Economic assessment of the impact of recent major changes to fisheries management in the WA West Coast demersal wetline fishery

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1 NON TECHNICAL SUMMARY

2009/081	Economic assessment of the impact of recent major changes to fisheries management in the WA West Coast demersal wetline fishery

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OBJECTIVES:

1 Determine the change in profitability of commercial wet line vessels operating in the west coast wet line fishery under the new management arrangements for the 3 year period 2004-07 (prior to the new arrangements) and 3 year period (FY 2008-11) after their implementation.

2 Determine the range in responses of a sample of charter boat owners and their clients to the fishery management changes introduced in the west coast wet line fishery in 2009 (interim and additional) and the impact on client satisfaction and on their businesses

3 Determine the range in responses of a sample of recreational fishing boat owners to the fishery management changes introduced in the west coast wet line fishery in 2009-11 (interim and additional) and the impact on the frequency of their fishing activities in the 2008-12 period

4 Conduct a socio-economic impact assessment of the three sectors as a result of fishery management changes introduced and a scenario analysis of the likely impact of the alternative management options on 3-4 West Coast study towns with boat harbours

NON TECHNICAL SUMMARY:

OUTCOMES ACHIEVED TO DATE

1. Developed a model of recreational fisher behaviour to explain how recreational fishers could be expected to react to changes in fishing regulations.
2. Completed two surveys of recreational fishers in the 2010 and 2011 seasons to document changes in fishing behaviour as a consequence of the new fishing rules and the closed season for the West Coast Demersal fishery and compared the results obtained to those from a previous survey of recreational fishers undertaken in 2003 when no such restraints existed.
3. Analysed survey results to show how fishing trip time and satisfaction with catch and experience attributes were affected by the changes to fishing rules and provide estimates of the impact that changes in expected catch rate would have on the number of fishing trips.
4. Analysed survey data to show how the two month closed season has changed fishers' behaviour.
5. Incorporated the results from the initial 2010 survey into analysis of recreational fishing behaviour for the Western Australian Marine Science Institution (WAMSI) project on recreational fishing and presented the results at the WAMSI public forums on research outcomes.
6. Undertook direct interviews of commercial fishers, including charter boat operators in the fishery and supplemented this with analysis of log book data.
7. Documented the impact of the changes to commercial fishing rules on financial performance and presented data on the adjustments that commercial fishers had made to their operations to secure better outcomes under the new rules.
8. Estimated how recreational fishing expenditure changed as a consequence of the management changes and estimated the employment impact of the commercial sector as part of understanding potential socio economic impacts
9. Incorporated these findings into the WAMSI project and presented the results at the WAMSI public forums on research outcomes.
10. Project results have been delivered to date through a number of seminars presented at the Western Australian Department of Fisheries and at WAMSI research forums. Internationally project results have been presented at the International Institute of Fisheries Economics and Trade (IFFET) conference in 2010.

Major changes in recreational fishing regulations were introduced in the 2009-10 season for demersal Scalefish in the West Coast Bioregion. These included substantial tightening of bag limits and the introduction of a closed season from Oct 15 to Dec 2015. The two month closed season required fishers to stop fishing for designated high risk species during the period within the West Coast Bioregion. Commercial fishing changes were implemented under a management plan from January 2008 that resulted in a reduction in vessel numbers, restrictions on fishing hours and the exclusion of commercial fishers from the Metropolitan zone.

Phone surveys of recreational fishers were undertaken in April/May 2010 and in April/May to 2011 to collect data on fishing behavior over the first two seasons of the new rules. A 2003 survey of individual

fishers from the same fishery and undertaken as part of an earlier FRDC Project 2001/065 was used as the benchmark for the pre-change fishing case.

A model of recreational fisher choice is used to assess the likely reaction by fishers to tighter management rules. Put simply, within this model the fisher stays fishing until the net benefit from another hour fishing is balanced against the opportunity cost of the extra time, reflected by the value of doing non-fishing activities elsewhere. Overall the survey results and associated analysis show a high degree of conformity with the model suggesting fishers behave quite rationally in the choices they make about fishing in the presence of tighter management rules.

Consistent with the intent of the new rules, catch per trip is significantly less for the prized and high risk demersal scale fish in the 2010 survey. The number of trips per annum did not change significantly compared to 2003 but trip time reduced significantly. Total trip time, time on the water and fishing time all fell. Non-fishing time per trip increased indicating that the 2009-10 season restrictions shifted trip-based activities away from fishing.

Fishers were asked to rate their satisfaction across number of fishing and trip related dimensions on a 1 (very dissatisfied) through 5 (very satisfied) scale. Consistent with the tighter new catch limits and rules, satisfaction scores for catch, species caught, time to catch the fish and fish size are all significantly lower in the 2010 survey than in 2003 indicating a decline in the perceived net benefit from fishing consequent upon the new rules. The 2011 survey tested for further changes in satisfaction when fishers had experienced the new rules for a second season. Mean satisfaction for catch rate decreased from 3.54 to 3.11 between 2003 and 2010. It was the least satisfactory aspect of fishing. Between 2010 and 2011 it increased to 3.14 but was still the least satisfactory aspect of fishing. Satisfaction with size of fish in both 2010 and 2011 is significantly below mean satisfaction with size of fish caught in 2003 when the restrictions were not in force. Mean satisfaction with species caught and retained is 3.85 in 2010 and 3.92 in 2011. The mean satisfaction was lower in 2003 with a mean score of 3.73.

The satisfaction scores for an enjoyable time on the ocean and overall fishing experience remain high in 2011 at 4.75 and 4.61 in 2011 compared to 4.78 and 4.69 in 2010. They are actually higher in 2011 than they were in 2003. Achieving the same overall satisfaction with the fishing experience despite lower bag limits implies an increase in societal benefit derived from the resource.

These are significant findings for understanding fishers and for fisheries managers. The reduction in trip time and fishing time and the switch toward non-fishing time is consistent with the reduced catch and benefit from fishing and with the predictions of the recreational fishing model. The high satisfaction scores for an enjoyable time on the ocean and the overall fishing experience indicate that fishers have adjusted their behaviour such that overall satisfaction is not significantly reduced. This indicates a degree of positive response to the new rules, if not acceptance.

Models of recreational fisher behaviour often assume that fishers only stop fishing when bag limits are reached. The model used in this study suggests that fishers stop when it is optimal to do so which may or may not be at the bag limit. Survey questions were included to determine whether fishers stopped fishing because they were constrained by bag limits or for other reasons. In both the 2010 and 2011 surveys, only 15 per cent of fishers reported that they stopped fishing because they had reached bag limits. It was the only the fourth most significant reason given for stopping in both

surveys. More important factors were: weather, running out of time and not catching the preferred species. However, the analysis does show that more skilled fishers are statistically more likely to be stopping because they have reached the bag limit. Again this is an important result for managers. Most fishers stopped voluntarily short of the bag limit and this is consistent with the high general levels of satisfaction recorded and with the recreational fishing model in which fishers optimize benefits from a trip by adjusting trip time and fishing activity.

The tighter bag limits and two month closed season represent significant management changes. Yet in the in the 2010 survey 84 per cent of respondents indicated that their behaviour had not changed as a result of the new rules being introduced. This was still high at 80 per cent of respondents in the 2011 survey. For those changing their fishing behaviour, fishing less often was the nominated response for only 6 per cent of fishers in the 2010 survey and 11 per cent of fishers in the 2011 survey. This pattern of adjustment is consistent with the high overall satisfaction scores.

Specific closed season behaviour changes were investigated in both the 2010 and 2011 surveys. Fishers were asked how their behavior between Oct 15 and Dec 15 had changed compared to previous years. The proportion indicating changed behaviour increased from 42 percent to 54 percent across the two surveys. This result is consistent with fishers having learnt from the initial experience and with more time to plan their 2010/11 activities in the closed season, undertaking appropriate changes. Overall the effect of the closed season is that fishers cannot fish for their designated high risk species in the West Coast Bioregion during the period. Yet very few fishers (5 per cent) opted to fish outside of the bioregion. The majority of fishers simply did not make fishing trips during the closed period and majority of those cited inability to fish for the designated species as the reason for not going fishing.

Catch rate is a reflection of the biomass. Analysis of the number of fishing trips shows that catch rate and number of trips per year are related. In both the 2003 and 2010 surveys, as catch rate increases the number of trips rises but at a decreasing rate. This suggests that successful regulations that reduce effort and improve catchability and catch rate over time, will induce a positive trip response. The analysis indicates that the probability of going bottom fishing weekly and fortnightly as opposed to monthly increases with catch rate. An improvement in size and the likelihood of catching preferred species consequent on the management changes will also encourage a positive trip response.

The commercial side of the fishery consists of charter and fishing tour operators and commercial fishers. Log book analysis and face to face surveys were used to assess the impact of the recent management changes on these operators.

The focus for the charter industry analysis was active holders on Fishing Tour Operators Licences (FTOL) and Recreational Fishing Tour Operators Licences (RFTOL) and the change in their behavior and performance over the two year period 2008/09 (pre - ban) and 2009/10 (2 month ban, individual bag limit & new boat limit introduced). Five distinct changes were detailed. These were:

1. Accelerated decline of charter boat catch rates and a reduction in total charter fishing effort (down 26.5% in 2009/10).

2. Increase in catch - and -release and alternative (non-demersal) fishing activity with Samson Fish now a major focus of activity.

3. Increase in non - extractive activities including eco tours and corporate functions

4. Transfer of more effort outside West Coast Bioregion, and

5. Exit of some active Fishing Tour Operators and retirement of some inactive licences

These changes are in part are a reflection of bio- economic and socio economic trends that have been reshaping the industry for the last 10 years. Management responses such as catch-and –release fishing, targeting other species; increasing effort in Gascoyne and Pilbara/Kimberley and the retirement of part of the latent effort exit of active operators and non-renewal of licences is part of the wider adjustment process. Operators who have found ways to adapt to these trends overall have been least impacted, even benefited from recent fisheries management reforms.

For the commercial sector, the changes have reduced the number of boats and employment in West Coast Demersal Scalefish Fishery. The analysis indicates that most remaining boats and crew have experienced reduced earnings from the fishery. However, the size distribution of boats is highly skewed with the top 5 vessels (10 per cent of vessels) accounting for more than forty per cent of earnings. These top five boats have improved their performance compared to the rest. In effect the Interim Managed Fishery Status has stabilized the fleet numbers, reduced risk and uncertainty for managers and existing fishermen, and improved catch rates and earnings for the top 5 boats in West Coast Demersal Scalefish Fishery. Industry revenue has not reduced as much as might be expected given the reduction in aggregate catch and vessel numbers. Revenue loss has been around $1.2 million, from $4.8 million in 2005/07 to $3.54 million in 2010.

An analysis of recreational fishing expenditure from the survey data indicates that fishers continue to spend substantial amounts of money on fishing activities. Expenditure per trip has increased between 2003 and 2010 by an estimated 23 per cent compared to a CPI increase 25 per cent. Hence it does not appear that the changes have had a major impact on expenditure levels associated with recreational fishing.

The commercial fishing sector is relatively small. In revenue terms it was worth $4.8 million in 2005/07 and $3.54 million in 2010. Fishers do not fish every day. It is estimated that based on the days fished, number of vessels and typical employment patterns, the full time equivalent employment is only 12 persons in 2010 and had been 24 in 2005/06. Structural changes occurring in the commercial West Coast Demersal Fishery will not have a significant impact on the wider regional economy.

KEYWORDS: recreational choice, catch rates, bag limits, closed season, West Coast Demersal Scalefish,

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3 BACKGROUND

The West Coast Demersal ScaleFish Fishery contains both recreational, commercial fishers and charter boat operators. It is one of the most significant recreational fisheries in the State. Recently, several of the individual species in the fishery have been identified as being at "high risk" including the key indicator species – Dhufish, Pink Snapper and Baldchin Groper. This means that future sustainability is contingent on reducing fishing effort to allow biomass to re build. To this end, more stringent fishing restrictions have been implemented for both commercial and recreational fishers.

Currently there are around 115,000 holders of a Recreational Fishing from a Boat Licence. From a recreational fishing perspective, the demersal species are highly prized, especially the ley indicator species Pink Snapper, Dhufish, and Baldchin Groper. Previous studies have indicated a significant willingness to pay to catch these species (McLeod and Nicholls, 2004). Pink snapper and Dhufish are also highly regarded by local retail fish consumers. Based on 2010 data, some 50 vessels fish in the fishery generating commercial revenues of approximately $3.5million per annum.

There would be a considerable loss of utility for Western Australians if wild capture finfish stocks for the key target species were to collapse and the changes to regulations that have been implemented are designed to avoid this outcome. However, the restrictions on catch and the changes to arrangements for fishing, such as closed seasons and tighter bag limits for recreational fishes and no fish areas for commercial fishes, themselves will change the relative attractiveness of fishing for the demersal species.

Commencing in March 2010, all persons fishing from a powered boat anywhere in the state have been required to hold a Recreational Fishing from Boat Licence or fish in the company of a licence holder. In parallel with the introduction of the new licence system, the recreational sector has had its bag limits severely reduced. The current limits are shown in Table 1. A two month closed season was introduced between October 15th and December 15th a part of the new measures.

Since 2008 the commercial sector has been managed under the West *Coast Demersal Scalefish (Interim) Management Plan 2007*. This restricts commercial fishing to 60 Interim Managed Fishery Permit holders. Gear and other restrictions apply (in the form of maximum numbers of lines and hooks and arrangements regulating the carriage of lines and fish) and boats are monitored under the Vessel Monitoring System (VMS). A restriction on the annual hours of fishing time is imposed. Importantly as part of the new measures the maximum number of allowed fishing hours within the with the

metropolitan area has been set to zero, meaning that commercial fishing is effectively banned within the metropolitan area.

The primary management objective for the commercial sector is to maintain catches of scalefish and the suites of demersal species below 50% of those recorded in the West Coast Bioregion during2005/06. This target also applies within each management area and to the indicator species. Effectively the same target also applies to recreational fishing. The management target underlying the new recreational rules introduced during 2009/10 is the same as for the commercial sector, that is reducing the recreational take demersal scalefish in the West Coast Bioregion by at least 50 % from 2005/06 levels.

Table 1: Rules Introduced for the 2010 Season.

Seasonal Closure	Two-month demersal scale fish closure 15 October to 15 December (inclusive).
Daily bag limit	Limit of two High Risk demersal scale fish and two pelagic fish.
Boat limit	Limit of two Dhufish per boat (six for charter boats).
Fish release	Compulsory possession of a 'release weight' when fishing for demersal scale fish.
Fishing Licence	Recreational Fishing from Boat Licence from 2 March, 2010.

Given the number of participants, a key to the success of these policies is an understanding of the way recreational fishers will respond in terms of the effort (time) that they will put into fishing, adjustments they will make in terms of their fishing activities and the consequences for catch mortality and biomass. This analysis is also important for understanding how recreational fishing value is influenced by catch rules and changes in biomass.

Understanding how fishers respond to the various management options that confront them presupposes that we have an understanding of the basic drivers of fishing behaviour.

A basic model of recreational fishing behaviour is presented in section 6 that will allows the role of recreational fisher modelling in the assessment of management options for the West Coast Demersal Fishery to be better understood.

Section 7.1 establishes some benchmarks for fishers in the West Coast Demersal Fishery by going back to survey results collected prior to the recognition of stock problems and the new rules. This is followed by an analysis of the results from two recent surveys carried out during the 2009/10 season and the 20101/11 season. This allows a comparison between the previous results associated with a period prior to the introduction of recreational fishing licenses and closed seasons and fisher behavior in the two seasons subsequent to the introduction of these new arrangements.

The new management regime also impacts on commercial fishers and fishing tour operators. In particular the effective reduction of catch by 50 per cent as a result of the new measures has put pressure on their individual operations, raising questions about their viability and the potential impact on communities of any reduction in commercial and fishing tour operations. The analysis considers how the changes have impacted on the commercial fishery through an analysis of changes in fishing

activities based on face to face surveys to determine operational and financial responses to the changes.

4 NEED

The demersal fish species that form the West Coast Demersal Scalefish fishery have been overfished. As a consequence of recent stock assessments management strategies have been revised based on achieving a 50% reduction in the catches of Category 1 "high risk" species from the 2005/06 harvest levels. These targets apply to all sectors of the fishery – recreational, commercial and charter and fishing tour operators.

New management initiatives have been implemented across the commercial, recreational and charter sectors to secure the target catch reductions. On the recreational side the initiatives include a tightening of bag limits and commencing in the 2009/10 season a two month closed season. The success of these initiatives depends upon each sector responding appropriately. Size limits and requirements to carry release weights are also included in the mix. On the commercial side, conversion to a limited access fishery has occurred. Sixty permit holders have been endorsed. The metropolitan zone has been closed to commercial fishing. A restriction on hours fishing has been imposed. An assessment of the impact of these changes and the response of each sector is essential to understanding how successful the cages are likely to be as part of achieving the overall objective of maximizing the economic and social value of the fishery.

The new restrictions will impact significantly on recreational fishers. There is a need to understand how the sector responds in terms of behaviour, catches, and overall satisfaction with the fishing experience. The recreational fisher surveys that are a core element of this study will assist in meeting this requirement, so that initial impact of the operation of the new regime can be measured, and compared to the pre-change situation captured in a similar survey funded under FRDC 2001/036 and reported in McLeod and Nicholls (2004). Knowledge about changes in behaviour and satisfaction with the fishing experience are crucial to understanding the impact of the changes.

Department of Fisheries estimates show that the commercial catch has been brought within the desired range. There is now a need to assess how these changes have impacted upon the commercial viability and the implication for employment. The charter and fishing tour sector is an important part of the industry. Understanding its response to management changes is an integral part of the assessment of the impacts of the recent policy changes.

5 OBJECTIVES

1 Determine the change in profitability of commercial wet line vessels operating in the west coast wet line fishery under the new management arrangements for the 3 year period 2004-07 (prior to the new arrangements) and 3 year period (FY 2008-11) after their implementation.

2 Determine the range in responses of a sample of charter boat owners and their clients to the fishery management changes introduced in the west coast wet line fishery in 2009 (interim and additional) and the impact on client satisfaction and on their businesses

3 Determine the range in responses of a sample of recreational fishing boat owners to the fishery management changes introduced in the west coast wet line fishery in 2009-11 (interim and additional) and the impact on the frequency of their fishing activities in the 2008-12 period

4 Conduct a socio-economic impact assessment of the three sectors as a result of fishery management changes introduced and a scenario analysis of the likely impact of the alternative management options on 3-4 West Coast study towns with boat harbours.

6 METHODS

6.1 Recreational Fishers

The analysis of recreational fishing behaviour requires a framework to assess how fishers might respond to changes in regulations and data to assess whether their changed behaviours are consistent with the nominated framework. For this study the selected framework in the model of recreational fisher choice outlined in Section 6.3.

Fishers can respond to fishing regulation changes in a number of way and those responses may have a variety of impacts on their overall fishing experience. To determine how the recreational fishes in the West Coast Demersal Fishery had changed their behaviour, two telephone surveys were used, one in 2010 subsequent to the introduction of the new recreational fishing licences and two month closure in the 2009/10 fishing season and a subsequent survey in 2011 after the closure of the closed season in the 2010/11 fishing season.

For the 2010 survey, the sampling frame was the data base on recreational fishing licences at that time. This was 26,919 license holders of which 21.045 were in the West Coast Bio region and 15,623 were in the metropolitan region. A final sample of 798 completed telephone surveys was obtained spread across metropolitan area, South West, Mid West and Kalbarri proportional to the population of license holders. The survey instrument is reproduced in Appendix 6.

The two month closed season and the new bag limits had been introduced in 2010. They were effectively one year old at the time of the 2011 survey. They key issue for the 2011 survey was to determine if with 12 months experience of these binding constraints, fisher behaviour had been further modified and whether the satisfaction scores recorded in 2010 were being maintained.

The 2011 survey used the same sampling frame that had been constructed from the data base on recreational fishing licences at that time of the 2010 survey. A final sample of 650 completed telephone surveys was obtained spread across metropolitan area. Of these, 567 had trips of one day duration or less. Considerable effort had gone into the 2010 survey to contact licence holders in the non-metropolitan areas -South West, Mid West and Kalbarri proportional to the population of license holders. However, in the event sample size was too small from some areas to justify separate analysis. For the 2011 survey the focus was on the metropolitan area

A major set of questions were introduced in 2011 to accommodate feedback received from fisheries managers in relation to the 2010 results. The comparison between 2003 and 2010 had documented some important and statistically significant results. In particular, catch per trip had declined for the preferred target species and trip time trip time was lower. Satisfaction scores with key catch related

measures (number of fish, size of fish, catch rate) were lower but overall satisfaction with the overall ocean experience and fishing experience remained high, with no significant decline. Questions were added to the 2011 survey to obtain information on other activities pursued by fishers while on a fishing trip, on the grounds that fishers may be responding to the fishing constraints by substituting other non-fishing activities

6.2 Commercial Surveys

The impact on charter boats and commercial fishing was initially investigated through an analysis of catch and effort logbook returns for all commercial fishing operators for calendar 2008 and 2009 and an analysis of catch and effort logbook returns for all charter boat operators for 2008/09 and 2009/10.

This data was supplemented by an operational and financial survey of 11 active operators across the three fishing zones of the West Coast Bioregion. These data were collected on field trips to the locations in which the operators were based.

6.3 A Simple Model of Recreational Fisher Choice

In order to understand how policies such as bag limits may impact on behaviour, and to interpret the survey results relating to behaviour, we need to develop a model of the choices that recreational fishers make, and how those choices will be influenced by various policy options.

Consistent with economic theory, the individual fisher is treated as a utility maximizing consumer who makes choices based on maximizing their individual welfare subject to a budget constraint.

The key choice variables for a recreational fisher are days fished per year, fishing time per trip, retained and released catch, and size of fish kept. Of particular interest in this model of individual recreational fishing behaviour is;

- the way that fishing time is analysed.
- the way catch and size tradeoffs are analysed, and
- the way “catch and release” and “catch and keep” are analysed.

In the following sections we consider various models based on different treatments of these three variables, and the implications that these models have for recreational fishing behaviour. In particular, we consider a benchmark case of no or minimal management compared to a management regime that entails restrictions such as bag and size limits.

In effect, we think of the fisher as a typical utility maximizer who must make trade-offs between fishing and other activities. Depending on the nature of the fishing constraints, the fisher may also have to make trade-offs within the recreational fishing activity, for example between catch and size.

6.4 The Basic Model

The model is presented in full in Section 15 (Appendix 3). In the following section only the key elements of the model are presented to establish basic propositions about fisher behaviour with and without catch constraints. . In the literature a common interpretation of fisher utility is as follows;

$$U = U(d, x, e(s_k, t_f, l_k)) \quad (1)$$

Where:

U is the utility or satisfaction that a fisher derives from recreational fishing,

d= number of days fishing per year,

x= "other goods",

and *e* = the overall fishing experience.

The fishing experience is key to understanding behaviour. Once out on the water, the fisher achieves a fishing experience which is a function of the fishing time, t_f, the fish caught and kept, l_k and the size of fish caught and kept, s_k, It is assumed that the fisher can gain benefit from both catch and keep and size and will be better off the larger the fish caught.

The simplest approach to understanding behaviour is to assume that all water time is fishing time, and that there is no formal allowance for catch and keep. Woodward (2003) and Anderson (1993) use a model of this general form. In addition in most models there is, either explicitly or implicitly, only one species. If the fishery is multi species, the model assumes that all species are equally vulnerable to fishing effort, and equally valuable to the fisher.

Each fisher must access the fishing areas by boat and has a cost per trip that consists of boat costs, c_b and fishing costs c_f. Hence the individual fisher as a consumer faces the budget constraint:

$$c_b + c_f + x \leq M \quad \ldots\ldots\ldots \quad (2)$$

This means that fisher can think about the number of trips and what they do on each trip only within the context of the cost of each trip and how it relates to their income and the competing demands for that income from other goods and services. The fisher could spend time in other activities if not fishing. Hence the fisher also incurs an opportunity cost for the time spent on a fishing trip. The starting assumption is that each trip costs the same no matter which boat ramp or location are used for fishing.

The biology impacts the fisher through stock abundance. Abundance will influence the catchability of the fish for the fisher and will therefore impact upon the time (and cost) required to catch fish. We assume that the fisher takes the biology as given. That is, the fisher experiences the biology as a harvest that simply depends on the biomass or stock at any given time.

The number of days fished, *d*, the fishing experience, *e* and consumption of all other goods, *x* feed directly into utility and are assumed to have a positive marginal impact upon the utility of the fisher.[1]

[1] That is the first derivatives of the utility function with respect to these variables is assumed to be positive. As is usual for consumer choice, all the relevant second derivatives are negative meaning that while each variable increasing utility it does so at a diminishing rate. For a fuller elaboration see Section 15

The variables, fishing time, t_f fish caught, l_k size of fish caught, $s_{k,}$ all impact utility indirectly through the fishing experience. The marginal impacts on the fishing experience for each of these variables is assumed to be positive. Different fishers will assign different marginal values to size, catch and time and will have a different willingness to tradeoff between catch and size.

We can use this basic model to consider various "scenarios' and how the fisher would behave in each. Relevant scenarios to consider are:

- No bag or size limits
- Bag limits
- Bag limits and size limits.

The key questions are:

- Are there distinct fisher types?
- How does fishing time (effort) respond to bag and size limits?
- How does catch (keep and release) respond to bag and size limits?
- How does the annual number of days fishing respond to bag and size limits?
- What role does price (cost) play in supporting bag and size limits?

6.4.1 No restrictions (no size or bag limits)

If there are no restrictions, the fisher has the task of optimizing days fished, *d,* harvest *h,* fishing time*,* t_f, fish caught and kept, l_k and the size of fish caught and kept, s_k based on maximizing utility subject to the budget constraint.

There are two points to note about this case. First, without any bag limits no distinction needs to be made between the harvest, *h*, and fish kept, l_k as all fish caught can be kept. Moreover, at this point, catch and release is not a variable in the utility function, so we must assume that fish caught will be kept.[2] Second the number and size of fish caught will depend on the biomass or abundance, and fishing effort measured as fishing time t_f. With no fishing restrictions there are no discards so we can follow Woodward (2003) and assume that the angler's average catch size would be a reflection of the "quality" of the biomass. An improvement in biomass will equate to an increase in average catch size.

The tradeoffs inherent in the fisher's decision making process will drive their behaviour. Without restrictions, on any given trip the fisher is free to optimize the catch and can trade off size and catch. That is they can simply keep catching more fish to secure the preferred size. Fishers are free to mix the fishing activity between catch and keep or discard. This offers the potential to adjust the average size of the catch and keep component by 'discarding' fish into the catch and release activity. Again different fishers will behave differently in this regard.

At this point it is convenient to treat the fisher decision as a two stage process. At one level, the fisher must determine the number of trips per year, *d*. Then for any given trip the fisher must determine the optimal trip time, t_f the optimal catch and keep*,* l_k*,* the optimal total harvest, *h* and the optimal average

[2] This assumption is relaxed in subsequent analysis,

size, s_k.[3] It is assumed that the fisher will optimize the fishing experience $e = e(s_k, t_f, l_k)$ based on their . positive marginal benefits from each argument in *e* so that and the margin the experience benefit increases , all other things equal, with an increase in the time sent fishing, , with the number of fish caught, l_k and with the size of fish caught, s_k .[4]

The primary function of the trip is assumed to be to catch and retain fish. In optimizing, the fisher is choosing the optimal combination of catch and keep and size of fish kept l_k^* and s_k^* The catch or harvest is determined by the fishing effort of t_f, and the abundance, *A*. The fisher needs to optimize catch level and size of fish caught and fishing time, t_f. At the margin increased fishing time enhances the fishing experience and thereby the satisfaction derived by the fisher from a fishing trip. Although time is conceptualized as "fishing time", it can be thought of as having a direct and indirect effect on the fishing experience. The direct effect arises through fishing time resulting in a harvest that allows the fisher to optimize catch and size. The indirect effect arises because the process of fishing adds value to the experience over and above that which is accounted for by fishing outcomes measures and catch and size.[5]

The fisher will optimize by pushing to the point where the marginal value of additional time is zero.

The relationship can be illustrated in Figure 1 where the marginal benefit from harvest and time as experience decline at different rates. The marginal experiential benefit from additional time falls to zero before the marginal benefit from the harvest achieved with additional time. . The optimal fishing time is t_f* where the overall marginal benefit of time is zero. In this case this is where the marginal benefit of fishing time (time only) is equal to the marginal benefit of fishing time (catch and size). Clearly anything that reduces (increases) the marginal benefit of fishing time (catch and size) will have a tendency to reduce (increase) fishing or trip time. Hence new fishing restrictions which have the potential to reduce the marginal harvest benefit from fishing/trip time and marginal experiential value from fishing/trip time may well result in a reduction in fishing/trip time.

The marginal benefit of additional trip time per se declines according to D. The marginal benefit of additional harvest from trip time declines according to F. At t_f* additional time benefit is negative and equal to the positive marginal benefit from harvest. At this point the fisher ceases fishing.

[3] Technically we assuming a separable utility function.

[4] A question arises as to the interaction across these variables. We assume that they are independent so that all cross derivatives are zero. This means for example that a higher catch has no impact on the marginal value of size. See 15.

[5] One interpretation is that it is an experiential value. This value may reflect a variety of dimensions. In a previous study of the West Coast demersal fishery, Nicholls and McLeod (2004) found that attributes such as "spending time with the family" were an important aspect of the fishing experience and appeared to be independent of the actual fishing outcomes.

