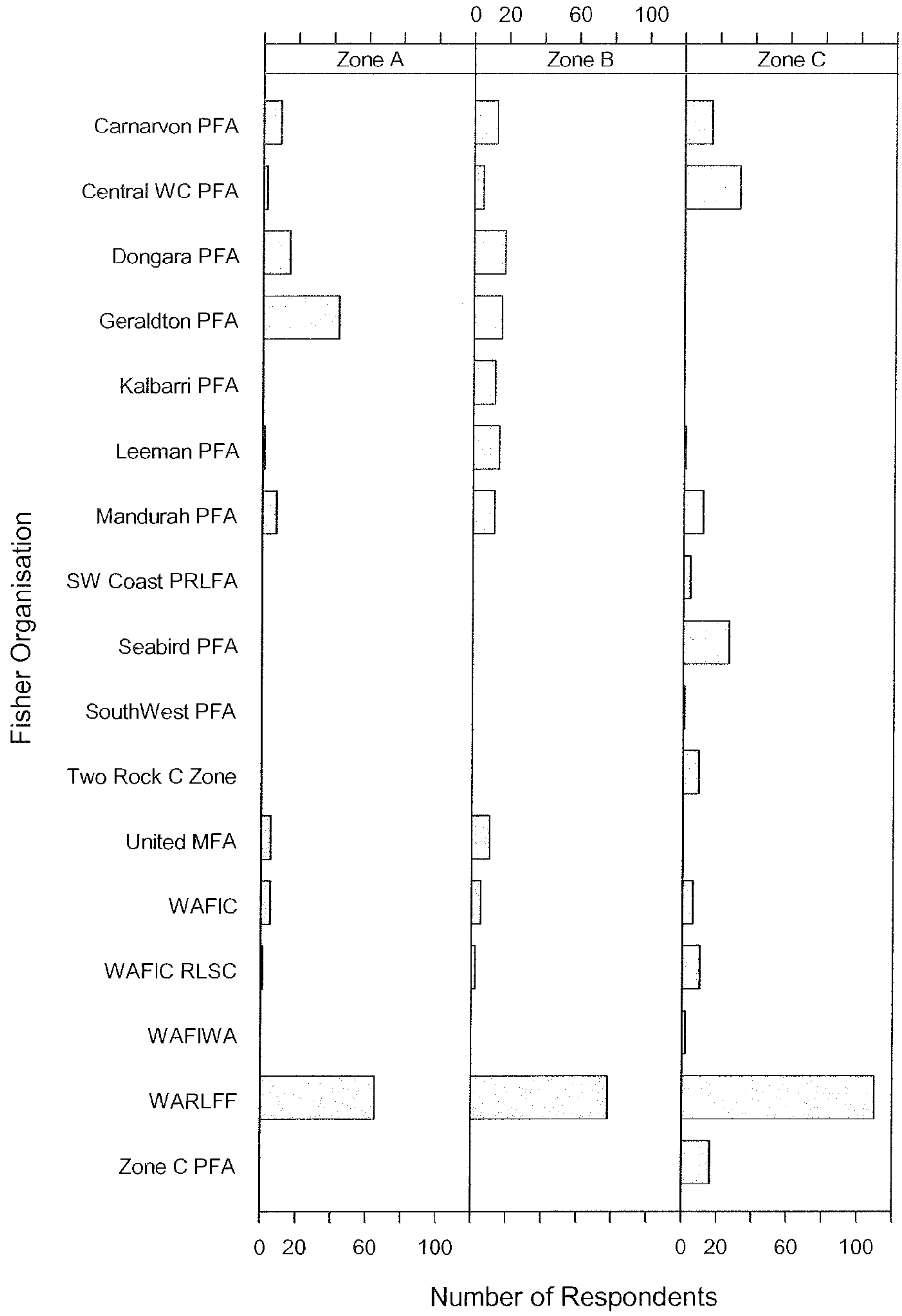


Figure 6.62 Respondent membership with fishing-related industry organisations, categorised by Zone and restricted to licensees and/or skippers only.

- Many fishers belong to more than one fishing association. Of particular interest is membership of the Fishermen's Federation (WARLFF); 59%, 50% and 59% of responding licensees and skippers from Zones A-C belonged to the WARLFF.
- Several fishers indicated membership to organisations not within the zones they currently fished (e.g. Carnarvon and Mandurah PFAs), perhaps indicating links from past fishing practices.

6.5 Discussion

6.5.1 Response Rates and Demographics

The level of interest shown by the commercial fishing industry in compliance related issues, as expressed by survey response rates, is considerable. Responses rates for skippers of 46%, 51% and 38% for Zones A-C compare favourably with ongoing attempts to engage industry in research-related activities. For example, a voluntary research logbook program typically attains a maximum skipper participation rate of 35% (Eric Barker, pers. comm.). Given the size and complexity of the survey examined in this study, skipper response rates approaching 50% are appreciably better than anticipated.

It is not possible to know the number of contract skippers in the fleet, since these are private contractual arrangements between licence-holders and the contract skippers. However, if the ratio of respondents who are skippers but not licence-holders to skippers who are licence-holders (~0.49) holds as representative of the entire fishery, this would indicate there might be as many as 120 contract skippers in the fleet. Since motivations for conservative fishing behaviour may be different between licence-holders who have a continuing stake in the future of the fishery, and contract skippers whose future employment may be subject to obtaining high catch rates, the degree to which licence-holders are leaving active fishing may be of concern to enforcement personnel.

Levels of crew participation in the survey were low, although, like employed skippers, the total number of crew operating aboard lobster boats is largely unknown, making it difficult to estimate participation rates. Certainly, participation rates are much lower than those observed for licence-holders, and may be as low as 5%. Reasons for such low participation are unknown, but it may be the case that if a skipper or licence-holder completed a survey for a vessel, then crew did not see the point in providing what they felt would be substantively the same information.

Most survey participants indicated the main language spoken at home to be English, however a substantial number of fishery participants, particularly in Zone C, are known to be of Italian, Portuguese or Yugoslavian descent. This suggests that fishers for whom English is a second language may be under-represented in the survey, an idea supported by the comparatively low skipper participation rate of 38% observed for Zone C. Under-representation among certain groups of fishers caused by language difficulties is a problem not easily overcome in mail surveys of this type. In the covering letter accompanying the survey fishers were asked to, if necessary, seek the help of a family member to assist in completion of the survey. However this is a poor substitute for personal interviews in situations where language difficulties exist. While many fishers of Italian or Yugoslavian descent may now speak English as the main language at home (and would therefore not be identifiable in the question asking about the main language spoken), the fact that most respondents also indicated Australia as their country of birth means that it is reasonable to assume some degree of bias in results may have arisen due to under-representation of these groups of fishers[19].

There is a long history of family-owned commercial lobster operations in Western Australia, and this is reflected in the number of years experience in the fishery indicated by most respondents, and in the proportion of respondents who stated that lobster fishing was a family tradition. Those with least history in the fishery tended to be licence-holders who were not skippers, and crew. Non-fishing licence-holders are slowly becoming more prevalent in the fishery as older fishers leave the industry and sell their licences on the open market to investors who then employ contract skippers to carry out fishing activities. Since contract skippers do not hold own secure property rights in the fishery, it is possible the disincentive to break regulations that is thought to exist for those with secure property rights will not function.

The characterisation of individual fishing operations was similar between zones. Most vessels fish with two or three crew and operate between 85 and 125 pots, with around half of all licence-holders indicating they lease pots in addition to their licence quotas. Crew are generally paid as a proportion of the value of the catch, creating an incentive for crew to maximise the catch. Most respondents, with the exception of some non-fishing licence-holders and crew, derive their entire income from lobster fishing.

6.5.2 Perceived Legitimacy of Fishing Rules

The legitimacy of regulations is often cited as a major factor contributing to an individual's decision to break fishery rules (Kuperan and Sutinen 1998, Hønneland 2000). When asked to nominate the main reason rock lobster fishers break regulations, the overwhelming majority of respondents indicated monetary gain as the motivating factor. Only small numbers of respondents indicated other factors, such as competition or financial hardship, play the primary role (the latter of which is closely linked to financial gain). However, answers to many other questions in the survey indicate that substantial numbers of fishers would like to see some rules changed or removed. Noteworthy among these were the maximum size for taking female lobsters, the split minimum size rule, and fishing time restrictions. In the following discussion I examine perceptions about these and other rules. I have tried not to assume that fishers expressing dissatisfaction with a particular rule necessarily break the rule, however where additional (often anecdotal) information from fishers or Fisheries Officers is available I have introduced it if relevant to the discussion.

Legal fishing times in the western rock lobster fishery have been designed to restrict fishing to approximate daylight hours in order that enforcement staff are able to observe illegal activity if it is occurring. For example, it is difficult to observe illegal pot-pulling or gear interference in the dark. However, a significant number of fishers in Zones A and B (up to 30%), and around 13% in Zone C, indicated that restrictions on

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[19] This is by no means certain, however, since many 1st generation Yugoslavian, Portuguese or Italian fishers have retired from active fishing.

fishing times should be removed. The differential result between zones provides a hint as to why so many fishers might advocate a removal of fishing time restrictions – it implies that those fishers in Zones A and B supporting no restrictions are likely to participate in the Big Bank fishery, where fishers must actively chase migrating lobsters in order to secure good catches. During the Big Bank "run" fishers generally stay at sea for several days at a time, and some fishers are known to pull their pots during the night and/or pull pots many times on the same night. The argument of fishers who engage in "night pulling" or "multiple pulling" is that the migrating lobsters move in closely grouped columns along the sea floor, and that to obtain good catches pots must be moved around to try and locate the migrating animals. Notwithstanding this argument, the practices of night pulling and multiple pot-lifts on the same day are illegal as they increase the rate of exploitation, and pose difficult problems for enforcement officers to police.

The main impediment to effectively policing these rules is that, when vessels operate under the cover of darkness, Fisheries Officers must literally pull alongside an offending vessel to secure an apprehension. Unfortunately, all fishers operating in the deep-water Big Bank fishery have excellent electronic navigation aides, including radar, and it is extremely unlikely Department of Fisheries patrol vessels could approach suspect vessels unobserved (in an electronic sense). Once alerted to the approach of a patrol vessel, a fisher need simply stop fishing to become "compliant". Quite aside from these difficulties, there are serious health and safety concerns when conducting enforcement activities at night (both for Fisheries Officers and fishers). While several propositions for addressing Big Bank night fishing have been considered (e.g. VMS for Big Bank vessels, or designated night-time anchorage areas), to date no satisfactory solution has been agreed. In the meantime, illegal night fishing in the Big Bank fishery will continue to be a problem.

The protection of female lobster in breeding condition is one of the major management controls introduced in recent years to help rebuild lobster breeding stocks. It is perhaps discouraging that some fishers, particularly in Zone C, considered removing setae to have only a small impact on sustainability. Several Zone C fishers also indicated that they perceived the probability of detection for this offence to be low or non-existent; it is to be hoped they are not speaking from experience. In recent seasons, Fisheries Officers conducting factory inspections have not routinely detected lobsters that have had setae removed, although the practice has not been unknown in the past. Results are suggestive that a small number of fishers may be engaging in the practice, and Officers should be alert to the possibility when checking factory consigned catch.

Effort limitation – restricting the total number of pots used in the fishery – is a primary management tool in the western rock lobster fishery. Fishers generally indicated they appreciate the importance of rules limiting pots numbers. When asked to indicate the minimum number of illegal pots used in excess of quota that warranted a suspension, and the length the suspension should be, most fishers answered that a suspension of 6 or 12 months was warranted for illegally using just 1-5 pots. This indicates that many fishers view the current rules regarding over-potting as too lenient. Unfortunately, several fishers from each zone thought that a licence suspension should not be imposed unless a fisher was apprehended with 10, or even 20, pots in excess of entitlement. It is difficult to judge why these fishers might hold such a view; perhaps it is because they themselves engage in over-potting, or perhaps because they have previously been caught over-potting and received a substantial fine or suspension.

A significant number of fishers felt that there should not be a maximum size limit for the take of female rock lobster. The maximum size rule was introduced in the 1993/1994 management package, and was one of a number of rules designed to boost the breeding stock in the fishery. Introduction of the rule, and a number of other rules, meant that fishers would suffer a reduction in catch, and there exists resentment among some fishers regarding the rule changes introduced in the package. Additionally, there is a perception among some fishers that very large female rock lobsters become senescent and do not contribute toward recruitment in the fishery. While the biology of lobster senescence remains uncertain, it is highly likely that most (if not all) female lobsters greater than the maximum prescribed size are still breeding. A modelling study undertaken by Hall and Chubb (2001) showed that the introduction of the maximum size rule only contributed moderately to rebuilding the breeding stock in the mid-late 1990's, and as a result the rule was removed for the 2001/2002 season to coincide with an environmentally-driven, lower than average, predicted catch. The rule was reintroduced for the 2002/2003 season, and remains an important, but small, contributing factor in maintaining an adequate breeding stock in the fishery.

While most fishers thought the current minimum sizes for retaining rock lobster were acceptable, a significant number of skippers and/or license-holders (29-43% across zones) thought that the split minimum size should be removed, making the minimum size 76 mm for the entire season. Like the maximum size rule for females, the split minimum size rule was introduced in order to help rebuild breeding stocks in the fishery. However Hall and Chubb (2001) have judged the rule change to have contributed negligibly to recovery in breeding stock levels. While there is debate about the continuing importance of the split minimum size, it is discouraging that such a large proportion of respondents expressed the view that the minimum size should be reduced to 76 mm. While removing the pre-1 February 77 mm minimum size regulation would eliminate the problem of fishers "holding-over" 76 mm animals prior to the rule change (see Chapter 5), removal of the rule would almost certainly prevent escapement of a proportion of juvenile animals from joining breeding stocks in deep water. It is questionable whether those fishers advocating removal of the split minimum size would accept further reductions in pot numbers as a trade-off to ensure the sustainability of the resource.

A particularly interesting result regarding undersize lobster was evident from a comparison of responses for Question 59 j) and k). This question asked respondents to judge the impact on sustainability, probability of detection and prevalence of: j) supplementing crew pay by allowing them to take home totally protected fish; and, k) commercial fishers taking home totally protected fish for personal consumption. In essence, the comparison is between whether it is acceptable for crew *or* skippers to take illegal lobster for personal consumption. Concerning crew, a majority of respondents indicated the practice only occurred to a small degree (most thought among less than 2% of fishers), and most ranked the impact on sustainability and probability of detection as medium-high. In contrast, if *skippers* took illegal lobster for personal consumption respondents thought that the impact on sustainability was generally *low*, the probability of detection was *low*, and prevalence among fishery participants *high*! It would appear that, compared with crew, some skippers eat a large number of ecologically irrelevant illegal animals, and are sneaky enough to get away with it!

6.5.3 Perceptions About Enforcement Services and Legal Processes

Most fishers were of the opinion that Fisheries Officers deal with similar offences consistently, however around 25% in each zone said they thought this was not always the case. This perception has been discussed with RLIAC fisher representatives several times since the survey took place. Those discussions have revealed that many fishers are not aware that the offence history of an individual caught breaking rules plays a role in determining punitive action. The wider fishing community may not know the previous history of an individual, sometimes leading to an assumption that "favouritism" or "victimisation" has contributed toward different outcomes for similar offences. This perception can be compounded when, for legal reasons (e.g. issues regarding continuity of evidence), the Department of Fisheries does not proceed with a case against a suspected offending fisher. While the Department takes every opportunity to reassure fishers of the probity of personnel and mechanisms leading to prosecutions, perceptions of bias can still arise since fishers can only be reassured in general, non-specific terms. It would be inappropriate, for example, to discuss individual cases, and enforcement personnel are quite rightly reluctant to divulge internal agency prosecution guidelines.

Fisher perceptions about the legal system were clear; around half thought the legal system often dealt with similar offences inconsistently. Part of this perception is due, as explained previously, to a lack of knowledge among fishers regarding the offence history of alleged offenders, and how this impacts on judicial outcomes. This is not the whole story, however. A particular problem facing enforcement personnel attempting to prosecute suspected offenders is that magistrates often lack knowledge about fishing processes and practices. While there are minimum prescribed penalties for many serious fisheries offences, this lack of knowledge on the part of magistrates has, on occasion, led to small penalties for offences that are considered serious by the general fishing community. To address this problem prosecuting staff (Fisheries Officers and government solicitors) attempt, through normal judicial procedural practices, to provide context to evidence of illegal fishing practices. In recent years this has included written reports profiling suspected offenders against their peers. The Department of Fisheries also publishes judicial outcomes in relation to fisheries offences in a quarterly magazine; this serves to demonstrate to the wider community, and in particular the fishing community, the severity of punitive action for particular offences.

Compared with most Australian States, penalties in the western rock lobster fishery are significant, and present a considerable deterrent effect to those fishers contemplating breaking fishery rules. Fisher perceptions about penalties were divided; around half thought penalties were currently set at an appropriate level, while a majority of the remainder thought that penalties were not harsh enough. This perhaps attests to the high compliance generally observed in the fishery, in that most fishers, a majority of who never break regulations, would like to see those who do suffer severe penalties.

Most respondents agreed or strongly agreed that enforcement and compliance had improved in the five-year period preceding the survey. Some disagreed, however, with 10-15% of respondents across zones indicating that the enforcement program had not improved, and 5-15% indicating that compliance had deteriorated. Overall, this is an encouraging result for the Department of Fisheries, since considerable effort is devoted to reviewing and improving the delivery of enforcement and educational services. It is worth noting that significant changes to the enforcement program have occurred since this survey was conducted, such as the introduction of a dedicated Rock Lobster Compliance Coordinator (see Section 6.5.5), greatly improved communications with industry about compliance issues, and annual compliance risk assessments involving commercial fishery participants. It will be interesting to review fisher attitudes at some point in the future.

Inspections of fishing gear at sea form an important component of monitoring effort restrictions in the western rock lobster fishery. Respondent perceptions about the amount of at-sea gear inspections approximate actual activity levels reported by Fisheries Officers, with around 50% of all respondents indicating their gear had been checked at least once in the previous season. The types of gear inspection conducted by enforcement personnel varies, such that a proportion of inspections are complete entitlement checks for individual fishers, while others focus on checking a subset of a fishers entitlement for conformity to gear restrictions (e.g. escape gaps, pot dimensions). It is likely that the latter type of check introduces a significant deterrent effect against over-potting, since random spot-checks of small numbers of pots can be interpreted more generally by fishers as checks of total pot entitlement. Given that a majority of gear inspections often occur in the absence of the owner, it is interesting that only 5% of respondents thought their gear had not been checked in the previous five years. While most fishers thought that the level of at-sea inspection work was acceptable, a substantial proportion of respondents (20-40% dependent on zone and employment status) thought that at-sea inspection activities should be increased. This result perhaps reflects the degree of concern among industry members about the level of gear interference occurring within the fishery, or the potential for over-potting among some commercial fishers.

In contrast to fisher views about at-sea inspection levels, an overwhelming majority of respondents (70-85%) thought that inspection effort in lobster processing factories was at an acceptable level. In general, there appears strong acceptance by commercial fishers of the factory inspection regime in place in Western Australia, and it is likely that factory compliance results presented annually to industry helps to foster this support.

Up to half of all survey respondents indicated they would only report commercial fishers involved in illegal fishing activity if they were engaging in particular types of offences. In other words, many commercial fishers indicated they would themselves judge the impact of any observed illegal activity (presumably on their own profitability or the sustainability of the resource) before making a decision to report the activity to enforcement personnel. This decision making process was not so apparent, however, in respect of reporting recreational illegal activity, with fishers predominantly indicating they would report the activity to enforcement personnel and/or take direct action themselves. Only around 5% of respondents stated they had called the Fishwatch Hotline at some stage of their fishing careers to report illegal recreational or commercial fishing activity, although it should be noted that most commercial fishers would ordinarily approach a (known) Fisheries Officer directly.

6.5.4 Commercial Perceptions of the Recreational Sector

In some areas of the fishery, particularly in near-shore waters close to population centres, commercial and recreational fishers compete for catch. There is currently no limit on the number of recreational licenses issued in the fishery, and over the previous ten years (1989-1999) recreational licence sales have increased from 16,000 to over 30,000, and catches have increased from 2% to around 5% of the total commercial catch (Melville-Smith and Anderton 2000). It would be fair to say there exists some degree of animosity between the commercial and recreational sectors of the fishery; in very general terms, recreational fishers feel inshore catch rates are low because of pressure from the commercial sector, and commercial fishers feel that increasing participation in the recreational sector is eroding their profitability. All recreational and commercial fishers do not, of course, universally hold these views, however it is important to bear them in mind when interpreting survey results.

While most fishers thought recreational fishers generally abide by fishery rules, a substantial number (around 35%) thought recreational fishers often break regulations. When questioned about recreational fisher compliance with specific rules, most commercial fishers stated that only a small proportion (1-2%) of recreational fishers either interfere with commercial gear, or steal lobsters from commercial pots. In some sense, this result probably reflects the spatial separation of the two sectors for most of the fishing season, a proposition supported by the fact that a substantial number (around 10%) of commercial respondents answered they “Didn’t Know” the degree to which recreational fishers engaged in these activities. In contrast, a majority of commercial fishers indicated that 25-50% of recreational participants sold or bartered catch. Fisheries Officers devote significant effort toward detecting and apprehending people involved in black-market sales, and all indications are that the commercial perception far exceeds reality.

Regarding recreational methods of catching lobster, many commercial fishers were of the opinion that recreational fishers should be restricted to only using pots, providing only moderate support for free-diving or (to a lesser extent) SCUBA diving as valid methods of capture. Spears, loops and shepherd’s crooks are devices used by divers to assist capturing lobster; the first is a destructive (piercing) non-legal method, while the second two are legal non-destructive methods (although some damage can occur to lobsters using loops and crooks). Those commercial fishers who agreed recreational fishers should be able to capture lobsters by diving responded that using loops should be allowed, but few respondents were in favour of recreational fishers using spears or crooks, perhaps because of the potential damage to lobster these methods can inflict.

Many respondents (up to 50% depending on zone) thought that a small number of commercial fishers (1-2%) steal catch from recreational fishers' pots, or interfere with recreational pots (e.g. by cutting off floats). Similarly, a small proportion of recreational fishers are known by Fisheries Officers to interfere with commercial fishing gear, or steal from commercial pots. While estimated to only occur at low levels, such theft or interference by either group does not help relations between the sectors, the majority of whom abide by fishery rules. In contrast to these results, 45-55% of respondents indicated they would take direct action, by cutting off pot floats, against a recreational fisher they knew to be fishing illegally. Such an attitude is naturally of concern to the Department of Fisheries, since any kind of gear interference is clearly illegal.

6.5.5 Perceptions of Commercial Fisher Compliance

A majority of fishers held the opinion that commercial fishers generally understood and complied with catch related rules (e.g. returning totally protected fish). Some rules appeared less well accepted than others, and most survey participants indicated that a small number of fishers actively undertake illegal activities for almost every rule. Certainly the "worst" breaches of fishery rules, as judged by commercial fishers, relate to those illegal activities that directly impact on the profitability of fishing operations. For example, almost all fishers agreed that gear interference, or stealing lobsters from other fishers' pots, are serious breaches and should incur high penalties. However, despite the overwhelming sentiment that such practices should not be tolerated, a surprisingly high number of fishers cited examples when they might engage in the practices – these usually related to recrimination or retaliatory action against fishers who were themselves breaking rules. Examples of such "self-regulation" have been well documented in the Maine and Massachusetts lobster fisheries (Acheson 1997, Sutinen and Gauvin 1989a,b), and it is perhaps not surprising to see similar peer-enforcement mechanisms operating in the western rock lobster fishery.

While many fishers view retaliatory actions as justified, and no doubt effective, activities carried out by vigilante fishers are often illegal and can lead to escalating conflicts between individuals. Enforcement personnel work to actively discourage such practices, but with only limited success. Part of the problem relates to the difficulty of at-sea enforcement of certain rules. Fishers suffering direct loss of product as a result of the illegal activities of others are faced with four non-exclusive alternatives: a) report the suspected offender to enforcement personnel; b) move fishing grounds to avoid the problem; c) simply accept the (suspected) loss of product as a cost of doing business; or, d) take direct retaliatory action against the suspected offender. Options b) and c) are often unacceptable to most fishers; repositioning gear to new fishing grounds will usually mean moving to less productive areas, and relatively few fishers are willing to knowingly accept theft of lobsters or gear interference. Of the remaining alternatives, many fishers will, in the first instance, report suspected illegal activity to enforcement staff, however fishers are well aware of the difficulties Fisheries Officers face when trying to apprehend offenders engaging in at-sea offences. For example, offences can be committed intermittently or at random, and canny offenders try to ensure their behaviour does not become predictable. This makes it difficult (or prohibitively expensive) to mount surveillance operations for a sufficiently lengthy period to guarantee an apprehension. If enforcement personnel cannot apprehend suspected offenders within a suitably short period, some fishers feel retaliation against the suspected offender is their only recourse.