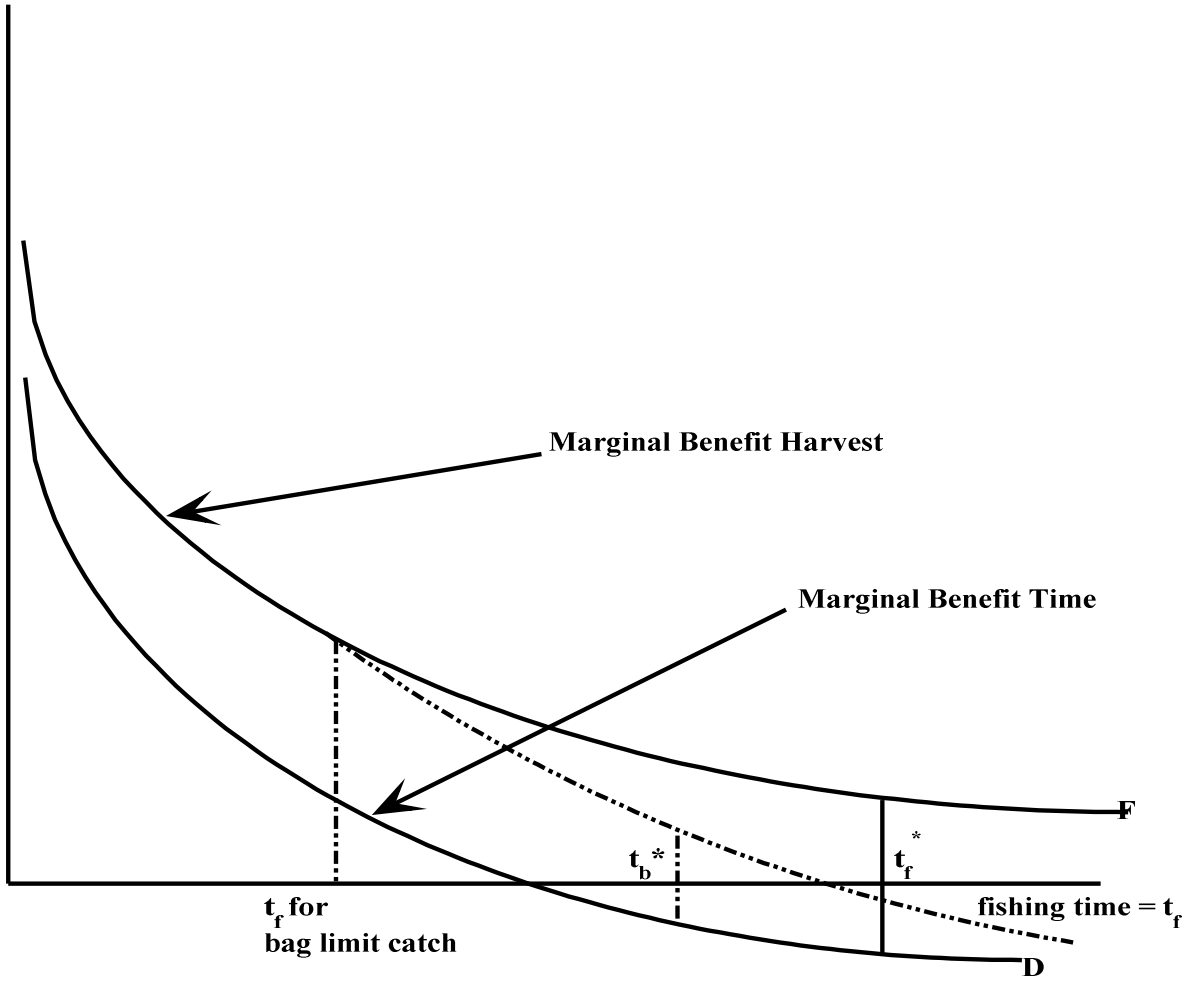

Figure 1: Determination of Optimal Trip Time

6.4.2 Restrictions -Bag Limits

A bag limit can only restrict effort if it is binding. In Nicholls and McLeod (2004) survey results for fishers in the West Coast demersal fishery indicated that for a majority of fishers the recreational bag limits at that time were not binding. [6]

In the presence of binding bag limits, the consequences for behaviour and therefore for fishing outcomes (catch and size) depend on how fishers react to bag limits in terms of compliance. The bag limit is a mandatory restriction that places an upper limit on the number of fish that an angler can retain during a fishing trip. The current rules for the West Coast demersal fishery are set out in Table 1, but are essentially 2 per trip for high risk species. The bag limit is defined in this model as l_k^b and means that actual catch must be less than or equal to the bag limit for every angler.

[6] In the empirical analysis presented later results from this study are used as an approximation of the no restriction case. However the new tighter limits are expected to be binding and have a consequent impact on fisher behaviour.

It is possible that fishers may simply cheat on the bag limit. This would then result in no discernible impact on the harvest and therefore on the fishing mortality. However there are well known penalties for non-compliance and fishers are therefore generally expected to comply with the limit and not be in blatant breach. There are still a number of ways that a fisher can react to the bag limit in the fishery. First, the fisher may comply by stopping fishing for the particular fish (e.g. Dhufish) when the bag limit is reached. Second, fishers may actively "high-grade". In this case they hold fish caught and then dispose of smaller fish only if larger fish are caught later in the day if a later larger catch takes the fisher over the bag limit. [7]

6.4.3 Absolute Compliance

With absolute compliance, the harvest of catch and keep fish, l_k is reduced to comply with the bag limit. If compliance is absolute, fishers will fish to the bag limit and then stop. Catch fall from the unconstrained harvest, l_k to the bag limits harvest, l_k^b If fishers' choose to high grade then fish caught earlier in the day are "released" later in order to increase average size of fish kept.

Clearly, because absolute compliance reduces the harvest *h*, it would reduce t_f. Absolute compliance with the bag limit reduces harvest, reduces retained catch, reduces trip time and has the desired effect on reducing mortality.

However, the simple concept of absolute compliance ignores the marginal value of size when the trip experience depends in part on size of fish caught, s_k. In turn size of fish caught depends the time spent fishing, t_f.

The extent to which actual catch exceeds the bag limit will depend on the way in which size is affected by additional fishing time, stock abundance and the nature of the individual fisher's trade-off between catch and size.

The previous interpretation of optimal fishing/trip time needs to be modified to allow for the fact that the fisher constrained by a bag limit still adjust the fishing experience at the margin by adjusting the size of fish caught, s_k.

The marginal return to fishing or trip time now is confined to the ability to increase the average fish size within the bag limit. The average size goes up with fishing time but the marginal value of size goes down. The marginal catch is now set at whatever the marginal value of catch is at the bag limit. Catching more fish adds to value of fishing based only on the marginal value of size, not catch. At the bag limit harvesting more fish adds less to the experience value than it did under an unrestricted regime. Than is the marginal value of time harvesting is reduced because of the bag limit. In effect, because of the bag limit the fisher is only harvesting for size.

This can be illustrated using

[7] Catch and release will have mortality commensurate with release procedures followed, high grading is likely to have higher mortality, perhaps 100%.

Figure 1. Once the fishing time t_f, needed for the bag limit catch is reached, further time rewards the fisher only through increased fish size and so the overall marginal benefit from harvest falls to the dashed line. Assuming the marginal value of time (time only) is unaffected, then the optimal fishing time is now t_f^{b*} which is less than the unrestricted fishing time t_f^*. Therefore a utility maximizing fisher will pursue fish beyond that required to simply fill the bag limit but the trip time will still be less than for the unrestricted case. With harvest related to fishing time this reduction in trip/fishing time means that overall harvest will fall, relative to the unrestricted case.

If fishers behave according to the above model then the key to understanding the mortality consequences of bag limits is to understand the marginal value of size as opposed to the simple catch quantum and to understand the proportion of fishers who will be "absolute compliers" versus "self-interested optimizers".

6.5 Extending the Model

There are two important ways in which the above model may fail to capture the detail of a recreational fishery like the West Coast demersal fishery. First, catch and release as a positive component of the overall fishing experience is not allowed for in the above model, yet catch and release can have a positive value as part of the fishing activity. To some extent this is recognized within the new management regime in the West Coast Demersal fishery. A release weight is to be used when fish are released to help with reducing the mortality rate. Second, fishers may not fish for the entire trip time, as the above analysis assumed, and may be willing to substitute between non-fishing and fishing time. Non fishing time in this context yields benefits unconnected to fishing outcomes. Third, like many recreational fisheries, the West Coast demersal fishery is multi-species. Fishers can switch/substitute between species. Each of these possible variations needs to be considered to make the model better approximate what actually happens in the fishery.

6.5.1 Non fishing time and catch and release

If we allow for non-fishing time, then we must have trip time broken down between fishing time, t_f and water time, t_w where the latter exceeds the former by the amount of non-fishing time, t_{nf}. Similarly, if we allow for voluntary catch and release then we must have total catch l, broken into retained catch, l_k, and released catch, l_r. The utility function consistent with this can be expressed as;

$$U = U(d, x, e(s_k, t_f, t_{nf}, l_k, l_r)) \text{ .....} \quad (3)$$

U is the utility derived from recreational fishing, d= number of days fishing per year, x= "other goods", and e = the fishing experience. Once out on the water the fisher achieves a trip experience which is a function of the harvest of fish , h, size of fish kept, s_k, the fishing time, t_f, the fish caught and kept, l_k, fish caught and released, l_r, and non fishing time t_{nf}. As previously, the marginal benefit for each variable is positive.

Fishing time impacts the fishing trip experience, e, through the harvest, fish caught and kept and fish caught and released. Non fishing time directly contributes to e not via fishing activity.

6.5.2 No restrictions (no size or bag limits)

If there are no restrictions then the fisher has the task of optimizing fishing trips, *d,* harvest*, h,* fishing time, t_f, and non fishing time, $t_{nf.}$ Within the fishing time the fisher optimizes the mix of fish caught and kept, l_k, the size of fish caught and kept, s_k and fish caught and released, l_r.

In the previous case, without bag limit we assumed that was no distinction could be made between the harvest, *h*, and fish kept, l_k as all fish caught could be kept. In this model specification, catch and release offers a positive contribution to experience, *e* and so some voluntary catch and release is feasible for any fisher seeking to optimize the fishing experience. The number and size of fish caught will depend on the biomass or abundance, and fishing effort measured as fishing time t_f. The fisher's average catch size would be a reflection of the "quality" of the biomass.

As with the previous analysis, the tradeoffs inherent in the fisher's decision making process will drive behaviour. Without restrictions, on any given trip the fisher is free to optimize the catch/keep, catch/release mix and can trade off size and catch, fishing time and non fishing time. It is assumed that fishers would be willing to trade off between average fish size and catch, between catch and keep and catch and release and between fishing and non fishing time. Different fishers will have different marginal willingness to substitute between these.

It is again convenient to treat the fisher decision as a two stage process. At one level, the fisher must determine the number of trips per year, *d*. For any given trip the fisher must determine, fishing time, t_f, non-fishing time, t_{nf}, catch and keep, l_r, catch and release, l_k, and size of fish kept, s_k. Total harvest, *h*, is the sum of catch and keep and catch and release.

It is assumed that the fisher will optimize the fishing experience expressed as: $e(s_k, t_f, t_{nf}, l_k, l_r)$. It is assumed that there are positive marginal benefits from each of the variables that influence experience, size of fish caught, fishing time, non-fishing time, fish caught and kept and fish caught and released. [8] The primary function of the trip is assumed to be to catch and keep. In optimizing the fisher can therefore be considered as choosing the optimal combination of catch and keep, catch and release and size of fish retained, s_k^*, l_k^*, l_r^*. In optimizing catch and size the fisher optimizes effort or fishing time $t_{f.}$ The fisher also optimizes non fishing time, $t_{nf.}$

At the margin the fisher will optimize the allocation of trip time by adjusting fishing and non fishing time to keep their marginal values the same. Total time will then be determined by the opportunity cost of time.

These relationships are illustrated in

Figure 2 which shows the marginal benefit from trip fishing time and the marginal benefit from trip non-fishing time. Both are downward sloping indicating a decline in marginal benefit as trip time

[8] As in the previous analysis this is premised on these variables being independent so that all cross derivatives are zero. This means for example that a higher catch has no impact on the marginal value of size or a higher non fishing time has no impact on the marginal value of catch and keep.

increases. The opportunity cost of time is represented by ω. The optimal total time is t_w^* which is split between the optimal fishing time, t_f^* and optimal non-fishing time, t_{nf}^*. Clearly anything that reduces (increases) the marginal benefit from fishing time will tend to reduce (increase) fishing and trip time. Anything that increases (decreases) the trip cost will tend to decrease (increase) overall trip time as well as decreasing both fishing and non fishing time. For a given opportunity cost, tighter restrictions such as those imposed in the West Coast Demersal fishery will reduce the marginal benefit from fishing time and will tend to reduce fishing time and increase non-fishing time.

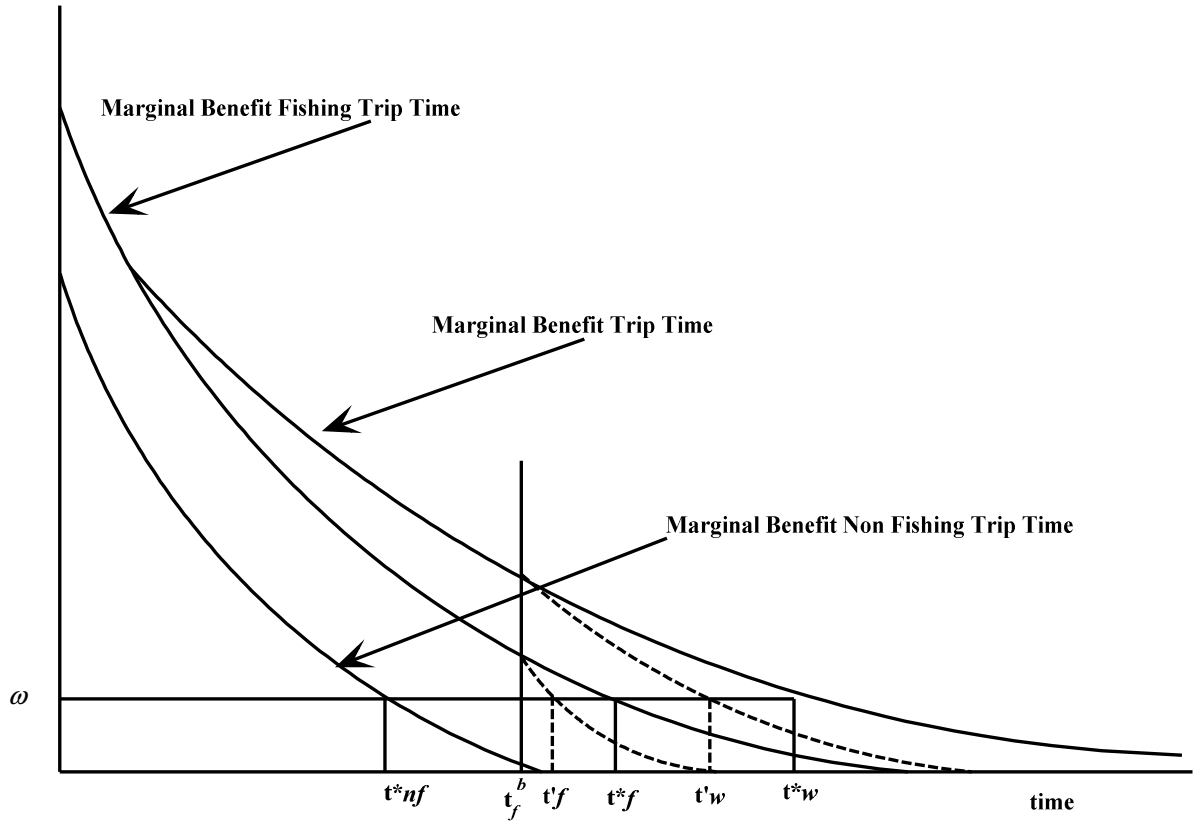

Figure 2: Determination of Optimal Trip Time when Fisher has Both Fishing and Non Fishing Trip Time

6.5.3 Restrictions -Bag Limits

As in the previous model specification, the bag limit, if strictly adhered to, reduces catch and keep to the bag limit. The consequences for behaviour and therefore for fishing outcomes depends on how fishers react to bag limits in terms of compliance and their willingness to substitute catch and release for catch and keep. Again the bag limit is a mandatory restriction that places an upper limit on the number of fish that an angler can retain during a fishing trip. The bag limit is defined in this model as l_k^b and means that for each angler actual catch and keep is less than or equal to the bag limit. As previously, fishers may simply cheat on the bag limit. There would be no impact on the

catch and keep harvest and therefore on the fishing mortality. However, as explained previously, there are penalties for non-compliance and fishers are therefore expected to comply with the limit and not be in blatant breach.

There are a number of ways that a fisher can react to the bag limit in this model. First, the fisher may comply by stopping fishing for the particular fish (e.g. Dhufish) when the bag limit is reached and terminate all fishing at this point. Second, fishers may actively "high-grade". In this case they hold fish caught and then dispose of smaller fish only if larger fish are a caught later in the day, when a later larger catch takes the fisher over the bag limit. Third they may continue to fish for catch and release. This could be done in strict compliance with the bag limit or with some high grading involved. Catch and release will have mortality commensurate with the release procedures followed.

6.5.4 Absolute Compliance

With absolute compliance, the catch and harvest is reduced to the bag limit. The bag limit restricts catch and keep and so actual catch and keep is reduced from the unconstrained harvest level to the bag limit level. If compliance is absolute fishers will fish to the bag limit and then stop fishing for catch and keep.

The effect on fishing time, catch and keep harvest, catch and release harvest and non-fishing time will depend on the extent to which the fisher sees fishing catch and release and non fishing time as a substitute for catch and keep.

If catch and keep and catch and release are independent, then the restriction of the bag limit has no impact on catch and release. This is illustrated in Figure 2 by the dashed lines.

Fishing time t^b_f is the time required to catch the bag limit. Fi8shing beyond this time delivers lower marginal benefit from fishing because it is only catch and release fishing. Fishing time falls from the unconstrained t^*_f to t'_f . The marginal benefit from non-fishing activity is unchanged so non-fishing time stays as previously at t^*_{nf} . Total trip time falls to t'_w.

The above assumes that catch and keep and catch and release are independent. If they are interdependent they may be substitutes or complements. Either case will influence how a change in the bag limit will influence catch and keep.

If they are substitutes then, as catch and keep harvest is reduced by the bag limit, catch and release increases, with the, with the exact response depending on the shape of the fisher's indifference curve. If they are complements then, as catch and keep harvest is reduced by the bag limit, catch and release also falls, again the exact response depends on the shape of the fisher's indifference curve.

7 RESULTS/DISCUSSION

7.1 Benchmark results for recreational fishing from the 2003 recreational fisher survey –the pre-change case-

In order to understand the significance of recent surveys, a reference point prior to the introduction, or even the expected introduction, of the new rules was needed.

This was achieved by referring back to a telephone survey of recreational fishers done in 2003 for the West Coast Demersal Fishery covering the region Augusta to Kalbarri. The focus of this survey was on the catch and related fishing behavior for the prized species – Dhufish, Pink Snapper and Baldchin Groper.

At that time there was no restriction on recreational fisher participation in the West Coast Demersal Fishery.

This was prior to the introduction of the recreational licence fee, but recognizing the need for a boat to access the fishery, the registration data on pleasure craft from the then Department of Infrastructure and Planning (Marine Transport Division) was used as the sampling frame. This gave around 70,000 craft that were potentially capable of being used to fish for these species. Charter boat operators were not included in this survey.

7.2 Fishing Regulations in 2003

7.2.1 Daily Bag Limits[9]

Under fishing regulations applying at that time each recreational fisher was limited to a maximum daily take of 4, Dhufish and a mixed bag limit of 8 reef fish, including Pink Snapper and Baldchin Groper.

These catch limits were under review at the time with the Fisheries Department of Western Australia releasing for public comment the possibility of halving the daily bag limit at the time of this case study. However, as outlined below, even a halving of the daily bag limit would effectively leave fishers unconstrained.

7.2.2 Size Limitations

A legal minimum fish size applies to each of these species that recreational fishers wish to retain. These were 500mm for Dhufish, 400mm for Baldchin Groper and 410mm for Pink Snapper.

7.2.3 Seasonal Limitations

At the time of the 2003 survey, fishing for Pink Snapper in Cockburn Sound was closed from the 15 September to the 31 October.

[9] The 'official' daily bag limit should not be confused with the range of daily catch limit offered to surveyed recreational fishers. The number of fish in the 'offered' range varied and went above and below the official bag limit.

7.2.4 Recreational Catch

There were no catch surveys close to the 2002/03 period. However, a Western Australian Fisheries Department 1996/1997 survey estimated recreational catch of the prized case study species – Dhufish, Pink Snapper and Baldchin Groper- to be around 182 tonnes.

These data are shown in Table 1 below. They indicate just how far the fishes at that time appeared to be below the daily bag limit. Hence we take this as an approximation to actual unconstrained behavior.

Table 2 West Coast Demersal Fishery: Recreational Dhufish, Baldchin Groper and Pink Snapper Catches (a): 1996-1997 Recreational Fishing Survey.

Species	Retained Catch (tonnes)	High Catch Locations	High Seasonal Catches	Catch Rate
Dhufish	132	Jurien Bay, Lancelin, Geraldton	Summer	0.42/angler trip
Baldchin Groper	23	Jurien Bay	Summer/Autumn	NA
Pink Snapper	27	Mandurah	Spring	0.27/angler trip
Total	182			

Source: Western Australian Department of Fisheries

McLeod and Nicholls (2004) scaled up the 1996/97 catch data to approximate 2003 based on the national recreational survey results and the growth in the number of pleasure vessels. The resulting estimate was a recreational catch between 300 and 350 tonnes as shown in Table 3. Given the estimated growth in boats and fishes this still left per fisher/trip catches well below the catch limits.

Table 3: Scaled Estimates of the Recreational Catch of Dhufish, Baldchin Groper and Pink Snapper in the West Coast Demersal Fishery (a) 2001-2002.

Species	Low estimate	High estimate
Dhufish	193	228
Baldchin Groper	47	53
Pink Snapper	60	69
Total	300	350

(a)Excludes recreational catches from commercially operated recreational charter vessels.
Source: McLeod and Nicholls (2004).

7.2.5 Survey Questionnaire for 2003

The data collected during the 2003 season was a telephone survey designed to elicit willingness to pay have the possibility of catching additional prized species fish. Although the focus was contingent valuation questions designed to elicit willingness to pay, the survey collected data on catch and keep, catch and release as well as data on attitudes to fishing and core socio demographic variables. Data was also collected on the time spent fishing, time spent travelling and time spent accessing the fishing locations. The complete survey instrument is given in Appendix 5.

7.2.6 Survey Population and Sample Size

Recreational fishing licences did not exist in 2003. Therefore the sampling frame was the pool of 70,000 pleasure craft registrations held by the Marine Section of the Department of Planning and Infrastructure in Western Australia. A stratified, random sample based on postcode locations of 2,000 pleasure craft owners were contacted (in writing) by the Marine Section asking them to advise the Department if they were not agreeable to their contact details being released for possible participation in our recreational survey. The Department made a sample of 1,734 contacts available.

7.2.7 The Sample Group and Response Rate

Of the 500 pleasure craft owners randomly selected from the 1734 contacts provided by the Marine Section of the Western Australian Department of Planning and Infrastructure, 380 (or 76 per cent) completed the telephone survey. This is typical for a telephone survey. Of the 380, 12 had trip length greater than one day leaving n=368 trips of less than a day. This is the primary data base for analysis.

7.2.8 Socio Economic Composition

Respondents were predominately male (96 per cent) and were mostly in the 30 to 60 years age group (75 per cent). Retirees and pensioners were around 17 per cent of the sample. The majority were engaged in full time employment.

Disclosed annual incomes (before tax) of respondents are summarized in Table 4. The incomes were oriented towards the higher income groups with 35 per cent earning above $51,999 annually. Median and average income was in the range $26,000 to $51,999. The average annual earnings for fully employed males in Western Australia at the time were $46,581.

Table 4 Income Distribution for 2003 Survey.

Annual Incomes	Percentage of Respondents
Less than $8,319	6
$8,320 to $15,599	7
$15,600 to $25,999	11
$26,000 to $36,399	17
$36,400 to $51,999	24
$52,000 to$77,999	20
$78,000 or more	15

Source: McLeod and Nicholls (2004)

7.2.9 Boat Use

On average, respondents' recreational fishing in the West Coast fishery for the case study species accounted for 53 per cent of the usage of their boats over the previous twelve months. These boat usage data are shown in Table 5.

Table 5: Percentage of Boat Use Spent Fishing Offshore for the Targeted Case Study Species 2003 Survey

Percentage of Boat Use	Frequency (%)
10 per cent or less	24
11 per cent to 30 per cent	15
31 per cent to 50 per cent	18
51 per cent to 70 per cent	5
71 per cent to 90 per cent	6
91 per cent to 100 per cent	32

Source: McLeod and Nicholls (2004)

7.3 Fishing Behaviour in 2003

7.3.1 Number of trips

On average, respondents went 'bottom fishing' 12.8 times in the West Coast Wetline fishery over the previous twelve months. Around 30 per cent fished 5 times or less, whilst 94 per cent fished 30 times or more. Two fished around every third day over the past twelve months. These data are shown in Table 6.

Table 6 Frequency of Fishing Trips 2003 Survey.

Number of	Trips Frequency (%)
10 trips or less	58
o 20 trips	28
21 to 30 trips	8
31 or more trips	6

Source: McLeod and Nicholls (2004)

Fishing trips typically involved two or three people, representing three quarters of the survey responses; although as many as 6 persons was not unusual. Most were either friends or family.

7.3.2 Trip Times and Fishing Times

For almost all (97 per cent) of the sample group, fishing trips in the West Coast Demersal Fishery for the case study species were of one day's duration or less. The mean fishing trip was 7.16 hours duration with the range from less than 2 hours to 17 hours. These data are shown in Table 7.

Table 7 Trip Time 2003 Survey.

Hours	Frequency (%)
2 to 3 hours	5
4 to 5 hours	22
6 to 7 hours	33
8 to 9 hours	21
10 hours or over	19

Source: McLeod and Nicholls (2004)

The pattern of trip time and fishing time for the 2003 survey is shown in Table 8. Mean total trip time was 7.9 hours. Of this travel to boat ramp and back was 1.3 hours and time on the water was 6.6 hours. Of the 6.6 hours of ocean time, 4.9 hours was spent fishing and 1.2 ours was spent in other activities. Bottom fishing was 3.8 hours of the 4.9 hours of fishing time.

Table 8 Trip Times and Fishing Times 2003 Survey.

	Obs.	Mean	Std. Dev.	Min	Max
Trip Time	363	7.88	3.24	2.00	20.50
Bottom Fishing	363	3.76	1.97	0.00	16.00
Travel to Ramp	363	1.28	1.97	0.00	14.00
Ocean Time	363	6.60	2.74	1.70	20.00
Fishing Time	363	4.89	2.59	0.14	15.73
Other Ocean Time	363	1.72	2.12	0.00	16.00

Source: McLeod and Nicholls (2004)

7.3.3 Bag Limits and Catches

In the previous twelve months, 81 per cent of the respondents had specifically targeted Dhufish when they went fishing, 64 per cent targeted Pink Snapper and 44 per cent Baldchin Groper. This affirmed strong preferences attaching to Dhufish among recreational West Coast Demersal fishers. Sixty three per cent of the respondents also targeted other species besides the case study species.

7.3.4 Catch and Keep

Over the previous twelve months, on average per trip, over 90 per cent had not achieved daily bag limit catches, in aggregate or individually, of the case study species whilst fishing in the West Coast Demersal fishery. Indeed, for each of the case study species, most respondents had not caught and kept any of the case study species. These data are shown in Table 9 and Figure 3.

Table 9 Retained Catch per Trip by Species 2003 Survey.

	Percentage of Respondents			
Number of Fish/Trip	Dhufish	Baldchin Groper	Pink Snapper	Other Species
0	37.1	71.3	54.5	16.1
1	34.7	16.8	23.4	10.0
2	17.9	7.1	13.7	17.2
3	5.5	1.3	2.9	9.5
4	2.1	1.8	2.9	8.4
5	0.5	0.5	0.8	6.6
6	1.3	0.5	0.5	9.8
>6	0.8	0.5	1.3	22.4

Source: McLeod and Nicholls (2004)

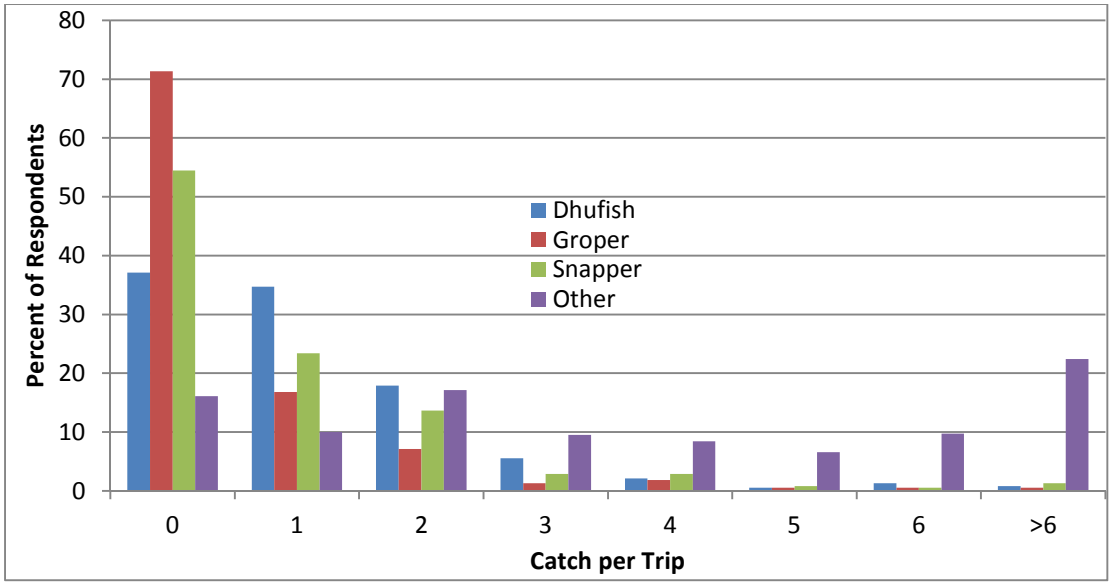

Figure 3 Retained Catch per Trip by Species 2003 Survey.

Table 10 shows summary statistics for retained catch. During the previous twelve months, the mean Dhufish catch/trip was just over one, with a range from 0 to 9. For Pink Snapper, the mean catch/trip was just under one, with a range from 0 to 15. For Baldchin Groper the mean catch/trip was just 0.46, with a range from 0 to 6.

Catches of "other species" were important. The mean catch/trip for other species was 5.82. Only 16 per cent of respondents had zero retained catches of other species and the range was 0 to 60.

Table 10 Summary Statistics for Retained Catch 2003 Survey.

	Dhufish	Pink Snapper	Baldchin Groper	Other Species
mean	1.07	0.88	0.46	5.82
min	0	0	0	0
max	9	15	6	60

Source: McLeod and Nicholls (2004)

7.3.5 Catch and Release

Over the previous twelve months, on average per trip, most respondents had not caught and released any of the case study species whilst fishing in the West Coast Demersal fishery. These data are shown in Table 11 and Figure 4.

Table 11 Released Catch per Trip by Species 2003 Survey.

Number of Fish	Percentage of Respondents			
	Dhufish	Baldchin Groper	Pink Snapper	Other Species
0	36.9	85.8	52.0	29.6
1	22.2	6.3	12.4	7.7
2	16.9	4.2	13.5	11.5
3	10.8	0.8	5.3	9.1
4	4.5	1.6	3.7	5.6
5	2.4	0.3	2.9	4.8
6	3.4	0.5	5.3	8.3
>6	2.9	0.5	5.0	23.5

Source: McLeod and Nicholls (2004)

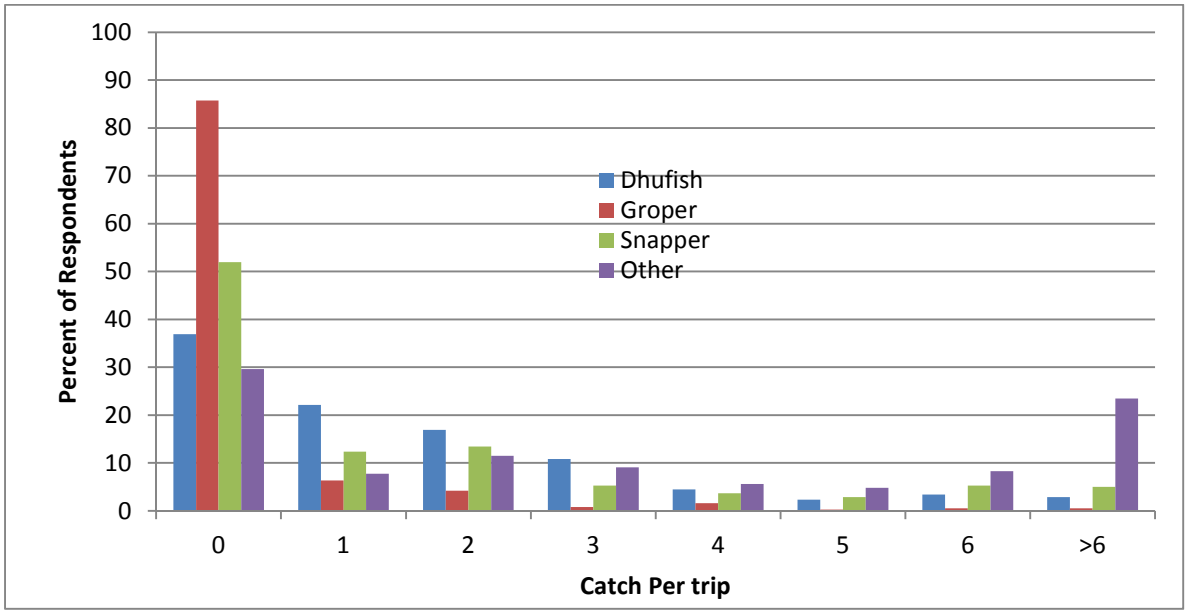

Figure 4: Released Catch per Trip by Species 2003 Survey.

Table 12 Summary Statistics for Released Catch 2003 Survey.

	Dhufish	Pink Snapper	Baldchin Groper	Other Species
Mean	1.7	2.0	0.3	5.0
Min	0	0	0	0
Max	30	50	10	50

Source: McLeod and Nicholls (2004)

Table 12 shows summary statistics for released catch during the 2003 survey. For the previous twelve months, the mean released catch of Dhufish was 1.7, with a range from 0 to 30. For Pink Snapper the

average was 2.0, with a range from 0 to 50. For Baldchin Groper the average was just .3, with a range from 0 to 10.

Other species were also important in catch and release. For "other species" the average catch and release per trip was 5.0, with 30 per cent of the respondents having zero released catches of other species and a range of 0 to 50.

The following table shows the combined data for Dhufish, Pink Snapper and Baldchin Groper. The average per trip for the combined retained and released catch was 6 fish with a range of 0 to 77. Only 15 percent of respondents had neither retained nor released catches over the past 12 months for the case study species.

Table 13 Aggregate Retained and Released Catches per Trip for the Three Key Species Over Previous 12 Months in 2003 Survey.

	N	Min.	Max.	Mean	Std. Dev.
Aggregate retained and released catch for Dhufish, Pink Snapper, and Baldchin Groper.	367	0	77	6.38	8.09
Aggregate retained catch of Dhufish, Pink Snapper, and Baldchin Groper.	368	0	21	2.42	2.76
Aggregate released catch of Dhufish, Pink Snapper, and Baldchin Groper.	367	0	70	3.97	6.61

Source: McLeod and Nicholls (2004)

Whilst catches of Dhufish, Pink Snapper and Baldchin Groper were modest for most fishers, most fishers had positive catches when other species are included. In particular the average of retained and released catch for combined Dhufish, snapper, groper and other species is 17.2 fish. Only 1.1 percent of respondents had zero for combined retained and released catch. For retained catch the average for combined Dhufish, snapper, groper and other species is 8.2 fish. Only 2.9 percent of respondents had zero retained catch. For released catch, the average released catch for combined Dhufish, snapper, groper and other species is 9.0 fish. Only 7.7 percent of respondents had zero released catch.

Therefore while virtually all fishers were catching only limited catches of the prized species and fell well short of the set bag limits, catching other species more than doubled the catching experience and very few fishers experienced zero catch when this activity is taken into account.

7.4 Satisfaction with the Fishing Experience in 2003

A range of questions were included in the survey dealing with the degree to which fishers were satisfied with various aspects of their fishing experience. The scores for each aspect ranged from 1(very unsatisfied) to 5(very satisfied). The list of attributes considered and the mean scores are given in Table 14.

Table 14 Mean Satisfaction Scores for Dimensions of Fishing Experience 2003 Survey.

	Mean Score
No congestion at the boat ramp	3.69
Catching as many fish as you expect to	3.47
The number of fish you catch and keep	3.59
The size of the fish you catch and keep	3.67
The species of the fish you catch and keep	3.73
The time it takes to catch the number of fish you expected to	3.54
The time it takes to catch the number of fish you want to keep	3.51
Catching enough fish for a decent feed	3.65
Enjoying the fishing experience, regardless of the number of fish caught and kept	4.50
Having an enjoyable time out on the ocean	4.67

Source: McLeod and Nicholls (2004)

On balance fishers in 2003 were well satisfied. Very high satisfaction scores were assigned to both the overall fishing experience and the overall experience of time on the ocean. The satisfaction scores for the broader fishing activity at above 4.5 are higher than the mean scores for any of the direct fishing activities. For the rest, respondents were reasonably happy.

7.4.1 Most Recent Fishing Experience in West Coast Demersal Fishery

For the most recent fishing experience, that is the most recent trip made prior to the survey, two thirds of the respondents indicated that they had not caught as many of the case study species as they wanted, although almost one quarter indicated that they had caught as many as they thought they would within the catch limit. Less than 2 per cent of the respondents indicated bag limit catches.

In relation to the most recent fishing trip, 62 per cent of the respondents thought they would have caught more fish, whilst 34 per cent indicated that they had caught as many as they thought they would. Only 4 per cent thought they would have caught less.

In terms of fish kept, one half thought they would have kept more, whilst 47 per cent indicated that they had kept as many as they thought they would. Only 2 per cent thought they would have kept less.

Despite outcomes below expectations from their most fishing experience in the West Coast Demersal Fishery it is still the case that:

- two-thirds were happy with the number of fish they caught,
- two-thirds were happy with the number of fish they kept,
- 71 per cent were happy with the size of the fish they caught,
- three-quarters were happy with the type of fish kept, and
- three-quarters were happy with the type of fish they kept.

7.5 Post Regulation: The 2010 Survey Results for Recreational Fishing in the Constrained Case.

The 2010 followed on from changes in the rules for fishing. These rule changes were made because of a threatening decline in stocks and the need to reduce both commercial and recreational fishing effort. The telephone survey was conducted in April/May 2010.

7.5.1 The 2010 Rules

By the time of the 2010 season, the rules reflected a more extensive closed season and much stricter bag limits. A summary of the revised rules is given in Table 15.

Table 15 Revised Rules for 2010 Season

Seasonal Closure	Two-month demersal scale fish closure 15 October to 15 December (inclusive).
Daily bag limit	Limit of two High Risk demersal scale fish and two pelagic fish.
Boat limit	Limit of two Dhufish per boat (six for charter boats).
Fish release	Compulsory possession of a 'release weight' when fishing for demersal scale fish.
Fishing Licence	Recreational Fishing from Boat Licence from 2 March, 2010.

The closed season and tighter bag limits applied across a wide range of demersal scale fish in the West Coast region. Breaches of the closed season regulation were subject to a fine of $5 000 for a first offence and a fine of $10 000 for a second offence.

The closed season was the period between 15 October and 15 December, both dates inclusive. The demersal scale fish to which this applied are show in Table 16.

Table 16 Demersal Scale fish subject to Closed Season in 2010.

Cod	Groper, Bass
Cod, Grey Banded Rock	Groper, Western Blue
Coral Trout	Hapuku
Coronation Trout	Nannygai
Dhufish, West Australian	Parrot Fish
Emperor and Seabream	Seaperch, Tropical
Emperor, Red (Government Bream)	Snapper, Pink
Snapper, Red (Redfish)	Snapper, Queen (Blue Morwong)
Foxfish, Western and Pigfish	Swallowtail
Groper, Baldchin	Trevalla
	Tuskfish

Outside of the closed season, the revised bag limits per day are those shown in Table 17. These limits are less than 1 and are much closer to the actual catches that fishers have been experiencing even as far back as 2003.

Table 17 Daily Bag Limits for 2010.

SPECIES	SCIENTIFIC NAME	MINIMUM LEGAL SIZE	BAG LIMIT
Cods (includes breaksea cod, harlequin fish, grey banded rock cod and Chinaman cod)	Family Serranidae	Epinephelus sp. (such as malabar cod and estuary cod) over 1,000 mm or 30 kg are protected (except grey banded rock cod) Breaksea – 300 mm Estuary – 400 mm	2
Coral trout and **coronation trout** – combined	*Plectropomus* spp. and *Variola louti*	Coral – 450 mm	1
Dhufish, Western Australian	*Glaucosoma hebraicum*	500 mm	1 Boat limit -2 (6 on charter)
Emperors ("**nor' west snapper**")	Family Lethrinidae	Spangled – 410 mm Blue-lined (black snapper) – 320 mm Other emperors – 280 mm	2
Foxfish and pigfish	*Bodianus* spp.	Not applicable.	2
Groper, baldchin and **tuskfish**	*Choerodon* spp.	Baldchin, blackspot & blue tuskfish – 400 mm	2
Groper, western blue	*Achoerodus gouldii*	500 mm. Protected in the Rottnest Island Reserve	1
Hapuku/bass groper and **trevella**	*Polyprion* spp. and Family Centrolophidae	Not applicable.	2
Parrot fish	Family Scaridae	Not applicable.	2
Pink Snapper	*Pagrus auratus*	410 mm 500 mm (South of 31° degrees south latitude, just north of Lancelin)	2
Queen snapper (blue morwong)	*Nemadactylus valenciennesi*	410 mm	2
Red snapper (includes bight redfish, nannygai and swallowtail)	*Centroberyx* spp.	300 mm	2
Tropical snappers and **sea perch** (includes red emperor, mangrove jack, ruby snapper, job fish, stripey sea perch etc.)	Family Lutjanidae	Red emperor – 410 mm Fingermark, mangrove jack and stripey sea perch – 300 mm	2

7.6 The 2010 Survey

The extended closed season and the new bag limits change the fishing environment significantly. Whilst the original survey could be regarded as an approximation to unconstrained behavior the 2010 survey was of fishers likely to be experiencing binding catch constraints.

7.6.1 Survey population and sample size.

Recreational fishing licences had commenced for the 2010 survey. Therefore the sampling frame was the data base on recreational fishing licences at that time. This was 26,919 license holders of which 21.045 were in the West Coast Bio region and 15,623 were in the metropolitan region.

A final sample of 798 completed telephone surveys was obtained spread across metropolitan area, South West, Mid West and Kalbarri proportional to the population of license holders. Of these, 750 had trip times less than one day.

7.6.2 Socio Economic Composition

Respondents were predominately male (91 percent). Retirees and pensioners were around 17 percent of the sample. The majority (70 percent) were engaged in full time employment.

Disclosed annual incomes (before tax) of respondents are summarized in Table 18. The incomes were oriented towards the higher income groups with 35 per cent earning above $51,999 annually. Median and mean income was in the range $52,000-$88,399. The average annual earnings for fully employed males in Western Australia at the time were $69.680.

Table 18 Income Distribution 2010 Survey.

Annual Incomes	Freq.	Percentage of Respondents
Nil or negative income	21	3.1
$1-$25,999	83	12.24
$26,000-$33,799	51	7.52
$33,800-$51,999	93	13.72
$52,000-$88,399	184	27.14
$88,400-$103,999	109	16.08
$104,000-$129,999	61	9
$130,000-$155,999	36	5.31
$156,000-$207,999	21	3.1
$208,000 or more	19	2.8
Total	678	100

7.6.3 Boat Use

The type of boats owned by respondents is shown in Table 19. As expected the bulk (97%) are power boats. Respondents were asked to indicate boat market value. The mean boat value was $62,271. The minimum value was $1,500 and the maximum was $9 million.

Table 19: Boat Type in 2010 Survey.

	Freq.	Percent	Cum.
Powerboat - moored or penned	29	4.78	4.78
Powerboat - transported on trailer	560	92.26	97.03
Sailboat - moored or penned	2	0.33	97.36
Sailboat - transported on trailer	1	0.16	97.53
Other	15	2.47	100
Total	607	100	

Boat usage patterns are shown in Table 20. Only 12 percent of boats are used more than once a week. Around 15 percent are used less than 6 times a year.

Table 20 Frequency of Boat Use 2010 Survey.

	Freq.	Percent	Cum.
0 times	6	0.99	0.99
1-2 (rarely)	8	1.32	2.31
3-6 (a few times)	78	12.85	15.16
7-12 (once a month)	129	21.25	36.41
13-24 (twice a month)	187	30.81	67.22
25-50 (weekly)	126	20.76	87.97
51 or more (more than weekly)	70	11.53	99.51
Don't Know	3	0.49	100
Total	607	100	

Fishing dominates boat use. Table 21 shows that for the 2010 respondents, on average 74 percent of the boat uses time was fishing activities.

Table 21 Percentage of Time Boat Used for Recreation, Fishing and Other Activities 2010 Survey.

Variable	Obs.	Mean	Min	Max
Recreation	598	17.95	0.00	100.00
Fishing	598	74.29	0.00	100.00
Other	598	7.75	0.00	100.00

7.7 Fishing Behaviour in 2010

The number of trips data was not asked in the same format across the surveys. The early survey recorded the exact number of trips in the previous 12 months; the 2010 survey recorded this information in ranges. The pattern of fishing trips for 2010 is shown in Table 22. The median is in the 7-12 (once a month), range. A linear interpolation implies a median of approximately 9 trips per year and a mean of just below 12 trips per year.

Table 22 Distribution of Number of Fishing Trips, 2010 Survey.

Description	Code	2010	
		#	%
1-2 (rarely)	2	110	14.67
3-6 (a few times)	3	211	28.13
7-12 (once a month)	4	205	27.33
13-24 (twice a month)	5	156	20.8
25-50 (weekly)	6	57	7.6
51 or more (more than weekly	7	11	1.47
		750	100

7.7.1 Trip Times and Fishing Times

The pattern of trip time and fishing time for the 2010 survey is shown in Table 23. Mean total trip time was 6.5 hours. Of this travel to boat ramp and back was 1.0 hours and time on the water was 5.5 hours. Of the 5.5 hours of ocean time, 3.4 hours was spent fishing and 2.1 hours was spent in other activities. Bottom fishing was 2.8 hours of the 3.4 hours of fishing time.

Table 23 Trip Times and Fishing Times 2010 Survey.

	Obs.	Mean	Std. Dev.	Min	Max
Trip Time	700	6.55	3.00	0.67	24.00
Bottom Fishing	700	2.77	2.09	0.00	12.00
Travel to Ramp	700	1.04	1.82	0.00	16.00
Ocean Time	700	5.51	2.24	0.33	18.00
Fishing Time	700	3.37	2.34	0.00	15.00
Other Ocean Time	700	2.14	2.00	0.00	10.00

7.7.2 Bag Limits and Retained Catch

The distribution of catch per trip for the previous 12 months in the 2010 survey is given in Table 24 and the average catch per trip is shown in Table 25. In the 2003 species the “other high risk species” category was not used. In order to compare 2010 with 2003 the “other high risk” and “other” species groups for 2010 need to be combined. The final column of Table 24 and Table 25 shows the combined result for “other species”.

The 2010 survey results indicate that for Dhufish, Baldchin Groper and Pink Snapper greater than 50% of respondents reported zero catch while over 80% reported catches of one or zero.

Once we come to the “other species” category the distribution spreads with 73% of respondents reporting a catch per trip greater than zero and twenty two per cent reporting catch per trip greater than six. The distribution of retained catch per trip is shown in Table 24 and Figure 5

Table 24 Distribution by Retained Catch per Trip by Species for 2010 Survey.

Number of Fish/Trip	Dhufish	Baldchin Groper	Pink Snapper	Other High risk	Other Species	All Other Combined
0	50	68.88	57.52	56.39	27.32	14.41
1	35.59	21.83	23.81	23.43	12.28	14.16
2	10.15	4.77	12.78	11.78	13.66	14.79
3	1.63	1.63	2.13	2.38	8.15	8.65
4	1.38	0.75	1.25	2.51	6.52	9.27
5	0.13	0.38	0.5	0.38	3.51	4.76
6	0.38	0.88	0.88	1.25	6.27	5.76
>6	0.75	0.88	1.13	1.88	22.31	28.2

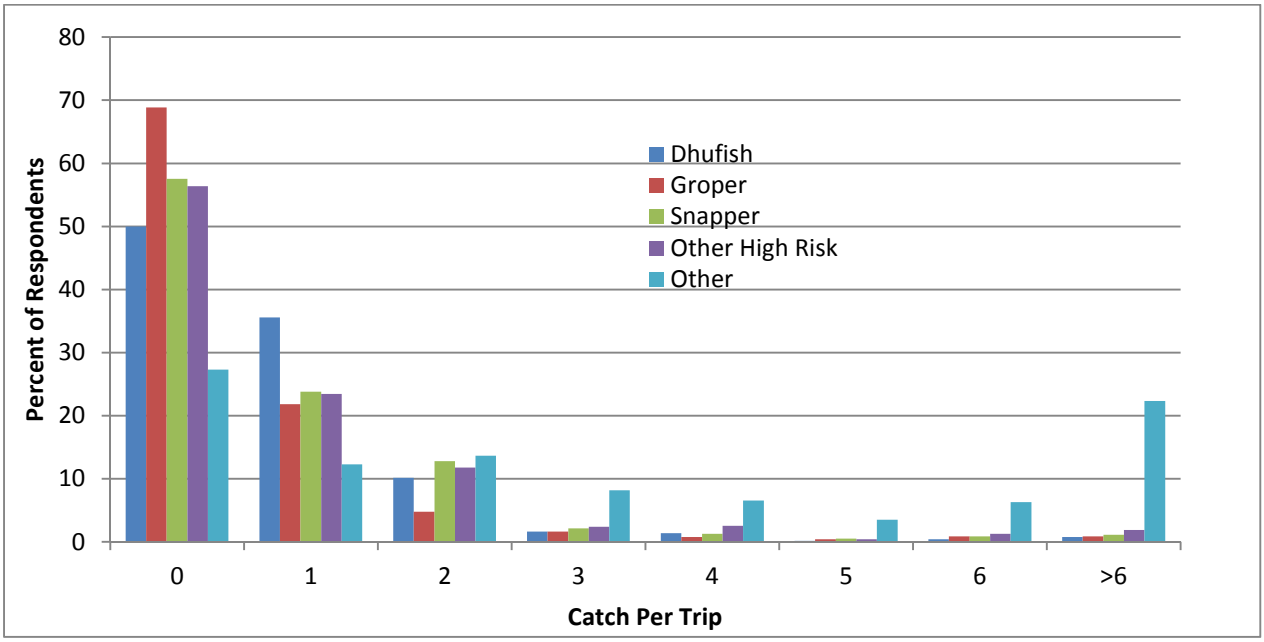

Figure 5: Distribution by Retained Catch per Trip by Species for 2010 Survey.

The retained catch statistics are given in Table 25. The mean catch per trip in the previous twelve months was 0.76 for Dhufish, 0.83 for Pink Snapper, 0.57 for Baldchin Groper, 0.97 for the other high risk species defined in Table 16 and 5.99 for the remaining species. Combined "other" species have a mean of 6.97.

Table 25 Summary Statistics for Retained Catch 2010 Survey.

	Dhufish	Pink Snapper	Baldchin Groper	Other High Risk	Other Species	All Other Combined
mean	0.76	0.83	0.57	0.97	5.99	6.97
min	0	0	0	0	0	0
max	12	22	20	30	200	204

7.7.3 Released Catch

Moving to the 2010 season there was a greater emphasis in management on release procedures catch including compulsory possession of a “release weight”.

Table 26 shows the distribution of released catch per trip by species for the previous twelve months. Most respondents released none or only one fish.

The mean number of fish caught per trip is shown in Table 27. For Dhufish the mean released catch per trip is 1.72 compared to 0.76 retained. For Pink Snapper the mean released catch per trip is 2.33 compared to only 0.83 retained. For Baldchin Groper the figure is 0.63 for released catch which only slightly above the mean of 0.57 for retained catch.

The retained catch relied heavily on other species. Other high risk species retained averaged 5.99 per trip but average released catch was less at only 1.11. For the other species category average retained catch was 6.97 per trip whilst average released catch was again less at 5.41.

Table 26 Distribution by Released Catch per Trip by Species for 2010 Survey.

Number of Fish/Trip	Dhufish	Baldchin Groper	Pink Snapper	Other High risk	Other Species	All Other Combined
0	44.86	81.2	50	64.91	41.6	29.82
1	20.8	8.27	13.66	13.78	8.77	9.77
2	16.42	5.14	12.78	9.27	11.78	11.65
3	5.51	1.38	6.77	3.76	6.77	7.89
4	3.88	1.38	4.89	3.01	4.64	6.64
5	2.51	0.5	2.26	0.63	4.76	6.27
6	1.75	0.5	2.88	1.88	7.27	6.52
>6	4.26	1.63	6.77	2.76	14.41	21.43

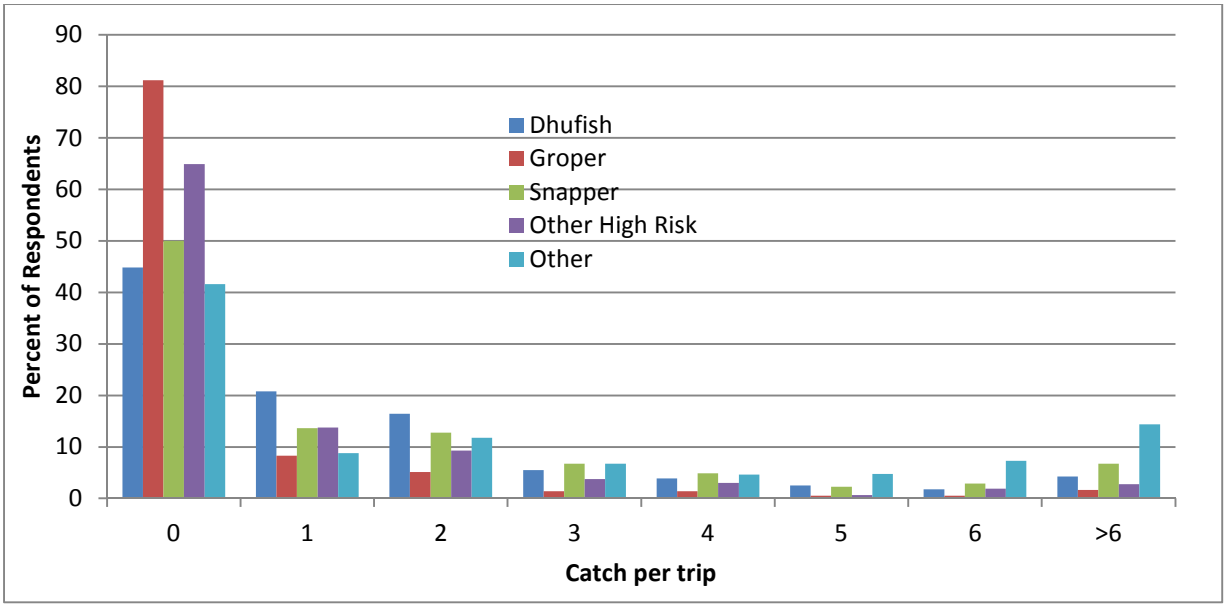

Figure 6: Distribution by Released Catch per Trip by Species for 2010 Survey.

Table 27 Summary Statistics for Released Catch 2010.

	Dhufish	Pink Snapper	Baldchin Groper	Other High Risk	Other Species	All Other Combined
mean	1.72	2.33	0.63	1.11	4.31	5.41
min	0	0	0	0	0	0
max	50	100	40	40	100	138

7.8 Satisfaction with the 2010 Fishing Experience

Questions to elicit satisfaction scores were also included in the 2010 survey dealing. These took the same form as for the 2003 survey and covered the degree to which fishers were satisfied with various aspects of their fishing experience. The scores for each aspect ranged from 1(very unsatisfied) to 5(very satisfied). The list of attributes considered and the mean scores are given in Table 28.

Table 28 Mean Satisfaction Scores for Dimensions of Fishing Experience 2010 Survey.

	Mean Score
No congestion at the boat ramp	3.49
Catching as many fish as you expect to	3.09
The number of fish you catch and keep	3.32
The size of the fish you catch and keep	3.54
The species of the fish you catch and keep	3.53
The time it takes to catch the number of fish you expected to	3.84
The time it takes to catch the number of fish you want to keep	3.09
Catching enough fish for a decent feed	3.53
Enjoying the fishing experience, regardless of the number of fish caught and kept	4.70
Having an enjoyable time out on the ocean	4.79

On balance fishers in 2010 were well satisfied. Very high satisfaction scores were assigned to both the overall fishing experience and the overall experience of time on the ocean. The satisfaction scores for

the broader fishing activity at above 4.5 are higher than the mean scores for any of the direct fishing activities. For the rest, respondents were reasonably happy.

7.9 Comparative Analysis of the Surveys 2010 and 2003

7.9.1 Comparing the Number of Fishing Trips per Year

The 2003 survey recorded the exact number of trips in the previous 12 months; the 2010 survey recorded this information in ranges. The earlier survey has been recoded to match the ranges used in the 2010 survey. The results are shown in Table 29. Figure 7 shows the two frequency distributions compared.

Table 29 Comparison of Number of Trips in the Previous 12 Months 2003 and 2010 Surveys.

Description	Code	2003		2010	
		#	%	#	%
1-2 (rarely)	2	49	13.32	117	14.66
3-6 (a few times)	3	110	29.89	233	29.2
7-12 (once a month)	4	97	26.36	213	26.69
13-24 (twice a month)	5	64	17.39	161	20.18
25-50 (weekly)	6	39	10.60	61	7.64
51 or more (more than weekly	7	9	2.45	13	1.63
		368	100	798	100

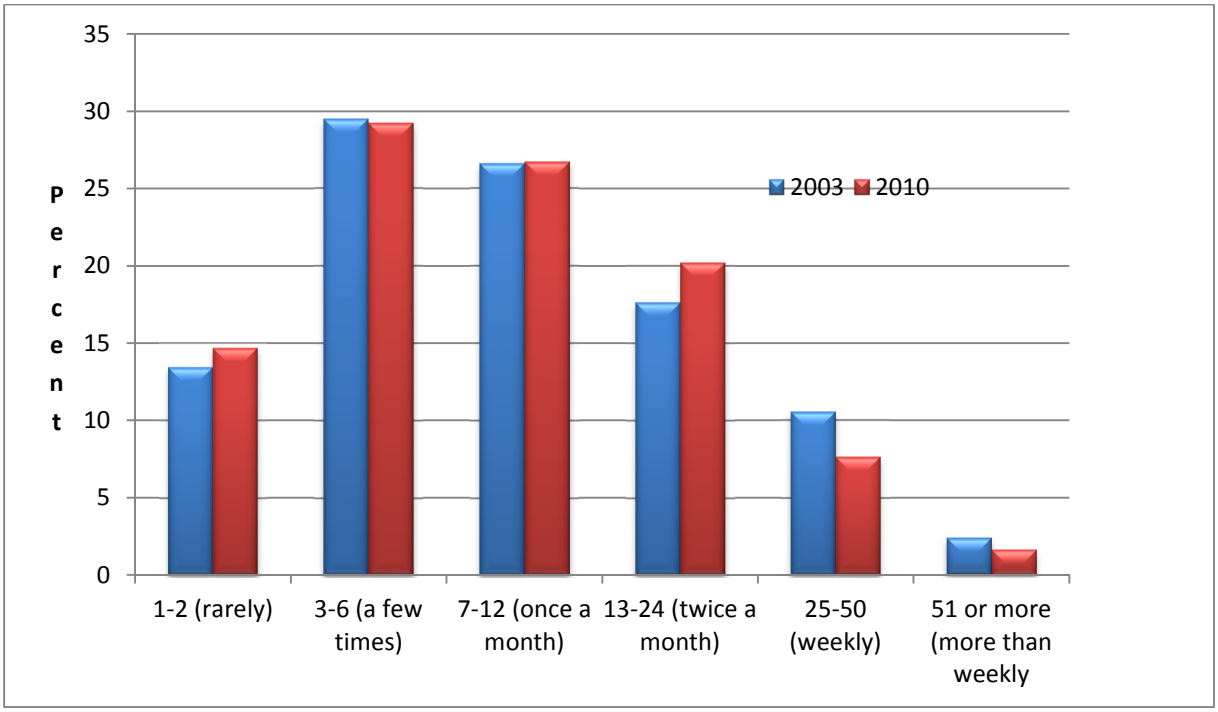

Figure 7: Number of Trips in Previous 12 Months 2003 and 2010 Surveys.