While many in the rock lobster industry consider "natural justice" to be an acceptable part of fishing, this is not a position supported by the Department of Fisheries. Unfortunately, the problem I have described has no easy solution. Satellite vessel monitoring systems (VMS) would enable enforcement personnel to monitor vessel movements, and provide a valuable link in establishing cases for prosecution of gear interference. Currently, introduction of VMS is being resisted by industry, despite the advantages such systems offer for enforcement, catch/effort reporting, and safety. Emerging surveillance technology (not discussed in this document) perhaps offers some hope as an alternative to VMS.

The principal method currently employed to combat the problem described above is to educate fishers about the timely provision of intelligence to enforcement personnel. Fishers too often alert Fisheries Officers to a suspected problem some time after it has occurred, negating the possibility of gathering evidence using certain investigative techniques. In part, this might explain why a small number of respondents suggested that reporting illegal recreational activity to enforcement personnel was a waste of time. Given that over 10% of fishers in each zone stated they regularly witnessed gear interference or theft, the level of information regularly received from the fleet remains disappointing. Furthermore, fishers are being encouraged to report even small instances of suspected illegal activity, or "anomalous events" (such as fishers leaving port early or returning late), since seemingly inconsequential information can add substantially to an overall picture of fisher behaviour. To some degree this last approach has proved useful on a number of levels, however, gear interference and theft of lobsters will continue to be a problem into the foreseeable future.

A particular concern to enforcement staff should be the perception among many respondents that reporting observed illegal behaviour might result in retaliatory action from the suspected fisher. While most respondents stated they would report illegal fishing, typically 10% indicated that contacting Fisheries Officers with information created a real danger of retaliation, and 20-30% indicated that it might be dangerous depending on the identity of the alleged offender. It would seem clear that, at least at the time the survey took place, many fishers felt uneasy about reporting observed illegal activity. In order to effectively target enforcement resources, it is important that Fisheries Officers are able to gather credible and timely information about suspected illegal activities. To achieve this it is important that fishers feel their confidentiality will be preserved if they report illegal activity, and that the likelihood of recrimination is low (also see Section 2.5.2).

I have been advised by Fisheries Officers with long-term experience in the fishery that fishers' concerns about breaches of confidentiality are linked, in part, to the changing nature of employment within the Department of Fisheries. Traditionally, district-based Fisheries Officers were stationed in small country towns for long periods of time, providing them the opportunity to develop strong links with a fishing community. The relationships they were able to establish helped foster trust and mutual respect between agency staff and fishers, which in turn promoted an exchange of information. However, over the last 10-15 years the nature of employment for Fisheries Officers has changed. Officers are now rotated through different districts on a periodic basis, partly to ensure they are not "marooned" in a small town for long periods of time, and partly to ensure Fishery Officer probity. This often means that fishers may have only 2-4 years exposure to a particular Officer before someone new is moved into a district; this barely provides an adequate amount of time for developing the relationships needed to engender trust. To help overcome this problem the Department of Fisheries recently established a position, the Rock Lobster Compliance Coordinator, to become the focal point for all contact with the commercial industry. A major role of the Coordinator is to travel the coast and meet with individual fishers and fishing organisations, and to attempt to re-establish the links with industry that have to some degree been lost in recent years. The initiative has proved very successful in the two years the position has been running, and it will be interesting to assess its effectiveness in future industry surveys.

6.5.6 Survey Deficiencies and Limitations

Generally, the survey of commercial fishers was very successful for mail surveys of this kind, with high survey response rates for skippers and license-holders, and low individual question non-response rates. The survey was not without its limitations, however, and perhaps the most important of these relates to the distribution and return of survey forms. Recall from Section 6.3.2 that Fisheries Officers distributed individual survey forms to all skippers and crew at the start of the 1999/2000 fishing season. This was a useful exercise since it provided Officers an opportunity to explain to fishers the intent and importance of the survey. Unfortunately, Fisheries Officers did not keep good records about the numbers of surveys they distributed, so it is not possible to ascertain if all vessels received surveys. This did not present a significant problem because surveys were also sent to all registered licence-holders, a majority of who are also skippers. Since this meant that some skippers who are also licence-holders received two surveys (one on their vessel and one in the post), an additional note was included with the mailed survey package asking licence-holders to only return a survey if they had not already received a survey aboard their boat.

While the method of distribution for the survey was less than ideal, there existed little opportunity for improvement due to a lack of clear links in the Department of Fisheries licensing system between registered licence-holders and skippers. The possibility exists that, in an effort to bias results toward their point of view, some licence-holders who are also skippers may have completed two survey forms. To some extent the assumption that each fisher completed only one survey must be taken on faith, something that is easier to do when the size of the survey and the effort required completing it is taken into account.

Some fishers encountered problems completing a small number of questions, either because of poor question formulation, or due to a reluctance to complete certain questions in the manner instructed. Question 26, for example, provided clear instructions on how the question should be answered, but many fishers chose to answer in a different way. Fishers who tested the survey prior to its distribution did not identify this as a potential problem, however it is likely that a larger pre-survey trial may have done so.

Another problem, relating mainly to the interpretation of results, occurred with Question 30. This question asked fishers about their attitude toward fishers who sell or trade in oversize female lobster. Unfortunately, the question did not sufficiently distinguish whether it related to recreational or commercial fishers trading in oversize lobster. It is likely that most respondents interpreted the question as relating to the commercial sector, since this is thought to be problematic among a small number of commercial fishers (as indicated, for example, in Questions Q59e).

6.5.7 Directions for Future Research

Results from this survey have identified several established or emerging compliance problems in the rock lobster fishery. While many of the issues identified are known to Fisheries Officers, it is usual that the extent and severity of particular problems cannot be accurately gauged from anecdotal information received from fishers. It is therefore highly instructive to gain a broad understanding of how industry views particular problems in the fishery, and many of the results will be useful in planning future enforcement activities.

There would be considerable merit in periodically repeating the type of survey presented in this chapter, both as a method of detecting changes in non-compliant behaviour, and to monitor changes in industry views about management and enforcement services. Future surveys should attempt to capitalise on information collected in the 1999 survey by focusing in more detail on those issues considered important by commercial fishers. For example, non-compliant behaviour in the Big Bank part of the fishery was not canvassed, but perhaps should be in future surveys. While results indicated non-monetary factors were important in influencing an individual's decision to violate, the survey contained no questions to obtain quantifiable information about expected monetary gains from illegal activity. Future surveys might be well served by attempting to assess quantitative measures of illegal gain for particular non-compliant activities.

Finally, the commercial survey presented in this chapter has generated a large and complex set of data. Results presented here represent only a partial, largely descriptive, analysis of the available information. Further analyses will focus on examining dependencies among groups of variables, and will be the subject of future publications.

7. ***Recreational Attitudinal Survey***

7.1 Overview

A postal survey of 4000 licensed recreational rock lobster fishers was undertaken at the end of the 1998/99 rock lobster fishing season. Respondents were asked to provide catch and effort data, information about their views on particular management issues, and their perceptions about enforcement and compliance within the fishery. In addition to presenting baseline demographic information, I examine responses to three issues considered important for successfully managing the recreational fishery: i) fisher perception about the effectiveness of rock lobster recreational fisheries management; ii) fisher understanding of minimum size regulations; and, iii) perceptions about the probability of detection should a fisher decide to break size limit rules.

From a total effective sample size of 3883, returns were received from 2429 recreational fishers (63% response rate). Respondents were predominantly male, with an average age of 43 years. Fishing activity was largely concentrated around the population centre of Perth, and to a lesser extent around Geraldton, Mandurah and Jurien. About 20% of respondents reported they did not fish during the 1998/99 season; of those that did, 54% exclusively used pots, 34% caught lobster while diving (SCUBA or free diving), and 11% both used pots and went diving. Over half the respondents who went fishing during the 1998/99 season recorded some contact with Fisheries Officers (including sighting), however only 25% reported contact with Voluntary Fisheries Liaison Officers (VFLOs).

Fisher responses were positive (over 80%) when asked if they thought Fisheries management was effective in conserving rock lobster stocks. However, when questioned on minimum size limit regulations, 49% of respondents got the answer wrong, didn't answer the question, or didn't know. Young fishers that had been involved in the fishery a short length of time were more likely to answer incorrectly, as were divers. Fishers were also asked to estimate how many times someone could break size limit regulations without being apprehended. Although many respondents had recorded little or no contact with Fisheries officers, the majority of respondents (65%) thought that fishers could never break regulations without getting caught.

The number of contacts with Fisheries Officers seemed strongly related to the three issues examined in this study. Even visual contact with Fisheries Officers seemed enough to positively influence confidence in management and understanding of regulations. There appeared no strong relationship between contact with VFLOs and fisher perceptions on management or enforcement issues, however contact with VFLOs was found to significantly increase understanding of minimum size limits.

7.2 Introduction

As demands on a fishery increase, effective regulation and a high level of compliance become vital. Measures must be undertaken to estimate the level of compliance and, if necessary, take steps to ensure that the level of compliance is adequate. Measuring the extent of illegal activity in recreational fisheries is often a difficult task. In the Western Australian rock lobster fishery, for example, the number of recreational fishers is large and their distribution is dispersed along approximately 1200 km of coastline. Additionally, substantial penalties ensure some offenders go to great lengths to conceal their activities, such that estimates of non-compliance from routine catch inspections can be misleading. One approach to obtaining qualitative estimates of non-compliant behaviour in a fishery is to conduct surveys of fisher attitudes (see review in Section 6.2). Such information can be important in understanding the extent and nature of non-compliance, and the reasons why it might be occurring. In turn, results may suggest ways to improve compliance, either by modifications to the enforcement program or through targeted educative campaigns.

Surveys of recreational rock lobster fishers have been conducted annually by the Department of Fisheries Western Australia since the 1986/87 fishing season. The aim of these surveys has been to estimate the catch and effort characteristics of the recreational sector of the rock lobster fishery (Melville-Smith and Anderton 2000). The survey for the 1998/1999 season was extended to include questions relating to fisher demographics, fisher perceptions on management and enforcement processes, catch and effort restrictions, and illegal activity. Melville-Smith and Anderton (2000) provide a detailed analysis of recreational catch and effort for the period 1987/88-1998/99, and demographic information from survey respondents in the 1998/99 fishing season.

7.3 Methods

The 1998/99 survey differed from those conducted in previous years. In addition to previously collected catch and effort information it included new questions relating to fisher demography, fishing gear, management, and compliance. The survey was designed in conjunction with experienced Fisheries Officers and representatives from Western Australian recreational fishing interest groups (Recfishwest and the Recreational Fishing Advisory Committee). Most questions required that respondents choose, from a range of answers, the response most closely aligned with their view on a particular topic. Survey questions were formulated, where appropriate, to provide respondents with a five-point ordered scale with a neutral category as the middle choice.

For the 1998/99 fishing season, a postal survey of 4000 licensed recreational rock lobster fishers was undertaken during July-September 1999. A sample of 4000 licence-holders (around 12% of the total population of recreational lobster fishers) was randomly selected from the Department of Fisheries licence database. These people were sent return-postage paid survey forms. One week later a reminder card was posted to all those surveyed. A second copy of the survey was distributed to those fishers who had not returned a completed survey within 6 weeks. A range of prizes was also offered to encourage fishers to participate. Additional detail on the sampling protocol and validation can be found in Melville-Smith and Anderton (2000)

Responses to management and compliance questions were analysed using Chi-squared tests (hereafter referred to as Chi^2 or χ^2) in order to test for independence of responses against a range of explanatory variables. Variables of interest include demographic information (age, education and gender), number of years experience in the fishery, fishing method used, main fishing location, catch history, along with a number of variables designed to gauge attitudes toward management and compliance.

Chi-squared homogeneity tests are the principal method of data analysis presented in this report. These tests examine simple dependence between two measured characteristics. It is important to note, however, that a significant association does not necessarily imply that the two characteristics are directly related. Spurious dependence may occur when two characteristics appear related, but are in fact influenced by a third characteristic not included in the analysis (sometimes referred to as Simpson's Paradox) (Johnson and Bhattacharyya 1985). Examining higher-order dependencies in three or more characteristics is the subject of continuing work and will be reported on elsewhere. Analyses presented in this paper should therefore be considered descriptive and exploratory, and Chi-squared tests for association should be interpreted cautiously until such time as higher order dependencies have been investigated.

The only non-standard graphical technique presented in this paper is a type of bar plot that I refer to as a Chi-plot (see Figure 7.6 for example; compare with raw data in Table 7.2). This graph shows two pieces of information about the cross-classification of two categorical variables. Firstly, it provides a graphical representation of expected values of the contingency table under the assumption of independence. These values are plotted such that the horizontal lengths of bars in the plot are proportional to the Chi^2 expected values. Second, proportional lack of fit is displayed as the vertical bar height; that is, bar height is the signed contribution of each cell in the cross-classification toward the overall Chi^2 statistic. Bars which extend upward represent cells with greater than expected frequency under the assumption of independence, and bars which extend downward indicate cells with counts fewer than expected.

Some figures make use of the Trellis display libraries developed by Becker, Cleveland and Shyu (Becker and Cleveland 1996). These plots comprise lattice-like displays of several panels defined by different levels of one or more categorical variables. Note that plotting scales have been standardised across panels in order that they are readily comparable.

7.4 Results

7.4.1 Non-Response

From an initial mailout to 4000 licence holders, and accounting for those surveys returned "address unknown", this study involved an effective sample size of 3883. A total of 2450 completed surveys were received, for a response rate of 63%. The reminder postcard and additional survey form sent to non-respondents in weeks one and six both served to improve response rates.

Respondents were asked to specify their main fishing location. Locations were grouped into four broad regions; south of Perth (South), the Perth metropolitan area and Rottnest Island (Metropolitan), a Central region from north of Perth to Lancelin (Central), and north of Lancelin (North) (Figure 7.1). Regions were chosen to approximately align with major concentrations of recreational fishing effort, and are represented by 371 (15%), 654 (27%), 564 (23%), and 352 (14%) respondents, respectively. There were an additional 509 (21%) respondents who did not nominate their usual fishing area, or who did not fish during the 1998/99 season. Smaller fishing areas are presented where appropriate. These are delimited by smaller sections of the WA coast and are largely self-explanatory (eg. Bremer Bay – Esperance).

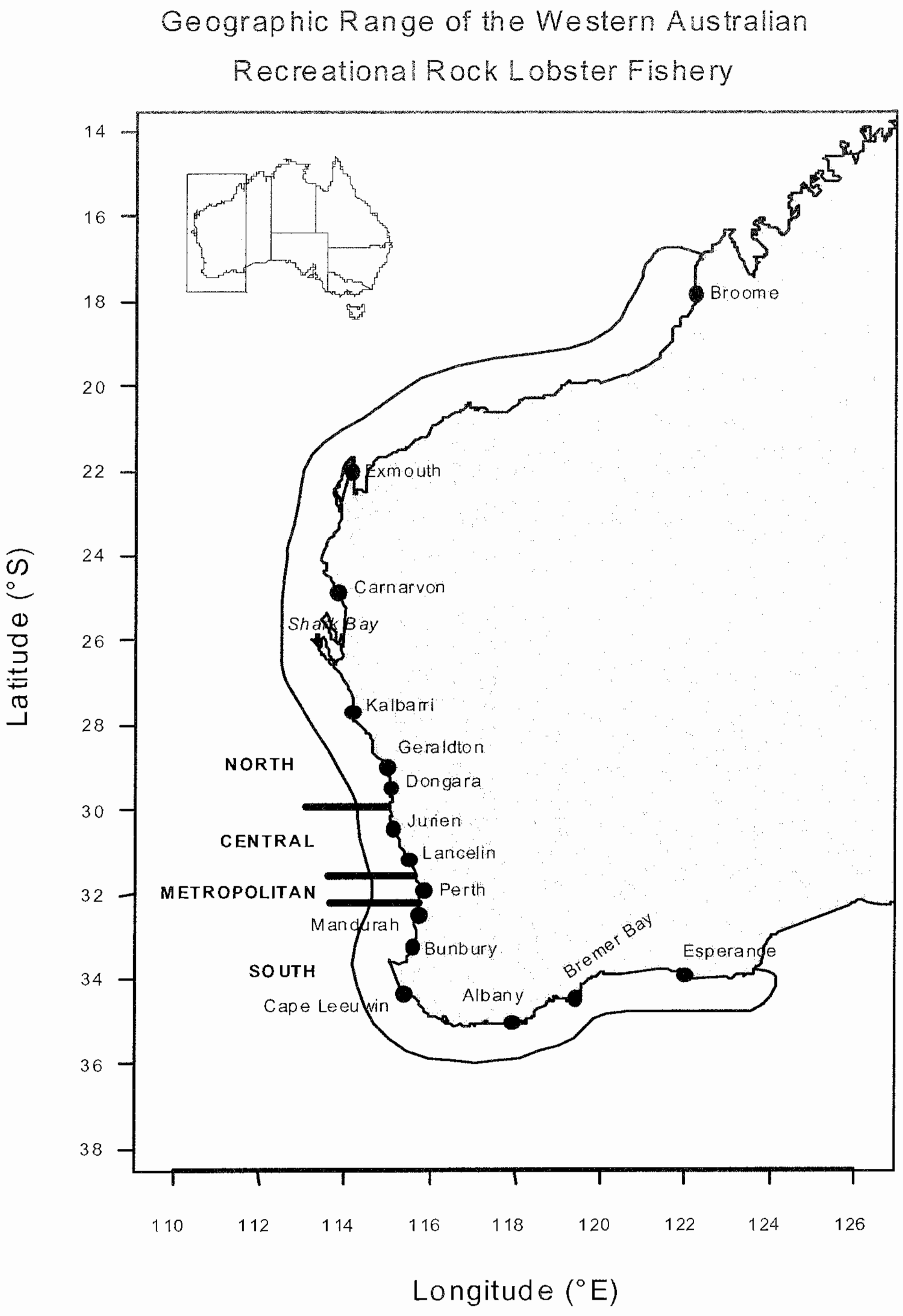

Figure 7.1. Map of the Western Australian coastline showing the geographic range of the rock lobster fishery. Most fishing occurs between Bunbury and Kalbarri.

7.4.2 Respondent Demographics

Responses were received from 2199 (90%) male fishers and 230 (10%) female fishers, with the majority of fishers aged between 30 and 50 years (Figure 7.2). Both male and female fishers were shown to have fairly normal age distributions, with a mean male age of 43 years and a mean female age of 45 years (Melville-Smith and Anderton 2000).

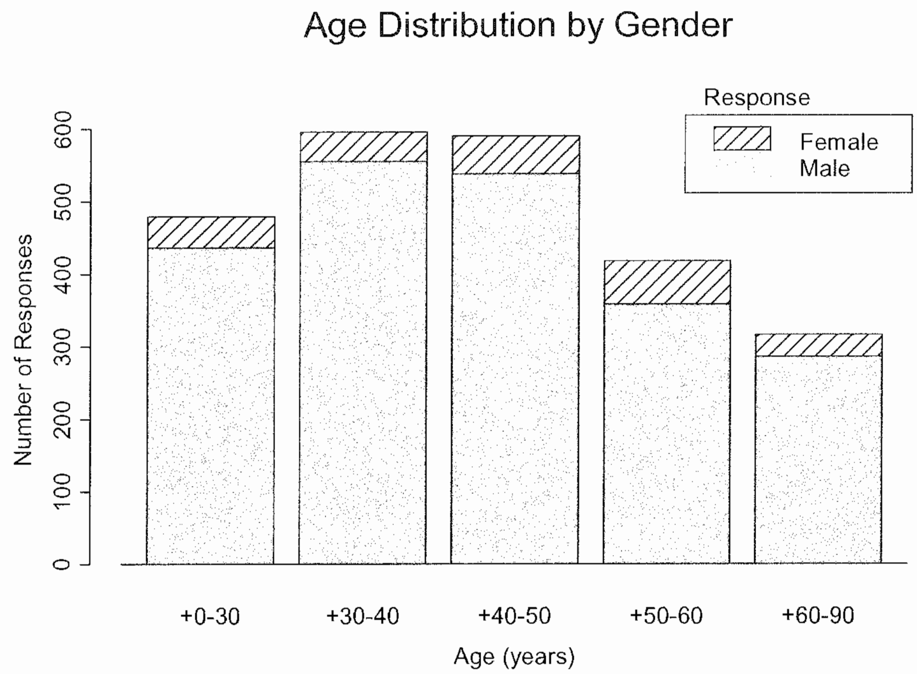

Figure 7.2. Age distribution of survey respondents, showing males and females individually.

Respondents were asked to nominate the main language spoken at home. Fishers predominantly reported English, with only 0.7% quoting an alternative first language. Italian was the second most common language with a total of 4 respondents.

Levels of respondent education were evenly distributed between secondary and tertiary. Of all respondents, 26% were educated below the Year 12 level, 26% had completed TAFE certificates or apprenticeships, 24% had tertiary qualifications, and 16% were educated at the Year 12 level. Female respondents were generally more likely to have completed Year 12 (25%) or attained tertiary qualifications (31%) compared with male respondents with 17% and 25%, respectively (χ^2=39.8, df=3, p<0.001) (Figure 7.3).

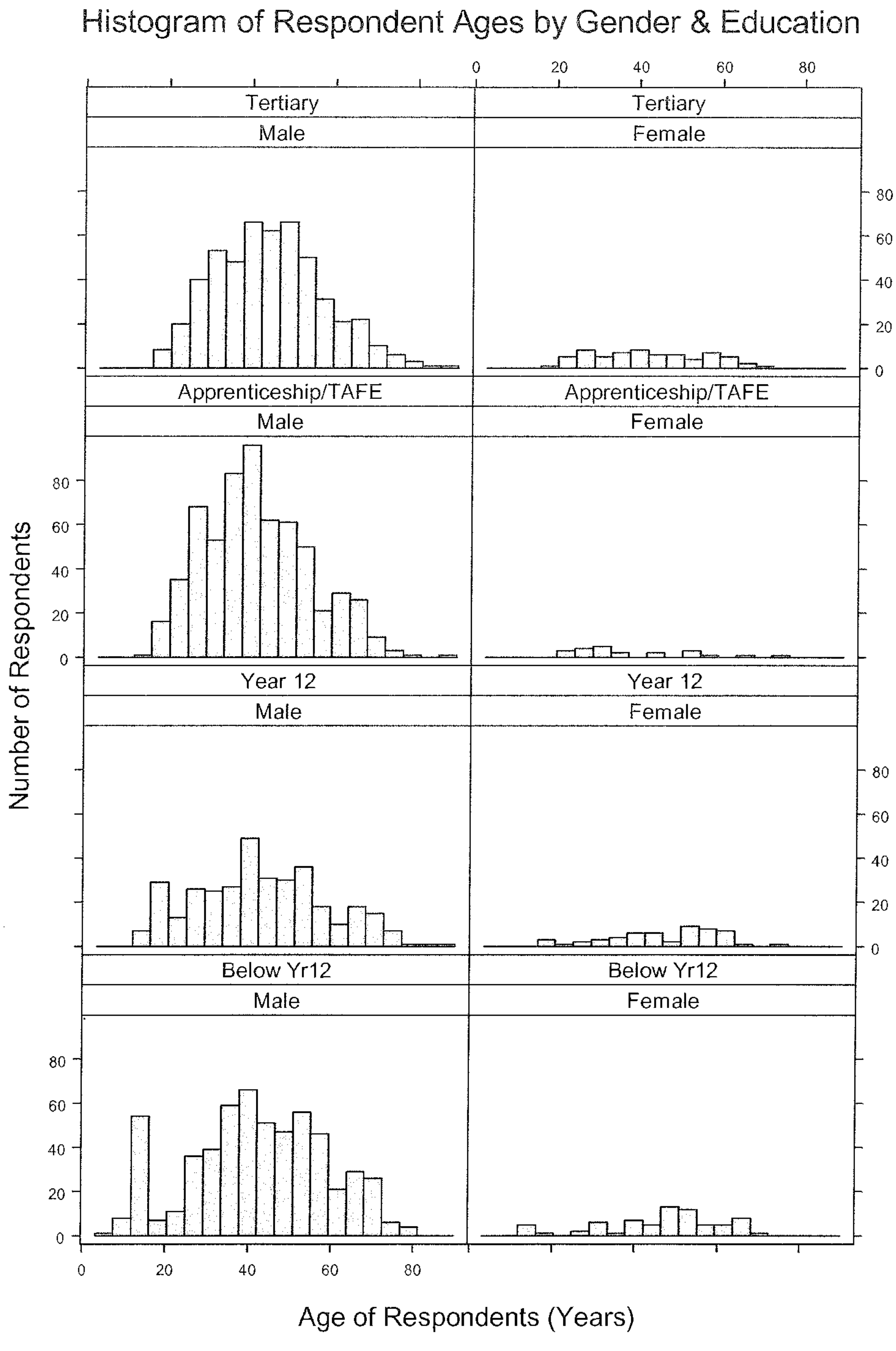

Figure 7.3. Histogram of respondent ages, stratified by gender and level of education. Individual panels show the age distribution cross-classified by gender and level of education.