The two distributions are not significantly different. The null hypothesis that they are the same cannot be rejected using the standard chi square test at the five per cent level.

7.9.2 Comparison of Trip Time and Fishing time

The comparison of 2003 and 2010 fishing time is shown in Table 30. Mean trip and fishing times are lower in 2010 apart from the category “non Fishing Ocean time”.

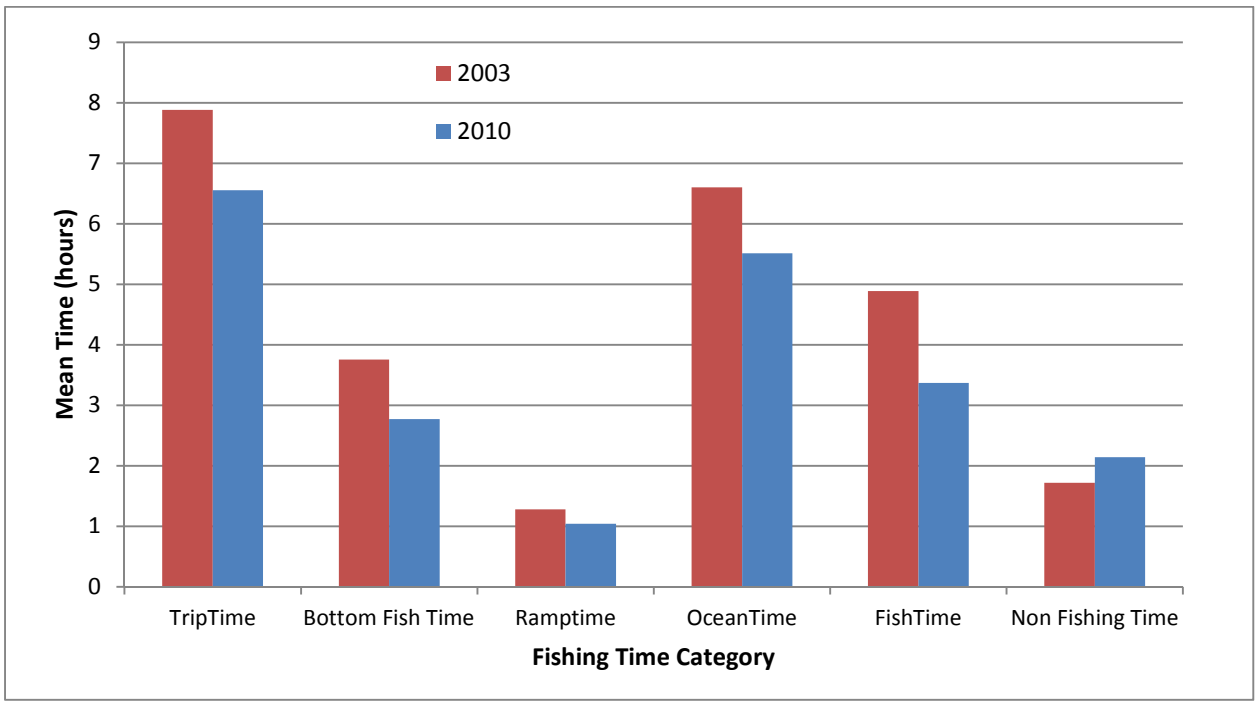

Table 30: Trip Time and Fishing Time in 2003 and 2010 Surveys

Table 31 shows the comparison between the mean trip and fishing times for 2003 and 2010 together with the t -values for the difference between the means. The differences are significant at 1% or better. The 2010 trip time, ocean time, fishing time, bottom fishing time are all significantly less than 2003. The non fishing time at sea is significantly higher in 2010 than it was in 2003.

Table 31: Test of Difference in Mean Trip and Fishing Time between 2003 and 2010 Surveys.

		2003			2010		T value
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	
Trip Time	363	7.88	3.24	700	6.55	3.00	6.5
Bottom Fishing	363	3.76	1.97	700	2.77	2.09	7.6
Ocean Time	363	6.60	2.74	700	5.51	2.24	6.5
Fishing Time	363	4.89	2.59	700	3.37	2.34	9.4
Other Ocean Time	363	1.72	2.12	700	2.14	2.00	-3.1

7.9.3 Comparing Retained and Released Catch

The catch performance of respondents across the two surveys is compared below. This is done on a retained/released catch basis by species. The mean catch per trip for the 2003 and 2010 surveys is given in Figure 8. Mean catch for Dhufish, snapper and groper are lower but higher for other species.

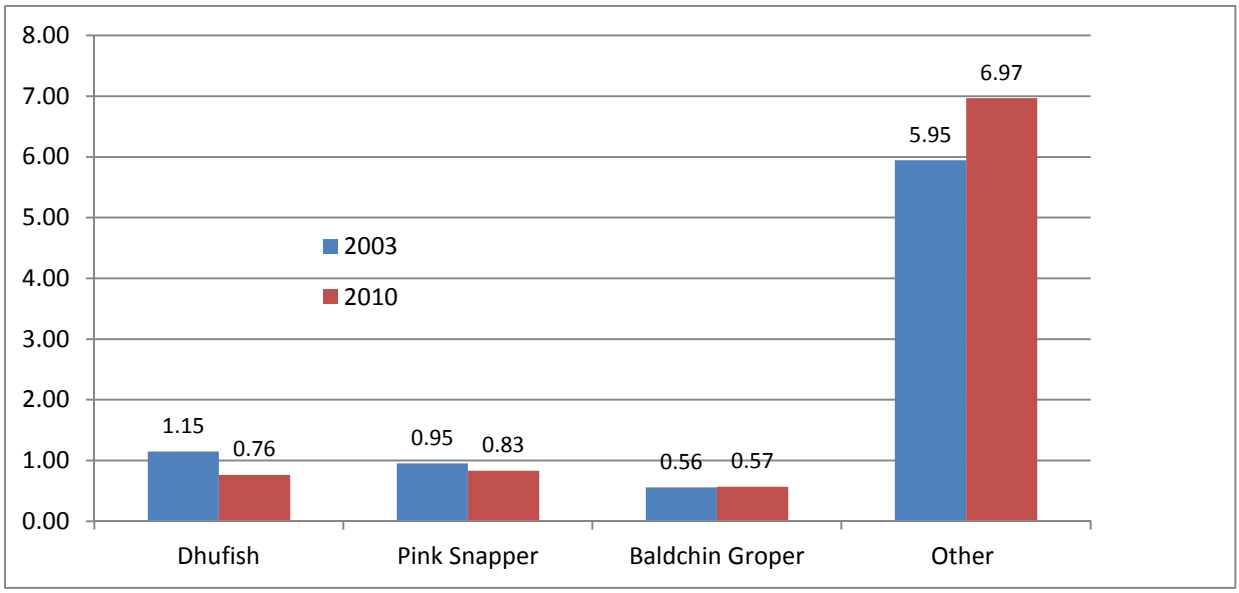

Figure 8: Mean Retained Catch per Trip 2003 and 2010 Surveys.

The T-test on means indicates that, at the 5% significance level, the mean retained Dhufish catch is significantly lower in 2010, but the mean catch per trip for snapper and groper and other species is not significantly different between the two periods.

The mean released catch per trip is shown in Figure 9.

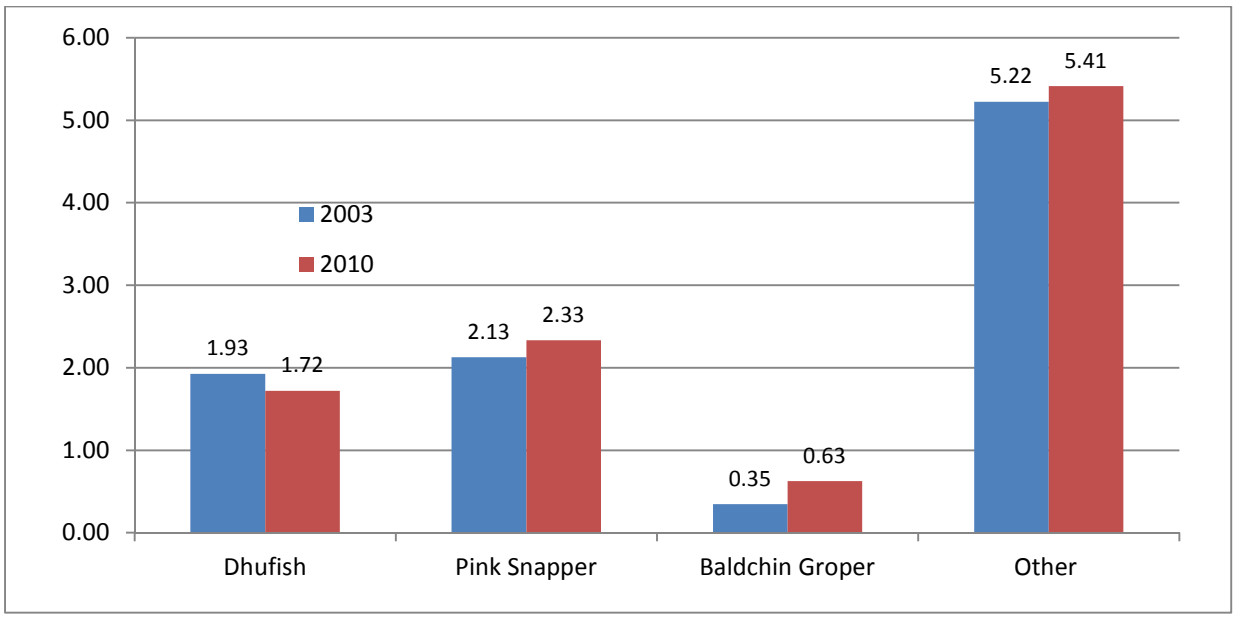

Figure 9: Mean Released Catch per Trip 2003 and 2010 Surveys.

The T-test on means indicates that, at the 5% significance level, the mean released groper catch is significantly higher in 2010, but the mean released catch per trip for Dhufish, snapper and other species is not significantly different between the two periods.

7.9.4 Comparative Satisfaction Scores for Fishing in the West Coast Demersal Fishery

In the 2003 survey fishers were very satisfied with the overall fishing experience, less so with individual catch experience (Table 14).

The 2010 survey contained a virtually identical set of questions dealing with the degree to which fishers were satisfied with various aspects of their fishing experience. The scores for each aspect ranged from 1(very unsatisfied) to 5(very satisfied). The mapping of these questions is shown in Table 32

Table 32 Mapping of Satisfaction Scale Questions between 2003 and 2010 Surveys.

2003 Question		2010 Question	
10ba	No congestion at the boat ramp	15a	Level of congestion at the boat ramp
10bb	Catching as many fish as you expect to	15b	The number of fish you catch
10bc	The number of fish you catch and keep	15c	The number of fish you keep
10bd	The size of the fish you catch and keep	15d	The size of the fish you catch
		15e	The species of fish you catch
10be	The species of the fish you catch and keep	15f	The species of fish you keep
10bf	The time it takes to catch the number of fish you expected to	15g	The time it takes to catch the number of fish you expected to
10bg	The time it takes to catch the number of fish you want to keep		
10bh	Catching enough fish for a decent feed	15h	Catching enough fish for a decent feed
10bi	Enjoying the fishing experience, regardless of the number of fish caught and kept	15i	Enjoying the fishing experience, regardless of the number of fish caught and kept
10bj	Having an enjoyable time out on the ocean	15j	Having an enjoyable time out on the Ocean

The mean satisfaction scores for the two surveys are given in Table 33.

Table 33 Mean Satisfaction Scores 2003 and 2010 Surveys.

	2003	2010
Level of congestion at the boat ramp	3.69	3.50
The number of fish you catch	3.47	3.09
The number of fish you keep	3.59	3.34
The size of the fish you catch	3.67	3.56
The species of fish you keep	3.73	3.85
The time it takes to catch the number of fish you expected to	3.54	3.11
Catching enough fish for a decent feed	3.65	3.55
Enjoying the fishing experience, regardless of the number of fish caught and kept	4.50	4.69
Having an enjoyable time out on the Ocean	4.67	4.78

There appear to be minor differences in satisfaction. In the following section we consider whether these differences are statistically significant.

7.9.5 Congestion at Boat Ramps

The satisfaction with boat ramp congestion is shown in Figure 10. The distributions are significantly different. The means satisfaction score fell from 3.69 50 3.50 and this fall is significant at the one per cent level.

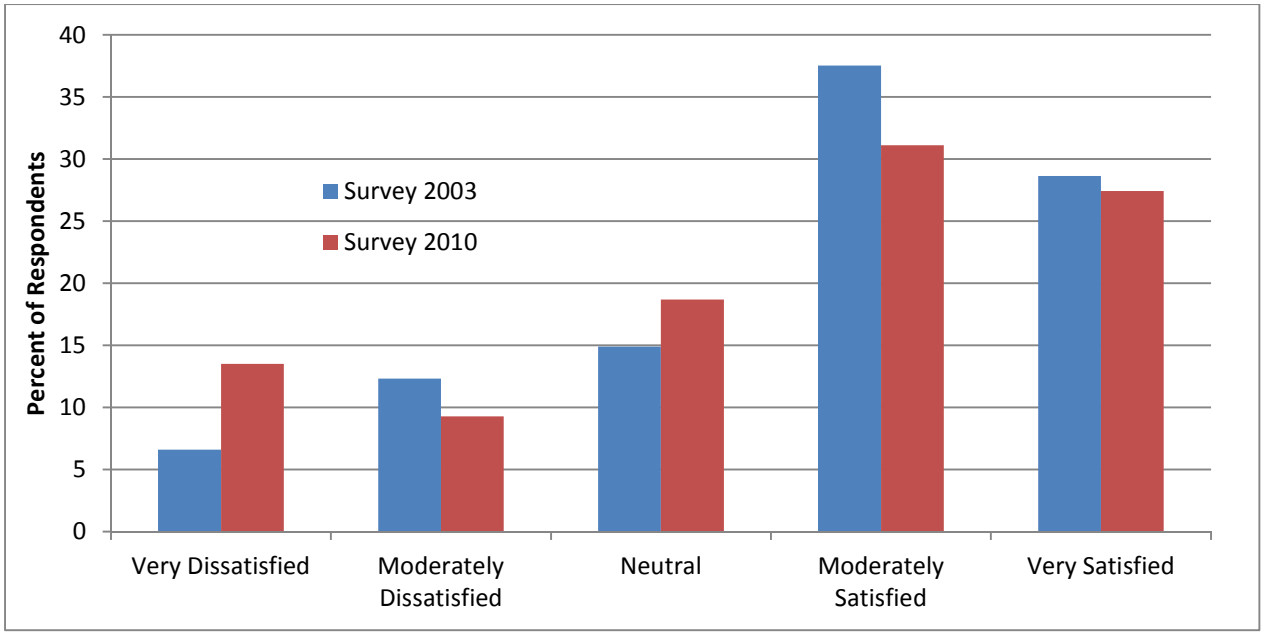

Figure 10: Satisfaction Scores for Boat Ramp Congestion 2003 and 2010 Surveys.

7.9.6 Fish Retained

Satisfaction with fish retained is given in Figure 11. Mean satisfaction fell from 3.59 to 3.34. The chi square test indicates that the distributions are significantly different. There has been a statistically significant fall in mean satisfaction with fish caught and kept at the one per cent level of significance.

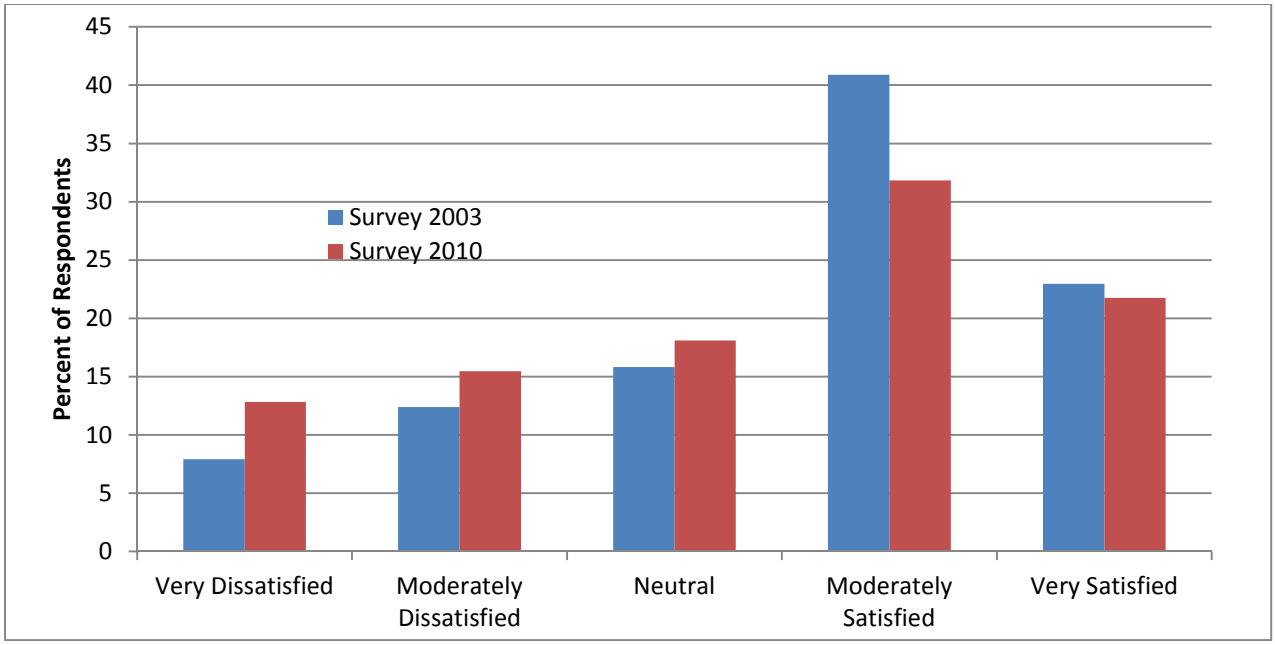

Figure 11 Satisfaction Scores for Fish Retained 2003 and 2010 Surveys.

7.9.7 Size of Fish Retained

Satisfaction with fish retained is given in Figure 12. Mean satisfaction fell from 3.67 to 3.56. The chi square test indicates that the distributions are significantly different. The mean score is not significantly different at the five per cent level.

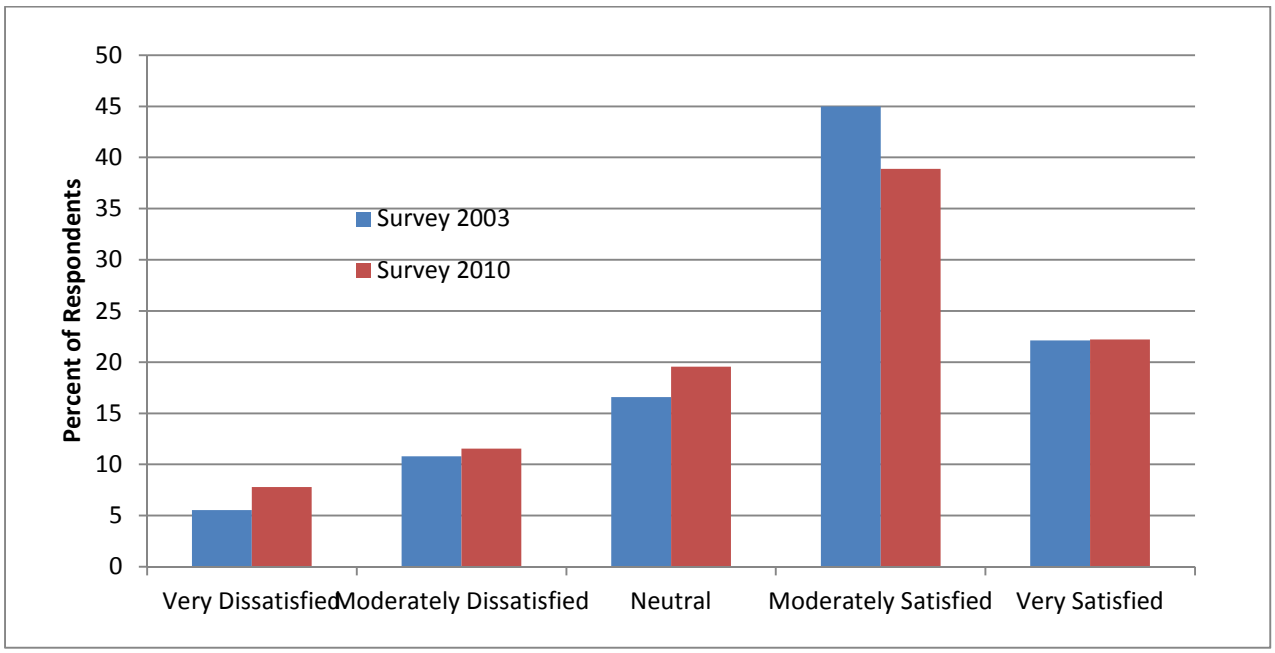

Figure 12 Satisfaction Scores for Size of Fish Retained 2003 and 2010 Surveys.

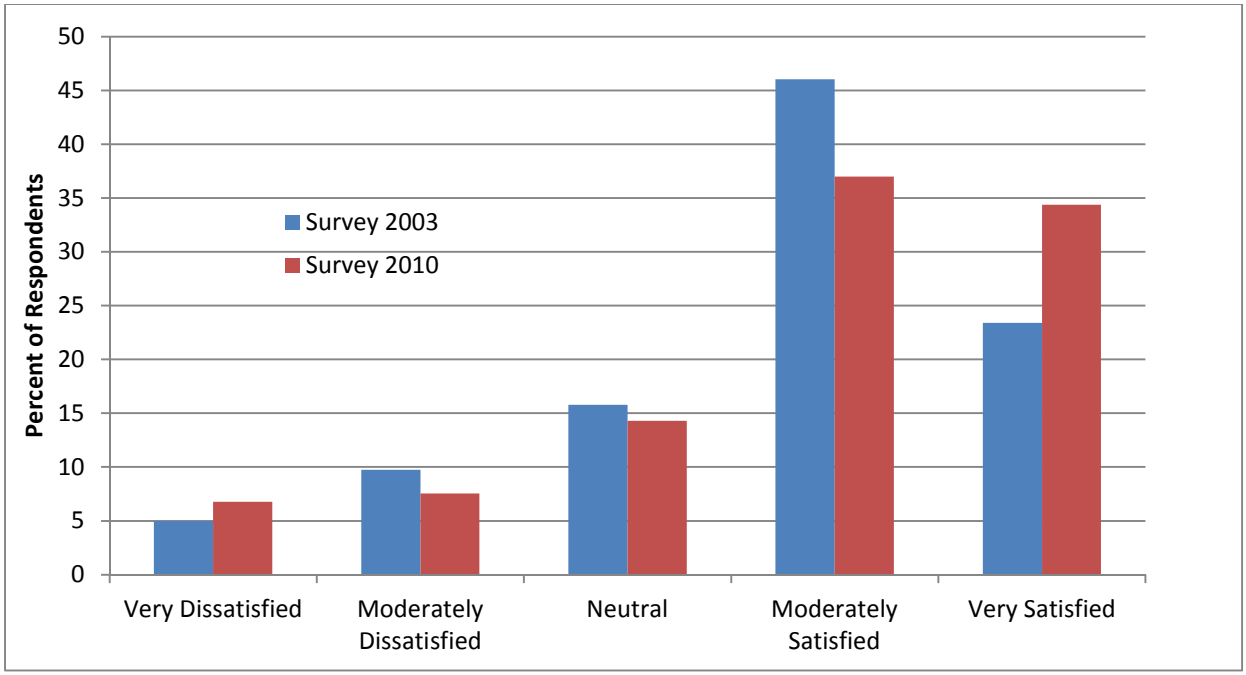

Figure 13 Satisfaction Scores for Species of Fish Retained 2003 and 2010 Surveys.

Satisfaction with the species of fish retained is given in Figure 13. Mean satisfaction in this case actually increased from 3.73 to 3.85. The chi square test indicates that the distributions are significantly different. In this case we can reject the null hypothesis of zero difference in favour of their being an increase in satisfaction with species caught. The mean score difference is significant at the five per cent level.

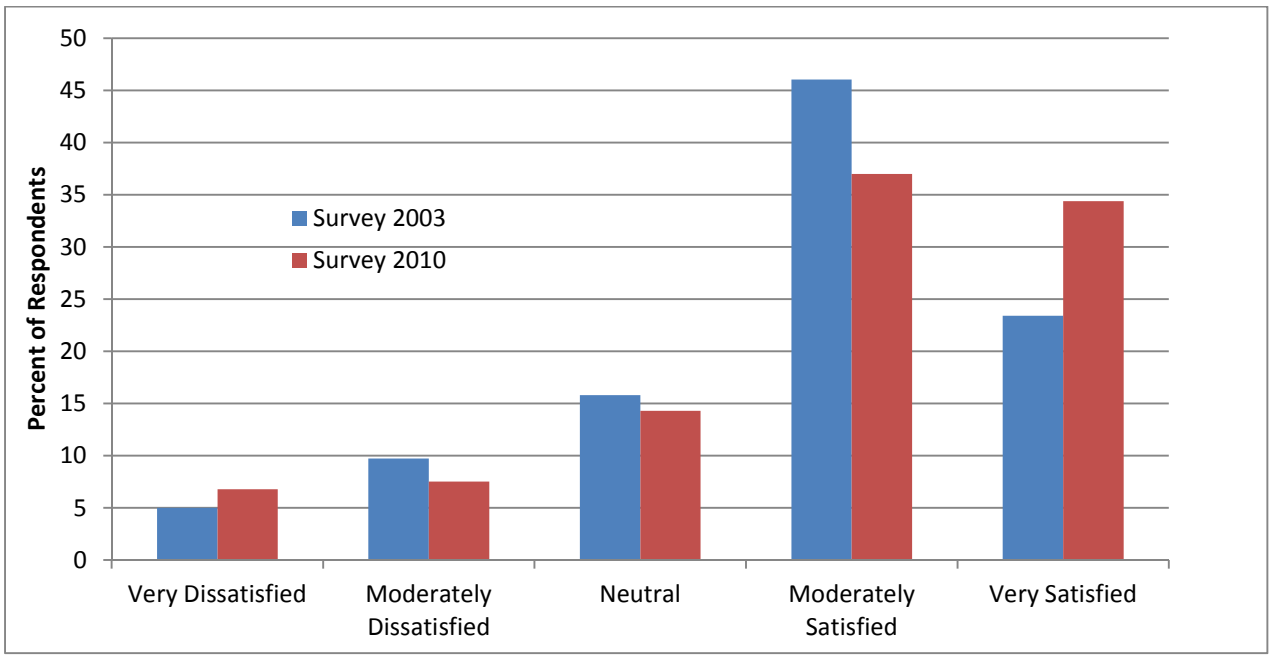

Figure 14: Satisfaction Scores for Species of Fish Kept 2003 and 2010 Surveys.

7.9.8 Time Taken to Catch Fish

In subsequent sections we investigate the role of catch rate in influencing behaviour. Satisfaction with catch rate is given in Figure 15. Mean satisfaction in this case decreased from 3.54 to 3.11. The chi square test indicates that the distributions are significantly different. In this case we can reject the null hypothesis of zero difference in favour of their being a decrease in satisfaction with catch rate.

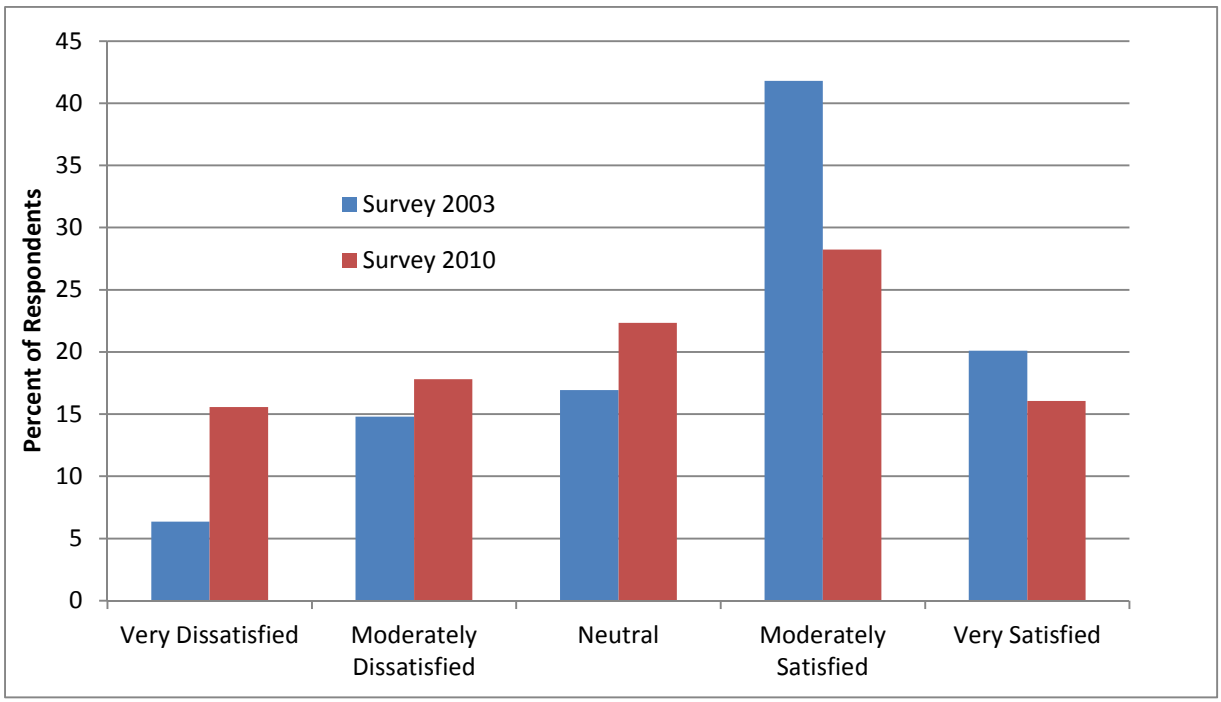

Figure 15: Satisfaction Scores for Time Taken to Catch Fish 2003 and 2010 Surveys.

7.9.9 Enough Fish for a Decent Feed

Satisfaction with catching enough fish for a decent feed is given in Figure 16. Mean satisfaction in this case decreased from 3.65 to 3.55. The chi square test indicates that the distributions are not significantly different. In this case we cannot reject the null hypothesis of zero difference in favour of their being a decrease in satisfaction with catch rate.

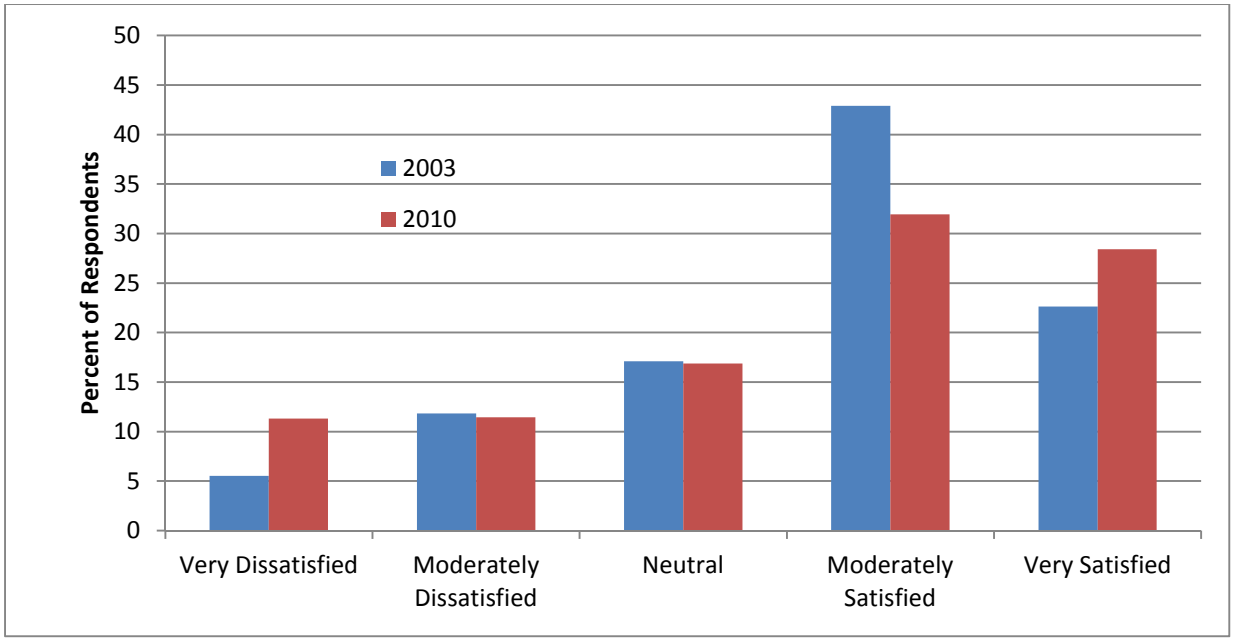

Figure 16 Satisfaction Scores for Catching Enough Fish for a Decent Feed 2003 and 2010 Surveys.

7.9.10 Overall Enjoyment of Fishing Experience

On most dimensions satisfaction scores have declined. The exceptions were satisfaction with species caught which increased and satisfaction with food value which was no different.

Satisfaction with overall fishing experience is given in Figure 17. Mean satisfaction in this case increased from 4.50 to 4.69. The chi square test indicates that the distributions are significantly different. In this case we can reject the null hypothesis of zero difference in favour of their being an increase in overall satisfaction with the fishing experience. The means are different at the one per cent level.

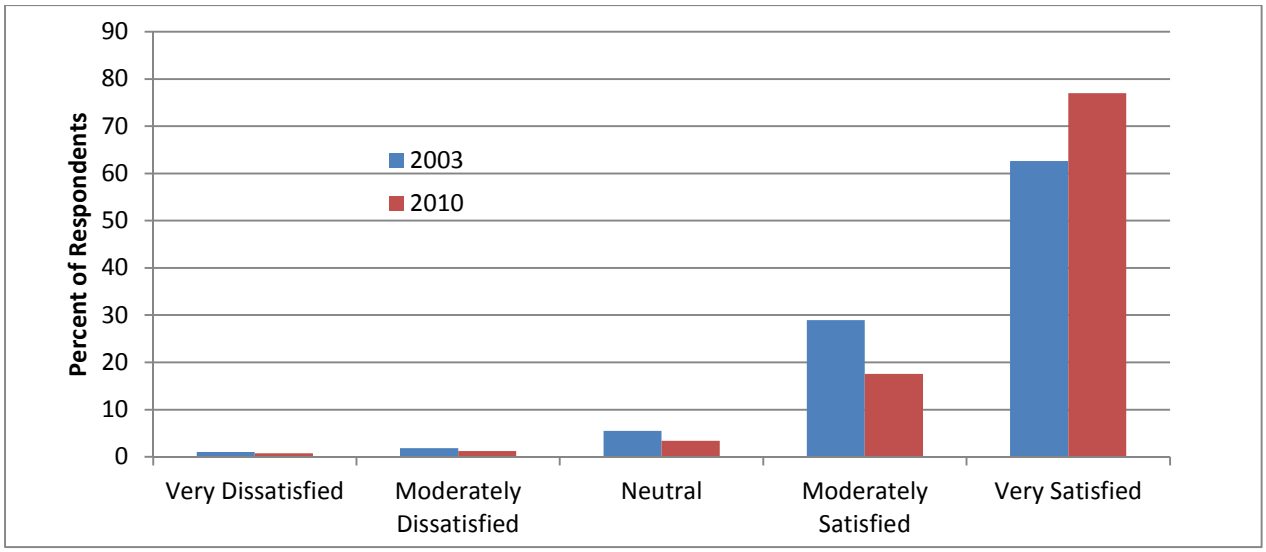

Figure 17: Satisfaction Score for Overall Enjoyment of Fishing Experience 2003 and 2010 Surveys.

7.9.11 Overall Enjoyment of Time on Ocean

As with the overall fishing experience respondents are also more satisfied with the overall ocean experience. Satisfaction with overall ocean experience is given in Figure 18. Mean satisfaction in this case increased from 4.7 to 4.8. The chi square test indicates that the distributions are significantly different Again this increase in overall satisfaction is reflected in the mean scores being significantly different at the one per cent level.

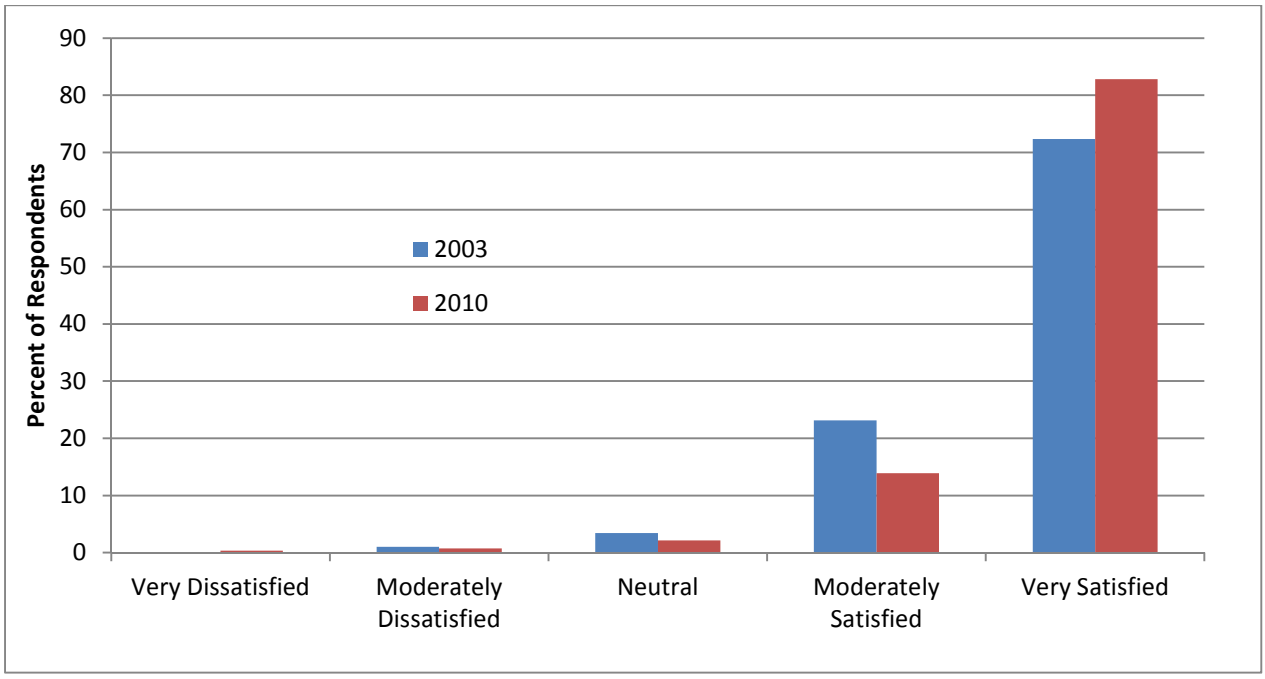

Figure 18: Satisfaction Scores with Overall Trip on Ocean 2003 and 2010 Surveys.

7.10 Post Regulation: The 2011 Survey Results for Recreational Fishing in the Constrained

7.10.1 The 2011 survey

The extended closed season and the new bag limits had been introduced in 2010. They were effectively one year old at the time of the 2011 survey. They key issue for the 2011 survey was to determine if with 12 months experience of these binding constraints, fisher behaviour had been further modified and whether the satisfaction scores recorded in 2010 were being maintained.

A major set of questions were introduced in 2011 to accommodate feedback received from fisheries managers in relation to the 2010 results. The comparison between 2003 and 2010 had documented some important and statistically significant results. In particular, catch per trip had declined for the preferred target species and trip time trip time was lower. Satisfaction scores with key catch related measures (number of fish, size of fish, catch rate) were lower but overall satisfaction with the overall ocean experience and fishing experience remained high, with no significant decline. Questions were added to the 2011 survey to obtain information on other activities pursued by fishers while on a fishing trip, on the grounds that fishers may be responding to the fishing constraints by substituting other non-fishing activities

7.10.2 Survey population and sample size.

Recreational fishing licences had commenced for the 2010 survey. The 2011 survey used the same sampling frame that had been constructed from the data base on recreational fishing licences at that time of the 2010 survey.

A final sample of 650 completed telephone surveys was obtained spread across metropolitan area. Of these, 567 had trips of one day duration or less. Considerable effort had gone into the 2010 survey to contact licence holders in the non-metropolitan areas -South West, Mid West and Kalbarri proportional to the population of license holders. However, in the event sample size was too small from some areas to justify separate analysis. For the 2011 survey the focus was on the metropolitan area.

7.10.3 Socio Economic Composition

Respondents were predominately male (93 percent). Retirees and pensioners were around 19 percent of the sample. The majority (66 percent) were engaged in full time employment.

This is virtually identical to the 2010 survey where 91 percent were male, 17 percent were pensioners and 70 percent were in full time employment. `

Disclosed annual incomes (before tax) of respondents are summarized in Table 34. In 2011, incomes were oriented towards the higher income groups with 61 per cent earning above $51,999 annually and 39 percent earning above $88,400 annually. Median and mean income was in the range $52,000-$88,399 for both the 2010 and 2011 surveys.

Table 34 Income Distribution 2010 and 2011 Surveys.

Annual Incomes	Obs. 2010.	Percentage of Respondents 2010	Obs. 2011.	Percentage of Respondents 2010
Nil or negative income	21	3.1	18	3.18
$1-$25,999	83	12.24	97	17.14
$26,000-$33,799	51	7.52	37	6.54
$33,800-$51,999	93	13.72	68	12.01
$52,000-$88,399	184	27.14	126	22.26
$88,400-$103,999	109	16.08	96	16.96
$104,000-$129,999	61	9	65	11.48
$130,000-$155,999	36	5.31	31	5.48
$156,000-$207,999	21	3.1	12	2.12
$208,000 or more	19	2.8	16	2.83
Total	678	100	566	100

7.10.4 Boat Use

The type of boats owned by respondents is shown in Table 35. As expected the bulk are power boats (97% in both 2003 and 2010). Respondents were asked to indicate boat market value. The mean boat value was $62,271. The minimum value was $1,500 and the maximum was $9 million.

Table 35 Boat Type for 2010 and 2011 Surveys.

	2010 Survey			2011 Survey	
	Freq.	Percent		Freq.	Percent
Powerboat - moored or penned	29	4.78		50	9.28
Powerboat - transported on trailer	560	92.26		473	87.76
Sailboat - moored or penned	2	0.33		1	0.19
Sailboat - transported on trailer	1	0.16		1	0.19
Other	15	2.47		14	2.6
Total	607	100		539	100

Boat usage patterns are shown in Table 36. Only 8 percent of boats are used more than once a week in 2011 compared to 12 percent in 2003. Around 15 to 16 percent of boats are used less than 6 times a year in both surveys.

Table 36 Frequency of Boat Use 2010 and 2011 Surveys.

	2010 Survey		2011 Survey	
	Freq.	Percent	Freq.	Percent
0 times	6	0.99	8	1.48
1-2 (rarely)	8	1.32	12	2.23
3-6 (a few times)	78	12.85	66	12.24
7-12 (once a month)	129	21.25	122	22.63
13-24 (twice a month)	187	30.81	163	30.24
25-50 (weekly)	126	20.76	123	22.82
51 or more (more than weekly)	70	11.53	44	8.16
Don't Know	3	0.49	1	0.19
Total	607	100	539	100

Fishing dominates boat use. Table 37 shows the per cent of the boat use time in the major activities. Fishing dominates with 74 per cent of boat use time in 2010 and 77 per cent of boat use time in 2011

Table 37 Percentage of Time Boat Used for Recreation, Fishing and Other Activities 2010 and 2011 Surveys.

	2010 Survey		2011 Survey	
Variable	Obs.	Mean	Obs.	Mean
Recreation	598	17.95	530	14.89
Fishing	598	74.29	530	76.91
Other	598	7.75	530	8.20

7.10.5 Skill and Experience of Fishers

Fishers may register satisfaction with fishing and react to changes according to their experience and skill. The 2011 survey collected information on number of years fishing and the way fishers perceived their skills. Self-assessed skills are shown in Table 38. Thirteen per cent of fishers consider themselves very skilled and thirty four per cent consider themselves 'above average'. The bulk, some forty seven per cent rate themselves 'average'. Years of fishing experience is shown in Figure 19. Mean fishing years for bottom species is 23 years with a minimum of one year and a maximum of seventy years.

Table 38 Self Assessed Skill Levels of Fishers 2011 Survey.

Skill	Freq.	Per cent	Cum.
Unskilled1	5	0.88	0.88
Below Average	21	3.7	4.59
Average	271	47.8	52.38
Above Average4	194	34.22	86.6
Very skilled	76	13.4	100
Total	567	100	

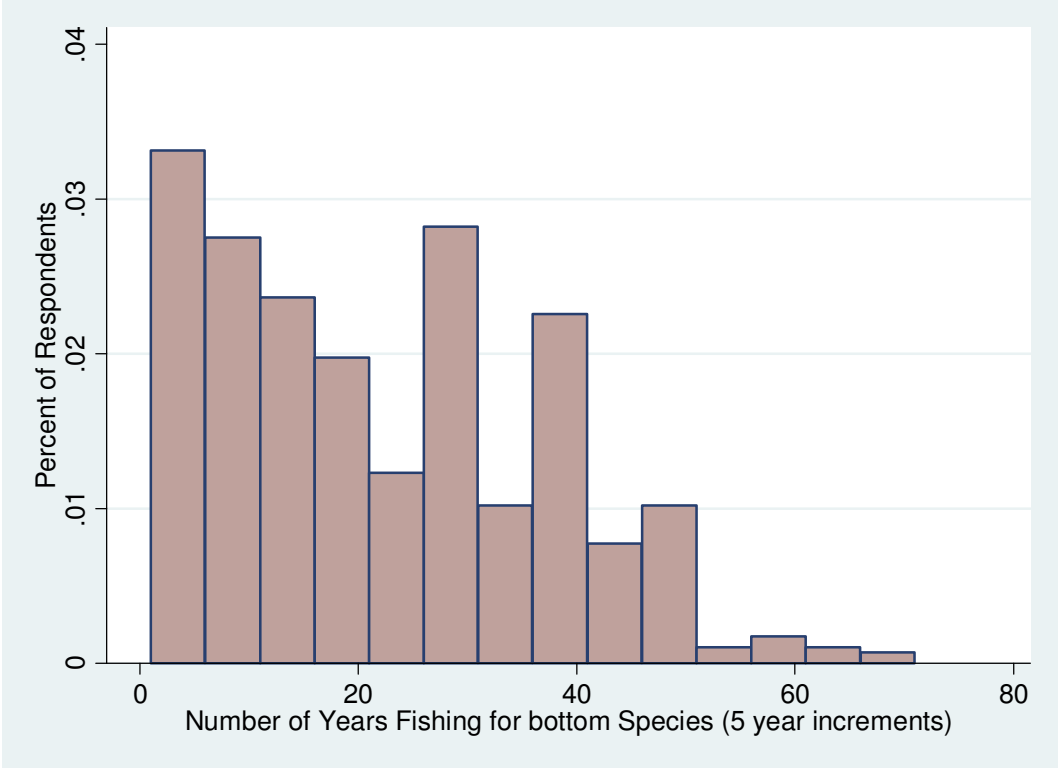

Figure 19 Years of Fishing Experience 2011 Survey.

7.11 Fishing Behaviour in 2011

7.11.1 Number of Trips per Year

The number of trips per annum for 2010 and 2011 are shown in Table 39 and in Figure 20. The median number of trips is 7-12 per month in both cases. The mean number of trips in 2011 was 12.05. The

distributions as shown in Figure 20 are significantly different with a reduction in the percent of fishers going rarely (1-2 times per year) and twice monthly (13-24 times per year).

Table 39 Number of Trips per Year in 2010 and 2011 Surveys.

Description	Code	2010		2011	
		#	%	#	%
1-2 (rarely)	2	110	14.67	53	9.35
3-6 (a few times)	3	211	28.13	184	32.45
7-12 (once a month)	4	205	27.33	160	28.22
13-24 (twice a month)	5	156	20.8	105	18.52
25-50 (weekly)	6	57	7.6	61	10.76
51 or more (more than weekly	7	11	1.47	4	0.71
Total		750	100	567	100

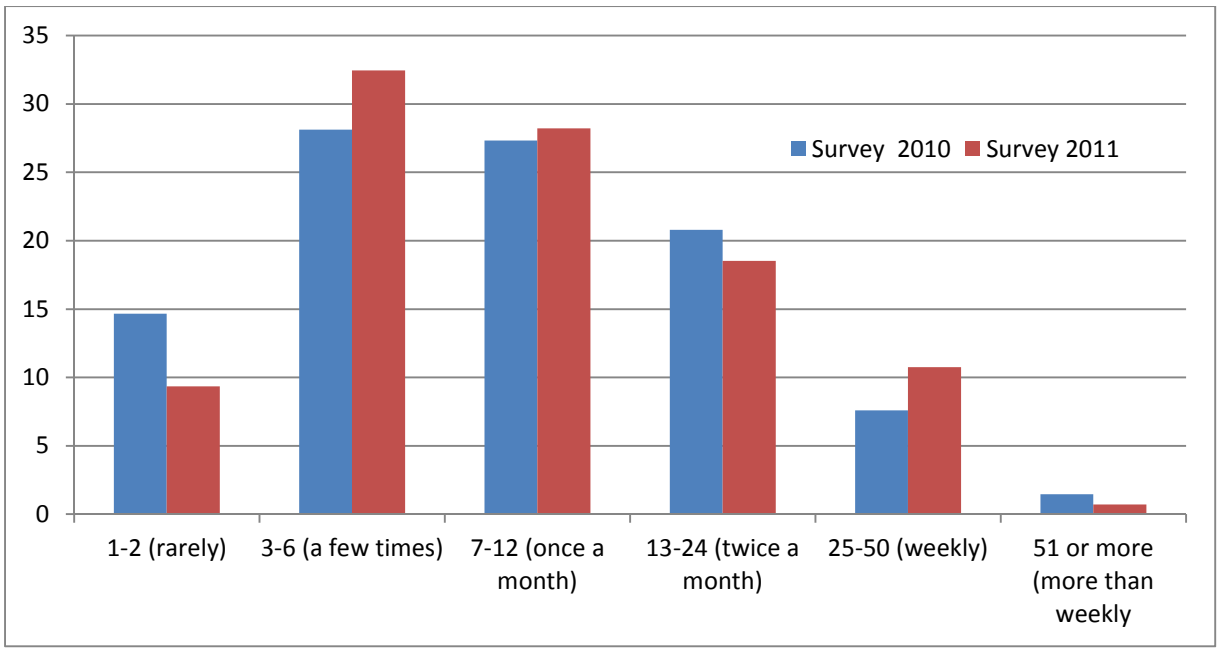

Figure 20: Comparison of Number of Trips in Previous 12 Months 2010 and 2011 Surveys.

7.11.2 Trip Times and Fishing Times

The previous analysis of trip and fishing time indicated that, compared to 2003 mean trip and fishing times were lower in 2010 apart from the category “non Fishing Ocean time”. This response was consistent with the choice model in Section 6.4 and the implication that anything that constrains the fishing activity and reduces the net benefit from fishing would reduce trip time and fishing time. Table 40 shows the trip time comparison between the 2010 and 2011 surveys. The total trip time is not significantly different However, compared to 2010, mean fishing time has increased and mean non

fishing time has fallen. This is a reverse of the change estimated for 2003 to 2010 when trip time, ocean time and fishing time all fell and fishing time fell as a proportion of ocean time.

Reasons for this result are not easily determined. Arguably 2010 was the 'shock' change with tighter bag limits and a new closed season, 2011 were 'refinement' changes. Hence levels of satisfaction did not further deteriorate and there is some evidence (see below) that some minor but significant increases in satisfaction levels occurred between 2010 and 2011 with key fishing indicators including number and species of fish caught.

Table 40 Comparison of Trip Time and Fishing Time between 2010 and 2011 Surveys.

	2010			2011			
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	t-value
Trip Time	700	6.55	3.00	567	6.50	2.67	0.31
Travel to Ramp	700	1.04	1.82	567	0.80	1.05	2.30
Ocean Time	700	5.51	2.24	567	5.69	2.23	1.42
Fishing Time	700	3.37	2.34	565	3.94	1.88	4.7
Other Ocean Time	700	2.14	2.00	567	1.65	1.04	5.2

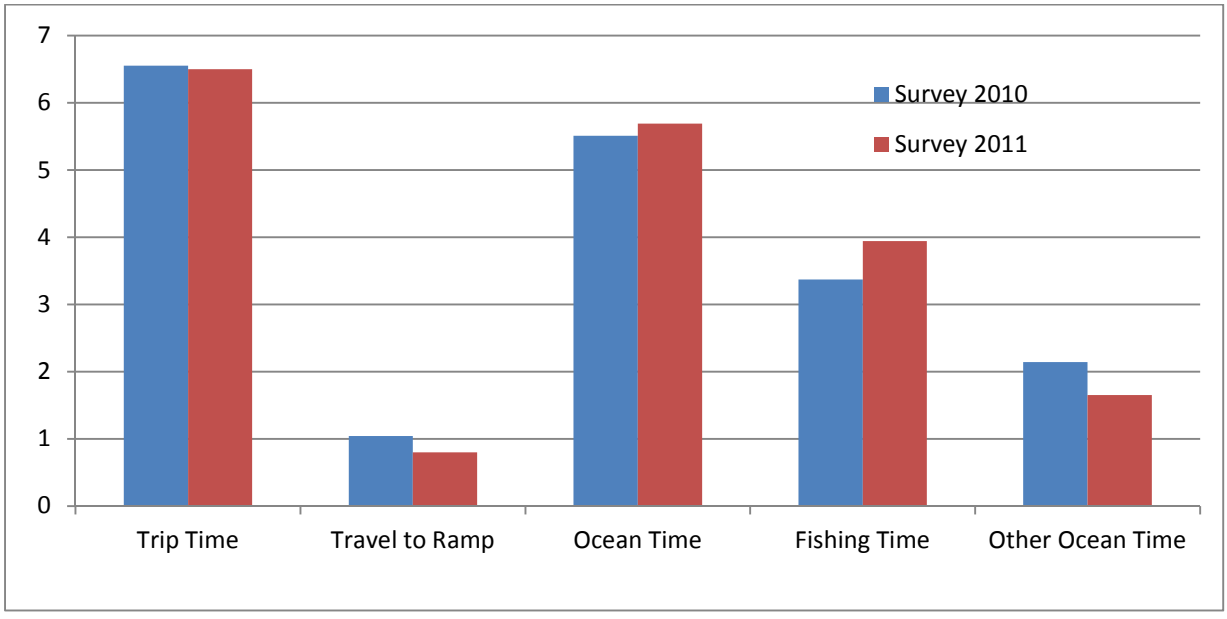

Figure 21 Trip Time and Fishing Time 2010 and 2011 Surveys.

7.11.3 Bag Limits and Retained Catch

The distribution of retained catch per trip by species for the previous 12 months in the 2011 survey is given in Table 41 and Figure 22 The 2011 survey results indicate that for Dhufish, Baldchin Groper and Pink Snapper and other high risk species greater than 50% of respondents reported zero catch while over 80% reported catches of one or zero. For the "other species" category the distribution spreads with 65% of respondents reporting a catch per trip greater than zero and twenty one percent reporting a catch per trip greater than six.

The mean number of fish caught and retained per trip is shown in Table 42. For Dhufish the mean retained catch per trip is 1. For Pink Snapper the mean retained catch per trip is 1.16 and for Baldchin Groper the figure is 0.82. Other high risk species have a retained catch of 1.12 while for other species the mean retained catch is 7.62.

Table 41 Distribution of Retained Catch per Trip by Species 2011 Survey.

Number of Fish/Trip	Dhufish	Baldchin Groper	Pink Snapper	Other High risk	Other Species
0	51.15	70.14	55.48	60.78	34.74
1	32.04	17.49	24.73	21.2	10.23
2	8.85	5.12	9.19	8.66	11.46
3	1.42	0.88	2.65	3	7.94
4	1.06	1.24	0.71	0.88	5.64
5	1.24	1.06	1.77	0.35	2.65
6	2.12	1.24	2.3	2.3	6
>6	2.12	2.83	3.18	2.83	21.34

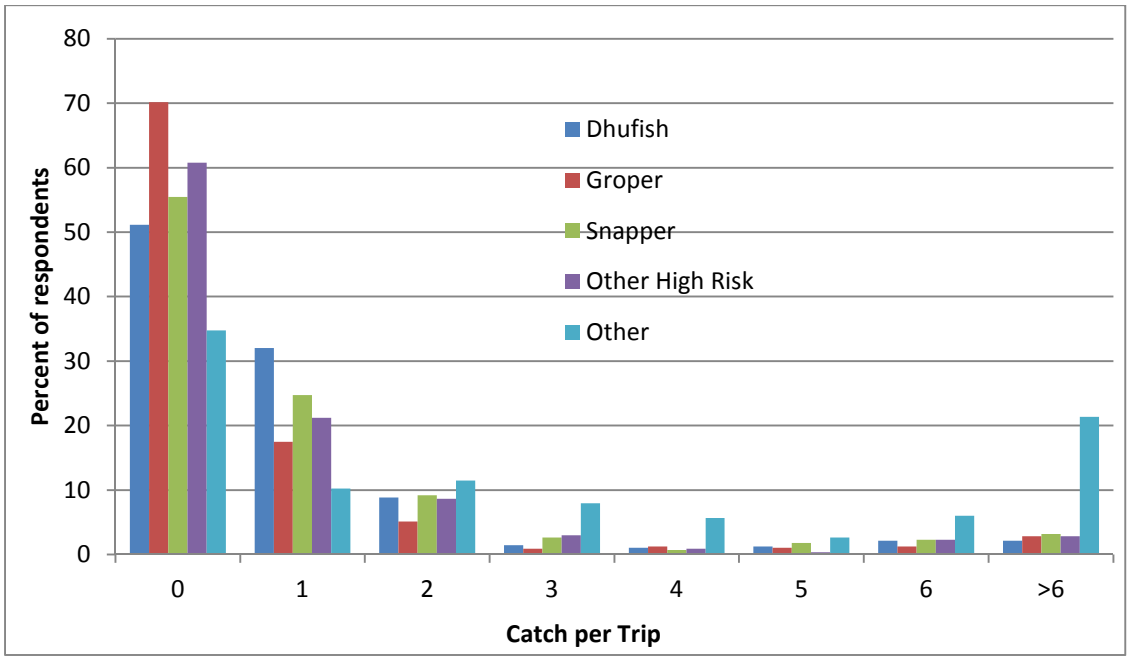

Figure 22 Distribution of Retained Catch per Trip by Species 2011 Survey.