7.4.3 Methods of Fishing

Respondents were asked to nominate their usual method of fishing. Of the 2450 respondents, 1952 (80%) indicated they fished during the 1998/99 rock lobster season; 498 (20%) did not fish (Table 7.1). Almost half of all licensees fished using pots, a further quarter only caught lobster by diving (SCUBA), and around 10% indicated they used both methods. A small number of respondents (15) fished using other methods, including free-diving and reef walking at low tide. Note that it was not possible to separate those respondents who dived using SCUBA from those that free-dived or used hookah. Results presented for the general category "divers" should therefore be interpreted as those respondents who dived by any method.

Table 7.1. Number of respondents according to method of fishing

Method	Number of Fishers	Percent
Did not fish	498	20
Pot only	1063	43
Dive only	659	27
Pot and Dive	215	9
Other	15	< 1
Total	**2450**	**100**

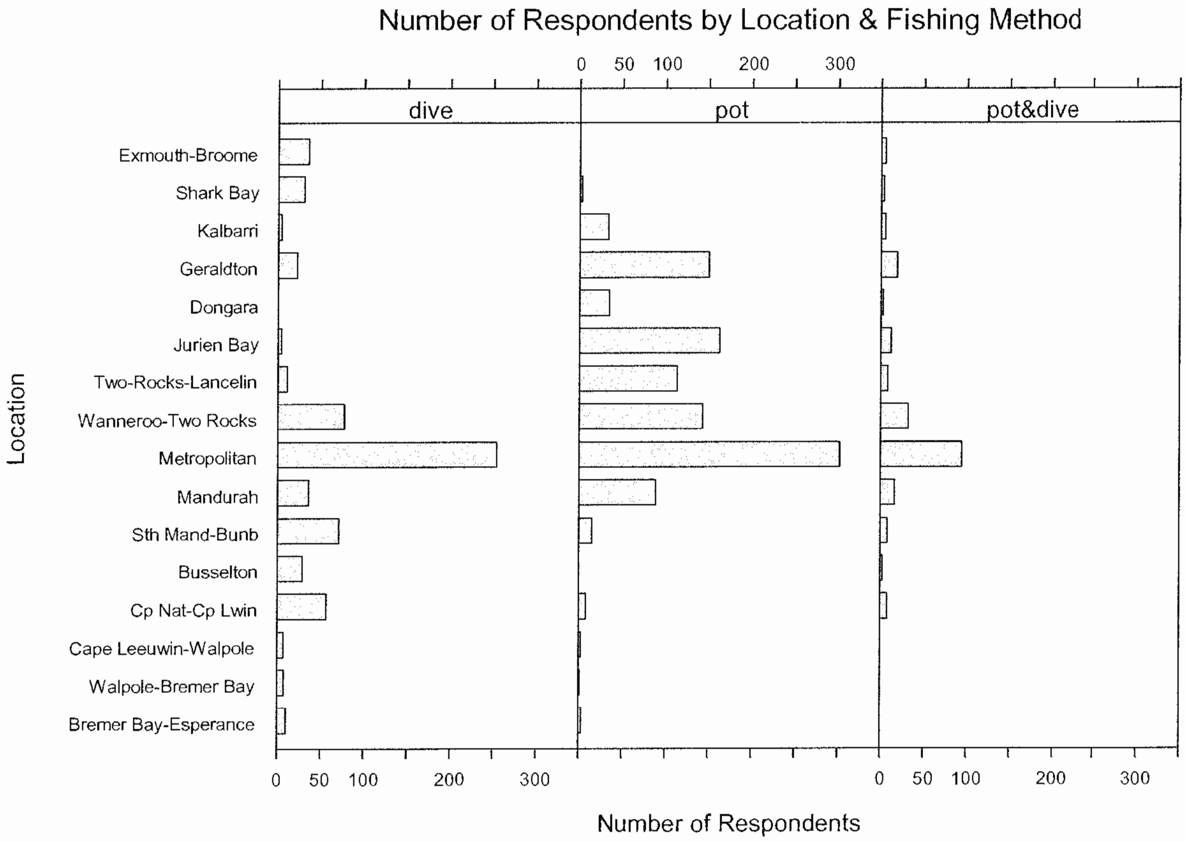

Figure 7.4. Barplot showing the numbers of fishers returning surveys categorised by fishing method and location.

Fishing locations tends to be concentrated around the major population centres of Perth, Geraldton, Mandurah and Jurien (Figure 7.4). Diving for rock lobster appears disproportionately popular in the southern regions of the fishery, particularly in the area Bunbury to Cape Leeuwin. Interestingly, the combined locations "Wanneroo-Two Rocks" and "Two Rocks-Lancelin" support about the same number of recreational fishers as locations Jurien Bay and Geraldton combined.

A comparison between the ages of pot fishers and divers shows that divers tend to be younger than pot fishers (Figure 7.5), with a mean age of 36 years compared with a mean age of 46 years for pot fishers (see also Melville-Smith and Anderton 2000).

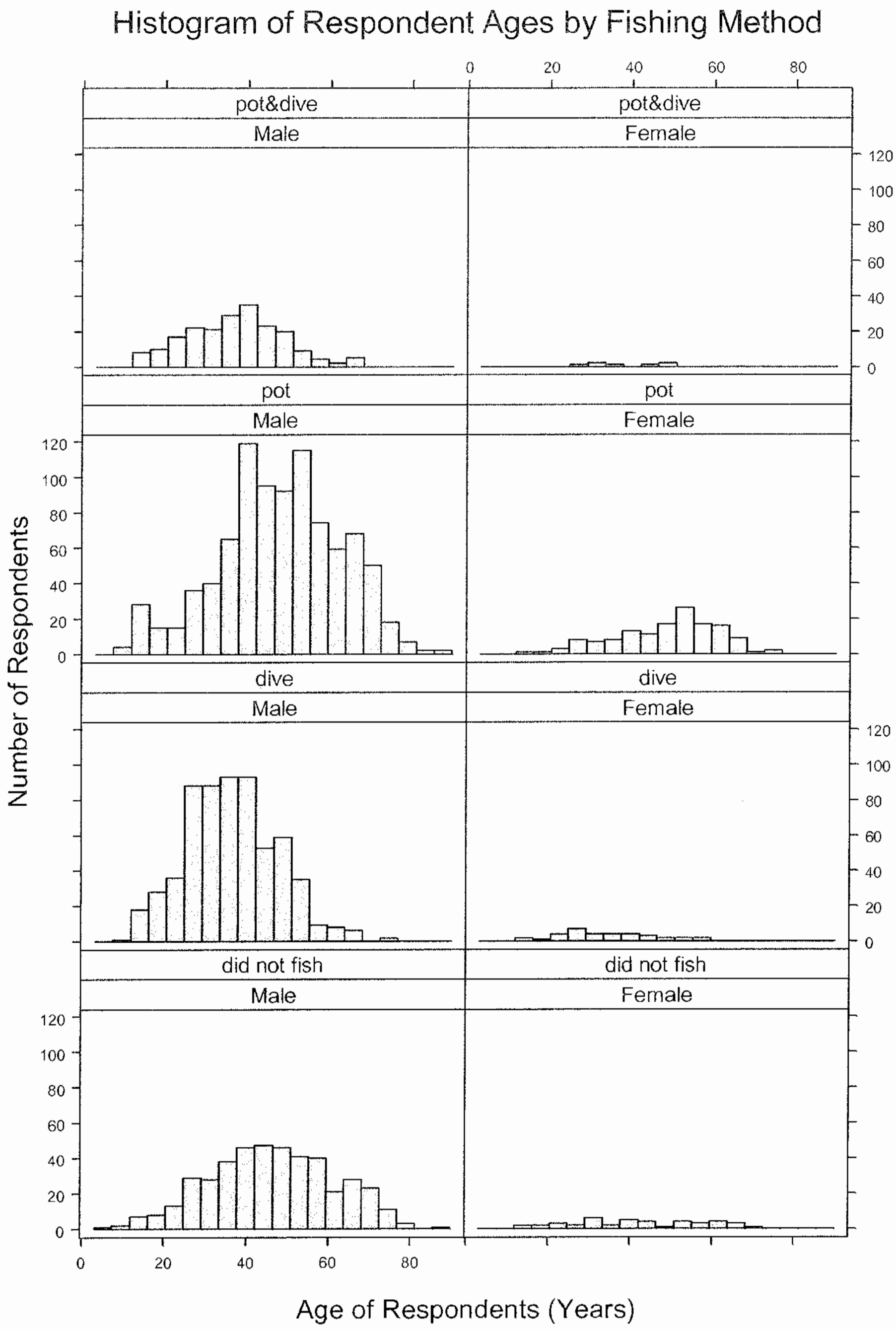

Figure 7.5. Histogram of age of respondents, categorised by gender and fishing method.

Catch and effort data showed that pot fishers tended to have slightly lower catch rates than divers. The mean catch rates for the 1998/99 season were 1.8 rock lobster per day dived and 1.4 lobsters per day. However, pot fishers have higher total catches for the season (mean 53.5 lobsters) than divers (mean 27.1 lobsters) because they fish more often. On average, pot fishers fish for 37.9 days per season compared with 15.6 days for divers. Half of all divers catch fewer than 13 lobsters per season and half of all pot fishers catch fewer than 21 lobsters per season (Melville-Smith and Anderton 2000).

7.4.4 Contact With VFLOs and Fisheries Officers

Respondents were asked to indicate their level of contact with Fisheries Officers and Voluntary Fisheries Liaison Officers (VFLOs) during the 1998/99 season. Of the 2021 licence holders who provided this information, 1080 (53%) had some contact with Fisheries Officers (including sighting), but only 342 respondents (17%) had two or more contacts with an Officer (Table 7.2). Contacts with VFLOs were less common than contacts with Fisheries Officers, with 1502 respondents (75%) recording no contacts with VFLOs. Only 10% of respondents reported seeing VFLOs during the season, 10% reported one VFLO contact, and only 5% recorded greater than one contact.

Table 7.2. Frequencies of respondents classified according to the number of times they came into contact with Fisheries Officers and Voluntary Fisheries Liaison Officers.

		Number of Fisheries Officer Contacts								Total
		0	**Sighted**	**1**	**2**	**3**	**4**	**5**	**6-10**	
Number of VFLO Contacts	**0**	834	215	272	54	59	25	20	28	**1507**
	Sighted	45	72	56	11	13	6	1	6	**210**
	1	54	32	62	26	20	7	3	6	**210**
	2	5	2	6	5	8	5	3	6	**40**
	3	2	2	9	7	4	1	3	2	**30**
	4	1	1	4	0	2	1	0	3	**12**
	5	0	0	2	0	0	0	0	1	**3**
	6-10	0	1	2	1	3	1	0	1	**9**
	Total	**941**	**325**	**413**	**104**	**109**	**46**	**30**	**53**	**2021**

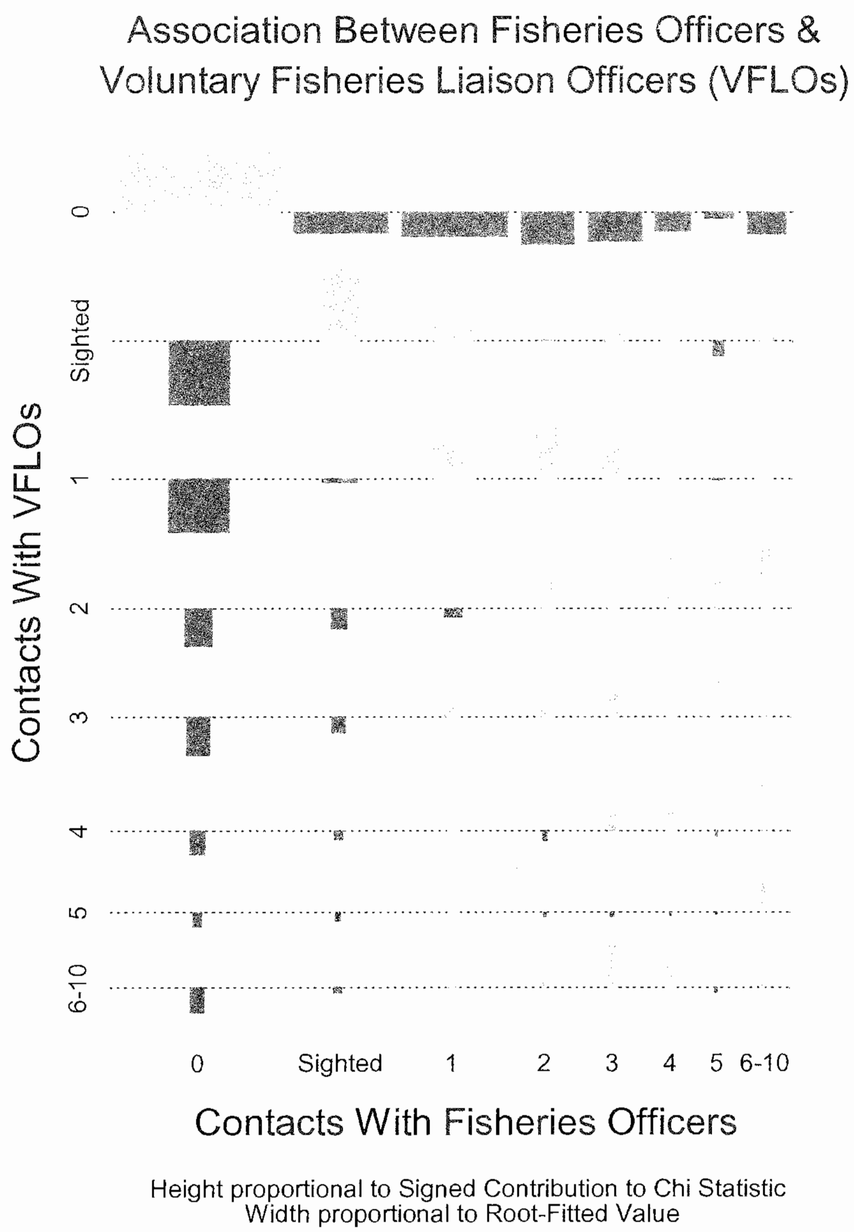

Figure 7.6 **Chi-plot showing the contribution of each cell of the cross-classification toward the overall Chi^2 statistic assessing independence between number of Fisheries Officer contacts and number of VFLO contacts.**

Despite low frequencies in some cells, it is useful to explore Table 7.2 as a Chi-plot (Figure 7.6). Under the assumption that the number of Fisheries Officer contacts and VFLO contacts are independent, it can be seen that respondents who had low numbers of contacts with VFLOs had relatively high levels of contact with Fisheries Officers. Note that the Chi^2 test of significance is not provided for Figure 7.6 because of low counts in some cells.

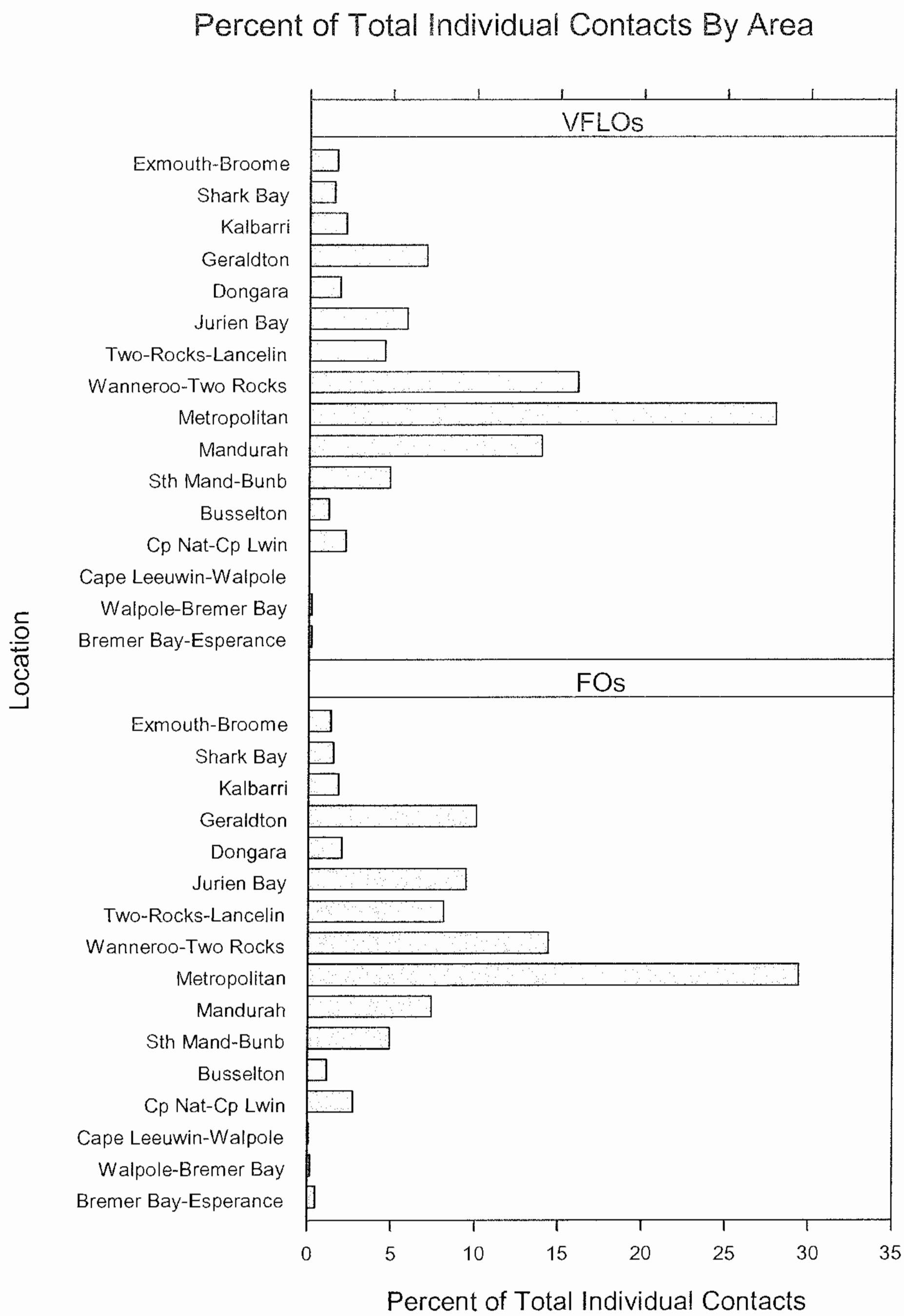

Figure 7.7. Barchart showing the percentage of total numbers of individual contacts in each region. This information is shown separately for Fisheries Officer and Voluntary Fisheries Liaison Officers.

Considering just those respondents who had some contact with Fisheries Officers or VFLOs, it is useful to examine the distribution of contacts spatially[20]. The regional distribution of contact "effort", as measured by respondents' contacts, appears similar for Fisheries Officers and VFLOs (Figure 7.7). For both groups, the greatest percentage of contacts occur between Two-Rocks and Mandurah, with 25% of all contacts for each group occurring in the Metropolitan region. Geraldton appeared to have a proportionately higher percentage of Fishery Officer contacts compared with VFLO contacts, contrasting with Mandurah where VFLO contacts were proportionately high. Another way to consider fisher contact information is to weight respondents by their reported number of contacts in the 1998/1999 season (Figure 7.8). Here, fishers who simply sighted Fisheries Officers or VFLOs are assigned a weight of 0.5 in order to reduce the influence they exert on *actual* fisher contacts. For example, if an individual reported they had two contacts with VFLOs, but had only sighted a Fisheries Officer, that respondent would contribute two VFLO contacts and half a Fisheries Officer contact. The distribution of weighted contacts by location shows a similar pattern for Fisheries Officer and VFLOs in the percentage of contacts between locations.

[20] Note that respondents who indicated they had seen Fisheries Officers or VFLOs, but had not spoken with them, have been included for Figure 7.7 and Figure 7.8.

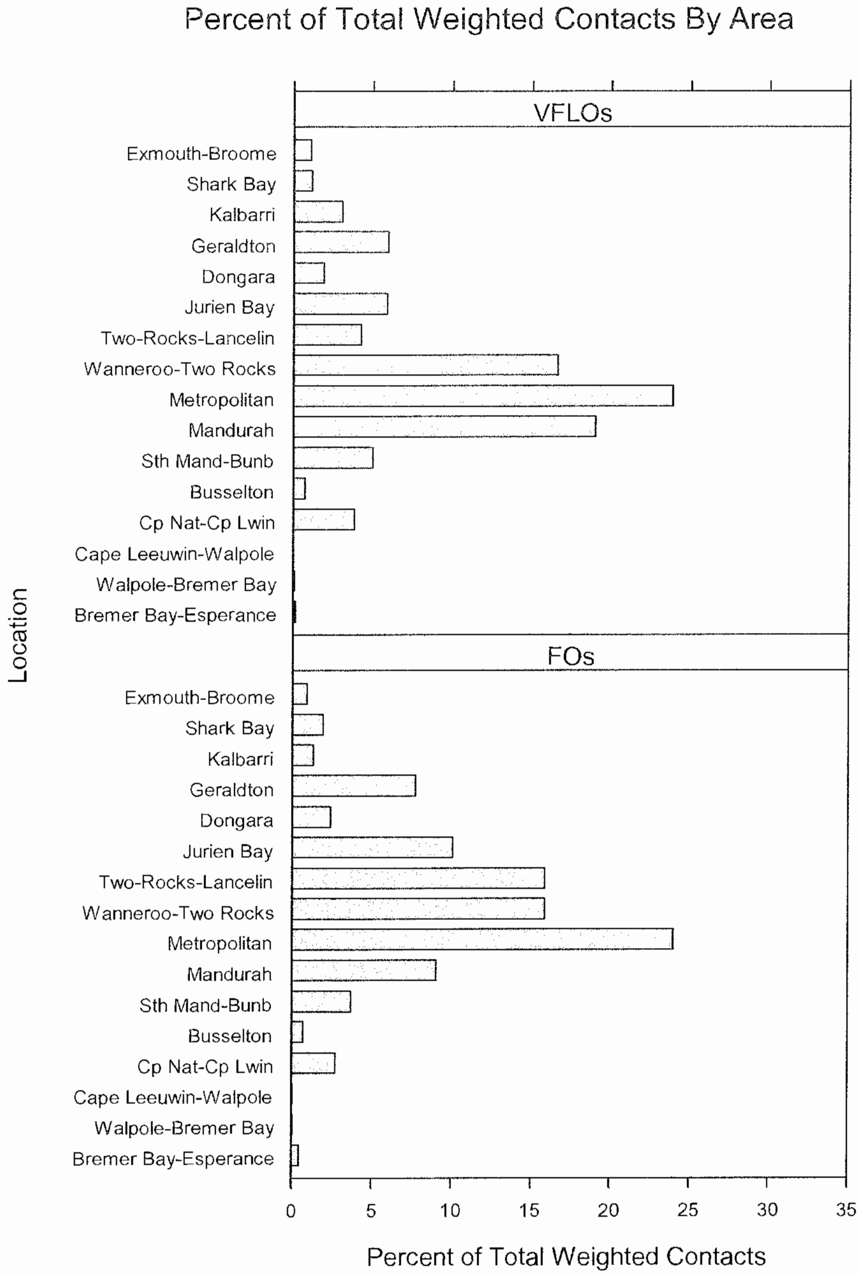

Figure 7.8 Barchart showing the regional breakdown of the percentage of total weighted contacts, shown separately for Fisheries Officers and VFLOs. Respondents who indicated they had seen FOs or VFLOs are included for the purpose of this graphic, but are assigned a contact weight of 0.5.