Table 42 Summary Statistics for Retained Catch 2011 Survey.

	Dhufish	Pink Snapper	Baldchin Groper	Other High Risk	Other Species
mean	1.07	1.16	0.82	1.12	7.62
min	0	0	0	0	0
max	50	30	50	36	280

7.11.4 Released Catch

The 2010 season introduced an emphasis on release procedures catch including compulsory possession of a "release weight". This continued in 2011.

Table 43 and Figure 23 show the distribution of released catch per trip by species for the previous twelve months. Most respondents released none or only one fish.

The mean number of fish caught and released per trip is shown in Table 44. For Dhufish the mean released catch per trip is 2.431. For Pink Snapper the mean retained catch per trip is 3.37 and for Baldchin Groper the figure is 0.71. Other high risk species have a retained catch of 1.48 while for other species the mean retained catch is 5.5.

Table 43 Distribution of Released Catch per Trip by Species 2011 Survey.

Number of Fish/Trip	Dhufish	Baldchin Groper	Pink Snapper	Other High risk	Other Species
0	41.70	78.66	41.45	71.78	41.27
1	20.14	7.41	17.46	9.70	8.99
2	15.02	6.70	14.64	5.29	9.52
3	7.24	2.12	5.82	2.65	6.88
4	4.06	1.41	3.17	3.70	4.94
5	1.77	0.88	3.53	1.23	3.88
6	2.30	1.59	3.35	1.41	6.53
>6	7.77	1.23	10.58	4.23	17.99

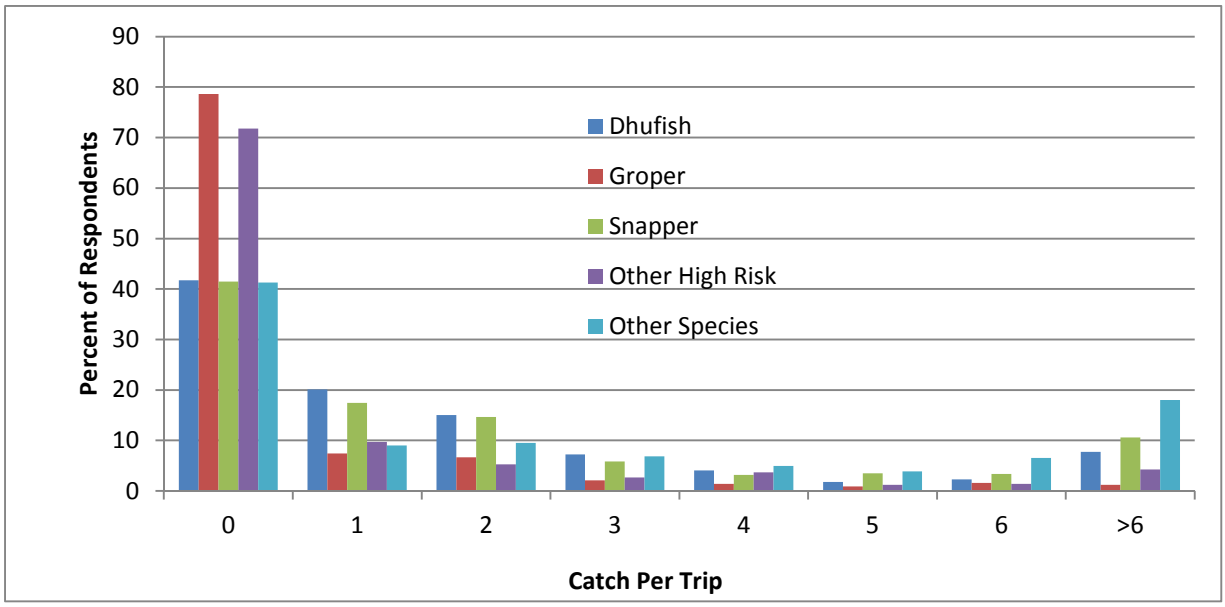

Figure 23: Distribution of Released Catch per Trip by Species 2011 Survey.

Table 44 Summary Statistics for Released Catch 2011 Survey.

	Dhufish	Pink Snapper	Baldchin Groper	Other High Risk	Other Species
mean	2.43	3.37	0.71	1.48	5.56
min	0	0	0	0	0
max	50	200	35	100	200

7.11.5 Comparison of Retained and Released Catch 2010 and 2011

The comparison between mean retained catch by species is shown in Figure 24. Reported mean catches are slightly higher in 2011. This is consistent with a slight increase in satisfaction ratings for catch, species and size as reported below.

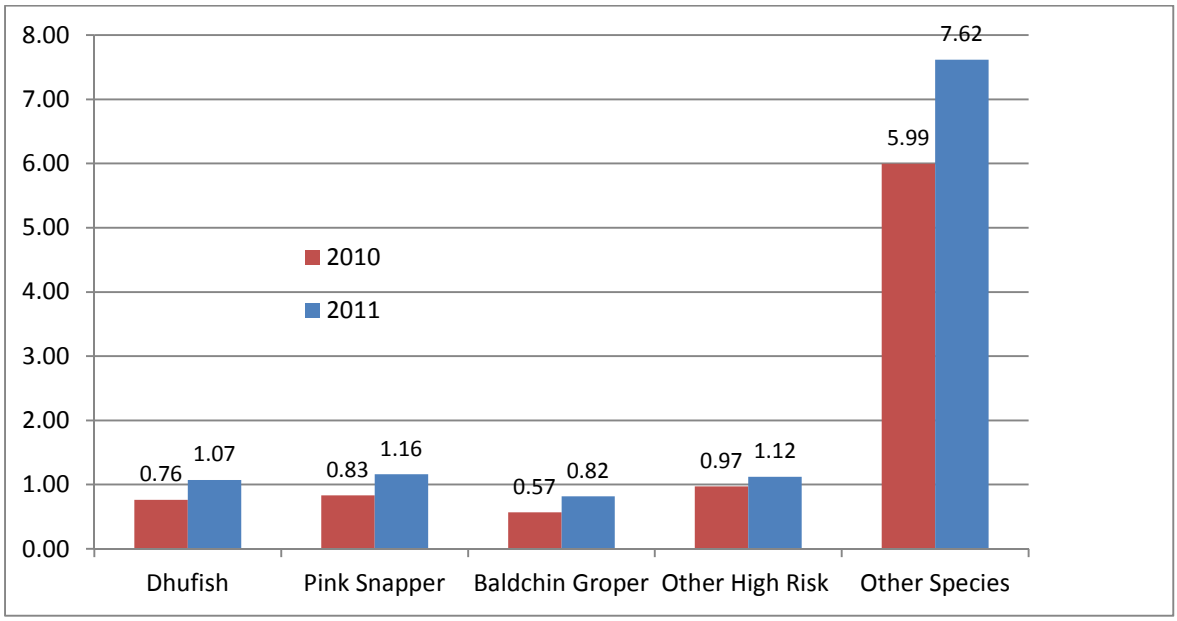

Figure 24 Mean Retained Catch per Trip by Species 2010 and 2011 Survey.

The comparison between mean released catch by species is shown in Figure 25. Reported mean catches are slightly higher in 2011. As with retained catch this is consistent with a slight increase in satisfaction ratings for catch, species and size as reported below.

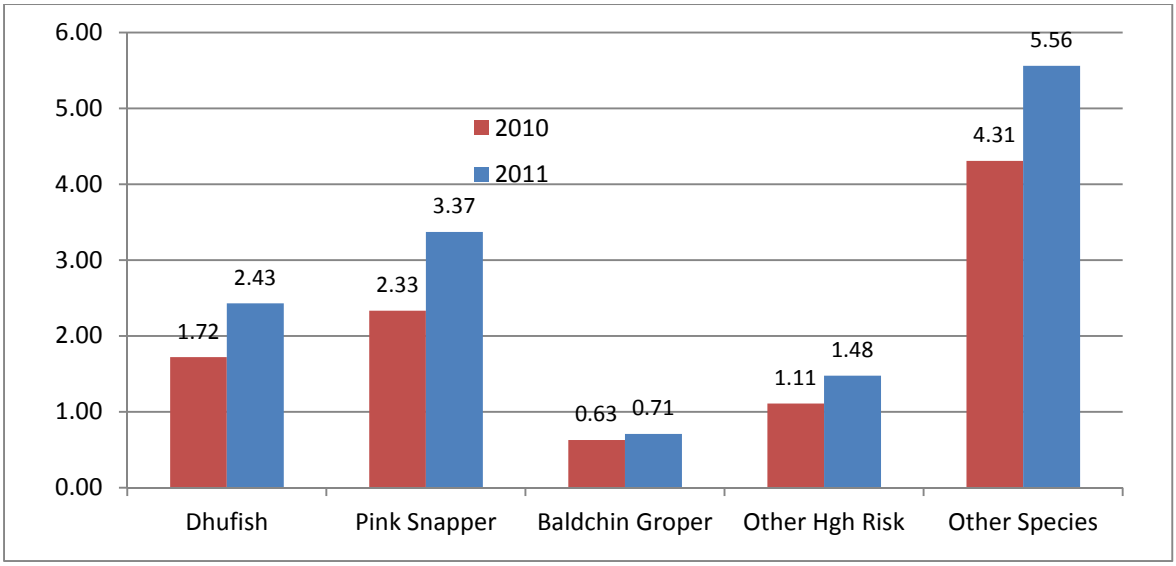

Figure 25 Mean Released Catch per Trip by Species 2010 and 2011 Surveys.

7.12 Satisfaction with the 2011 Fishing Experience

In the 2003 survey fishers were very satisfied with the overall fishing experience, less so with individual catch experience (Table 14). They were surveyed again in 2010 and 2011 along the same dimensions.The scores for each aspect ranged from 1(very unsatisfied) to 5(very satisfied). The satisfaction scores are shown in Table 45, ranked from high to low based on 2011 mean scores. Overall experience is rated highly cross all three surveys. The species caught and kept is rated next most highly across all three. Size of fish caught and number of fish caught rate the lowest are lower post the regulation change in both the 2010 and 2011 surveys.

The significance of these differences is considered in the following section.

Table 45 Comparative Satisfaction Scores 2003, 2010 and 2011 Surveys.

	2003	2010	2011
Having an enjoyable time out on the Ocean	4.67	4.78	4.75
Enjoying the fishing experience, regardless of the number of fish caught and kept	4.50	4.69	4.61
The species of fish you keep	3.73	3.85	3.91
Level of congestion at the boat ramp	3.69	3.49	3.58
Catching enough fish for a decent feed	3.65	3.55	3.66
The species of fish you catch	NA	3.53	3.64
The number of fish you keep	3.59	3.34	3.53
The size of the fish you catch	3.67	3.56	3.55
The number of fish you catch	3.47	3.09	3.2
The time it takes to catch the number of fish you expected to	3.54	3.11	3.14

7.13 Comparative Satisfaction Scores for Fishing in the West Coast Demersal Fishery

7.13.1 Congestion at Boat Ramps

The level of satisfaction with boat ramp congestion was lower in 2010 than in 2003 and higher again in 2011. The pattern between 2010 and 2011 is shown in Figure 26. The distributions are significantly different although the mean score is not significantly different at the five per cent level.

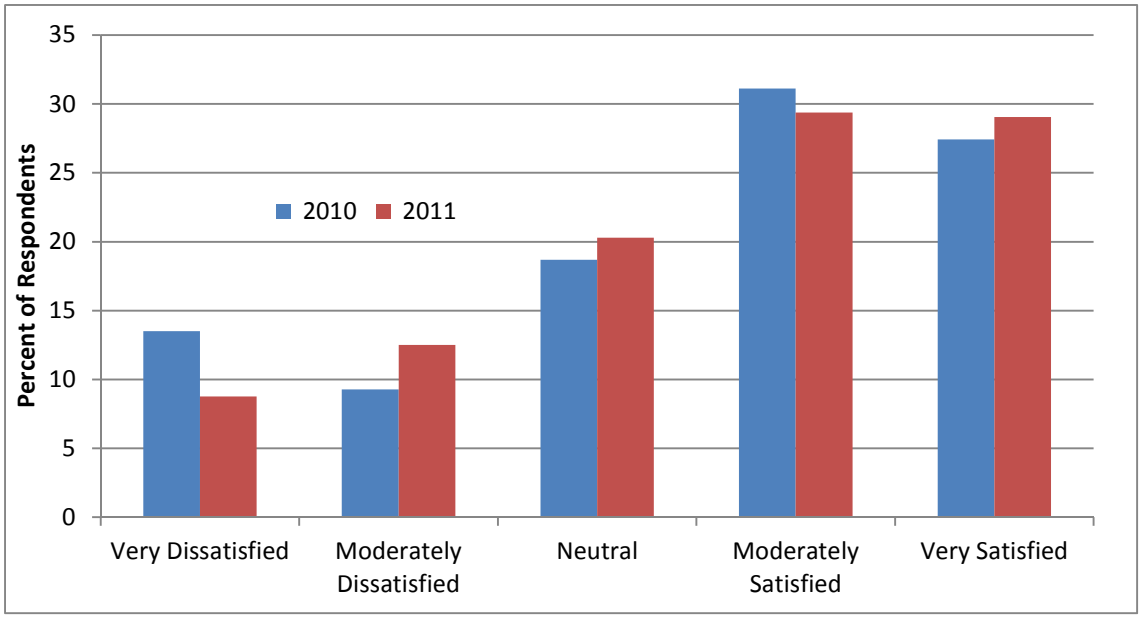

Figure 26 Satisfaction Scores with Boat Ramp Congestion 2010 and 2011 Surveys.

7.13.2 Fish Retained

Satisfaction with fish retained between 2010 and 2011 is given in Figure 27. Mean satisfaction increased to 3.56 from 3.34. The chi square test indicates that the distributions are significantly different. There has been a statistically significant increase in satisfaction at the five per cent level with fish caught and kept in 2011. Mean satisfaction is back close to the 2003 level which was 3.67.

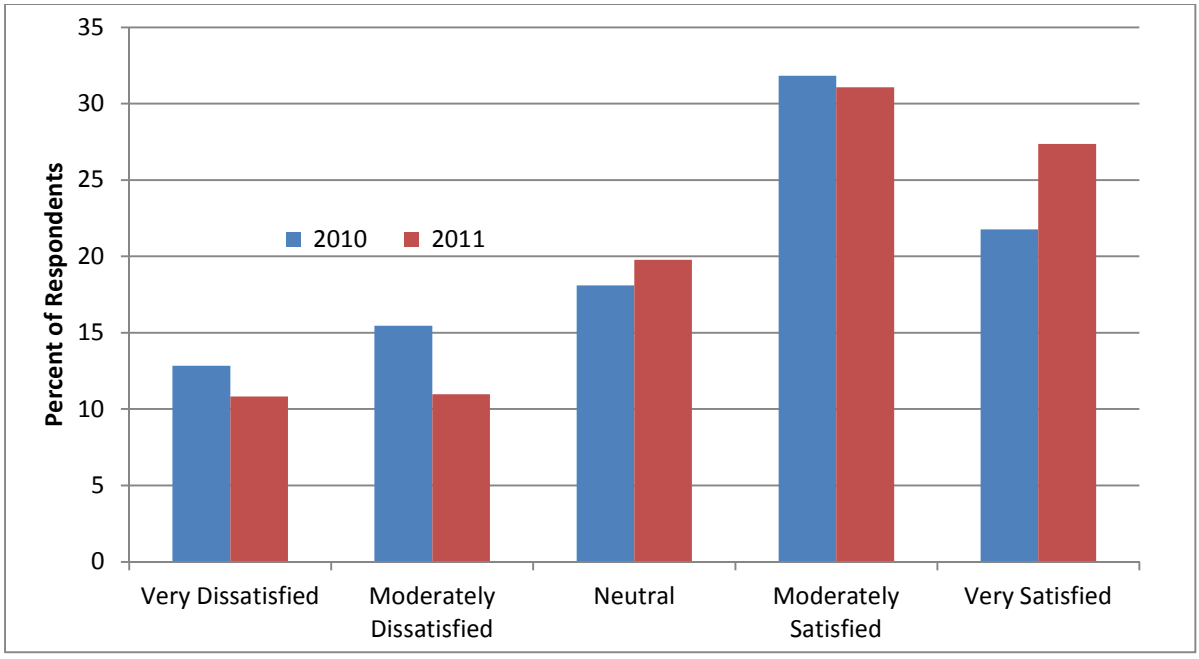

Figure 27 Satisfaction Scores for Fish Retained 2010 and 2011 Surveys.

7.13.3 Size of Fish Caught

Satisfaction with fish caught is given in Figure 12. Mean satisfaction is the same in 2010 and 2011 at 3.56. The chi square test indicates that the distributions are not significantly different. Both 2010 and 2011 are significantly below mean satisfaction with size of fish in 2003.

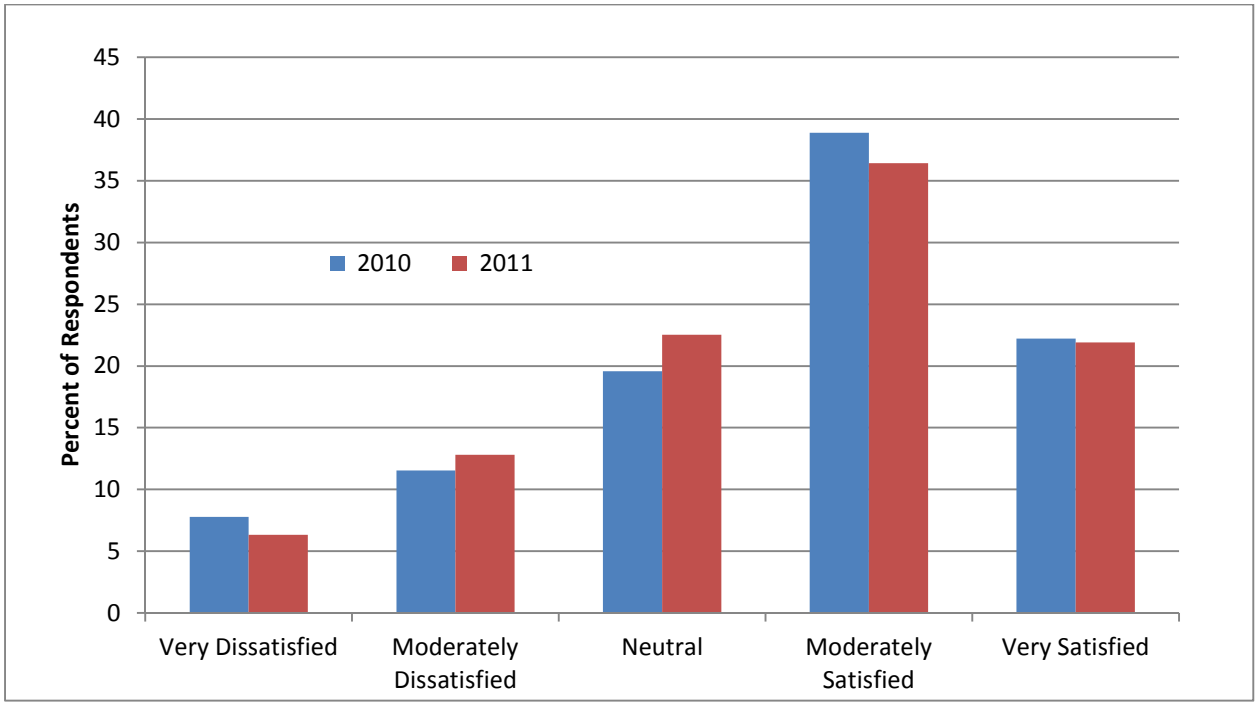

Figure 28 Satisfaction Scores for Size of Fish Retained 2010 and 2011 Surveys.

7.13.4 Species of Fish Kept

Satisfaction with species caught and retained is given in Figure 29. Mean satisfaction was 3.85 in 2010 and 3.92 in 2011. The mean score is not significantly different at the five per cent level between 2010 and 2011. The mean satisfaction was lower in 2003 with a mean score of 3.73.

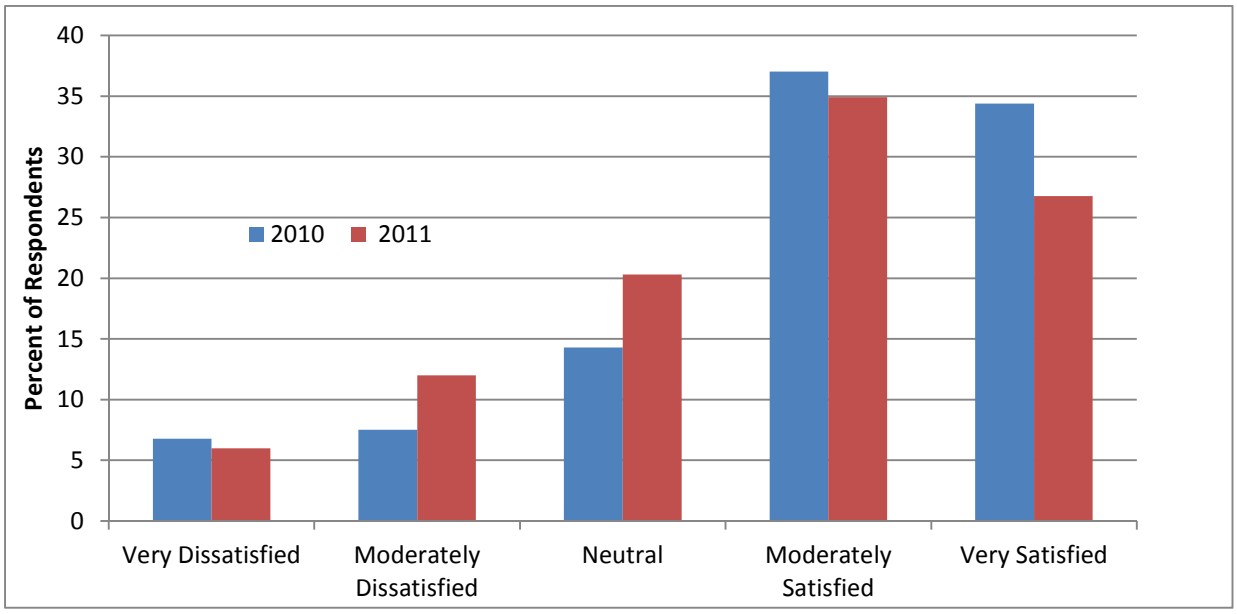

Figure 29 Satisfaction Scores for Species of Fish Retained 2010 and 2011 Surveys.

7.13.5 Time Taken to Catch Fish

Catch rate in an important driver of behaviour. Mean satisfaction in this case decreased from 3.54 to 3.11 between 2003 and 2010. It was the least satisfactory aspect of fishing. Between 2010 and 2011 it increased to 3.14 but was still the least satisfactory aspect of fishing. The chi square test indicates that the distributions are significantly different. The mean score is not significantly different between 2010 and 2011 at the five per cent level. The score is still significantly below 2003 level. Satisfaction with catch rate is given in Figure 30.

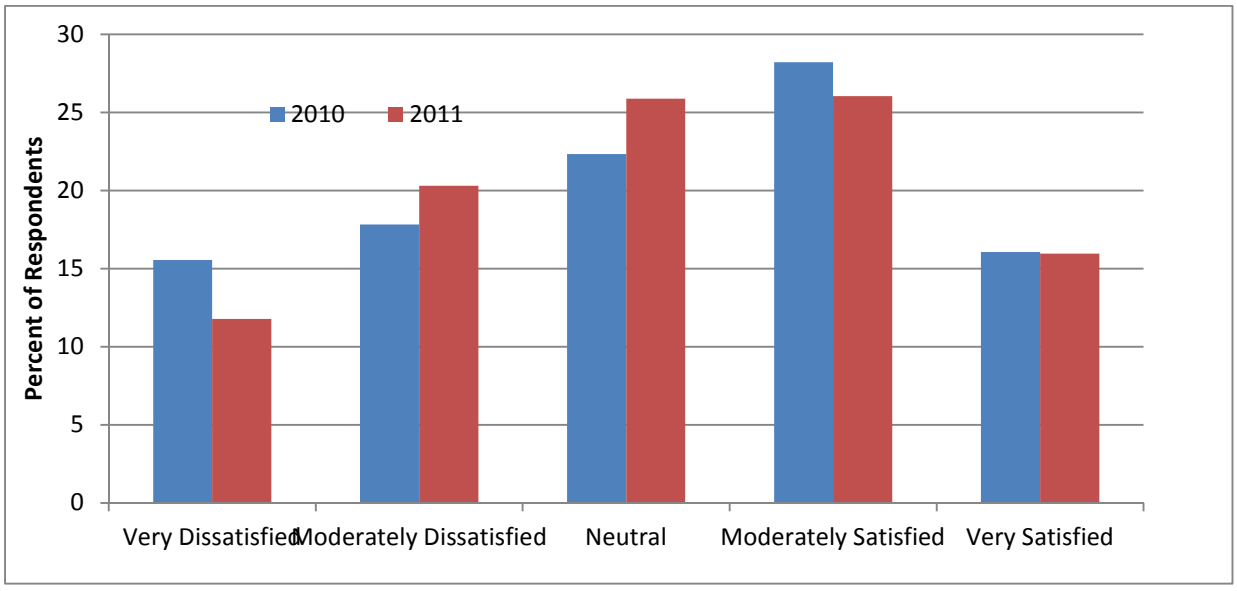

Figure 30 Satisfaction Score for Time Taken to Catch Fish 2010 and 2011 Surveys.

7.13.6 Enough Fish for a Decent Feed

Satisfaction with catching enough fish for a decent feed is given in Figure 31. Mean satisfaction in this case decreased from 3.65 to 3.55 between 2003 and 2010. There was no statistically significant difference in the satisfaction distributions. In 2011 it increased to 3.69. This increase in the mean is significant at the 3 per cent level and the mean score is back to the 2003 level.

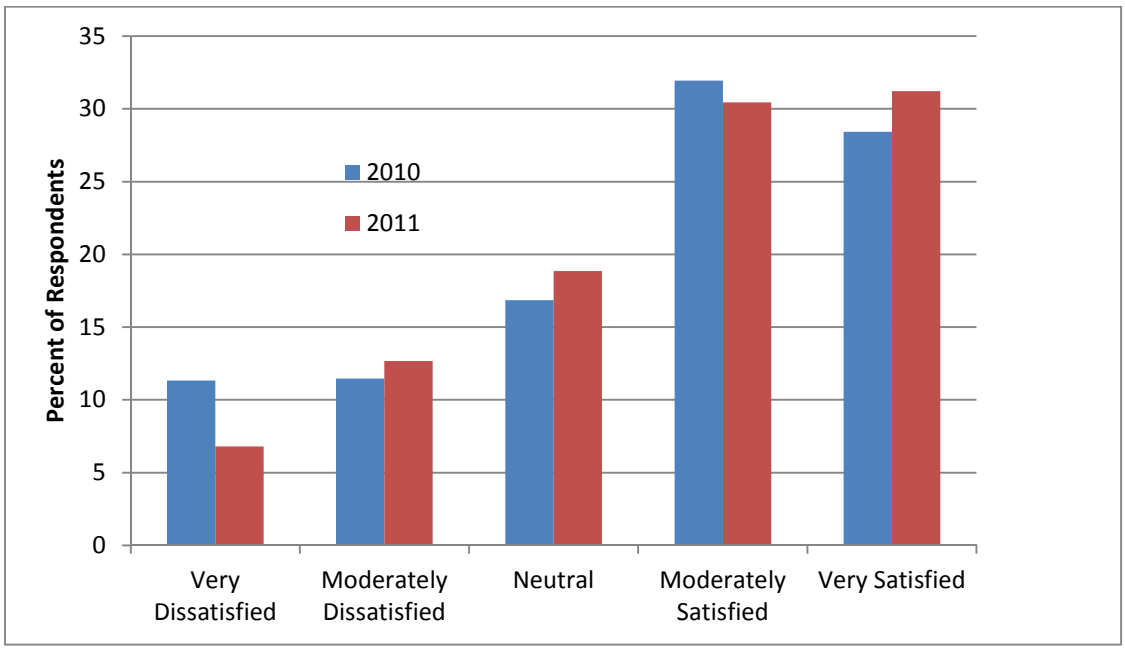

Figure 31 Satisfaction Scores for Catching Enough Fish for a Decent Feed 2010 and 2011 Surveys.

7.13.7 Overall Enjoyment of Fishing Experience

Between 2003 and 2010 most satisfaction scores declined. The notable exceptions were measures of satisfaction with overall fishing experience. Between 2003 and 2010 mean satisfaction increased from 3.50 to 4.69. In 2011 it remained high with a mean of 4.62. However, the chi square test indicates that the distributions are significantly different between 2010 and 2011. In this case we can reject the null hypothesis of zero difference in favour of their being a decrease in overall satisfaction with the fishing experience between 2010 and 2011, although still significantly higher than in 2003. Satisfaction with overall fishing experience is given in Figure 32.