The distribution of respondents according to main fishing location and number of contacts with Fisheries Officers shows that, independent of location, very few fishers had more than one contact with a Fisheries Officers during the 1998/99 season (Figure 7.9). This pattern is even more pronounced when considering contacts with VFLOs (Figure 7.10).

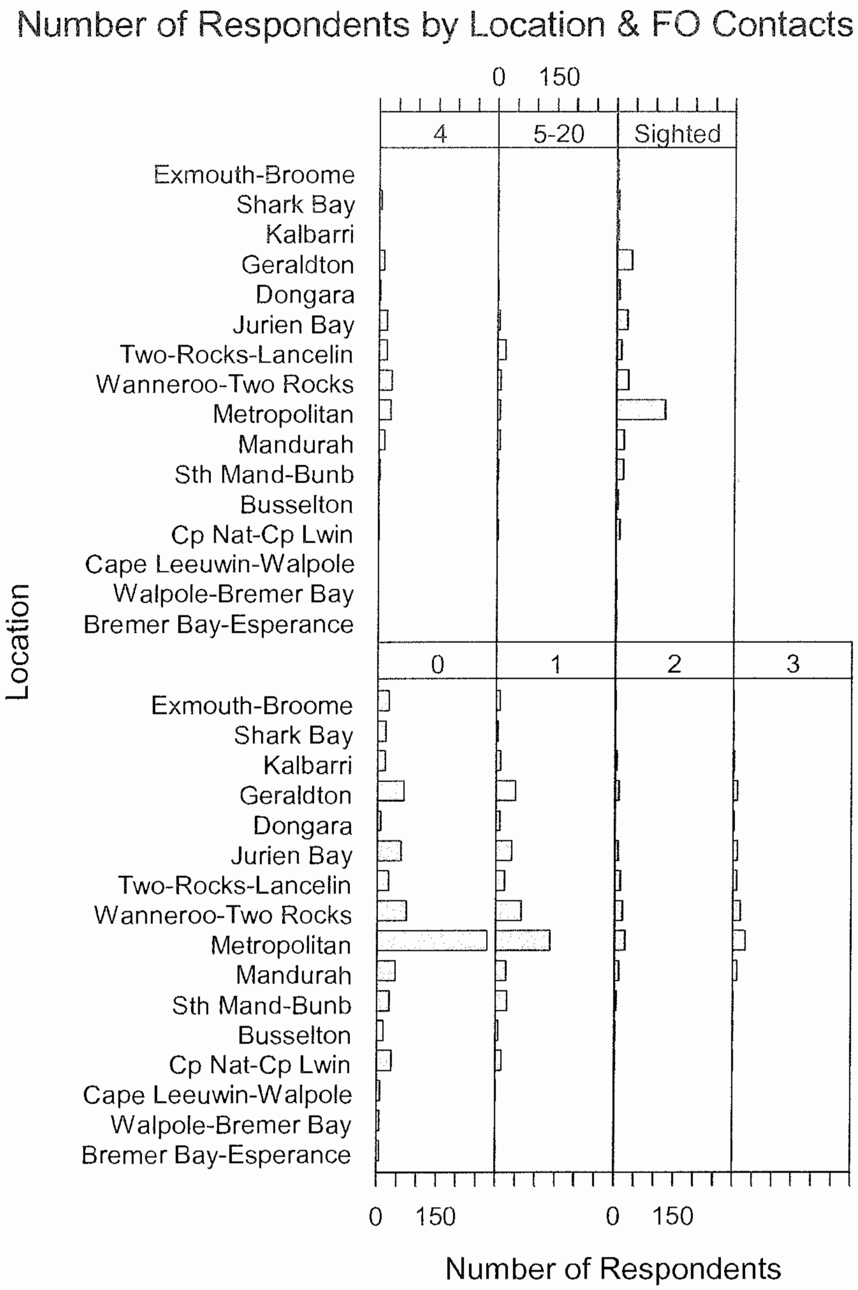

Figure 7.9. Number of respondents reporting a given number of contacts with Fisheries Officers, split by fishing location. Each panel is labelled according to the number of contacts with Fisheries Officers reported by respondents.

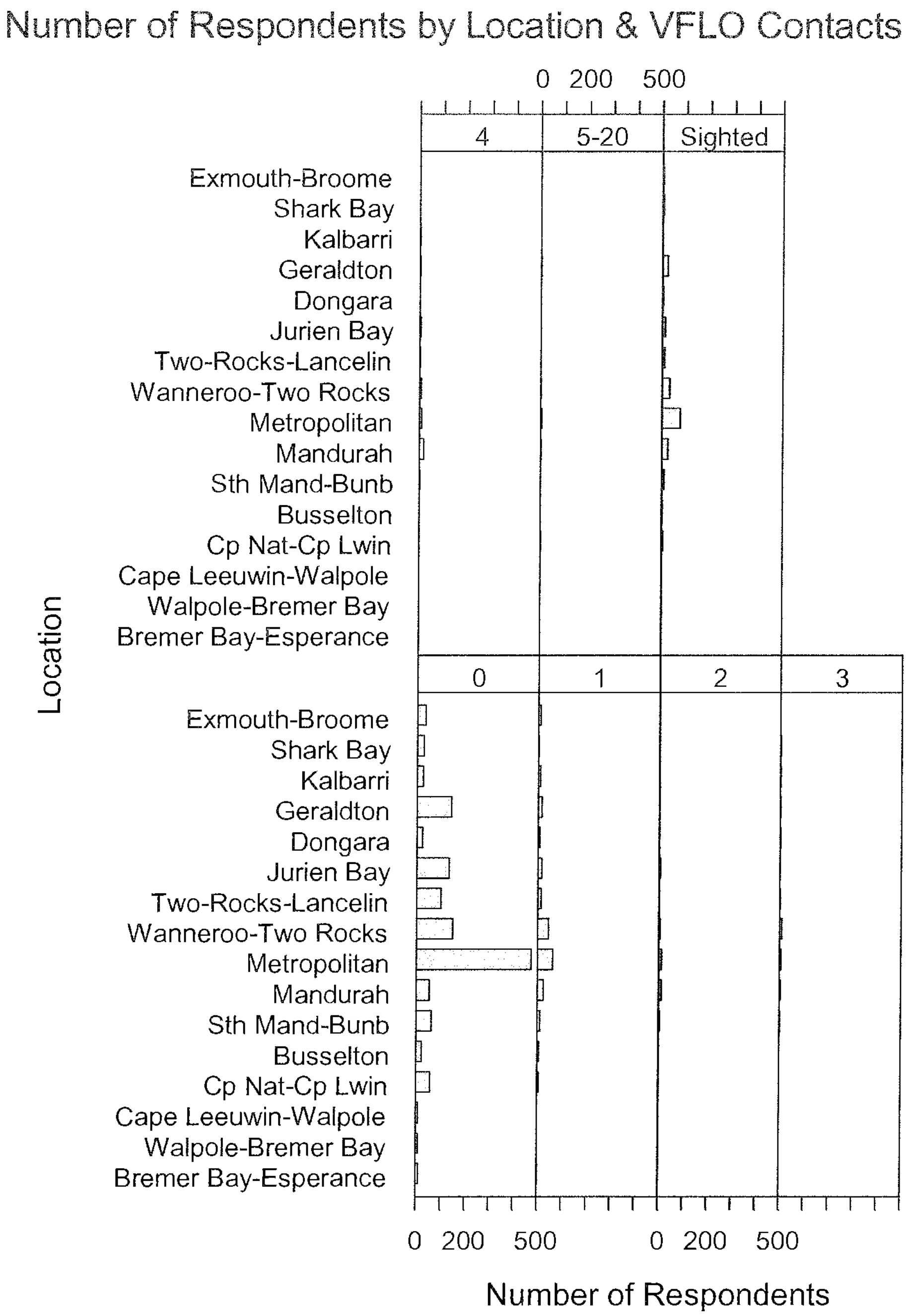

Figure 7.10 Number of respondents reporting a given number of contacts with VFLOs, split by fishing location. Each panel is labelled according to the number of contacts with VFLOs reported by respondents.

7.4.5 Perceptions on Recreational Management

Licence holders were asked to consider whether fisheries management was effective in conserving rock lobster stocks, and their response was overwhelmingly positive. Over 80% of fishers agreed or strongly agreed that fisheries management was effective, a small percentage (11%) of respondents were unsure, and around 4% disagreed or strongly disagreed with the statement.

When responses for this question were examined in relation to respondent age, fishing method, and number of years in the fishery it appeared that these demographic factors only marginally increased the likelihood of agreeing or disagreeing that management is effective. The comparison with age showed that licence holders in younger age groups are more likely to be unsure or disagree that fisheries management is effective, whereas older people appeared more likely to agree (Figure 7.11).

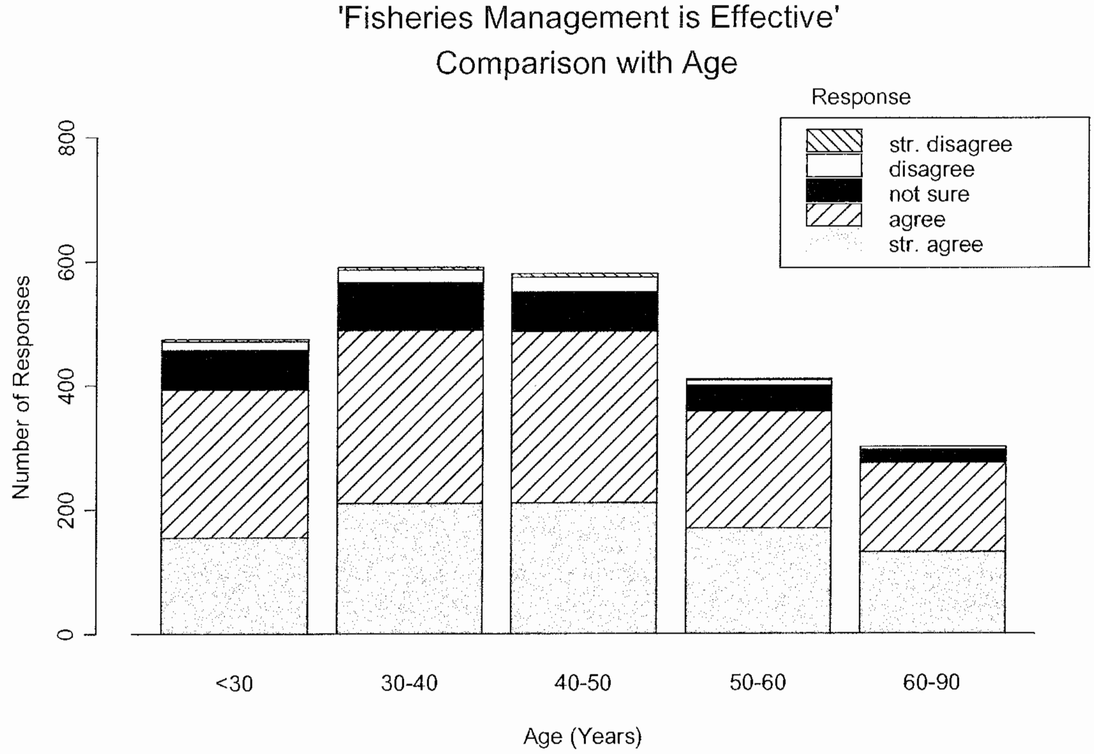

Figure 7.11 Barplot of responses to the question "Fisheries management is effective in conserving rock lobster stocks", split by age categories.

When perception on fisheries management was compared with the number of contacts that respondents had with Fisheries Officers a trend emerged linking confidence in fisheries management with contacts with Fisheries Officers (Figure 7.12). Respondents that had no contacts with Fisheries Officers were more likely to be unsure whether the fishery was effectively managed. Conversely, those that had seen or had contact with fisheries personnel were less likely to be unsure and more likely to respond positively.

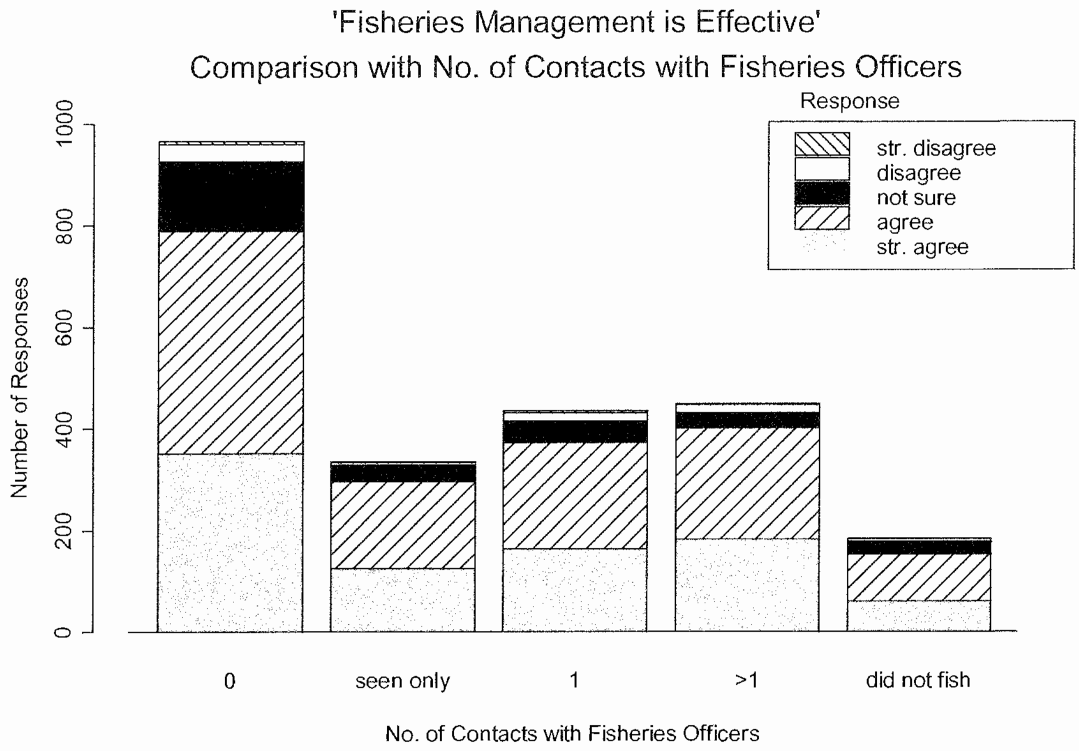

Figure 7.12 Barplot of responses to the question "Fisheries management is effective in conserving rock lobster stocks" categorised by the number of time respondents came in contact with Fisheries Officers.

7.4.6 Do Recreational Fishers Understand Minimum Size Rules?

Survey participants were provided a question to test their understanding of the minimum size rule for western rock lobster. Fishers were provided with a choice of 4 scenarios concerning the minimum size rule, two of which were correct. Disturbingly, 48% of respondents either got the answer wrong (34%), did not answer the question (6%), or indicated that they did not know the answer (8%). Several trends emerged when these responses were compared across demographic factors. A comparison with age showed a significant association between age and understanding of the minimum size rule (χ^2=15.2, df=4, p=0.004). The youngest (0-30 years) and oldest (60-90 years) age groups seemed most likely to misunderstand the regulations, whereas licence holders in the 30 to 60 year age range were more likely to answer correctly (Figure 7.13).

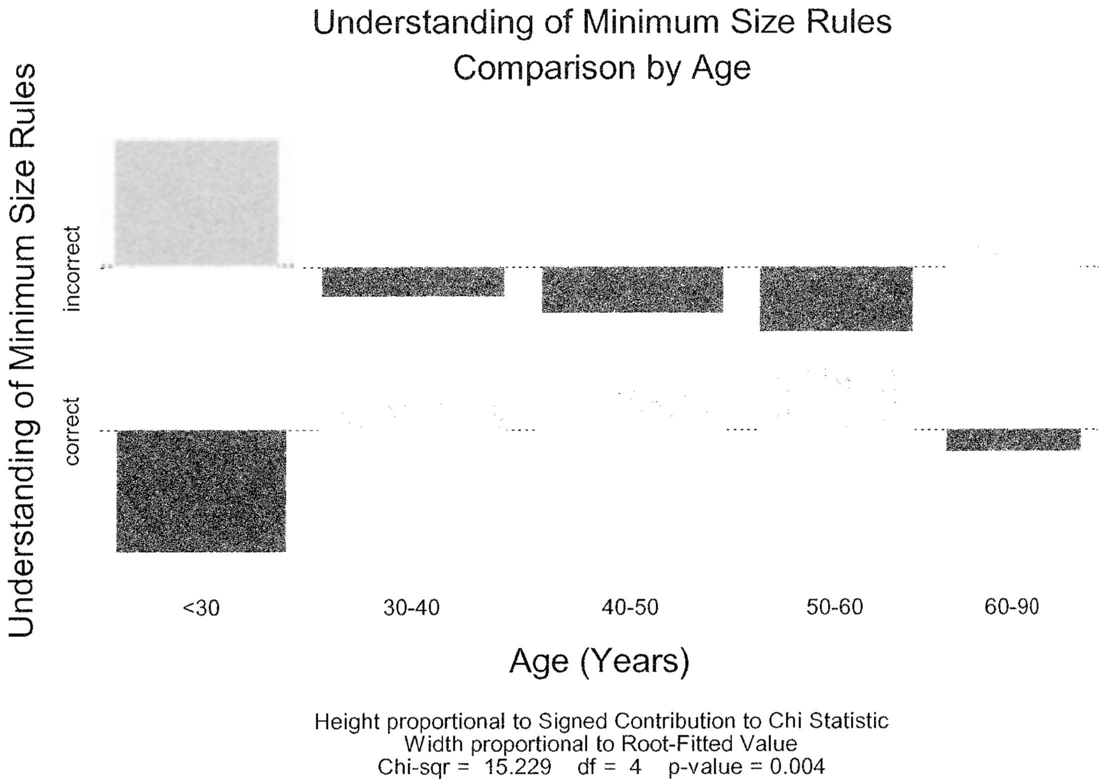

Figure 7.13 Chi-plot assessing independence between fisher age and understanding of the minimum size rule.

A comparison of responses by region showed that fishers in the Central region, from Perth to Lancelin, and the North region were more likely to understand the regulations. Respondents that declined from answering where they fished were by far most likely to answer the question incorrectly or not at all (Figure 7.14).

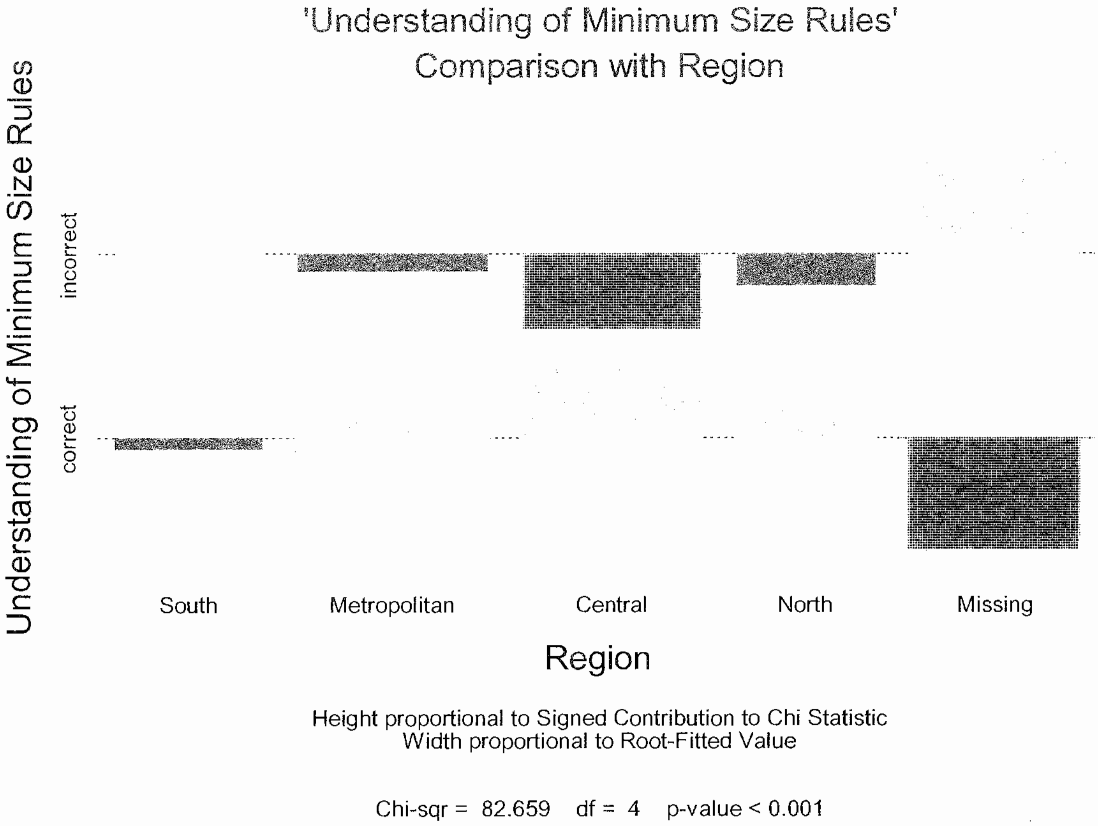

Figure 7.14 Chi-plot assessing independence between regions of the fishery and fisher understanding of the minimum size rule.

A significant relationship was found between the respondents chosen method of fishing and their understanding of the minimum size rule (χ^2=92.6, df=4, p<0.001). Fishers that used pots were more likely to understand the regulations than those diving (59% compared with 48%). As might be expected, those licence holders that had not fished in the 1998/99 season were more likely to answer incorrectly (Figure 7.15 and Figure 7.16).

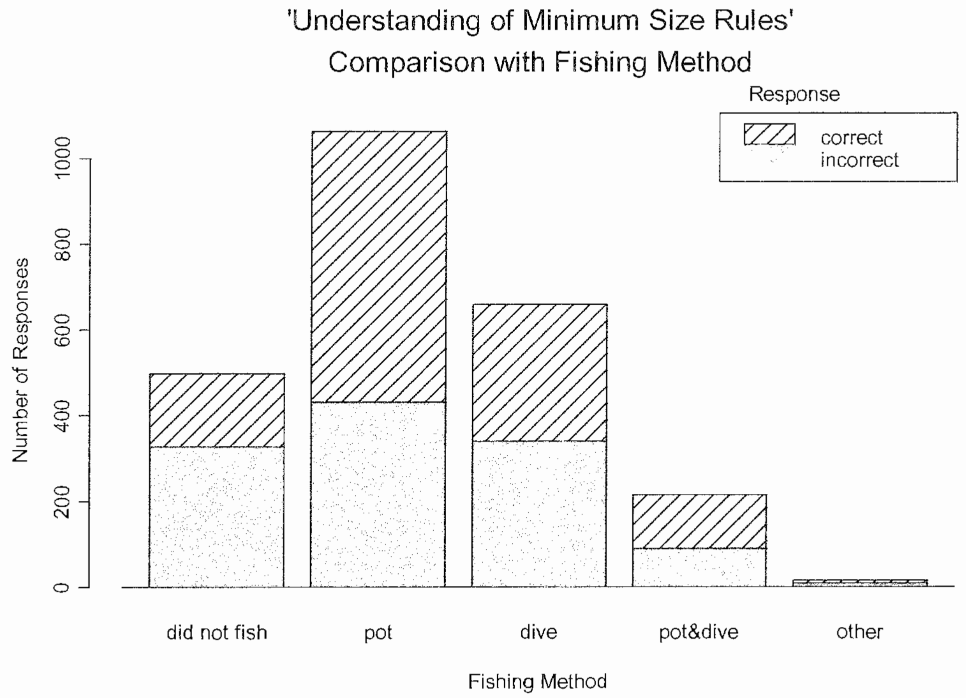

Figure 7.15 Bar chart showing respondents knowledge of the undersize regulations according to fishing method.