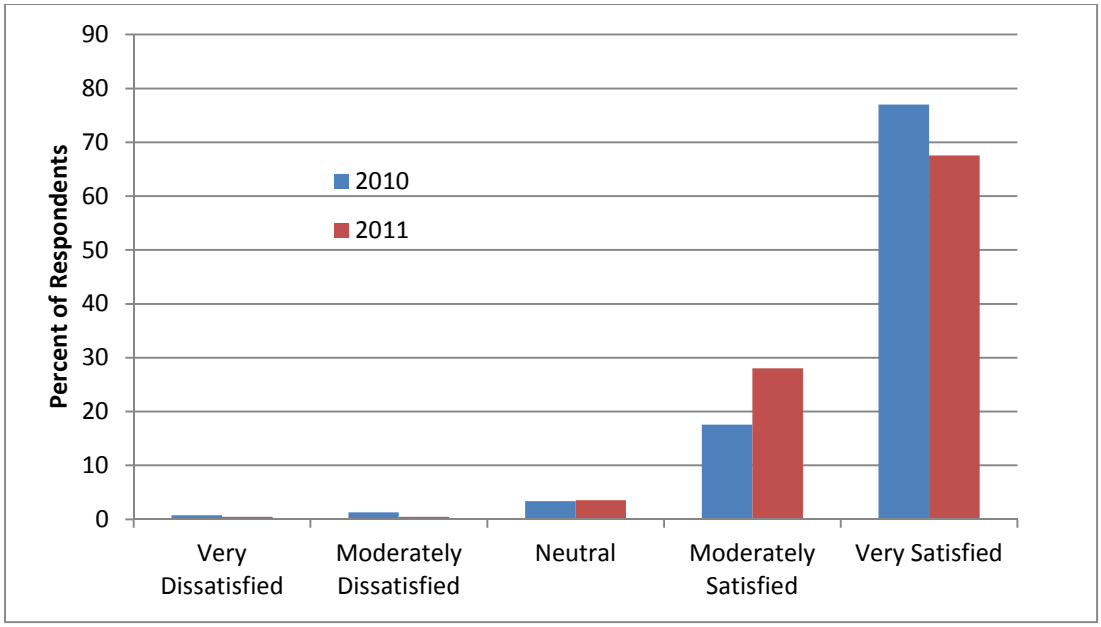

Figure 32 Satisfaction Score for Overall Enjoyment of Fishing Experience 2010 and 2011 Surveys.

7.13.8 Overall Enjoyment of Time on Ocean

In the 2003 survey respondents were highly satisfied with the overall ocean experience recording a mean satisfaction score of 4.7. This remained high at 4.8 in 2010. The difference was significant indicating an increase in overall satisfaction with the ocean experience. The recent experience is presented in Figure 33. The mean in 2011 is 4.75 compared to 4.8 in 2010. The difference in the mean satisfaction score is not significant. Fishers remain highly satisfied with the overall ocean experience.

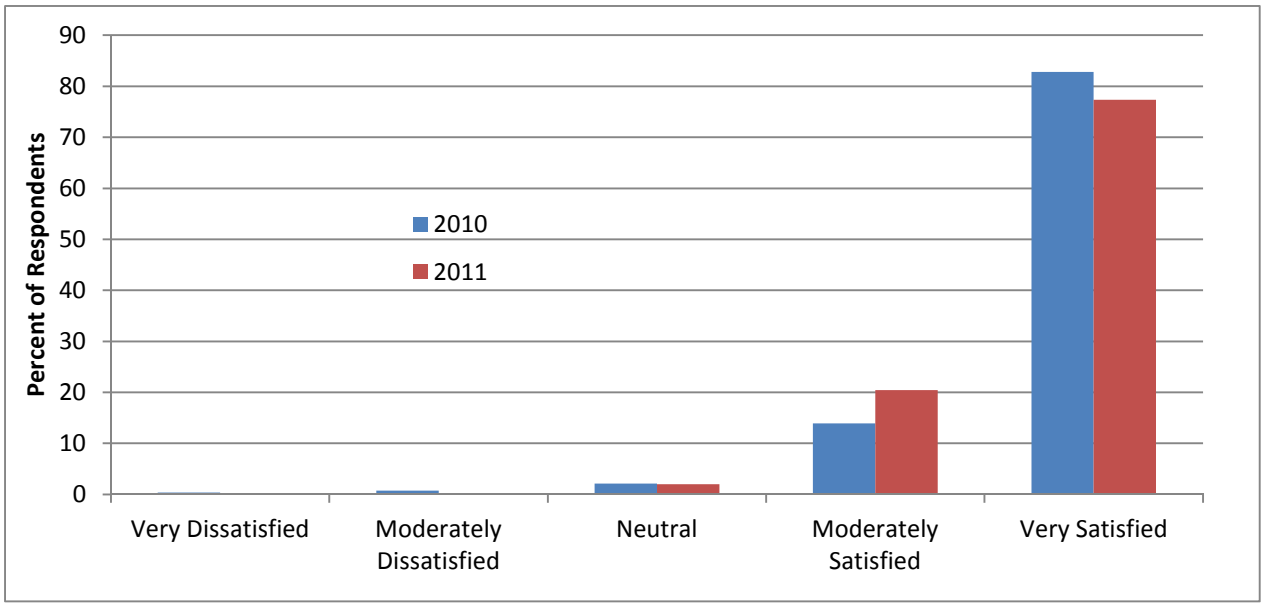

Figure 33 Satisfaction Scores with Overall Trip on Ocean 2010 and 2011 Surveys.

7.14 Trip Response Functions

The comparison between trip times and catches indicates significant differences between the two surveys. These differences are also reflected in the significant differences in satisfaction between the two surveys. They indicate that fishing behaviour has changed significantly across the two periods.

An important further question is how the changes in circumstances between the two periods and in the associated regulatory regimes have influenced the responsiveness of fishers to changes in variables such as catch rates and travel times.

There are two forces at work. Based on the model developed previously, for a given number of trips per year, tighter regulations such as reduced bag limits reduce catch. This is expected to trigger changes in behaviour leading to a reduction in trip and fishing time, the substitution of non-fishing trip time for fishing trip time. Al of this is consistent with the findings from the two surveys.

Tighter regulations are designed to reduce effort. The initial reduction in catches will give the biomass a chance to build up. Over time this will improve the catchability of the fish. It will also have an impact on the size of fish in the biomass and may result in the average size of fish caught increasing.

Of particular interest is the way fishers respond to changes in catchability and expected average size. The survey results indicate that satisfaction with both these aspects of the fishing experience declined across the two surveys.

7.14.1 Number of Trips, Fishing Time and Catch Rate

The previous analysis of the two surveys (Table 29) indicated that there was no significant difference between the distribution of trips per year across the two surveys However the analysis of trip times indicated a significant shortening of trip time, ocean time and fishing time and a significant increase in non-fishing trip time (Table 30).

Catchability is not something that can be directly analysed from the survey responses. It is the case that satisfaction with the time it takes to catch the fish declined significantly over the two surveys. This suggests that the perceived time it took to catch a given number of fish had declined. Catch rates can be used as a proxy for catchability, all other things equal.

Data on catch by species and fishing times is available from the survey data. The fishing time data that can be derived applied to the whole fishing activity. Within this time the fisher catches high risk and highly prized demersal scale fish as well as other fish. Hence, although catch data is available by species, it is appropriate to include all catch (all species and catch and release) in the estimated catch rate.

7.14.2 Analysis of Trips and Catch Rate

The 2003 survey collected data on the number of trips per year. The 2010 survey collected trip data in categories. The 2003 data was recoded to the equivalent categories to allow the following analysis. The comparison of the trip data from the two surveys indicated that the two distributions of trip

frequency are not significantly different (Figure 7). The table of trip frequencies is repeated in Table 46.

Table 46 Trip Frequency for 2003 and 2010 Surveys.

Description	Code	2003 Survey		2010 Survey	
		#	%	#	%
1-2 (rarely)	2	49	13.32	117	14.66
3-6 (a few times)	3	110	29.89	233	29.2
7-12 (once a month)	4	97	26.36	213	26.69
13-24 (twice a month)	5	64	17.39	161	20.18
25-50 (weekly)	6	39	10.60	61	7.64
51 or more (more than weekly	7	9	2.45	13	1.63
		368	100	798	100

Using the actual number of trips would enable conventional count data models to be estimated. These models have been used extensively in the literature,[10] including application to fisheries.[11]

When the dependent variable is categorical as in Table 46, ordinary regression or count data models will not suffice. When the outcome variable is categorical and ordinal as in Table 46, where the order of categories is meaningful but the distances between them are arbitrary, the logit model is appropriate. Ordinary regression is not appropriate because 5the it assumes that the distances between categories are the same – e.g. the distance from “rarely” and “a few times” equals to that from “twice a month” to “weekly”, and this is not appropriate in the current case.

Stepwise ordered logit analysis was used to estimate a trip response function for each of the 2003 and 2010 surveys. The dependent variable was the frequency of trips as set out in Table 46. In both cases the independent variables included catch rate and catch rate squared and travel time to launch location. Explanatory variables were considered included: age, income, employment, gender, boat value, expenditures on various fishing items and satisfaction with the various aspects of the fishing experience. Apart from catch rate, catch rate squared and travel time launch location, the specification was not forced to be similar across the two surveys.

The best fitting ordinal logit model for 2003 is shown in Table 47. The best fitting ordinal logit model for 2010 is shown in Table 48.

[10] Count data models have been used to estimate recreational values routinely in valuation literature (Hausman *et al.* 1984; Shaw 1988; Grogger and Carson 1991; Creel and Loomis 1992; Englin and Shonkwiler 1995; 1995a; Bowker and Leeworthy 1998; Chakraborty and Keith 2000; Eiswerth *et al.* 2000; Ovaskainen *et al.* 2001; Shrestha *et al.* 2002).

[11] See Woodward and Griffin 2003; and Prayaga et al. 2010.

Table 47 Ologit Trip Equation for 2003.

Number of obs. = 314						
LR chi2(9) = 39.59						
Prob. > chi2 = 0.0000						
Log likelihood = -486.45068	Pseudo R2 = 0.0391					
McKelvey & Zavoina's R2:	0.13					
Dep. Var.= Trip Frequency	Coefft.	Std. Err.	z	P>z	[95% Conf.	Interval]
Catch Rate	0.1008	0.0348	2.89	0.004	0.0326	0.1691
Catch Rate^2	-0.0018	0.0008	-2.27	0.023	-0.0033	-0.0002
Travel Time	-0.2363	0.0647	-3.65	0.000	-0.3632	-0.1094
Top 30% income earners	0.5703	0.2335	2.44	0.015	0.1126	1.0279
Boat club pen fees	-0.0003	0.0002	-1.61	0.106	-0.0006	0.0001
Safety gear	-0.0016	0.0008	-2.12	0.034	-0.0031	-0.0001
Rods and reels	0.0003	0.0002	2.15	0.032	0.0000	0.0006
Fish club membership	0.0042	0.0025	1.66	0.096	-0.0007	0.0091
Book, magazines	0.0012	0.0008	1.56	0.118	-0.0003	0.0027
/cut1	-1.6181	0.2241			-2.0574	-1.1789
/cut2	0.0356	0.1929			-0.3425	0.4137
/cut3	1.2383	0.2065			0.8336	1.6429
/cut4	2.3725	0.2430			1.8963	2.8487
/cut5	4.5115	0.4544			3.6208	5.4021

Table 48 Ologit Trip Equation for 2010.

Number of obs. = 620						
LR chi2(8) = 59.00						
Prob. > chi2 = 0.0000						
Log likelihood = -954.0507	Pseudo R2 = 0.0300					
McKelvey & Zavoina's R2:	0.100					
Dep. Var.= Trip Frequency	Coefft.	Std. Err.	z	P>z	[95% Conf.	Interval]
Catch Rate	0.03239	0.0117	2.78	0.01	0.0096	0.0552
Catch Rate^2	-0.00021	0.0001	-2.46	0.01	-0.0004	0.0000
Travel Time	-0.09433	0.0408	-2.31	0.02	-0.1742	-0.0145
Group Size	-0.16342	0.0634	-2.58	0.01	-0.2876	-0.0393
Satisfaction Overall Experience on Ocean	0.50802	0.1472	3.45	0.00	0.2195	0.7965
Rods and Reels	0.00019	0.0001	2.81	0.01	0.0001	0.0003
Club Membership	0.00159	0.0007	2.17	0.03	0.0002	0.0030

Diving Gear	0.00027	0.0002	1.79	0.07	0.0000	0.0006
/cut1	0.35294	0.7284			-1.0747	1.7806
/cut2	1.87984	0.7330			0.4431	3.3166
/cut3	3.10133	0.7399			1.6511	4.5516
/cut4	4.65376	0.7521			3.1796	6.1280
/cut5	6.55730	0.8071			4.9754	8.1391

Both equations are statistically significant using the Chi-square test indicating that the models are contributing to the explanation of trip frequency. The cut off used for a variable in the stepwise analysis was .15. Catch rate and catch rate squared are highly significant in both cases as is travel time to the boat launch site. After that the significant variables vary across the two periods. Expenditure on equipment is significant in both cases. The annual expenditure on rods and reels was included in both surveys and is significant. For 2003 expenditure on safety equipment such as life jackets and education and information is significant. Neither of these is available in the 2010 survey. For 2010 expenditure on club membership and diving gear is significant. Satisfaction with the overall ocean experience is significant in the 2010 survey but not the 2003 survey.

Using the 2010 function, Figure 34 shows how the probability of fishing more frequently goes up with catch rate. Fortnightly probability increases from .21 to .25 for a doubling of catch rate from 5 fish per hour to 10 fish per hour.

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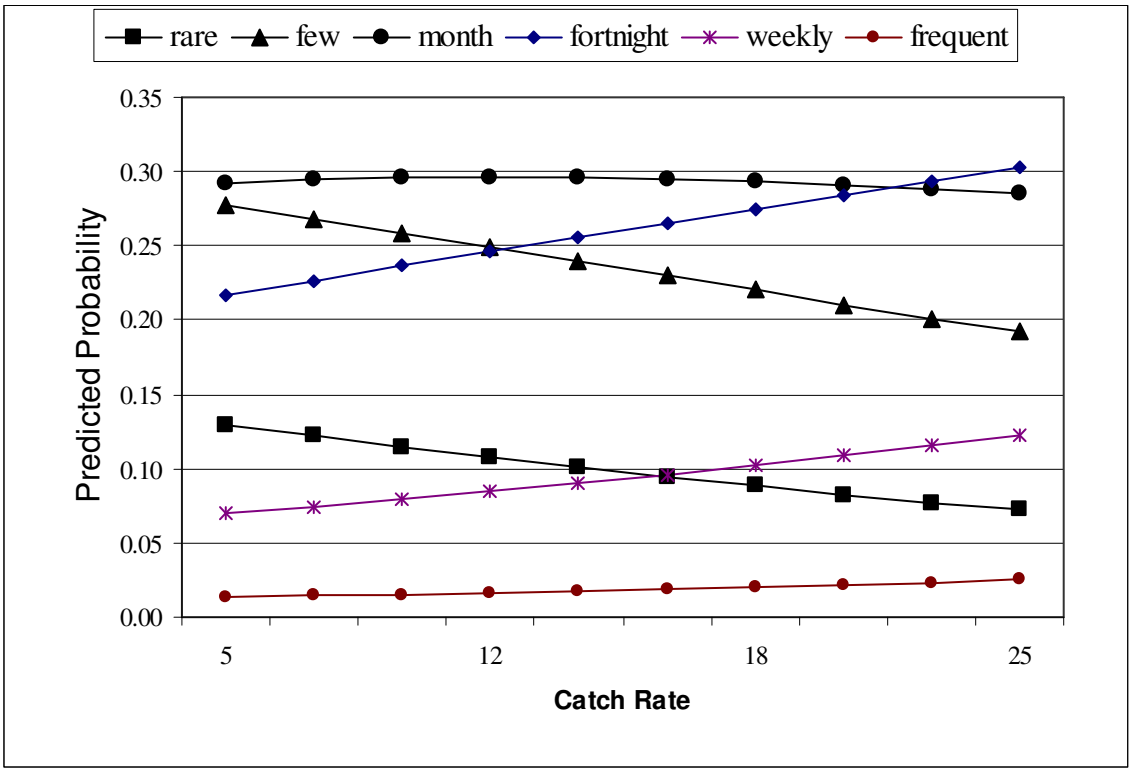


Figure 34 Change in Probability of Trips with Increase in Catch Rate 2010.

7.15 Why do Fishers Stop Fishing on a Trip?

The recreational fisher choice model outlined in Section 6.1 is based on a fisher optimizing trip time by staying out fishing until the net benefit from another hour fishing is balance against the opportunity cost of the extra time. The reasons for stopping fishing on any given trip are important. In particular, are fishers in the West Coast Demersal fishery stopping because they are constrained by bag limits (as per Section 6.4.2) or because they have reached a voluntary trade-off position balancing the net benefits against the opportunity cost?

Realistically a fishery will be composed of a number of fisher 'types' so reasons for stopping may vary.

Table 49 Reasons for Stopping Fishing 2010 and 2011 Surveys.

	2010 Survey		Rank	2011 Survey		Rank
Out of time - other commitments	120	19.61	3	136	23.99	2
Not catching preferred species	122	19.93	2	37	6.53	6
Caught the bag limit	92	15.03	4	85	14.99	4
Weather	151	24.67	1	122	21.52	1
Spend as much time as I wanted	na	na		124	21.87	3
Caught as many fish as I wanted to	na	na		54	9.52	5
Other	39	6.37	6	9	1.59	7
Not applicable.	88	14.38	5	na	na	
	612	100		567	100	

Table 49 shows the respondents' reasons for stopping fishing for the 2010 and 2011 surveys. N the 20010 survey (2009 season), fourteen per cent of respondents answered 'not applicable'. For 2011 additional reasons were added. Notably in both surveys, weather is the most important reason for stopping fishing with twenty four respondents of respondents in 2010 and twenty one per cent of respondents in 2011 nominating this.

In both surveys 'caught the bag limit' was the fourth ranked reason. The proportion was identical at fifteen per cent. This suggests that only about fifteen per cent of recreational fishers stop because they experience a bag limit constraint.

Time issues were important in both surveys. In the 2010 survey, 'out of time- other commitments' was the second ranked reason with just under twenty of respondents nominating it. For 2011 this proportion was higher at twenty four per cent.

In the 2010 survey 'not catching preferred species' was the second ranked reason with twenty per cent but this was only the sixth ranked in 2011 with only for seven per cent of respondents nominating it. In the 2011 survey 'spent as much time as I wanted to' and 'caught as many fish as I wanted to' were introduced as new reasons and both scored well ranking 3 (twenty two per cent of respondents) and 5 (ten per cent of respondents).

Taking the 2011 survey, time is nominated by just over forty five per cent of respondents. This is consistent with the basis choice model which sees the trade-off with the opportunity cost of time as an important driver of trip time, fishing and non-fishing time. Only fifteen per cent stop because of a bag limit constraint. It should remembered however, that these fishers have more generous bag limit

constraints for non-high risk species and may be responding to the overall bag limits. That is, they have caught the bag limit on high risk species and continue to fish for non-high risk species. Hence many may not reach the bag limit overall.

7.15.1 Skill and Reasons for Stopping

Self-assessed skill levels for the 2011 respondents were reported in Figure 19. Not surprisingly there is a correlation between above average skill, catching bag limits and catching desired species. Reasons by skill level are shown Table 50. The distributions are significantly different at the 5 per cent level. Above average fishers are less likely to be stopping because they cannot catch the preferred species and more likely to be stopping because they have caught the bag limit and more likely to be stopping because they have caught as many fish as they want to.

Looking at each individual reason matched with skill level via cross tabs shows that the only statistically significant relationship is that between skill and stopping because of reaching the bag limit. More skilled fishers are statistically more likely to be stopping for this reason. The full set of cross tabs with statistics of association is presented in Appendix 4.

Table 50 Self Assessed Skill level and Reasons Why Stopped Fishing 2011 Survey.

Reason to Stop Fishing	Above Average Skill		Average and Below Average Skill	
	Freq.	Per cent	Freq.	Per cent
Out of time - other commitments	68	25.19	68	22.9
Not catching preferred species	13	4.81	24	8.08
Caught the bag limit	49	18.15	36	12.12
Weather	59	21.85	63	21.21
Spend as much time as I wanted	50	18.52	74	24.92
Caught as many fish as I wanted to	31	11.48	23	7.74
Other			9	3.03
Total	270	100	297	100

7.16 Self-Reported Behavioural Changes with New Rules and Closed Season

The 2010 changes to fishing regulations were the most significant changes introduced for many years. A tightening of bag limits was aligned with a closed season and the introduction of licence fees. The 2011 continued with these back changes but refined the bag limits.

As already noted in the previous analysis, based on trip times and satisfaction scores the 2010 seasons was associated with significantly different outcomes to the previous “unconstrained” 2003 season. Most notably satisfaction levels were lower for key fishing outcomes – catch, species, size and time to catch. Trip time ad fishing time declined. The 2011 survey, after changes had been in for one full season, was not associated with any further decline in satisfaction levels. Indeed on key parameters the sample revealed a marginal increase. Trip time was virtually unchanged but the fishing time component increased compared to 2010.

Moreover the satisfaction scores with the overall fishing experience remained universally high across both surveys.

Whilst these results are indicative of fishers adjusting to the new rules into 2011 with marginal adjustments to fishing times and catches and satisfaction scores, they do not reveal whether fishers themselves believe their behavior to have changed. There are two issues here- fishing generally and closed season fishing.

In both surveys fishers were asked about their fishing behavior in light of the new licence system and about their closed season behavior.

7.16.1 Self-Reported Behavioural Changes

In both surveys fishers were asked whether the introduction of licence fees and associated regulations had changed their fishing behavior. The comparative results across 2010 and 2011 are shown in Table 51. The overwhelming majority of respondents indicate no change in behavior in both surveys. On balance less than 20 percent indicate changed behavior.

Table 51 Changed Fishing Activities under New Licence Regime 2010 and 2011 Surveys.

	2010 Survey		2011 Survey	
	No.	%	No.	%
Fish more often	26	5.27	11	1.94
Fish less often	30	6.09	67	11.82
Fish from the shore	5	1.01	5	0.88
Fish for rock lobster or abalone from a	5	1.01	18	3.17
Other	12	2.43	9	1.59
No change	415	84.18	457	80.6
	493	100	567	100

Table 52 and Figure 35 show the distribution of the main adjustments for those respondents indicating that they did change fishing behaviour because of licence fee regime. The most notable difference is that in 2011 fishing less is the dominant response whereas in 2010 respondents were spilt between fishing less and more often. Fishing less often is a response more consistent with choice theoretic models because the licence fee and associated restrictions were designed to make fishing activities less attractive. The initial 2010 response may well be a “catch up” behavior whereby fishers attempt to make up for reduced catch per trip, by increasing the number of trips.

Table 52 Adjustment Responses for Those Respondents Who Did Change 2010 and 2011 Surveys.

	2010 Survey		2011 Survey	
	no	%	no	%
Fish more often	26	33.33	11	10.00
Fish less often	30	38.46	67	60.91
Fish from the shore	5	6.41	5	4.55

Fish for rock lobster or abalone from a boat	5	6.41	18	16.36
Other	12	15.38	9	8.18
	78	100.00	110	100.00

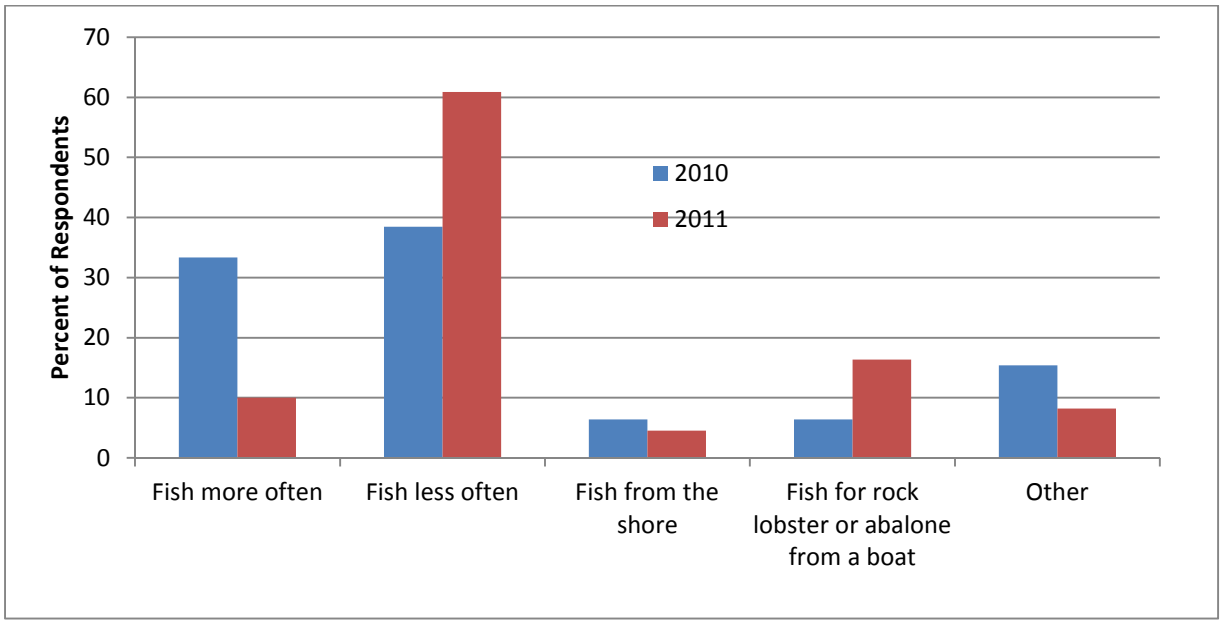


Figure 35 Distribution of Adjustment Types for Those Respondents Who Did Change 2010 and 2011.

7.16.2 Closed Season Behaviour

The closed season runs from Oct 15 to Dec 15. The first closure was in 2009 (2010 survey), the second in 2010 (2011 survey). Fishers were surveyed regarding fishing behavior in the closed season.

An important question is the extent to which the closed season causes changes in behavior. Several adjustments are possible including; don't fish, fish for the designated species outside the bioregion in an area without a closed season, fish in bioregion but from the shore, fish in the bioregion from a boat but for the non high risk species.

Remembering that these were the first closed seasons, fishers were asked whether their behavior in the closed season was different from their normal behavior. That is, they were asked how their behavior between Oct 15 and Dec 15 had changed compared to previous years. The results are presented in Table 53. The majority answered 'no' for the 2009 season but by the time of the 2010 season the balance had shifted with the majority answering 'yes'. The 'yes' proportion increased from 42 percent to 54 percent. A test of difference in proportions indicates that the increase in the ''yes' proportion is significant at the one per cent level. This result is consistent with fishers having learnt from the 2009 experience and with more time to plan their 2010 activities in the closed season, undertaking appropriate changes.

Table 53 Has Fishing Behavior Changed Because of Closed Season?

	2009 Closed Season		2010 Closed Season	
	No.	%	No.	%
Yes	258	42.16	305	53.
No	354	57.84	262	46.2
	612	100	567	100.0

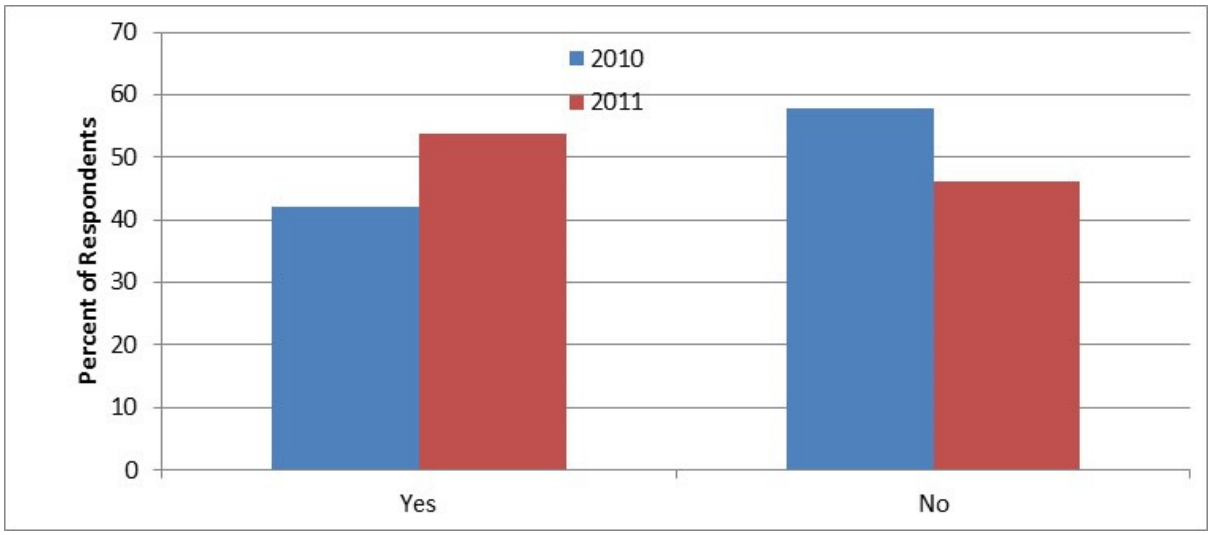


Figure 36 Has Fishing Behavior Changed Because of Closed Season?

7.16.3 Fishing For high risk species outside of the West Coast Bioregion

Only five percent of respondents indicated that they had fished for high risk species such as Dhufish, Pink Snapper and Baldchin Groper outside of the West Coast Bioregion during the closed season. Table 54 shows the responses for 2010 and 2011.

Table 54 Fishing Outside of West Coast bioregion During the Closed Season.

	2009 Closed Season		2010 Closed Season	
Yes	36	5.88	28	4.94
No	576	94.12	539	95.06
	612	100	567	100

For the five percent of respondents who did venture outside of the bioregion, the number of trips is shown in Table 55 and Figure 37. The number of respondents actually travelling outside of the bioregion is too small to draw meaningful conclusions about changes in the number of trips between the two surveys.