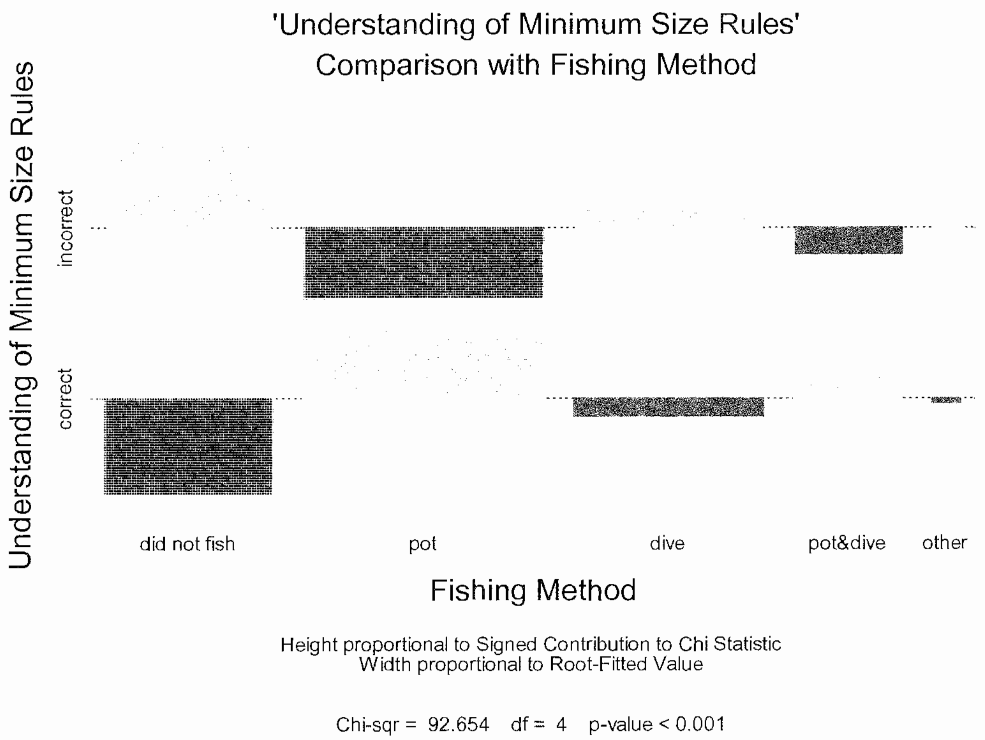

Figure 7.16 Chi-plot assessing independence between method of fishing and fisher understanding of the minimum size rule.

Results also showed that an understanding of the minimum size regulations was related to the number of years that the licence-holder had spent in the fishery ($\chi2=34.8$, df=5, $p<0.001$) (Figure 7.17). Predicably, the longer a person spends in the fishery, the more likely they are to understand the undersize regulations. The only exception to this trend occurred for fishers who have been in the fishery more than 30 years. This group were only marginally more likely to answer correctly, and showed a marked decline in their understanding compared with respondents who had 6-30 years experience.

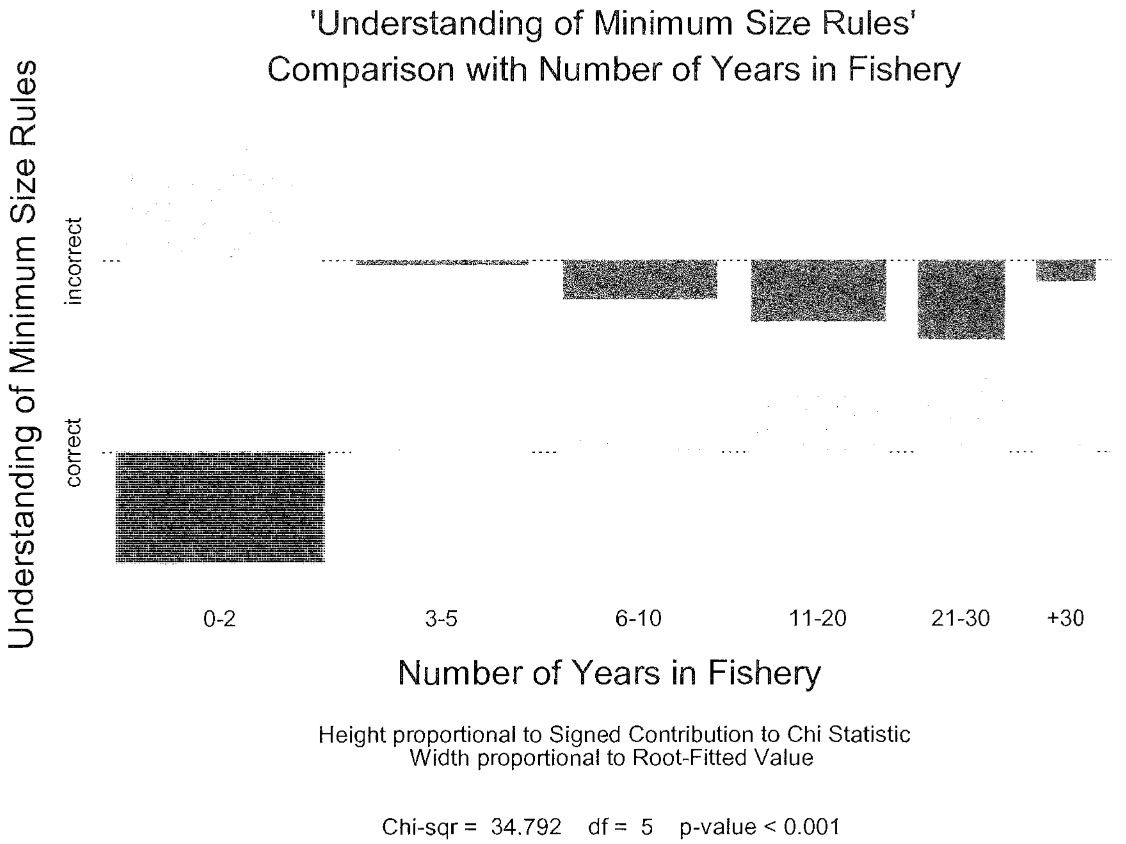

Figure 7.17 Chi-plot assessing independence between number of years in the fishery and fisher understanding of the minimum size rule.

A significant relationship exists between an understanding of minimum size rules and contacts with fisheries personnel and VFLOs. Respondents that recorded contact with Fisheries Officers were marginally more likely to answer correctly (55% correct) than if they had no contacts, but if they recorded more than one contact they were significantly more likely to be correct (67% correct) (Figure 7.18 and Figure 7.19).

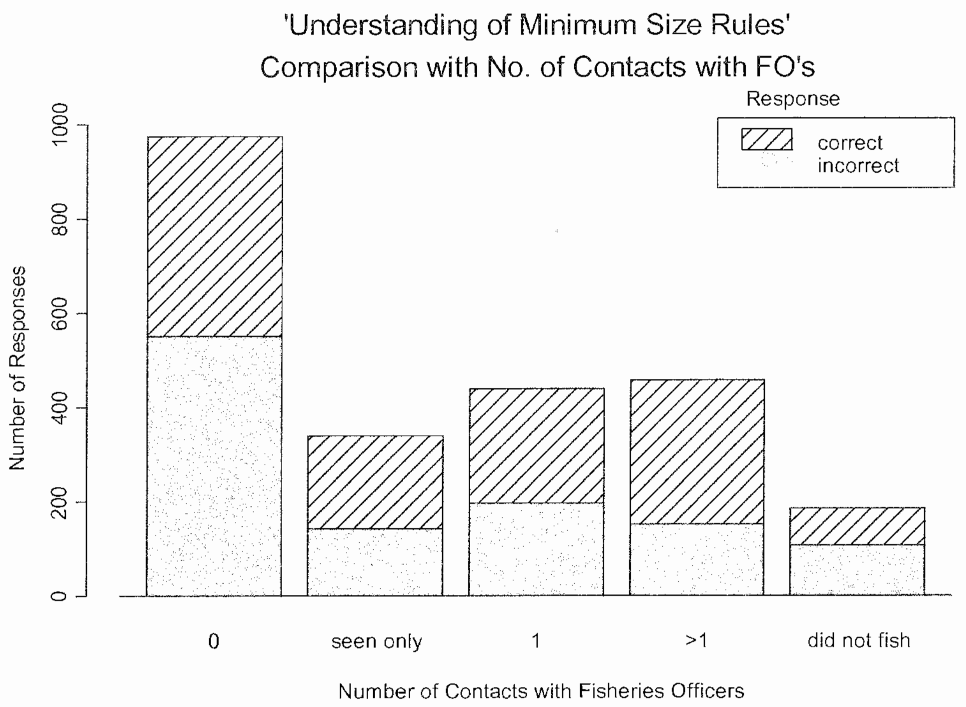

Figure 7.18 Bar chart showing respondents knowledge of undersize regulations according to number of contacts with Fisheries Officers.

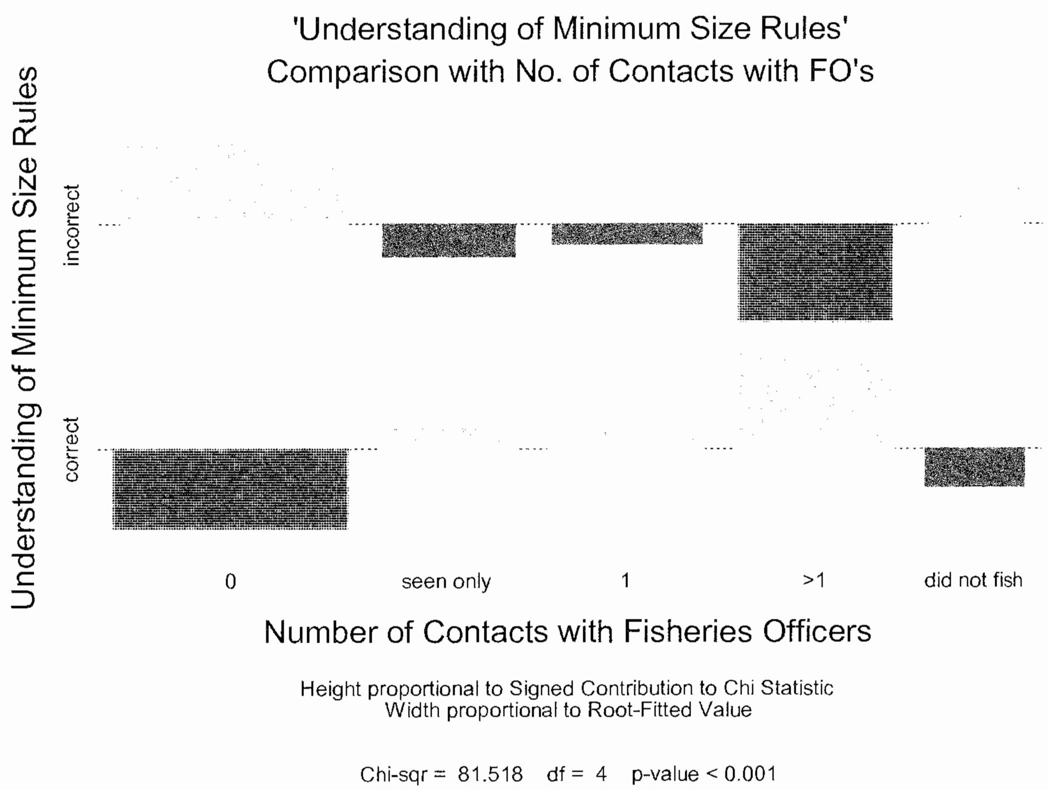

Figure 7.19 Chi-plot assessing independence between number of contacts with Fisheries Officers and fisher understanding of the minimum size rule.

In contrast, fishers who had any contact with a VFLO were more likely to understand the minimum size regulations, regardless of whether the contact was seen only, one contact, or more than one contact (χ^2=16.2, df=4, p=0.003) (Figure 7.20 and Figure 7.21). However, this result is dominated by the large number of respondents who had zero contact with VFLOs during 1998/99, and should be interpreted cautiously.

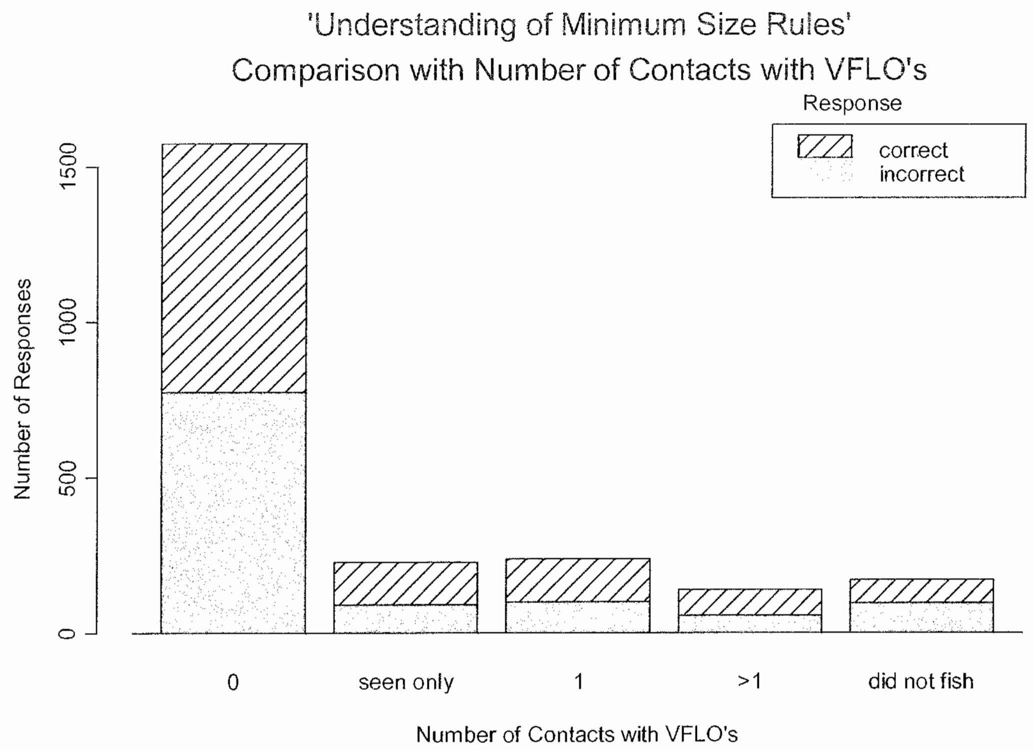

Figure 7.20 Bar chart showing respondents knowledge of undersize regulations according to number of contacts with VFLOs.

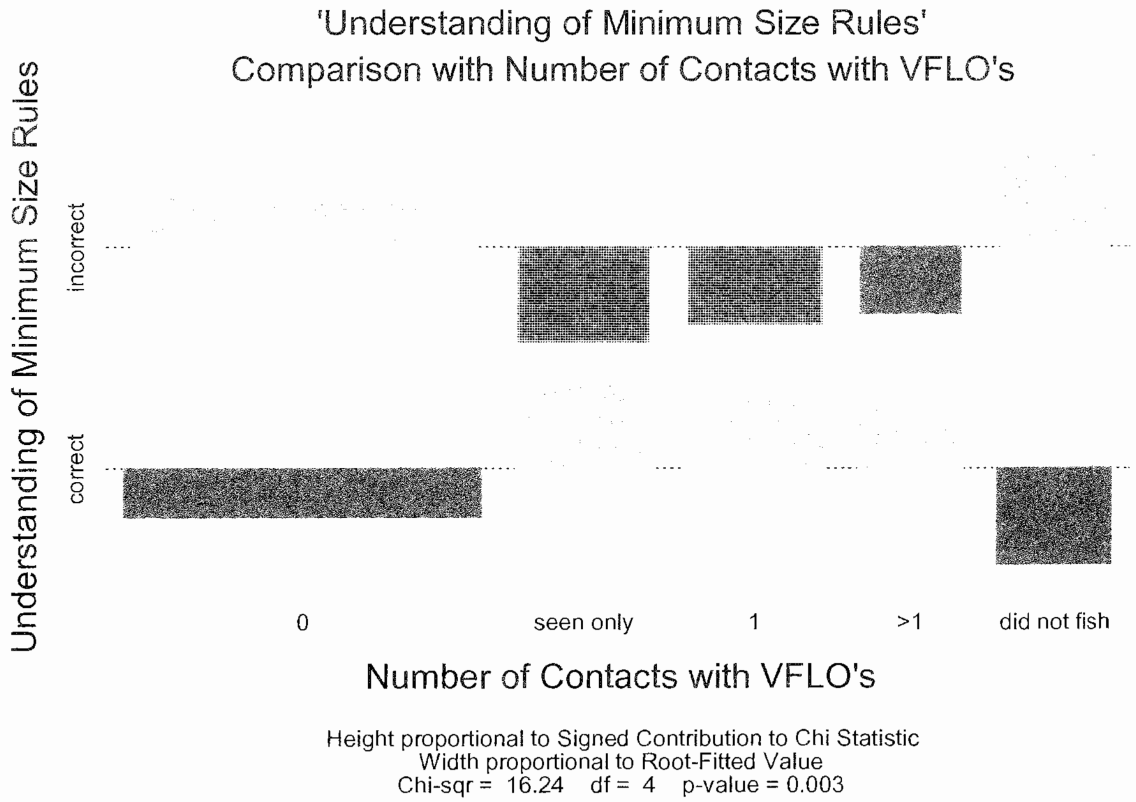

Figure 7.21 Chi-plot assessing independence between number of contacts with VFLOs and fisher understanding of the minimum size rule.

7.4.7 Is it easy for recreational fishers to break minimum size rules?

Another question on the survey asked licence holders to estimate how many times they thought people could break the size regulations in their usual fishing area without getting caught by Fisheries Officers. The majority of respondents (65%) thought that people could never break the regulations without getting caught. However, of the respondents that did believe that it was possible, most thought that it was possible 75-100% of the time. This response was different among different age groups (χ^2=72.8, df=16, p<0.001), and seemed to monotonically decline with increasing age (Figure 7.22 and Figure 7.23).

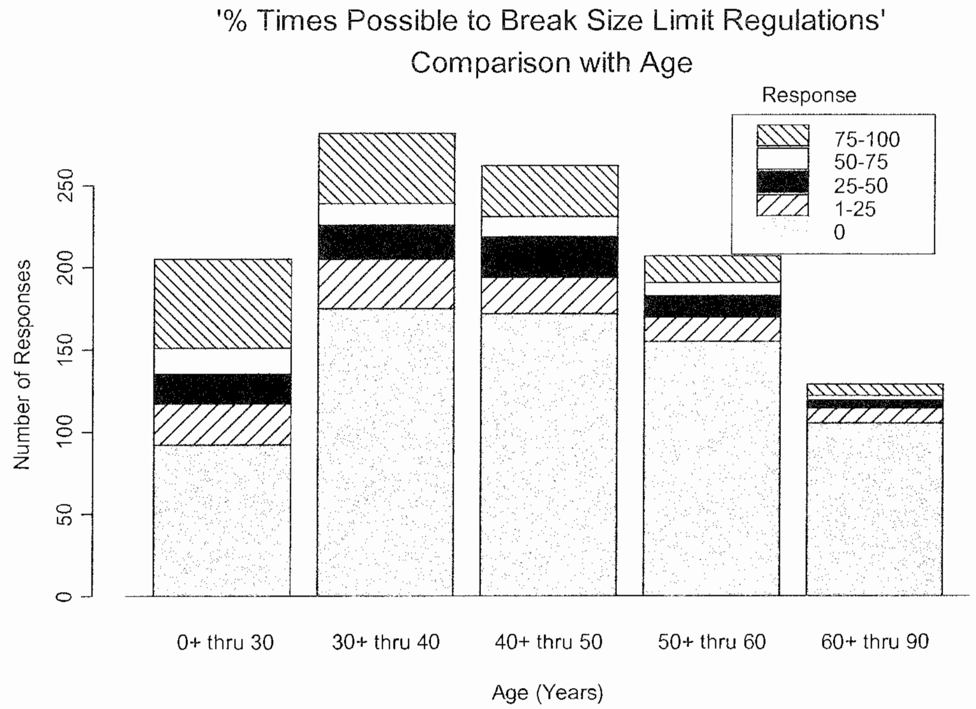

Figure 7.22 Bar chart showing respondents perception of enforcement effort according to age.

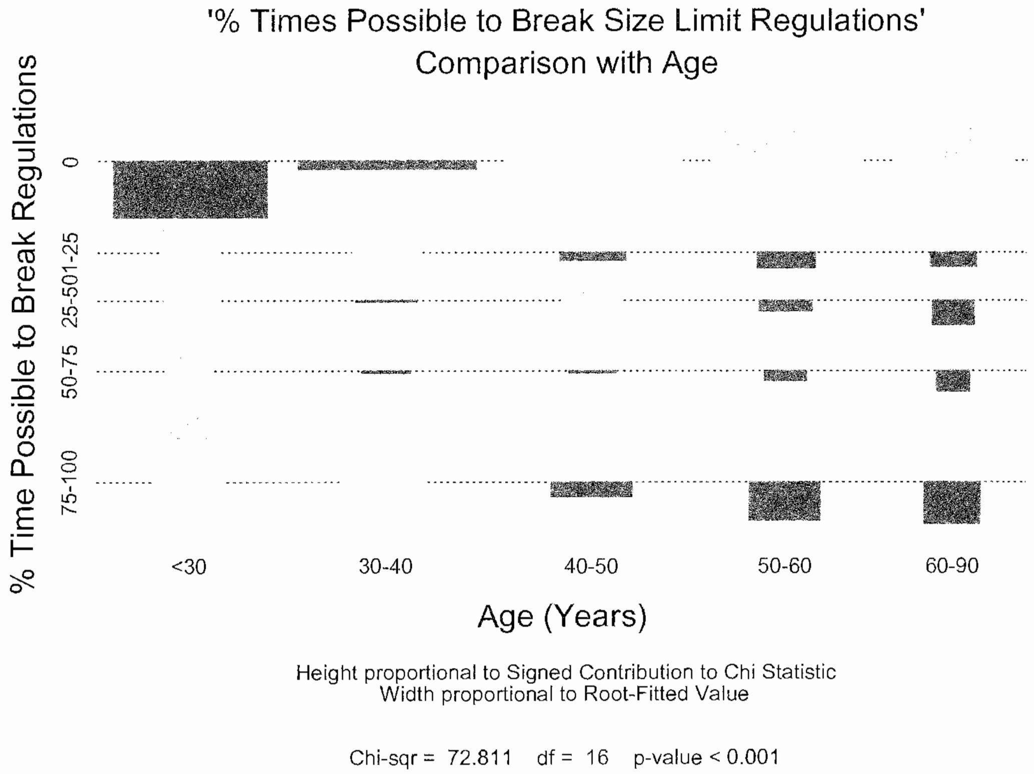

Figure 7.23 Chi-plot assessing dependence between perception of enforcement effort and fisher age.

Trends concerning perceptions about the ability to break size regulations also emerged among other demographic factors. A comparison with education levels showed that tertiary educated respondents were more likely to think that fishers could break regulations without getting caught ($\chi 2=67.6$, df=12, $p<0.001$) (Figure 7.24). Alternately, respondents educated below Year 12 or with TAFE/Apprenticeship qualifications were more likely to think people could never break regulations without being caught.

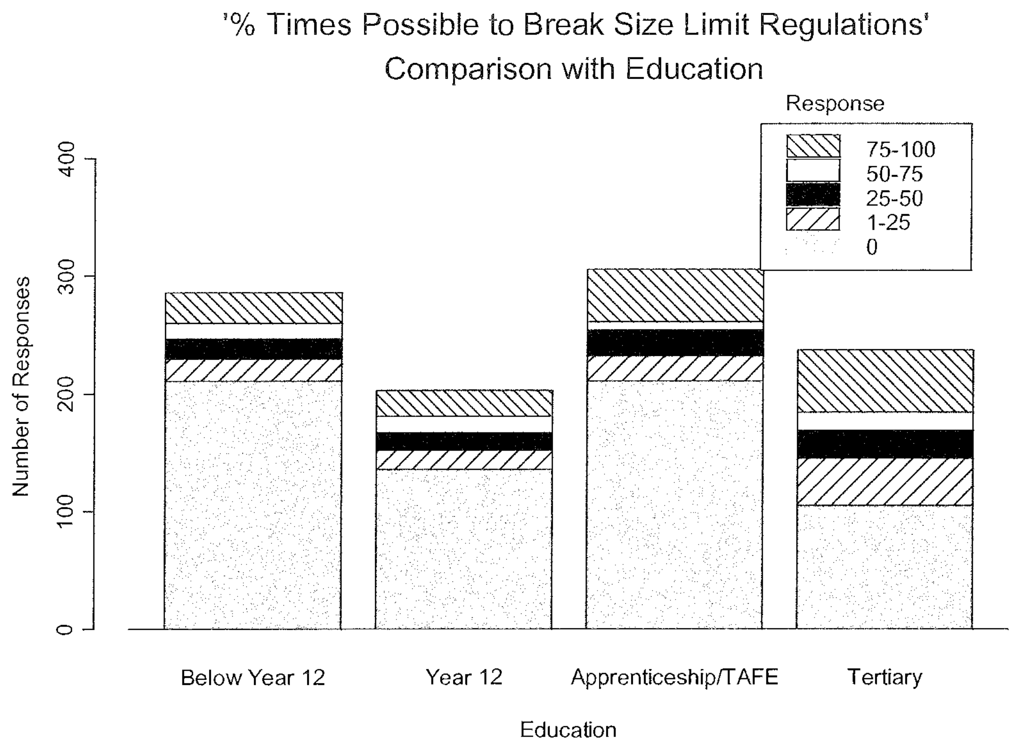

Figure 7.24 Bar chart showing respondents perception of enforcement effort according to level of education.

Regional comparisons indicated that respondents fishing in the Metropolitan and South regions were more likely to think it was possible to break fishing regulations without being caught, with 25% of all Metropolitan respondents indicating they thought fishers could break the regulations without fear of apprehension 75-100% of the time (Figure 7.25 and Figure 7.26). In the relatively sparsely populated North region of the fishery, respondents perceived there was a higher probability of detection if fishers broke fishery rules. Respondents that declined from recording where they preferred to fish on the survey were much more likely to think they could never break regulations and significantly less likely to think that they could break regulations 75 to 100% of the time ($\chi^2=50.7$, df=16, $P<0.001$).

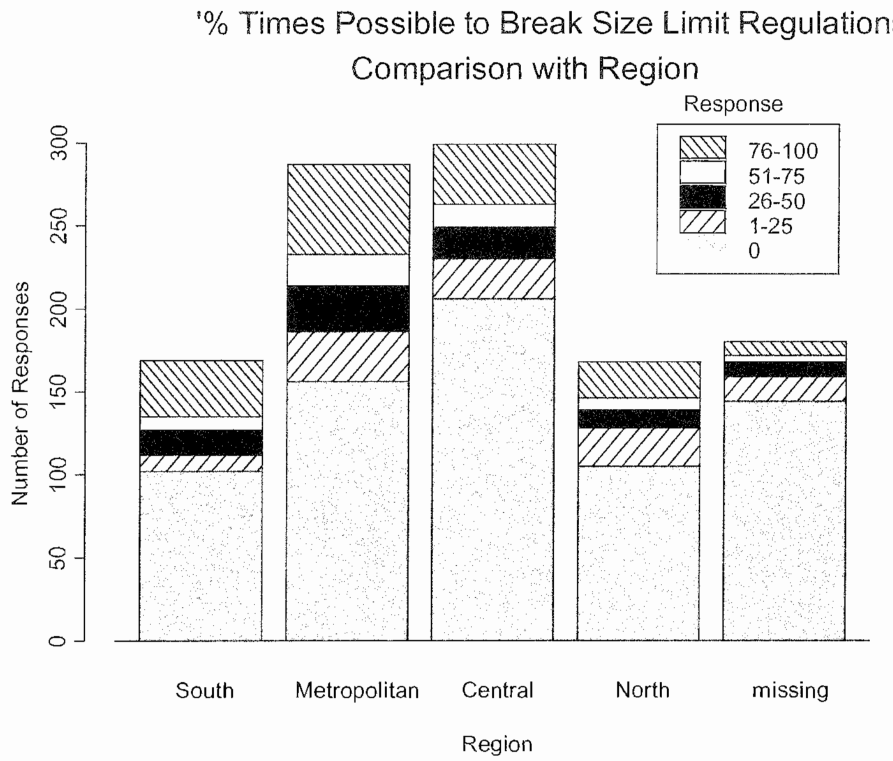

Figure 7.25 Bar chart showing respondents perception of likelihood of apprehension for breaking fishery rules, according to region of the fishery.

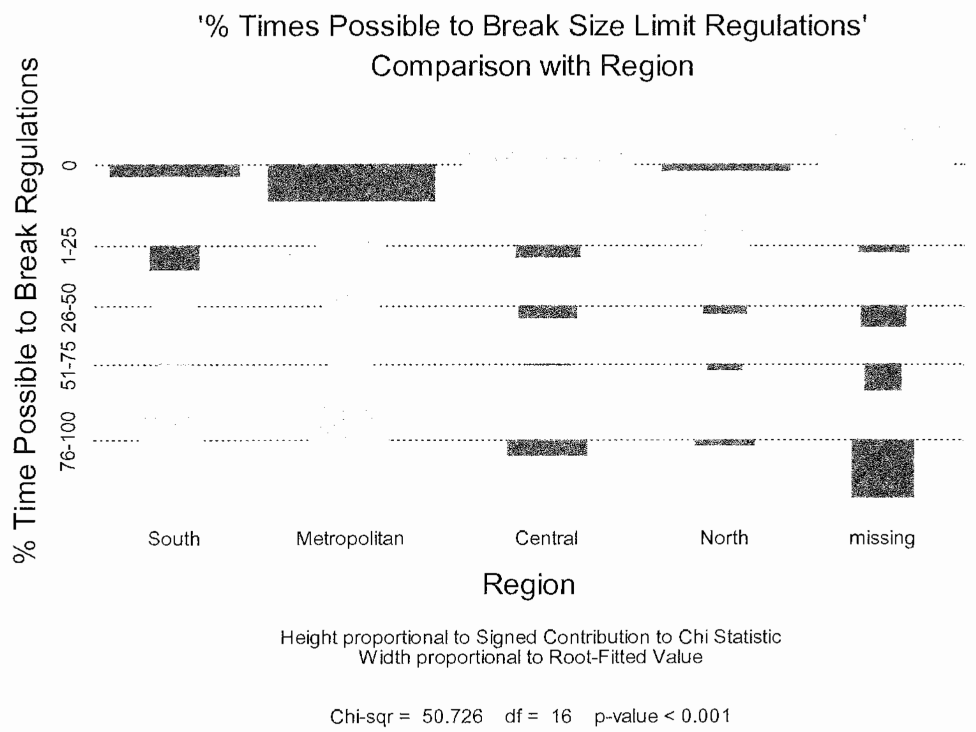

Figure 7.26 Chi-plot assessing independence between perception of enforcement effort and region of the fishery.

A comparison between the percentage of time possible to break regulations without apprehension and the fishing method used by licence holders showed that divers were significantly more likely to think they could break the rules than fishers using pots (χ^2=77.3, df=12, p<0.001) (Figure 7.27). Fishers that both potted and dived were also more likely to think they could break regulations without getting caught. Respondents that had not fished in the 1998/99 season were less likely to think that they would be able to break the law without being detected.

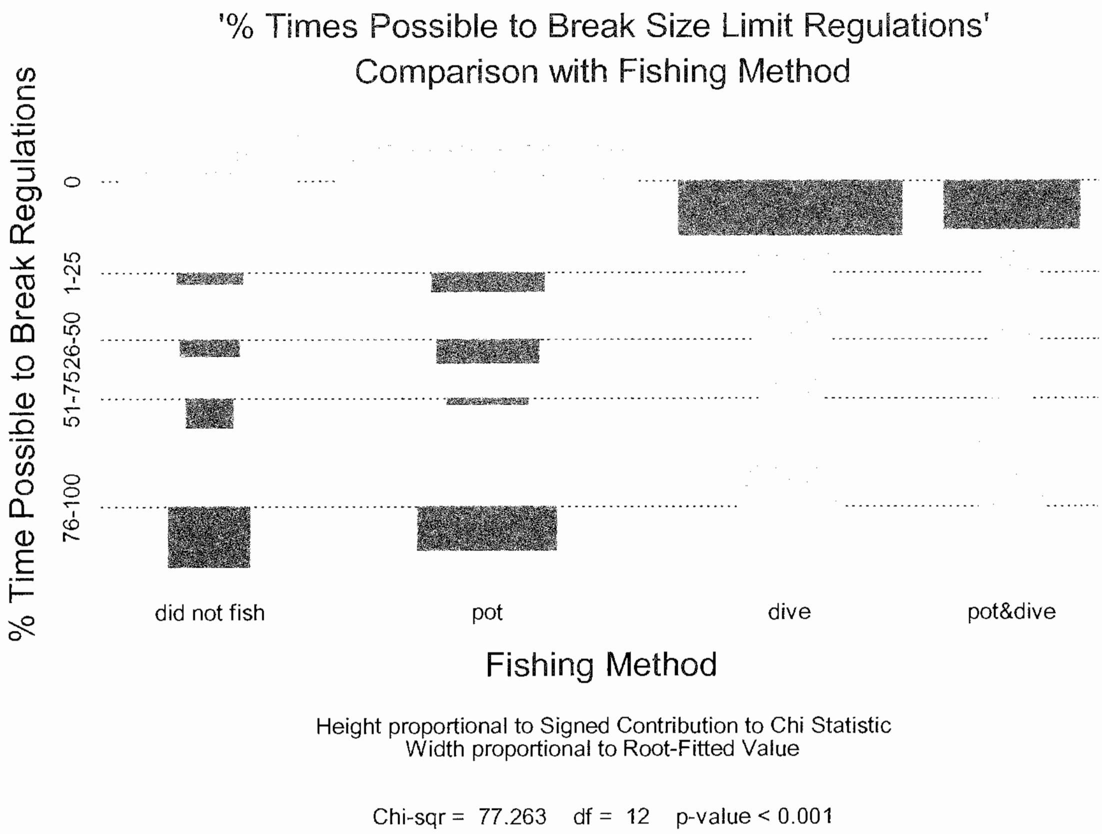

Figure 7.27 Chi-plot assessing independence between perception of enforcement effort and method of fishing.

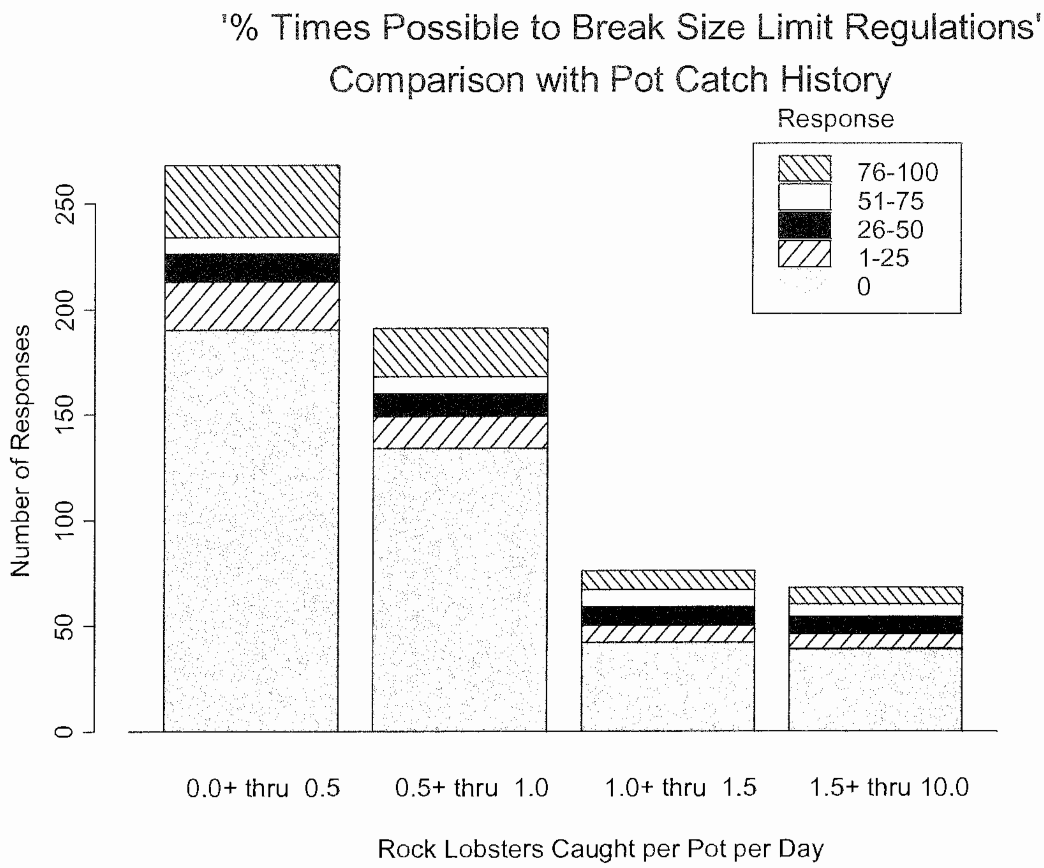

Figure 7.28 Bar chart showing respondents perception of enforcement effort according to catch rate.

A marginal relationship was found between catch per pot over the 1998/1999 season and the possibility of breaking regulations (χ^2=20.3, df=12, p=0.06). Catch history was calculated for the duration of the 1998/99 season for each fishing method. The total catch or total catch per pot was divided by the number of days diving or potting, respectively. Fishers with low catch rates were more likely to think that they could never break the regulations, while fishers with high catch rates were more likely to think that they could break the regulations up to 75% of the time (Figure 7.28 and Figure 7.29).

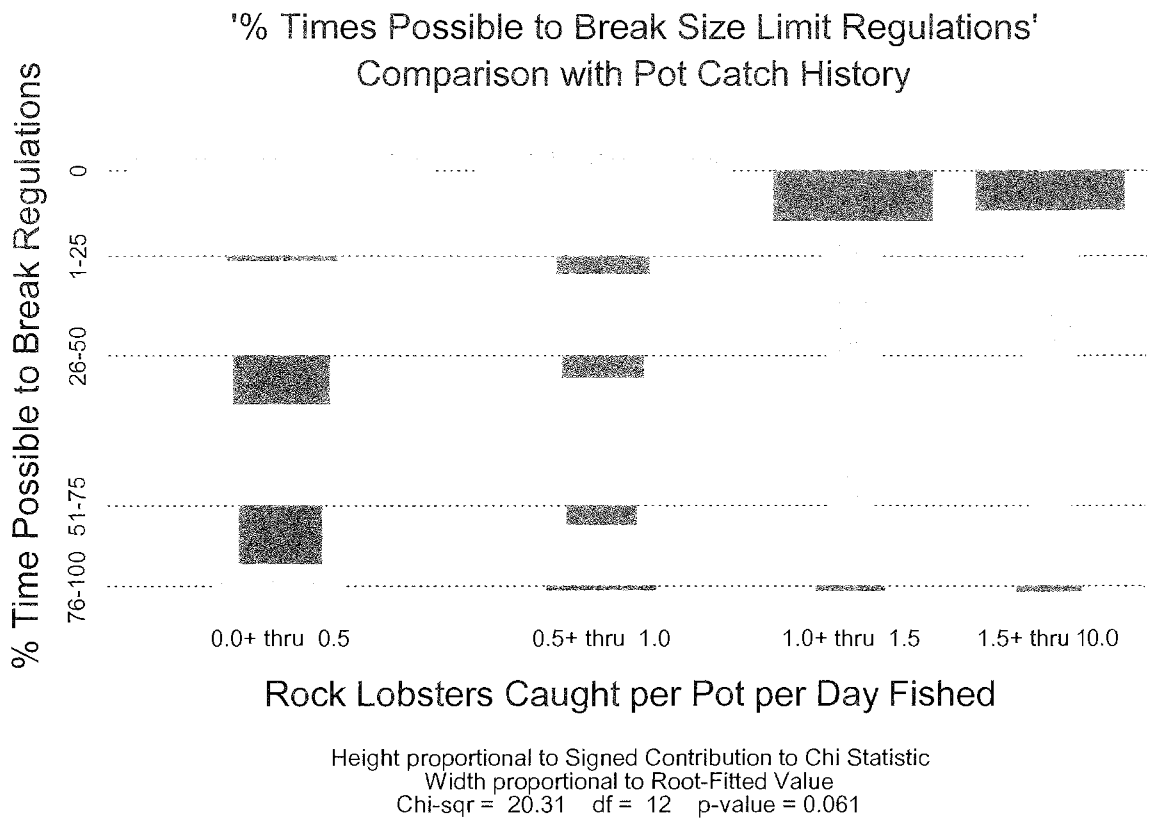

Figure 7.29 Chi-plot assessing independence between perception of enforcement and catch rate.

The possibility of breaking regulations without detection was found to be related to the number of contacts with Fisheries Officers, but was not related to the number of contacts with VFLOs. The respondents most likely to think that they could break regulations were those that had no contact with Fisheries Officers, or those that had only seen Fisheries Officers. As expected, the respondents that had more than one contact with fisheries enforcement staff were more likely to think they could never break regulations without being caught (Figure 7.30).

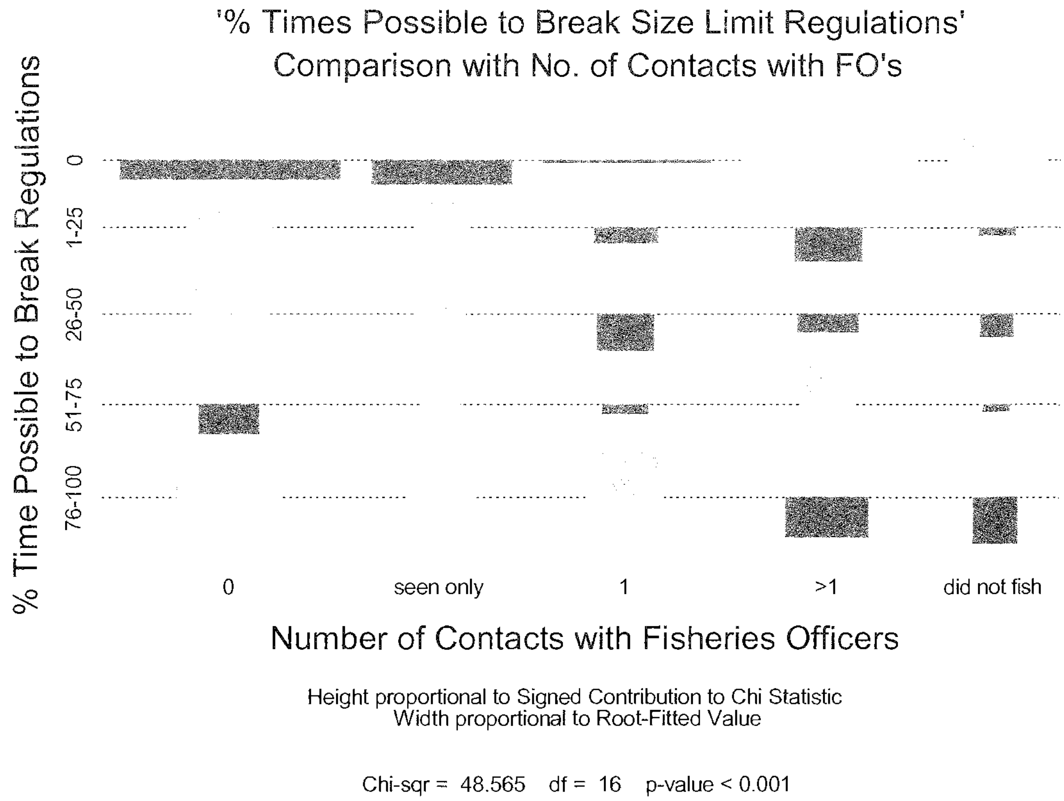

Figure 7.30 Chi-plot assessing independence between perception of enforcement effort and contact with Fisheries Officers.

7.5 Discussion

The present study comprised a mail survey of 4000 fishers, with an effective sample size of 3883 and a total response rate of 63%, which is high for mail surveys of this nature. There are many potential biases that may affect mail survey results (see Brown 1991 for review), with non-response often cited as the potentially strongest biasing factor. Fisher (1996) divides non-response into two categories, unit non-response and question non-response. Unit non-response refers to people who receive a survey but do not complete/return it, and question non-response describes the situation where a survey is returned, but the respondent failed to complete a particular question. Bias occurs when non-respondents have different characteristics and perceptions from respondents, and this may occur with regard to unit non-response or to question non-response. In many studies, non-respondents may account for a significant proportion of survey recipients, with non-response rates as high as 30-40% typical for many fisheries surveys (Brown 1991).

The non-response rate for the present survey was 37% for unit non-response, and typically 5-15% for question non-response. Unit non-response may be a result of many factors, some of which are being examined in other studies currently conducted by the Department of Fisheries WA. One disturbing trend that emerged from current work, however, is that very few respondents marked English as their second language. This raises the possibility that a proportion of fishers who received a survey did not complete it because of poor English skills.

Telephone surveys are often proposed as one mechanism for avoiding the bias of non-response associated with mail surveys. A telephone survey of the WA public was conducted in June 1999 to examine public perceptions about Department of Fisheries programs (Baharthah and Sumner 1999). Comparing questions from the recreational rock lobster fishing survey with similar questions from the telephone survey revealed minimal differences. For example, 6.5% of telephone respondents (including non-fishers) had a negative or very negative impression of Fisheries WA, compared with 4% in this mail survey that disagreed or strongly disagreed with the notion that Fisheries management was effective. It is reassuring that – at least on a qualitative level – the two surveys found similar results for similar questions.

Question non-response has not been investigated for this initial analysis, but may be a significant factor in understanding recreational fisher perceptions on enforcement and compliance. The survey asked a range of questions about compliance activities. Most of these were framed in the third person because of the sensitive nature of the information being sought. Nonetheless, it is possible that some people avoided particular questions because they were embarrassed, because they did not wish to incriminate themselves, or because they did not know the answer. There are several methods for assessing and adjusting for question non-response (Schill and Kline 1995, Fisher 1996), and this remains an area of further investigation.

7.5.1 Understanding Regulations

The understanding of minimum size limits was answered incorrectly – or not at all – by half of all respondents, indicating that many fishers do not know the regulations and are likely not adhering to them. Younger respondents (less than 30 years) were more likely to misunderstand minimum size limit regulations. This result was also evident when understanding of the minimum size rule was compared with experience in the fishery; those respondents that had fished for less than two years were less likely to understand regulations. This is perhaps not surprising since fisher age and years experience in the fishery are likely to be highly correlated.

Understanding of regulations also appears related to the locations licensees prefer to fish. Respondents from the highly populated regions of South and Metropolitan are less likely to understand the regulations than those from Central or North. The high degree of understanding in the Central region may reflect a familiarity with the rock lobster fishery as a whole, as this area is where most commercial rock lobster fishing takes place.

Fishers that use pots were more likely to understand size limit regulations than their diving counterparts. This may be because pot fishing requires more outlay, infrastructure, and organisation. For example, pot fishers must buy pots and baits, they must maintain, set and check pots, and they usually must have access to a boat.

Due to the high degree of outlay and planning required, pot fishers are more likely to fish for more than one season and have a continued involvement in the fishery. Alternately, diving requires less organisation and infrastructure, and may be more an occasional activity and less a way of life. Divers tend to fish less, often with a lower total catch (but higher catch rate). Free diving or SCUBA diving can be conducted from the shore without access to boat ramps, so divers may be less exposed to other fishers and enforcement staff. Low exposure to Fisheries Officers may also contribute toward divers feeling that they can break the size-limit regulations a high percentage of time without getting caught (see below). If the likelihood of detection is low there is no incentive for divers to learn and respect fishing regulations, since potential prosecution is unlikely to be a significant deterrent.

7.5.2 Probability of Detection

When asked to estimate the amount of times possible to break minimum size regulations without getting apprehended by Fisheries Officers, the majority of respondents stated that they would never be able to break size limit regulations without getting caught. While this is a very positive result, the same respondents indicated that they had not had significant contact with fisheries personnel. In fact, most respondents who provided an estimate greater than zero indicated it was possible to break regulations 75-100% of the time. This disparity suggests that many of the respondents indicating they would not break regulations would make this choice *regardless of any real deterrent*. In other words, some respondents simply would not estimate the number of times they could break regulations without being caught, because they would never do so themselves. These respondents are unlikely to require a large deterrent effect in order to obey regulations.

Those respondents that indicated a high possibility of breaking minimum size regulations without being apprehended were more likely to fish in the South or Metropolitan regions. The coastline in these areas is densely populated, and there are far fewer Fisheries Officers per capita than in other areas of the state. Respondents who thought there was a high possibility of offending without being apprehended also tended to be young and to have high catch rates. A likely explanation of this result is that high catch rates correspond to respondents that fish often and hence observe how frequently (or infrequently) Fisheries Officers are present.

7.5.3 The role of Fisheries Personnel

A telephone survey of the Western Australian public conducted to examine understanding and support of Fisheries WA programs (Baharthah and Sumner 1999) found that in the last 12 months 5.3% of participants had been approached or contacted by Fisheries Officers, while 4.3% had been approached by VFLOs. From that study it was estimated that the overall participation rate for recreational fishing in Western Australia was 34%, suggesting recreational fisher contact rates of 15.6% for Fisheries Officers and 12.6% for VFLOs. These figures appear lower than the recreational rock lobster fisher contact rates of 37% and 16% for Fisheries Officers and VFLOs found in this study. This result perhaps indicates that rock lobster recreational fishers are more likely to come into contact with Fisheries Officers than participants in other recreational fisheries. I can suggest two reasons for this: i) rock lobster fishers require a licence to fish, and this can be purchased or renewed at fisheries offices; and, ii) it is likely that many recreational fishers come into contact with enforcement personnel undertaking checks of commercial catches or gear.

In order to successfully manage a fishery a sufficient number of participants must understand and comply with fishing regulations (McKinlay 1999). Results indicate that many recreational fishers will comply with regulations regardless of *actual* enforcement level. There is some evidence to suggest this result is linked to confidence in fisheries management. Some fishers, however, require extra encouragement. Results showed that simply the presence of Fisheries Officers increased confidence in fisheries management. Contact with Fisheries Officers and VFLOs also seemed associated with an increased understanding of fishing regulations. This may happen directly by Fisheries Officers and VFLOs talking to and educating fishers. However, an increased understanding of fishery rules was apparent amongst those people who had only visual contact with Fisheries Officers and VFLOs. In this case, the threat of committing an offence and being apprehended encourages people to know the rules.

In general, respondents who thought it was possible to break regulations without being caught felt they could regularly break regulations without risk of apprehension. One contact, or only visual contact, with Fisheries Officers did not appear to influence the number of times licensees thought it possible to commit an offence. In fact, Fisheries Officer contact did not significantly decrease estimates until more than one contact was made. This may be a reflection of the fact that some fishery participants will break fishing rules if they can, and for these fishers a significant deterrent effect remains important.

In contrast, VFLOs were not found to influence confidence in management, or to pose a deterrent against fishers breaking rules. This result is perhaps due to the low number of contacts respondents reported with VFLOs, or it may be linked to the lack of statutory authority held by VFLOs.

7.5.4 Survey Limitations and Deficiencies

A major identified deficiency with the survey relates to the method of sampling employed to select survey participants. Fishers are selected for inclusion in the survey by simple random sampling from the entire database of recreational licence-holders. This was done to ensure that the sampling scheme used was consistent with previous recreational surveys (recall that compliance questions were "piggybacked" onto an existing survey). Due to the aggregated nature of fishery participants around the Perth metropolitan area, simple random sampling means that the vast majority of respondents are naturally drawn from Perth fishers, with very few fishers surveyed from regional towns. From an enforcement/compliance perspective, it would be useful to increase sample-sizes in smaller population centres, and this might usefully be achieved by stratifying random sampling according to areas of interest. Such stratification should be considered for future compliance-related attitudinal surveys of recreational fishers.

7.5.5 Conclusion

This study has presented a subset of results from a survey that has generated a large, complex data set with many hundreds of variables. It is possible that higher order dependencies may exist among some variables examined, and among other variables not yet considered. Grambsch and Fisher (1991) emphasise the need to examine survey information with more than simple cross-tabulations, and analyses of these data are continuing. Examining a range of bi-variate dependencies has so far suggested interesting relationships between enforcement effort, compliance, and education. Education campaigns can be devised to target those groups that appear to be most likely to commit offences. For example, campaigns designed to educate divers, or fishers new to the fishery, would directly target those participants more likely to break fishery rules. Requiring that the first licence bought by an individual be purchased at a Fisheries Office, and not a post office, is another idea. It also seems that merely sighting a Fisheries Officer or VFLOs can often send an important deterrent message to fishers. Nonetheless, it appears a deterrent effect – in the form of Fisheries Officers and not VFLOs – is required to ensure some recreational rock lobster fishers abide by fishing rules.

8. General Discussion

8.1 Methods of this Report: Features and Limitations

This study focused on three methodologies for examining the enforcement program and fisher compliance in the western rock lobster fishery: a) detailed analyses of data arising from inspections of commercial catch in rock lobster processing factories; b) self-response attitudinal surveys of commercial and recreational fishery participants; and, c) planned experiments to examine non-compliance with specific rules. These approaches were chosen with due regard to resource constraints and the original objectives of the study, and with an understanding that this was the first detailed study of its kind to take place in a fishery in Australia (and possibly anywhere in the world). This last point is an important one: while different, perhaps equally valid approaches may have provided interesting and useful insights into enforcement and compliance within the fishery, as the first study of its kind it was necessary to focus on those approaches that would provide results most useful for management, and to establish baseline data upon which future studies might build. To the extent available data have allowed, I believe the current study has provided a useful framework for examining the efficiency and effectiveness of enforcement in the fishery. The methods used are not without their limitations, however, and in the following sections I discuss their weaknesses, and possible alternate approaches.

Inspections of commercial catch in licensed rock lobster processing factories formed a major focus in this study. This was a natural choice since most commercial catch is consigned to factories for export to overseas markets, and a pre-existing time-series of historical data on enforcement inspections in processing factories was available to the study. However, factory inspections are not the only important component of the enforcement program for the western rock lobster fishery. This begs the question: why were not other aspects of the program examined in detail? In fact they have been, and continue to be, as part of a companion project examining enforcement and compliance in all W.A. commercial and recreational fisheries (FRDC 2001/069). Fisheries Officers often conduct inspection work in a multitude of fisheries simultaneously; for example, checking vehicles for illegal catch at roadside checkpoints, or inspecting wholesale/retail outlets, or conducting gear and vessel inspections at sea. These types of activities are often not specific to rock lobster, and collecting data relating to such work required a comprehensive method to capture all enforcement activities in all fisheries. At the time of completing the current project (FRDC 1998/156), the new data collection system was in its infancy and data were not considered of sufficient quality for inclusion in this report. With suitable qualifications, interim results specific to rock lobster have been presented on an ongoing basis to fishery managers and stakeholder groups. It is anticipated that future analyses will allow compliance rates to be estimated for the full range of enforcement activities conducted by Fisheries Officers. I discuss the new project further in Section 8.3, *Further Development in Compliance Evaluation*.

This study used self-completion surveys to gauge fisher attitudes toward fishery rules and perceptions about levels of illegal activity. Mail surveys were chosen as the only feasible method, within cost constraints, of soliciting views from all of industry. This approach has some benefits in that fishers were able to provide frank responses knowing the survey was anonymous, however there are the possibility of (at least) two problems with the method.

First, self-completion surveys can suffer from immeasurable biases arising from non-response. In other words, if the views and behaviour of fishers who did not respond to the survey differ markedly from those who did, results may be misleading if assumed to represent all fishers. While response rates observed in this study were high, there were still large proportions of the sampled fishing community that chose not to respond (ie. around 50% non-response for commercial licence-holders, and around 35% non-response for recreational fishers). Response rates can often be maximised by utilising different survey methods, such as telephone surveys or structured personal interviews. Biases arising from mail surveys can sometimes be estimated by utilising additional survey methods on subsamples of respondents and non-respondents (if possible), and comparing with mail survey results. Unfortunately, telephone surveys and personal interviews are labour intensive (and therefore expensive), and were not possible for the current study.

Second, self-reporting of illegal activity (by any survey method) should be viewed cautiously since biases may arise because people may not accurately represent how often they break the law (Tyler 1990). I attempted to minimise this potential by framing survey questions in the third person, asking about the "average" fisher, or "fishers in your usual fishing area". However, the issue is complicated due to animosities existing between the commercial and recreational sectors about determining resource shares – not only might fishers tend to under-estimate the prevalence of illegal activity in their own sector of the fishery, but they might *over-estimate* illegal activity in the other. Again, personal interviews would provide a mechanism for minimising biases arising for these reasons, since such an approach would allow a greater level of detail to be explored for particular questions of interest.

Finally, this study has purposefully not attempted to quantify the economic benefit of the enforcement work conducted. This may be possible by collecting suitable economic data relating to business structures of fishing operations and monetary gains to be realised by illegal fishing, however collecting such data was not possible given the scope of this study.

8.2 Benefits: Use of Results By Industry, Enforcement and Fishery Managers

The benefits of this research detailed in the original application have, in general, been fully realised. That is, the research has directly benefited the Western Australian rock lobster fishery by providing a critical evaluation of the enforcement program, and by providing a basis for improving the use of limited enforcement resources. Strengths and weaknesses of the program have been identified based on empirical analyses of data, and by soliciting the opinions of the commercial and recreational sectors of the fishery. Results have been presented to industry on an on-going basis, and this information has provided a sound basis for discussing levels of fisher compliance, and resource requirements for enforcement activities. The results have been used by industry to recommend changes to the levels of enforcement inspections in rock lobster processing factories. Fisheries Officers utilise results to improve their ability to target previous offenders.

The techniques developed in this study are relevant to many managed fisheries in WA and other Australian states. Seminars and workshops demonstrating results have been provided several times during the life of the project to national compliance groups, such as the Australasian Fisheries Law Enforcement Conference and the National Fisheries Compliance Committee. The study was well received and many organisations expressed an interest in collecting similar data in their fisheries. There may exist impediments to other Australian states adopting similar measurement and reporting systems, however, since the current project involved significant financial contributions from both the FRDC and the Department of Fisheries. In Western Australia it has been judged that improvements achieved in the rock lobster enforcement program as a result of this project far outweigh the expense, and the Department of Fisheries has identified enforcement data collection and compliance evaluation as important continuing component of the overall enforcement program.

8.3 Further Development In Compliance Evaluation

An FRDC project to extend upon the work presented in this study is currently underway in Western Australia. The hub of the new project centres on a data recording system designed for use by Fisheries Officers to record contact and offence rates across all compliance activities in all commercial and recreational fisheries. Contacts will be recorded for a range of activities, including general land- and sea-based patrols, processor inspections, aerial surveillance, wholesale/retail inspections, and roadside checkpoints. This information will be available for all patrol-based work (including educational activities) at a number of spatial scales. A range of offence categories are also recorded, and it is intended that the system will integrate with more detailed information held in the Department of Fisheries prosecutions system. More detailed information is collected for commercial vessel checks, including fishery-specific licence, gear and catch checks.

An essential objective of the new project is that measures of enforcement and compliance rates should be recorded in a consistent way throughout the state. Since Fisheries Officers will be responsible for recording enforcement information, it is important to encourage accurate and timely data recording. To this end, ownership of the data by Officers is being encouraged by developing database reporting mechanisms that will assist Fisheries Officers in their day-to-day inspection activities, including mechanisms for alerting enforcement personnel to changes in compliant behaviour. Additionally, a detailed procedures manual on how to correctly record data will be produced, and training sessions with Fisheries Officers will be conducted.

Worldwide, most enforcement evaluation studies have focused on econometric, largely theoretical analyses. While it is increasingly accepted that purely economic approaches are often not able to adequately describe enforcement/compliance relationships, incorporating economic data into models of enforcement-compliance relationships nevertheless remains an important area to be addressed in analyses of western rock lobster enforcement program.

It is desirable that further attitudinal surveys be conducted in 3-5 years in order to identify changes in fisher attitudes toward rules and emerging compliance issues in the fishery.

8.4 Planned Outcomes

Analyses of factory data provide a range of information now regularly used in management of the enforcement program, including: i) inspection levels are adjusted regionally through time in response to changing conditions in the fishery and predicted levels of catch; ii) fishers who habitually infringe regulations are tracked, and targeting occurs based on consignment history; iii) total levels of illegal catch consigned to processing factories are estimated; iv) compliance rates for individual factories are monitored. Analyses concerning individual fishers and/or processing factories are presented to enforcement managers and Fisheries Officers on a periodic basis, and summary information (not identifying individual fishing entities) is presented to RLIAC and fishers on an annual tour of the fishery.

Attitudinal surveys of fishery participants have allowed managers and enforcement staff to identify several areas of concern held by recreational and commercial fishers. Through continuing consultation with resource users (eg. through risk assessment processes) strategies are developed to address compliance issues in the fishery. An important outcome to arise from these surveys is that the Department has taken conscious steps to increase the awareness amongst fishery participants about the nature and extent of the enforcement program; many perceived shortcomings in the enforcement program related by survey participants were in fact just that – perceptions – and did not accord with the range of activities undertaken or observed compliance rates. This information has been presented to fishery stakeholders during annual presentations undertaken by the Department of Fisheries and RLIAC.

Overall, the project has been of benefit to industry in that the Department now has the capacity to assess the cost-effectiveness of the enforcement program, and to the community through improved education of fishers and higher compliance with fishery rules. Results have also been of benefit to interstate agencies (who have been involved through national workshops), in that the project has demonstrated that careful collection of enforcement and compliance related data can be used to provide sound information on which to base decisions regarding enforcement service delivery.

8.5 Conclusion

This study has demonstrated that routine measures of enforcement activity show compliance in the western rock lobster fishery is high, and that only a minority of fishers regularly engage in illegal activity. To some extent, high compliance in the fishery can be attributed to the prominent role fishers play in the management process, and in the pride many fishers take in the "clean and green" status of their industry. Involving industry in compliance risk assessment processes, along with appropriate and timely analysis of enforcement-related data, helps to ensure that the enforcement program is highly geared toward those illegal activities posing the greatest risk to the continued sustainability of the fishery.

Systematic data collection in rock lobster processing factories provides standardised measures of enforcement effort and compliance. These data are vessel and factory specific, and differentiated with respect to targeted and random inspections. Analyses provide Fisheries Officers and managers with a range of information to assist optimise enforcement activities, and this work has become an integral and continuing part of the rock lobster enforcement program. Estimates of non-compliance are presented on an ongoing basis to enforcement staff in order to plan the distribution of enforcement effort, and to assist target those fishers habitually infringing regulations. Aggregated results are presented annually to industry, and these are eagerly anticipated each year. Key results indicate that commercial compliance with catch-related rules is exceptional, with only 1.1-2.4 illegal lobsters detected in every 1,000 animals checked. In the 2000/2001 season, total illegal catch consigned to processors was estimated in the range 16.3-16.9 tonnes; compared to a total catch of 11,273 tonnes this only accounts for 0.15% of the total landed catch.

Experimental manipulations of enforcement effort in processing factories have provided interesting insights into the relationship between levels of enforcement and consequent changes in compliance. Experiments indicated that non-compliance rates are inversely proportional to levels of inspection effort, a result that has allowed industry and enforcement staff to have informed debates about appropriate levels factory inspections for the fishery. Further work in this area is required, but results to date present a reasonable basis for discussion between government and industry about required levels of enforcement to achieve acceptable levels of compliance.

Attitudinal surveys of commercial and recreational fishers have provided information on motivations for non-compliance, and fisher perceptions about the legitimacy of rules and the deterrence effect of enforcement. Results for both surveys were highly instructive in gaining a broad understanding of how each sector views particular problems in the fishery, and in particular how each sector views the other. The latter may prove useful in future cross-sectoral discussions relating to resource shares.

Generally, results indicate that respondents from both sectors believe that a majority of fishers comply with rules, but that for most rules a small number of individuals are non-compliant. While support for fishery rules was high among most commercial respondents, a small number were unhappy with the formulation of several fishing regulations. Many commercial fishers nominated monetary gain as the primary reason for fishers breaking rules, although small numbers of respondents also thought competition between fishers and financial hardship were strong motivating factors. Information from the surveys has prompted the Department of Fisheries to increase the level of feedback to the fishing community about the activities and successes of the enforcement program, and about estimated levels of compliance.

Experimentation to examine specific compliance issues has played an important role in the current study, and such approaches are likely to be increasingly valuable in relation to rule breaches that are difficult to prove by conventional investigative techniques. Biological sampling was able to determine the relative abundance of illegal and legal animals available for capture on the fishing grounds, allowing identification of fishers whose catch was unlikely to have arisen from legitimate fishing practices. These experiments were successful in identifying fishers suspected of breaking regulations and, subject to further refinements, may in future contribute important supporting evidence in cases of prosecution.

My final concluding remark relates to the general principal of using data to plan effective management strategies. Due to the difficult nature of collecting and interpreting enforcement-compliance related data, many fisheries agencies relegate such exercises to the "too hard basket", or collect only rudimentary information in order to satisfy fishing industry requests for increased transparency in compliance spending. Results from the present study indicate there are many benefits and efficiencies to be gained from adopting a data-rich, evidence-based approach to managing compliance programs, and I would encourage national fisheries agencies to think seriously about the ideas and methods in this report. Perhaps the proof of the approach should rest with my harshest critics – Fisheries Officers. When commencing the study there was considerable resistance by Officers to collecting information and adopting data-based approaches to managing enforcement activities. Over time, however, Officers have developed a reliance on data to assist their own day-to-day enforcement activities, and slowly but surely this mild resistance is turning into active support.

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Appendix 1 – Intellectual Property

The data will be published in scientific journals in due course and in that respect remains the intellectual property of those who have participated in its collection and analysis. There is no information of a commercially sensitive nature, although for confidentiality reasons certain information relating to individual fishers or processing factories has been withheld. This confidential information is contained in Appendix 5, and will not be released for distribution outside of the Department of Fisheries WA enforcement services.

Appendix 2 - Staff

Mr J.P. McKinlay	Research Scientist	100% #
Ms E. Stewart	Technical Officer	30% #
Ms S. Anderson	Technical Officer	10% #
Mr R. Humphreys	Database Programmer	10% #
Dr N. Caputi	Research Supervisor	5% *
Mr J. Looby	Compliance Manager	5% *
Dr B. Jones	Principal Research Scientist	5% *
Dr R. Melville-Smith	Principal Research Scientist	5% *
Mr N. Sarti	Compliance Manager	5% *
Ms A. Kidd	Technical Officer	5% *
Various (10-20)	Fisheries Officers	5% *

* Trained staff who assisted with the project using non-FRDC funds.

Staff employed for parts of the project under FRDC funding.

Appendix 3 – Commercial Survey Questionnaire

FISHERIES
WESTERN AUSTRALIA

4th November 1999

Dear Commercial Fisher,

The Research Division of Fisheries WA is undertaking a research project examining compliance and enforcement in the rock lobster industry. The idea behind this project is to try to determine how the enforcement strategy for the fishery can be improved. This is important for two reasons: i) Compliance with fishery rules is important to ensure the long-term viability of the industry; and, ii) Enforcement is expensive, and the research may provide information to optimise (or even reduce) the amount of money spent on enforcement.

As part of the research, I am assessing enforcement operations in both the commercial and recreational sectors of the fishery. I recently conducted a survey of 4000 recreational fishers to obtain their views on enforcement, their understanding of fishery rules, and their perceptions about illegal activity. It is most important that the commercial side of the story is also presented, and that's where I need your help.

The enclosed survey asks questions about a range of issues important to you, and important to effective policing of the fishery. I have compiled these questions with the help of a number of experienced fishermen, and you should find most of the questions relevant to your fishing. As an example, you will be asked the following kinds of questions: How much do you think fines should be? Should there be restrictions on the start-times for pulling pots? Do you think there are enough compliance inspections at sea?

I have tried to make the survey as simple and short as possible, but unfortunately, the rock lobster fishery is very valuable, and so has a complex set of rules to ensure it is not over-fished. If you are having trouble filling in the survey, please ask a family member or friend to help you fill it in. ***Please contact either myself on 9246 8440 or Emily Stewart on 9246 8481, to answer any questions you may have regarding this survey.***

The information you supply will be treated as highly confidential

The answers and comments you provide us will remain strictly confidential. To ensure your privacy, you are not asked to supply your name or address, and results will only be released for publication such that no individual fisher can be identified by the information they have provided (as guaranteed by the *Fish Resources Management Act, 1994*). The survey forms are not marked or numbered in any way. All returned questionnaires will remain the property of the Research Division of Fisheries WA, and will not be supplied to enforcement personnel at any stage.

This survey gives you an opportunity to have a direct say about enforcement practices and regulations in the rock lobster fishery. Please take this opportunity to let us know what you think.

Yours sincerely

John McKinlay
Research Scientist

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Fish for the future

FISHERIES
WESTERN AUSTRALIA

Commercial Rock Lobster Fishing Survey 1999

Please note that all information supplied will be treated as strictly confidential

Please complete and return (free postage) to:
W.A. Marine Research Laboratories PO Box 20, North Beach, 6020
Enquiries: (08) 9246 8461 or (08) 9246 8440

How to complete this survey:

⇒ Most questions ask you to circle a single answer which best reflects your response - these have the words "(circle one)" after the question

⇒ Some questions require you to circle more than one answer if appropriate - these have the words "(circle more than 1 answer if appropriate)" after the question

⇒ Some questions require you to write in your answer - these usually have "(please specify)" written after the question

⇒ If you make a mistake place an "X" through the error and recircle or rewrite your desired response.

⇒ There are no right or wrong answers. We ask that you provide answers that truly reflect your beliefs about the issue the question asks.

⇒ **Your responses will be treated in the strictest confidence.** Only aggregated results will be published and no respondent will be identified from the research.

If you have an interest in more than one vessel fishing in the rock lobster fishery, please complete the survey for the vessel in which you hold the largest interest. In the event that you are the sole owner of 2 or more fishing operations, complete the survey for the larger of the fishing operations (eg the one fishing the most pots).

ALL FISHING QUESTIONS APPLY TO THE 1998/1999 ROCK LOBSTER SEASON

1. How many years have you been involved in the rock lobster fishery? __________

2. What is **length** of your boat? ____________ metres

3. What is the **main language** spoken at home? ______

4. What is your **country** of birth? ______________

5. Does your family have a **tradition** in the rock lobster fishery? (circle one) Yes No
If you answered yes, how many years? ____________

6. How many **crew** (including the skipper) worked your boat in the 1998/1999 season? _____

7. In the 1998/1999 season, were you the: (circle one)
a) Licence-holder (or stake-holder) and skipper
b) Licence-holder but not skipper
c) Lease-holder and skipper
d) Employed skipper (neither a lease-holder nor a licence-holder)
e) Crew
f) Other (please specify) _____ ______________

8. If you work as part of the crew, how are you paid for your work: (circle one)
a) Flat rate of pay (hourly or daily)
b) Paid as a proportion of the value of the catch
c) Paid a flat rate + a proportion of the value of the catch
d) Other (please specify): _____ ______________
e) Not part of the crew

9. What is the **full pot entitlement** (excluding the 18% reduction) of your fishing boat? (tick one)
☐ 60-69 ☐ 110-119
☐ 70-79 ☐ 120-129
☐ 80-89 ☐ 130-139
☐ 90-99 ☐ 140-149
☐ 100-109 ☐ 150-159

10. Do you lease pots from any other fishing operations as investments? (circle one)
Yes No
If you answered yes, how many pots? _______

11. What percentage of your gross **income** comes from fishing?
a) 0-20%
b) 21-40%
c) 41-60%
d) 61-80%
e) 81-100%

12. What **zone** is your vessel licenced to fish? (circle one)
a) Zone A
b) Zone B
c) Zone C

13. Please list the 3 **main landing points** where you unload rock lobster during the fishing season.
Main point: __________
2nd Point: ___________
3rd Point: ___________

14. Have you ever called the Fishwatch 1800 phone number to report **illegal recreational fishing activity**? (circle one)
Yes No

15. Have you ever called the Fishwatch 1800 phone number to report **illegal commercial fishing activity**? (circle one)
Yes No

16. Consider a fisher who is to have their licence suspended for an overpotting offence. What do you consider the minimum number of extra pots that warrants a suspension, and for what period?
______ pots
______ months suspension

1

17. In your experience, do **Fisheries Officers** deal with similar infringements and offences in a consistent manner? As far as you know, do they treat people:(circle one)
a) Always consistently
b) Usually consistently
c) Often inconsistently
d) Don't know, no contact with Fisheries Officers

18. In your experience, when different people are prosecuted for similar offences, do you think the **legal system** deals with them in a consistent manner? As far as you know, does the legal system treat people: (circle one)
a) Always consistently
b) Usually consistently
c) Often inconsistently
d) Don't know, no contact with the legal process

19. In your usual fishing area, what percentage of factory consignments of rock lobster do you think would contain undersized lobster? (circle one)
a) 0-5%
b) 5-10%
c) 10-20%
d) 20-30%
e) More than 30%
f) If you answered e), please write percentage _ _ _ _ _ _ _ _

20. Consider a fisher trading in **illegal lobster** in your usual fishing area (eg black market sales of undersize or setose lobsters). What chance does a Fisheries Officer have of detecting the activity? (circle one)
a) Very low chance of detection
b) Low chance of detection
c) Good chance of detection
d) High chance of detection
e) Don't know

21. Consider the following statement: "**Commercial** rock lobster fishers generally abide by fisheries regulations". Do you: (circle one)
a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

22. Consider the following statement: "**Recreational** rock lobster fishers generally abide by fisheries regulations". Do you: (circle one)
a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

23. If you saw a **commercial** rock lobster fisher breaking fishing regulations, would you report their actions to Fisheries staff? (circle one)
a) Yes, depending on who it was
b) Yes, depending on the offence
c) Yes, irrespective of who or what offence
d) No. If "No", why not? _ _ _ _
_ _ _ _ _ _ _ _ _ _ _ _
_ _ _ _ _ _ _ _ _ _ _ _
_ _ _ _ _ _ _ _ _ _ _ _

24. Please indicate the number of times your **vessel/gear** was **inspected** by Fisheries Officers last season: (circle one, but if greater than 2 inspections please write number)
a) None
b) Inspected once
c) Inspected twice
d) Inspected more than twice (please specify) _ _ _ _
e) Don't know

25. Please indicate the number of times your **vessel/gear has been inspected** by Fisheries Officers in the last 5 years: (circle one, but if greater than 2 inspections please write number)
a) None
b) Inspected once
c) Inspected twice
d) Inspected more than twice (please specify) _ _ _ _
e) Don't know

26. For serious fishery offences, the Executive Director of Fisheries WA may cancel, suspend or refuse to renew boat and fishing licences. For each of the following offences, indicate whether you think a convicted fisher's licence should be suspended and for what length of time, and the fines you think a court **would** and **should** impose on that fisher:

Type of offence	**Frequency of offence**	**Cancel/ suspend licence?** Yes	No	**If Yes: Length of suspension**	**What size fine do you think a <u>court</u> would impose? ($)**	**If it were up to <u>you</u>, what size fine would you impose? ($)**
Possession/consigning 50 totally protected fish	1st offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
	2nd offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
Possession/consigning 100 totally protected fish	1st offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
	2nd offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
Gear interference (cutting floats or drowning pots)	1st offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
	2nd offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
Poaching lobster from another fisher's pots	1st offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
	2nd offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
Using more pots than licenced to fish (over-potting by 4 pots)	1st offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
	2nd offence	☐	☐	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _

27. Do you think that current **penalties for illegal rock lobster fishing** are generally: (circle one)

a) Too harsh
b) About right
c) Not harsh enough
d) Don't know

28. How do you think **recreational rock lobster fishers** should be able to catch lobster: (tick more than 1 answer if appropriate)

- Free-diving ☐
- SCUBA ☐
- Pots ☐
- Hookah ☐
- Spear ☐
- Loops ☐
- Shepherd's crook ☐
- Other (please specify) _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

29. If you see a **recreational** fisher breaking the rules, what do you do? (circle more than 1 answer if appropriate)

a) Do nothing about it
b) Report the illegal activity to Fisheries WA
c) Talk to the person directly
d) Tell other fishers about what you witnessed
e) Don't know
f) Other (please specify) _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

30. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who trade (sell or barter) in **oversized female lobster**? Would they think the practice is: (circle one)

a) Very wrong
b) Basically wrong, but OK if it's not too many
c) Fine if you can get away with it
d) Not sure

31. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who trade in **undersized lobster**? Would they think the practice is: (circle one)

a) Very wrong
b) Not sure
c) Fine so long as it's not too many
d) Fine if you can get away with it
e) Basically wrong, but OK depending on circumstances

32. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who interfere with **other fishers' pots**? Would they think the practice is: (circle one)

a) Very wrong
b) Fine if you can get away with it
c) Not sure
d) Basically wrong, but OK depending on circumstances

If you answered d), in what circumstances is it OK? _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _

33. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who fish with **more than their pot entitlement** (overpot)? Would they think the practice is: (circle one)

a) Very wrong
b) Basically wrong, but OK provided it's only a few pots
c) Fine if you can get away with it
d) Not sure

34. Among commercial rock lobster fishers you know, how would you describe their attitude toward fishers who trade (sell or barter) in **setose lobster**? Would they think the practice is: (circle one)

a) Very wrong
b) Basically wrong, but OK if it's not too many
c) Not sure
d) Fine if you can get away with it

35. Consider the statement: "You are likely to be caught by Fisheries Officers if you occasionally include a small number of illegal animals in a factory consignment of catch". Do you: (circle one)

a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

36. Fishers tell us that the following issues are considered important in the commercial rock lobster fishery. Please number these according to the priority you think Fisheries Officers should give each issue (1 for highest priority, 10 for lowest priority - **please use each number only once**)

Issue	**Number**
Education of commercial fishers about fishing regulations	
Commercial fishers trading in undersize lobsters	
Illegal pot-pulling of commercial pots by recreational fishers	
Commercial fishers trading in oversize female lobster	
Commercial fishers using more pots than their entitlement	
Recreational divers poaching rock lobster from pots	
Commercial fishers trading in mature female lobster (setose, berried)	
Enforcing recreational fisher bag limits	
Commercial fishers poaching lobster from other commercial fishers pots	
Commercial fishers interfering with other commercial fishers' pots (eg dragging away from their fishing grounds, cutting floats, etc.)	

37. Are there any issues you feel are important which were not listed in Q36? _

38. Consider the **maximum legal size rules for female western rock lobster.**
Do you think: (circle one)
a) Maximum size should be larger
b) Maximum size is about right
c) Maximum size should be smaller
d) Shouldn't be a maximum limit at all
e) Don't know

39. Consider the rules restricting the **start-times for pulling lobster pots.**
Do you think: (circle one)
a) Start-times are OK
b) Start-times should be earlier
c) Start-times should be later
d) Shouldn't be a restriction on start-times
e) Start time should be restricted to daylight hours
f) Don't know

40. In your experience, what percentage of **recreational fishers** do you think illegally take lobsters from **commercial fishers' pots**? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%, write percentage: _ _ _ _ _ _ _
f) Don't know

41. In your experience, what percentage of **recreational fishers** do you think **interfere** with **commercial fishers' pots (move or cut floats)**? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%, write percentage: _ _ _ _ _ _ _
f) Don't know

42. In your experience, what percentage of **recreational fishers** do you think regularly **sell or barter** some or all of their catch? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%, write percentage: _ _ _ _ _ _ _
f) Don't know

43. Consider the **minimum legal size rules** for western rock lobster
(77 mm 15 Nov-31 Jan; 76 mm 1 Feb-30 Jun).
Do you think: (circle one)
a) Minimum size should be larger
b) Minimum size is about right
c) Minimum size should be smaller
d) Shouldn't be a minimum limit at all
e) Should make the minimum limit 76 mm all season
f) Should make the minimum limit 77 mm all season
g) Don't know

44. In your experience, what percentage of **commercial fishers** do you think illegally **take** lobsters from **recreational fishers' pots?** (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%, write percentage: _ _ _ _ _ _ _
f) Don't know

45. In your experience, what percentage of **commercial fishers** do you think **interfere** with **recreational fishers' pots** (move or cut floats)? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%,write percentage: _ _ _ _ _ _ _
f) Don't know

46. In your experience, what percentage of **commercial fishers** do you think illegally **take** lobsters from other **commercial fishers' pots?** (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%, write percentage: _ _ _ _ _ _ _
f) Don't know

47. In your experience, what percentage of **commercial fishers** do you think **interfere** with **commercial fishers' pots** (move or cut floats)? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) If more than 10%, write percentage: _ _ _ _ _ _ _
f) Don't know

48. What **evidence** have you seen of **illegal pot pulling** among **commercial** rock lobster fishers?
(circle more than 1 answer if appropriate)
a) None
b) Have heard rumours it occurs (reliability of information unknown)
c) Have heard rumours it occurs (very reliable information)
d) Occasionally witnessed it
e) Regularly witnessed it occurring

49. What evidence have you seen of **illegal pot pulling** among **recreational** rock lobster fishers?
(circle more than 1 answer if appropriate)
a) None
b) Have heard rumours it occurs (reliability of information unknown)
c) Have heard rumours it occurs (very reliable information)
d) Occasionally witnessed it
e) Regularly witnessed it occurring

50. If you see a **commercial** fisher breaking the rules, what do you do?
(circle more than 1 answer if appropriate)
a) Do nothing about it
b) Report the illegal activity to Fisheries WA
c) Talk to the person directly
d) Tell other fishers about what you witnessed
e) Don't know
f) Other (please specify) _ _ _ _ _
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
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_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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51. Some fishers claim that they are **unwilling to report the illegal behaviour** of other commercial fishers because they may be harassed or victimised (eg. gear interference, or physical violence). Do you think: (circle one)

a) This is often a real danger if reporting illegal activity
b) This is occasionally a danger, depending on the people involved
c) This is rarely a concern when reporting illegal activity
d) I don't report illegal activity, so this is never a concern
e) I would report illegal activity, the risk doesn't concern me
f) Don't know

52. What do you think about the amount of **compliance inspections** Fisheries Officers carry out **at sea** (eg. gear checks and pot counts)? Do you think: (circle one)

a) There are too many at-sea inspections
b) There are about the right number of at-sea inspections
c) There are too few at-sea inspections
d) Don't know

Comment: ______________________
____
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53. What do you think about the amount of **compliance inspections in processing factories** that Fisheries Officers carry out (eg checking for totally protected animals)? Do you think: (circle one)

a) Should increase the number of factory inspections
b) The amount of factory inspections is about right
c) Should decrease the number of factory inspections
d) Don't know

Comment: ______________________
____
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____

54. What do you think about the amount of **compliance inspections in retail outlets** that Fisheries Officers carry out (eg checking restaurants for totally protected animals)? Do you think: (circle one)

a) Should increase the number of retail inspections
b) The amount of retail inspections is about right
c) Should decrease the number of retail inspections
d) Don't know

Comment: ______________________
____
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55. Do you think Fisheries Officers spend enough time investigating allegations of fishers **interfering with fishing gear** (eg dragging gear or cutting floats)? (circle one)

a) Should increase the time spent investigating gear interference
b) The amount of time spent investigating gear interference is about right
c) Should decrease the time spent investigating gear interference
d) Don't know

Comment: ______________________
____
____
____

56. Consider the statement: "The overall **enforcement program** in the western rock lobster fishery is **better than it was 5 years ago**". Do you: (circle one)

a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

Comment: ______________________
____
____
____

57. Consider the statement: "Overall, **compliance with fisheries regulations** in the western rock lobster fishery **is better than it was 5 years ago**". Do you: (circle one)

a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

Comment: ______________________
____
____
____

58. In your experience, what is the main reason you think fishers break fishing regulations? (circle one)

a) Fishers do not know the fisheries regulations
b) Fishers do not believe in the fisheries regulations
c) Fishers believe in the rules, but are willing to break them for personal gain
d) There is an existing culture of non-compliance with regulations
e) Fishers are suffering financial hardship
f) Competition between fishers
g) Other (please specify) ______________________
____
____
____
____

339

59. Please consider each of the following activities relating to illegal rock lobster fishing. For each line of the table, indicate your assessment of the activity's impact on sustainability of the fishery, it's prevalence among fishers, and the probability of a fisher being apprehended if they engage in the activity.

	Activity	Impact on sustainability: How would you rate the impact of the following activities on the sustainability of the fishery? (tick one)					Prevalence among fishers: What percent of lobster fishers from your fishing area do you think would engage in the activity?		Probability of detection: What do you think is the probability of a fisher being caught by Fisheries Officers if they regularly undertake the following activities? (tick one)				
		No Impact	Low Impact	Medium Impact	High Impact	Don't Know	Percent %	Don't Know	None	Low	Medium	High	Don't Know
	General Activity												
a	Fishing in closed areas	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
b	Stretching lobsters to fit gauges	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
c	Keeping 76's in holding pots prior to the change of min. size	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
d	Removing setae (hairs) from setose rock lobster	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
e	Keeping oversize female lobster	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
f	Failure to immediately return protected animals to the water after each pot-pull	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
g	Commercial fishers (other than rock lobster fishers) diving for lobster	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
	Commercial Activity												
h	Under-reporting catch in fishing returns	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
i	Commercial fishers trading in undersized rock lobster	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
j	Supplementing crews pay by allowing crew to take home illegal lobster	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
k	Commercial fishers taking home protected rock lobster for personal consumption.	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
l	Commercial fishers trading in mature female (setose or berried) rock lobster.	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
m	Commercial fishers poaching lobster from other commercial fishers' pots	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
n	Commercial fishers poaching lobster from recreational fishers' pots	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
o	Overpotting by commercial fishers	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐

340

	Activity	Impact on sustainability					Prevalence among fishers		Probability of detection				
		How would you rate the impact of the following activities on the sustainability of the fishery? (tick one)					What percent of lobster fishers from your fishing area do you think would engage in the activity?		What do you think is the probability of a fisher being caught by Fisheries Officers if they regularly undertake the following activities? (tick one)				
		No Impact	Low Impact	Medium Impact	High Impact	Don't Know	Percent %	Don't Know	None	Low	Medium	High	Don't Know
	Recreational Activity												
p	Pot poaching by recreational divers	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
q	Recreational fishers poaching lobster from commercial fishers' pots	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
r	Overpotting by recreational fishers	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
s	Recreational fishers keeping undersized rock lobster	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
t	Black market sales of rock lobster by amateur fishers	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐
u	Recreational fishers interfering with commercial fishers' gear.	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐

Comments on Question 59 ....

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General comments ....

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8c. Please indicate which **fishers' organisations** you are a member (tick more than 1 if appropriate):

- ☐ Central West Coast Professional Fishermans Association
- ☐ Dongara Professional Fishermen's Association
- ☐ Fremantle Professional Fishermans Association Inc.
- ☐ Kalbarri Professional Fishermans Association Inc.
- ☐ Geraldton Professional Fishermen's Association Inc.
- ☐ Leeman Professional Fishermen's Association
- ☐ Leeuwin Professional Fishermen's Association
- ☐ Seabird & Ledge Point PFA
- ☐ South West Licenced Fishermens Association
- ☐ SW Coast Professional Rock Lobster & Wet Fishermen's Association
- ☐ Two Rocks Central C Zone Association
- ☐ United Midwest Fishers Association
- ☐ WA Fishing Industry Council
- ☐ WA Fishing Industry Women's Association
- ☐ WAFIC Rock Lobster Sub-Committee
- ☐ WARL Fishermen's Federation
- ☐ Zone C Professional Fishermen's Association
- ☐ Other, please write: ______________________________

Fold First ↑ ←Tape Tape→

Postage is Paid

Fold the form along the 2 fold lines to <u>show the return address</u>.
Use the tape provided above to secure the survey then mail it.
Thank you for taking the time to participate in this survey

Fold Second ↓

No stamp required if posted in Australia

Delivery Address:
PO Box 20
NORTH BEACH WA 6920
Rock Lobster Research

Marine Research Laboratories
Fisheries Department WA
Reply Paid 20
NORTH BEACH WA 6920

Appendix 4 – Recreational Survey Questionnaire

FISHERIES
WESTERN AUSTRALIA

Recreational Rock Lobster Fishing Survey: 1998/99 Season

Participating in this survey will put you in the running to win one of three cash prizes:
1st prize $500, 2nd prize $200, 3rd prize $100

Please complete and return (**free postage**) to:
W.A. Marine Research Laboratories
PO Box 20, North Beach, 6020
Enquires: (08) 9246 8482 or (08) 9246 8444

Please note that all information supplied will be treated as strictly confidential

1. **Contact details** in case we need to verify any information you provide. We will also contact you if you win a prize.

Name: ______________________ *Ph:* __________
Home address: ______________________________
______________________ *Postcode:* __________

2. How are you **licensed** to fish for rock lobster? (tick one)
☐ Rock lobster licence only
☐ Umbrella licence (all recreational fisheries)

3. What is your **age**? _____

4. What is your **gender**? Male ☐ Female ☐

5. What is the **main language** spoken at home?
____

6. What is your highest level of **education**? (circle one)
a) Below Year 12
b) Year 12
c) Apprenticeship or TAFE certificate
d) Tertiary

7. **Did you fish** for rock lobster between 15 November 1998 and 30 June 1999? (tick Yes or No).

YES ☐ If you answered Yes, please **go to question 8**, complete this survey, and return it to us.

NO ☐ If you answered No, please **skip ahead to Q21**, complete the survey, and return the form to us.

All the questions refer to you as a single licence holder - please fill out one form for one licence.

8. What **methods** did you use to fish for rock lobsters last season? (please tick)
Pots ☐
Diving ☐
Other ☐
If Other, please describe:
____

9. Please indicate **the approximate number of days** you fished for rock lobster in each month using the following methods:

	Pots	Diving	Other
Nov '98	___	___	___
Dec '98	___	___	___
Jan '99	___	___	___
Feb '99	___	___	___
Mar '99	___	___	___
Apr '99	___	___	___
May '99	___	___	___
Jun '99	___	___	___

10. **Where** did you do most of your fishing? (list locality or town with [1] being the most often fished). Please note the number of days fished using each method.

[1] Town/Locality ____________ Postcode ____ (if known)
Number of days fished at locality:
Pots ____ Diving ____ Other ____

[2] Town/Locality ____________ Postcode ____ (if known)
Number of days fished at locality:
Pots ____ Diving ____ Other ____

[3] Town/Locality ____________ Postcode ____ (if known)
Number of days fished at locality:
Pots ____ Diving ____ Other ____

11. If you used pots, **how many lobster pots** did you typically pull each day you went fishing? ________

12. **When** did you do most of your fishing for rock lobster? (tick more than one if appropriate)
Weekends ☐
Weekdays ☐
School Holidays ☐
Annual Holidays ☐

13. What was the **total number of legal size western rock lobster** you caught during the season? (your best estimate)
By using pots _____
By diving _____
By other methods _____

14. Please indicate the **number** of legal size **tropical** (green/painted) or **southern** rock lobster caught during the season:

Lobster	Pots	Diving	Other
Tropical	___	___	___
Southern	___	___	___

15. Do you own (or have regular access to) a **boat?** (tick one)
Yes ☐ Go to Q16
No ☐ Skip to Q18

16. What is the **length of the boat** in metres? ______ m

17. Please tick the equipment you used: (tick more than one if appropriate)
- B/W Echo Sounder ☐
- Colour Echo Sounder ☐
- View Bucket ☐
- Radar ☐
- Pot Winch ☐
- GPS ☐
- None of the above ☐

18. In what **depth range** did you **dive** for rock lobster last season?

Depth	Percentage of Time Diving
0-10 m	_____
11-20 m	_____
21-30 m	_____
Below 30 m	_____
Didn't dive	☐

19. In what **depth range** did you fish for rock lobster using **pots** last season?

Depth	Percentage of Time Potting
0-10 m	_____
11-20 m	_____
21-30 m	_____
Below 30 m	_____
Didn't pot fish	☐

20. Please tick the **type(s) of pots** you used when fishing for lobster last season: (tick more than one if appropriate)
- Stick/cane beehive ☐
- Batten pots ☐
- Plastic pots ☐
- Don't use pots ☐
- Other ____________ (please specify)

21. For **how many years** have you participated in the recreational rock lobster fishery? _____

22. Consider the following statement: "Fisheries management is effective in conserving rock lobster stocks". Do you: (circle one answer only)
a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

23. In your experience, how fair do you think fisheries officers are in dealing with infringements that they find. As far as you know, do they treat people: (circle one)
a) Always fairly
b) Sometimes fairly
c) Never fairly
d) Don't know, no contact with fisheries officers.

24. Consider the following statement: "**Recreational** rock lobster fishers generally abide by fisheries regulations". Do you: (circle one answer only)
a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

25. Please indicate the **number of contacts** you had with fisheries personnel while fishing for rock lobster in the last season: (circle one, but if greater than 1 contact please write number)

i) Fisheries officers:
a) None
b) Seen only
c) 1 contact
d) More than 1 contact _____
e) Did not fish last season

ii) Volunteer fisheries liaison officers (VFLO's):
a) None
b) Seen only
c) 1 contact
d) More than 1 contact _____
e) Did not fish last season

[Note: VFLO's are recreational fishers who donate their time to educate other fishers about conservation and fish management. They usually wear distinctive yellow shirts and hats].

26. How many times in total (over all your fishing years) have you come into contact with a fisheries officer (not a VFLO) while fishing for rock lobster? ________

27. Consider the following statement: "**Commercial** rock lobster fishers generally abide by fisheries regulations". Do you: (circle one answer only)
a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

28. The current **pot limit** is 2 for recreational fishers. Do you think this number is: (circle one)
a) Too low
b) About right
c) Too high
d) Don't know

29. The current **bag limit** is 8 lobsters per day for recreational fishers. Do you think this number is: (circle one)
a) Too low
b) About right
c) Too high
d) Don't know

30. In your experience, what percentage **of recreational fishers** do you think **regularly sell** some or all of their **catch?** (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) More than 10%
f) Don't know

31. In your experience, what percentage of **recreational** fishers do you think **illegally pull other recreational** fishers' pots? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) More than 10%
f) Don't know

32. In your experience, what percentage of **recreational** fishers do you think **illegally pull commercial** fishers' pots? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) More than 10%
f) Don't know

33. In your experience, what percentage of **commercial** fishers do you think **illegally pull recreational** fishers' pots? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) More than 10%
f) Don't know

34. What **evidence** have you **seen of illegal pot pulling** in the rock lobster fishery?
a) None
b) Heard rumours it occurs
c) Occasionally witnessed it
d) Regularly witnessed it

35. If you see a recreational fisher breaking the rules, what would you do? (circle one answer only):
a) Do nothing, but feel bad about it.
b) Report the illegal activity
c) Talk to the person directly
d) Ignore it
e) Don't know

36. What percentage of recreational fishers do you think illegally keep undersized lobster? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) More than 10%
f) Don't know

37. In your usual fishing area, how many times do you think you could break the size regulations without getting caught by fisheries officers?

_ _ _ _ _ _

38. What is your understanding of the minimum size rules for taking western rock lobster?
(tick more than 1 box if appropriate)
☐ 76 mm, 15 Nov-30 Jun
☐ 76 mm, 1 Feb-30 Jun
☐ 77 mm, 15 Nov-30 Jun
☐ 77 mm, 15 Nov-31 Jan
☐ Don't know

39. What percentage of days fished do you usually catch your **daily bag limit** for Western rock lobster?
(circle one)
a) less than 20%
b) 20-40%
c) 41-60%
d) 61-80%
e) More than 80%
f) Don't know

40. In your experience, what percentage of recreational fishers do you think **fish out of season**? (circle one)
a) 0%
b) 1-2%
c) 3-5%
d) 6-10%
e) More than 10%
f) Don't know

41. What size fine do you think **would be imposed** on someone convicted of being in possession of 6 undersized lobster as a first offence?
(circle one)
a) $200 to $500
b) $500 to $1000
c) $1000 to $2000
d) $2000 to $3000
e) More than $3000
f) Don't know

42. How much do think someone **should be fined** if they are caught with 6 undersized lobster (and have no previous convictions)? $ _ _ _ _ _

43. Among recreational rock lobster fishers you know, how would you describe their attitude towards fishers who keep undersized lobster? Would they think the practice is: (circle one)
a) Very wrong
b) Basically wrong, but OK every so often
c) Fine if you can get away with it
d) Don't know

44. How should recreational rock lobster fishers **be able to catch lobster**:
(tick those appropriate)
Free-diving ☐
SCUBA ☐
Pots ☐
Hookah ☐
Spear ☐
Loops ☐
Shepherd's crook ☐
Other _ _ _ _ _ _ _ _ _ _ _ _ _ _
(please specify)

45. Consider the statement: "It doesn't hurt to keep lobsters if they are just undersize". Do you: (circle one)
a) Strongly agree
b) Agree
c) Not sure
d) Disagree
e) Strongly disagree

46. Do you think **the current legal size** for western rock lobster is: (circle one)
a) Too small
b) About right
c) Too large
d) Shouldn't be a limit
e) Don't know

47. Fishers tell us that the following issues are considered important in the recreational rock lobster fishery. Please number these according to the priority Fisheries Officers should give each issue (1 for highest priority, 8 for lowest priority).

Issue	**Priority**
Divers poaching rock lobsters from pots	_ _ _
Education	_ _ _
Undersize lobsters	_ _ _
Illegal pot-pulling of recreation pots by recreational fishers	_ _ _
Oversize female lobster	_ _ _
Over-potting	_ _ _
Illegal pot-pulling of recreation pots by commercial fishers	_ _ _
Mature female lobster	_ _ _
Bag limits	_ _ _

48. Are there any issues you feel are important which were not listed in Q47?

....
....
....
....
....
....
....
....

Thankyou for taking the time to complete this survey

Comments (optional)

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Thank you for taking the time to participate in this survey.

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Rock Lobster Research
Western Australian Marine Research Laboratories
PO Box 20
NORTH BEACH WA 6020

Appendix 5 – Confidential Information Available Only To Department Of Fisheries Enforcement Personnel

This appendix contains information that could be used to identify individual fishing operators or factory processors, and will only be provided to Department of Fisheries W.A. enforcement personnel.