Table 55 Number of Trips Outside of West Coast Bioregion during the Closed Season.

	2009 Closed Season		2010 Closed Season	
Zero	4	11.11	2	7.14
One (once)	10	27.78	6	21.43
Two (once a month)	14	38.89	5	17.86
3-4 (twice a month)	3	8.33	7	25
5-9 (weekly)	4	11.11	4	14.29
10 and over (more than weekly)	1	2.78	4	14.29
	36	100	28	100.01

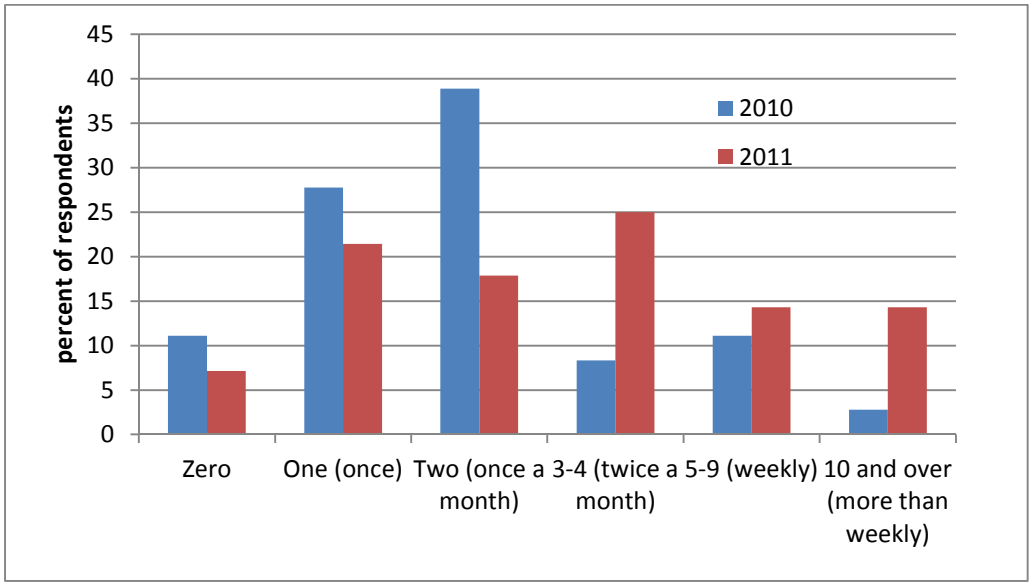


Figure 37 Number of Trips Outside of West Coast Bioregion During the Closed Season.

Even though the number of respondents going outside of the bioregion during the closed season is small their reasons for doing so are important. These are shown in Table 56. Less than twenty percent of respondents in the 2011 survey indicated that the2010 closure had prompted their trips.

In effect less than 2 percent of respondents in 2010 survey and 1 percent of respondents in 2011 survey appear to have shifted to fishing outside of bioregion in the previous year's closed season because of the closure.

Table 56 reasons for Fishing Outside of the Bioregion for Designated Species.

	2009 Closed Season		2010 Closed Season	
On holidays	10	27.78	12	42.86
Fishing is better	5	13.89	4	14.29
Due to closure in the West Coast Bioregion	12	33.33	5	17.86
Other	5	13.89	6	21.43
Don't Know	4	11.11	1	3.57
	36	100	28	100

7.16.4 Fishing from a Boat in the Bioregion during the Closed Season

Although most fishers did not fish outside of the bioregion as a consequence of the closed season, they could continue to fish from a boat in the bioregion if they switch to other species, away from the designated high risk species. The results for this option are presented in Table 57 and Figure 38. In both the 2010 and 2011 seasons 45 percent of respondents opted not to fish from a boat.

Table 57 Continuing to Fish from a Boat during the Closed Season.

	2009 Closed Season		2010 Closed Season	
Zero	272	44.44	257	45.33
One (once)	42	6.86	49	8.64
Two (once a month)	96	15.69	51	8.99
3-4 (twice a month)	101	16.50	92	16.23
5-9 (weekly)	74	12.09	78	13.76
10 and over (more than weekly)	26	4.25	38	6.70
Don't Know	1	0.16	2	0.35
	612	100	567	100

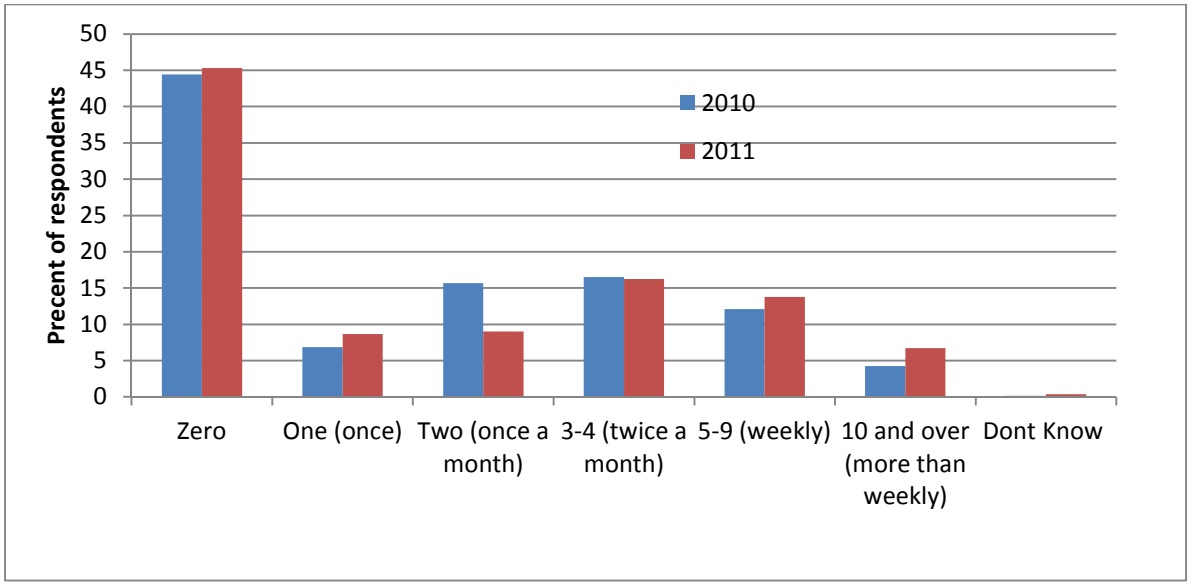


Figure 38 Continuing to Fish from a Boat during the Closed Season.

Some insight can be gained into which fishers stopped fishing by matching closed season trip making and annual trip making. One hypothesis might be that those whose typical pattern of behavior was to make less frequent trips might be more easily dissuaded during the closed season. The cross tabulation between the frequency of trip going in the closed season and on an annual basis is shown in Table 58. The relationship is positive indicating that there is a correlation between trips going across the two time periods. In the table of those who did not fish from a boat in the West Coast bioregion during the closed season, 14.8 person fished rarely (1-2 times per year), 40.7 percent fished infrequently (3-6 times per year) and 24.1 percent fished monthly. The exact means for this group are given in Table 59. Mean trips for the 2011 respondents were 12 per year or around 1 per month. Mean annual trips for those who made no closed season trips averaged only 9 trips per year and those who had only 1 closed

season trips averaged 7.5 trips per year. Those who fished twice in the closed season averaged 11 trips per year. Those who continued to fish frequently in the closed season were above average for trips per year.

This implies that the effect of the closed season was to reduce the total number of trips for a significant proportion of the respondents.

The mean number of trips per year in the 2003 survey was 12.81. For the 2011 survey it was 12.06. The difference is significant at the 10 percent level, indicating that mean trips were lower in 2011. The evidence suggests that the closed season was an important contributing factor.

Another way to consider the impact of the closed season is by way of the reasons given for not undertaking boat trips during the closed season. Table 57 shows that for 2010 survey (2009 closed season) some 272 respondents (44%) elected not to fish from a boat during the closed season. For the 2011 (2010 closed season) survey the figure was 257 respondents (45%). Of the 45 percent of respondents who made no fishing trips during the closed season, more than half (57.6 percent) indicated that the reason was inability to fish for the preferred species.

The effect of the closed season is that fishers cannot fish for their designated high risk species in the West Coast bio region during the period. The evidence suggests that very few fishers opted instead to fish outside of the bioregion. Instead a large proportion of fishers simply did not make fishing trips during the period. The majority of those cited inability to fish for the designated species as the reason for not going fishing. The data does not permit an analysis of the fishing behavior of those that did fish from a boat within the closed season.

Table 58 Pattern of Trips – Annual versus 2010 Closed Season.

	2010 Closed Season Trips						
Annual Trips	Zero	One (once)	Two (once a month)	3-4 (twice a month)	5-9 (weekly)	10 and over (more than weekly)	Total
1-2 (rarely)	38	7	1	3	3	1	53
	14.79	14.29	1.96	3.26	3.85	2.63	9.38
3-6 (a few times)	104	24	18	17	10	10	183
	40.47	48.98	35.29	18.48	12.82	26.32	32.39
7-12 (once a month)	62	11	21	41	16	8	159
	24.12	22.45	41.18	44.57	20.51	21.05	28.14
13-24 (twice a month)	37	6	7	23	24	8	105
	14.4	12.24	13.73	25	30.77	21.05	18.58
25-50 (weekly)	15	1	4	7	23	11	61
	5.84	2.04	7.84	7.61	29.49	28.95	10.8
51 or more (more than weekly	1	0	0	1	2	0	4
	0.39	0	0	1.09	2.56	0	0.71
Total	257	49	51	92	78	38	565
	100	100	100	100	100	100	100

Table 59 Mean Annual Trips by Closed Season Trip Category 2010.

Closed Season Trips	Mean Annual Trips
Zero	9.21
One (once)	7.49
Two (once a month)	11.12
3-4 (twice a month)	13.67
5-9 (weekly)	19.95
10 and over (more than weekly)	18.45
Total	12.06

Table 60 Primary Reason for Not Fishing in the Closed Season 2010.

Primary Reason	Freq.	Per cent	Cum.
Other commitments (no time)	63	24.51	24.51
Couldn't catch preferred species due to	148	57.59	82.1
Not a regular fisher	5	1.95	84.05
General cost of fishing	3	1.17	85.21
Other	35	13.62	98.83
Don't Know	3	1.17	100
Total	257	100	

7.16.5 Post Closed season Responses

Fishers might respond to a closed season by fishing harder (more frequently, longer etc.) when the season reopens. In the 2011 survey fishers were asked about their post closed season behavior. Table 61 shows the self-reported assessment. Some 78 percent of respondents indicated no change in behavior.

Table 61 Have Fishing Activities Changed Post Closed Season 2010?

	Obs.	Per cent	Cum.
Yes	133	21.73	21.73
No	479	78.27	100
Total	612	100	

7.17 Socio Economic Impacts of New Rules

The focus in previous sections was on the way that recreational fishers have adapted to the changes in fishing rules in terms of trips, trip time and catch. A particular issue was whether the rule changes and subsequent behavioural adjustments had reduced satisfaction from fishing. Given the results showing a high overall level of satisfaction and only a small reduction in the mean number of trips, it would be expected that fishers had dramatically cut their expenditure commitment.

If fishers did fishers reduce the expenditure they incur on fishing activities, then the flow on impacts of recreational fishing as measured by jobs created in supplying industries will be reduced.

Trip and boat related fishing expenditures can be compared across the 2003 and 2010 surveys.

7.17.1 Fishing Costs 2003

A range of cost data was collected in the 2003 survey. Annual fishing costs for the previous twelve months are shown in Table 62.

Table 62 Annual Fishing Costs for Previous 12 Months, 2003 Survey.

	N	Mean	Min	Max
Fishing-related equipment for a motor vehicle such as roof racks or a tow bar?	361	62.23	0	7,500
Life jackets and safety gear?	361	52.78	0	5,050
Recreational fishing club membership?	361	9.79	0	300
Rods, reels or other fishing equipment?	360	405.01	0	25,000
Books, magazines, videos etc. on boat fishing, locations, fishing gear, etc. to help you find and catch fish	362	44.61	0	1,600
Angling Club membership fees	361	6.28	0	600
Aggregate	359	578.53	0	30,750

The mean boat value was $30,494. The maximum was $900,000. A small number of respondents (N=8) recorded boat values <$1000.

Fishing dominates boat use. Table 63 shows that for the 2003 respondents, on average, 75 per cent of the boat use time was for fishing activities.

Table 63 Percentage of Time Boat is in Use for Recreation, Fishing and Other Activities 2003 Survey.

Variable	Obs.	Mean	Min	Max
Recreation	363	15.53	0	95
Fishing	363	75.09	2	100
Other	363	9.39	0	98

Boat related expenditures are shown in Table 64.

Table 64 Boat Related Expenditures 2003 Survey.

Variable	Obs.	Mean	Min	Max	% Zero
New equipment (GPS or sounder or motor)	344	853.63	0	18,000	62.79
Parts for boat, boat motor or trailer	345	462.6	0	10,000	48.41
Maintenance of boat, motor or trailer	345	392.63	0	10,000	25.80
Insurance for boat, motor or trailer	333	351.53	0	8,000	35.74
Boat and trailer licence fees.	322	181.03	0	3000	1.24
Boat club membership and boat pen fees	362	191.07	0	6,500	76.23
Aggregate	316	2,296.2	50	40,500	

7.17.2 Fishing Costs 2010

Data on expenditure similar to the 2003 survey was also collected in the 2010 survey.

Annual fishing costs for the previous twelve months are shown in Table 65.

Table 65 Annual Fishing Costs in 2010 Survey.

	Obs.	Mean	Min	Max
Rods, reels, pots	612	652.84	0	10,000
Special clothing, incl. hats, footwear	612	68.75	0	2,000
Diving gear	612	121.46	0	7,000
Boats and equip hire	612	452.79	0	120,000
Fishing club membership fees	612	39.51	0	1,600
Other	77	557.70	0	8,000
Aggregate	612	1,335.36	0	121,100

Very few respondents recorded expenditures over and above the main categories used. Excluding the "other" category the mean aggregate expenditure was $1335.

Boat related expenditures are shown in

Table 66. The bulk of the respondents (86% and 89%) incur no club or pen fees and other costs.

Table 66 Boat Related Expenditures 2010 Survey.

Variable	Obs.	Mean	Min	Max	% Zero
New Boat or boat equipment (motor, sonar)	437	5,051.93	0	150,000	33.87
Parts for boat, boat motor or trailer	437	650.38	0	35,000	53.32
Maintenance of boat, motor or trailer	437	699.26	0	10,000	23.80
Insurance for boat, motor or trailer	437	439.18	0	12,000	21.74
Boat and trailer licence fees.	437	179.56	0	1,000	1.60
Boat club membership and pen fees	437	196.40	0	6,500	84.21
Other	437	30.61	0	5,000	89.47
Aggregate	437	7,216.73	0	151,798	

Fishers continue to spend substantial amounts of money on fishing activities. Using only the comparable expenditure categories across the two surveys, the expenditure change is shown in Table 67.

Table 67: Expenditure Comparison 2010 and 2003.

Annual expenditure on:		2003	2010
Parts for boat, boat motor or trailer		462.60	650.38
Maintenance of boat, motor or trailer		392.63	699.27
Insurance for boat, motor or trailer		351.53	439.19
Boat and trailer licence fees.		181.03	179.57
Boat club membership and pen fees		191.07	196.40
Rods and associated gear		405.01	652.84
Special clothes		52.78	68.75
Club fees		16.07	39.51
Per trip		415.44	512.09

Allocating fixed cost across the number of trips, the expenditure per trip for the comparable categories has increased by an estimated 23 per cent.

The CPI for Perth over the period has increased by 25 per cent meaning the real level of expenditure is virtually unchanged, falling by just 2%. The number of trips of course is estimated to have fallen marginally between 2003 and 2010, by 6%. The mean number of trips estimated to be around 12.8 in 2003 and 12.06 in 2011. Hence it does not appear that the management changes had a major impact on expenditure levels from boat based recreational fishing in the West Coast Demersal Fishery.

7.18 Impact of Changes on Fishing Tour Operators

7.18.1 Fishing Tour Operators in Western Australia

Two licences exist for fishing tour operators, a fishing tour operator licence (FTOL) and a restricted fishing tour operator licence (RFTOL). In Western Australian there were 205 operators in 2007/08, 202 in 2008/09 and 188 in 2009/10. The distribution of active operators is shown in Figure 39. The major changes have affected the West Coast Bioregion. There were 116 licenses and 81 active operators in 2008/09 season but this declined to 75 operators holding 94 licenses in 2009/10. Operators are spread across all the bioregions. The number of operators by region is shown in Figure 39. Operators in the West Coast bioregion fell in the 2009/10 season to 75 from 81 in the previous season

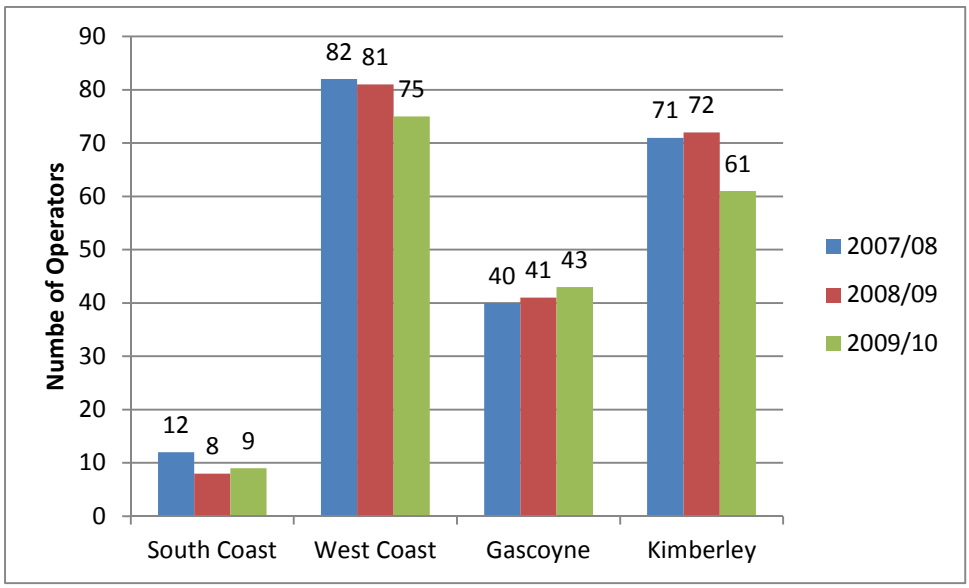


Figure 39 Active Fishing Tour Operators in Western Australia. *Source: DoF and McElroy et al (2011).*

7.18.2 Fishing Tours Operations

Fishing tour or charter boat operators take customers into the West Coast Demersal fishery with the specific objective of catching prized species such as Dhufish, Pink Snapper and Baldchin Groper. These are small to medium enterprises and most are operated as family (husband and wife) businesses

By the time of the survey, there were approximately 45 active Fishing Tour Operators in West Coast Bioregion in 2010. This is a much reduced number of operators. Thirty Fishing Tour Operator licenses were not renewed in 2010 following the changes to the management regime in the West Coast Demersal fishery during the 2009/10 season.

The survey revealed the extent of changes to the method of operation. Mobile (no fixed location) charter boats are spending longer outside the West Coast Bioregion since the introduction of 2 month ban or closed season. Fixed location Charter Boats are diversifying their operations. In particular they are moving into eco tours and private functions as a way of sustaining commercial viability. The following analysis is based on the pattern of trips for two boats operating within the Perth

Metropolitan zone. As there are only a few charter boat operators, survey results must be treated as indicative. The change is shown in Figure 40.

Total trips between the 15 Oct to15 Dec 2008 (the 2008/09 season) were 78.Total trips between 15 Oct to15 Dec 2009 (the 2009/10 season) when the closed season was in operation were reduced to 59. In 2010, there was a shift to corporate/private functions and whale watching.

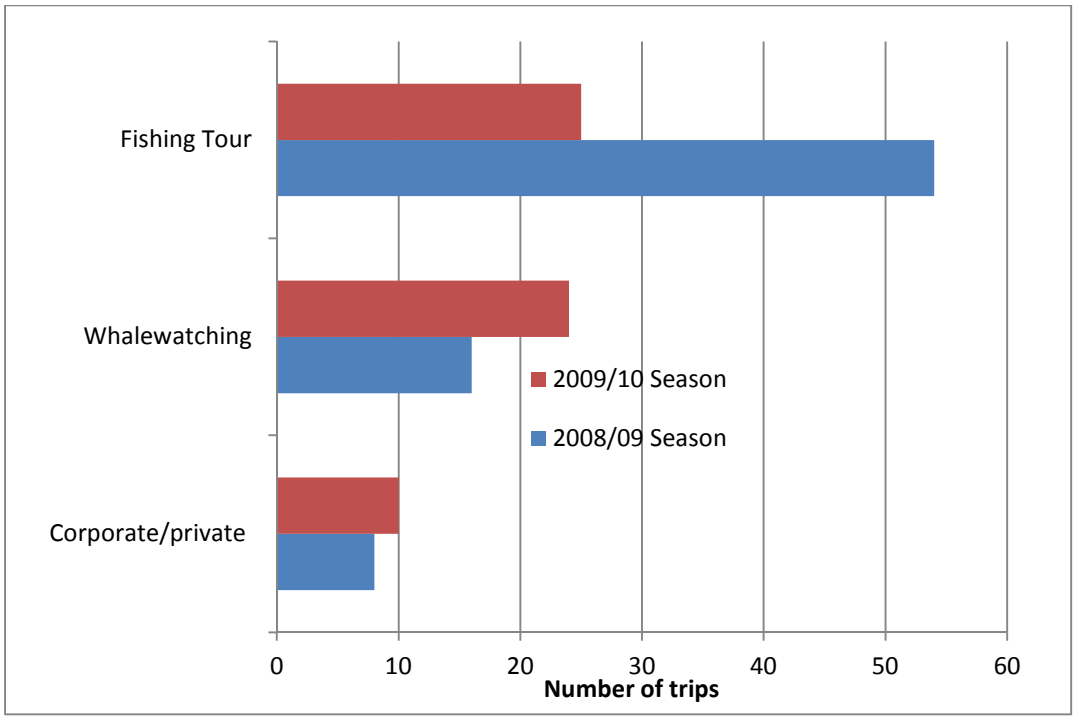


Figure 40 Indicative Changes in Pattern of Charter Boat Usage.

7.18.3 Charter Boat Industry

The core activity of the charter boat industry is the provision of a safe at-sea platform for recreational fishers to allow them to catch the desired species at various key points within the West Coast Bioregion and beyond. The key to suggest is the combination of safety and the high probability of a recreational fisher catching the desired species by a charter boat service.

The industry has been in state of flux for some time. The peak in activity measured as fisher days was back in peaked in 2002/03. Activity has steadily decline since then with the downward trend intensifying with the introduction of the fishery management changes in 2009/10. A 26.5% drop was recorded at this time.

Associated with the decline in activity devoted to facilitating catch by recreational fishers has been a shift toward non-extractive activities with a greater emphasis on total activity outside of the West Coast Bioregion. The feedback is that a number of drivers exist for these changes. The major forces represent a combination of biological, social and economic factors. The biological factors are the decline of demersal stocks impacting abundance and therefore catch rates, reduced bag limits, the closed season and recovery of whale and sea lion populations.

On the social indicators, the population growth and projected population growth in Western Australia (2%/year) along with increasing boat ownership is increasing the demand for marine experiences. This is combined with the and widespread adoption of improved fish locating & fishing technology a shift towards more conservation values for recreational fishers (use of catch & release) and a rising demand for multiple (incl. non-extractive) marine based activities mean that fishes derived satisfaction from the marine activity in ways not entirely dependent on catch and keep fishing.

Economic factors are related to Western Australia's growth rate which is associated with rising disposable incomes and falling unemployment. This has been the experience for at least the last decade and is expected to continue. It appears that this has allowed charter boat prices to rise at about the rate of inflation. Improved accessibility of Gascoyne and Pilbara/Kimberley Bioregions has facilitated selling services.

The recent trend in charter tour fishing activity is shown in Figure 41.

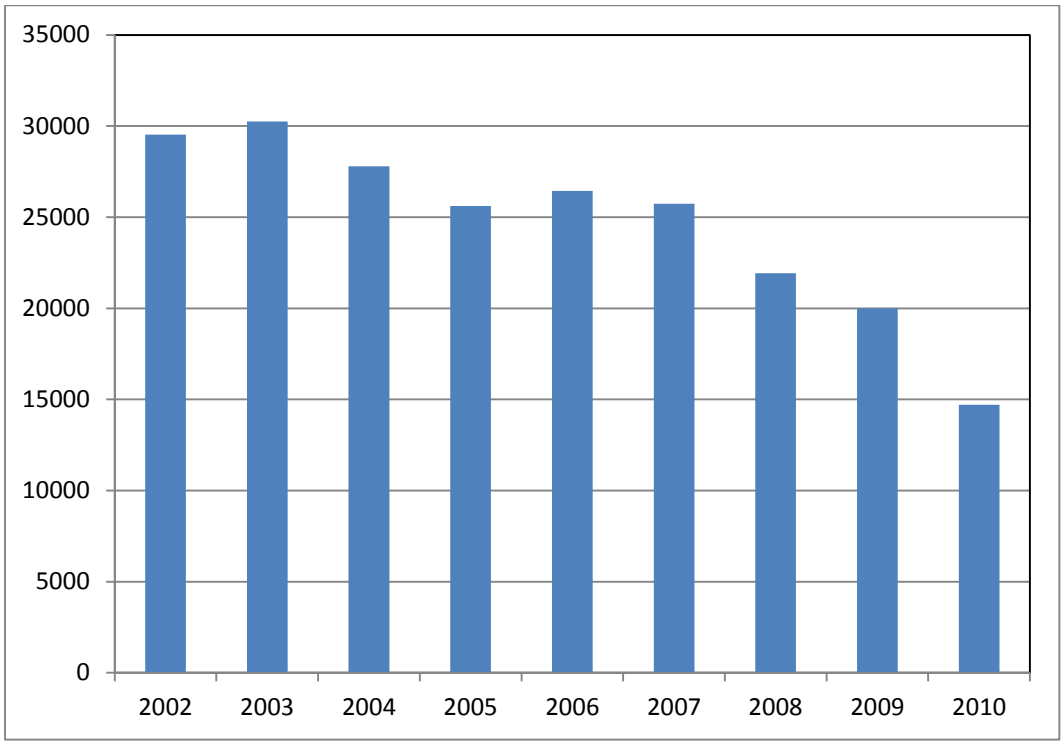


Figure 41 Fisher Days, Charter Boat Industry, West Coast Bioregion, 2001-2010. Source: DoF and McElroy et al (2011)

7.18.4 Adjustments and Impacts on Charter Boat Operators

Significant changes have occurred for operators in the West Coast Bioregion consequent upon the new management rules. Active FTOL and RFTOL holders in the West Coast Bioregion during the introduction of the 2 month ban on fishing between 15th Oct and 15th Dec, the individual bag limits and new boat catch limits have adjusted in a variety of ways including:

- effort reduction in the pursuit of catch and keep in the West Coast Bioregion and an increase in catch-and-release and pursuit of alternative (non-demersal) species.
- switch to non-extractive activities such as eco tours and corporate functions

- greater emphasis on activities outside of the West Coast Bioregion
- exit the industry.

The survey of charter boat operators enabled some casse study conclusions. Table 68 shows changes in fishing behaviour for two vessels in the West Coast Bioregion across the pre ban two month period in 2008 to the closed season two month closed season in 2009. The results are as expected. There was a complete cessation of catch and keep for the restricted species, an increase in catch and release and a switch to other species, (in this case Samson fish). The aggregate number of fish caught went from 759 to 789 but the per cent of release went from 32 per cent to 90 per cent. A key question is whether this change in mix changes economic viability. This is considered below.

Table 68 Case Study Results for Two Vessels in West Coast Bioregion.

	15 Oct to 15 Dec 2008		15 Oct to 15 Dec 2009	
	Kept	Released	Kept	Released
Dhufish	34	44	0	0
Baldchin Groper	13	1	0	0
Pink Snapper	348	148	0	49
Samson Fish	120	51	73	667
	515	244	73	716

Combining the data on fisher days and the indicative survey data on financial performance allows an estimate of the overall impact of the changes on the financial performance of charter boats in the West Coast Bioregion. These estimates are shown in Table 69. The decline in revenue due to overall decline in fisher days is split between loss of revenue attributable to the two-month season (centre) and loss of revenue due to the reduction in fisher days for the ten-months excluding the closed season (below).

Table 69 Impact of Changes in management on Economic Performance of Charter Boats.

Loss in revenue from fall in total fisher days, 2008/09 versus 2009/10	
Item Units	
Fisher days 5	705
No. of trips	489
Clients/trip	11.67
$/fisher day	210
Gross revenue loss	$1,198,050
Net revenue loss	$778,733
Loss of revenue attributable to closed season 2008/09 versus 2009/10	
Item Units	
Fisher days	1,702
No. of trips	126
Clients/trip	13.51
$/fisher day	210
Gross revenue loss	$357,420
Net revenue loss	$232,323
Loss of revenue attributable to trend decline/new management regulations s outside closed season, 2008/09 versus 2009/10	
Item Units	
Fisher days	4,003
No. of trips	348
Clients/trip	11.51
$/fisher day	210
Gross revenue loss	$840,630
Net revenue loss	$546,410

Changes to the pattern of fisher days across bioregions are shown in *Figure 42*. Overall fisher days fell from the 2008/9 to the 2009/10 season. The largest fall was in the West Coast Bioregion resulting in the Pilbara/Kimberley now accounting for more fisher days than West Coast Bioregion. Interviews with operators revealed that switching some effort to the other areas (Gascoyne and Pilbara/Kimberley) was a conscious strategy with one case company indicating that it was extending its Monte Bello fishing season into November until the onset of monsoon season.

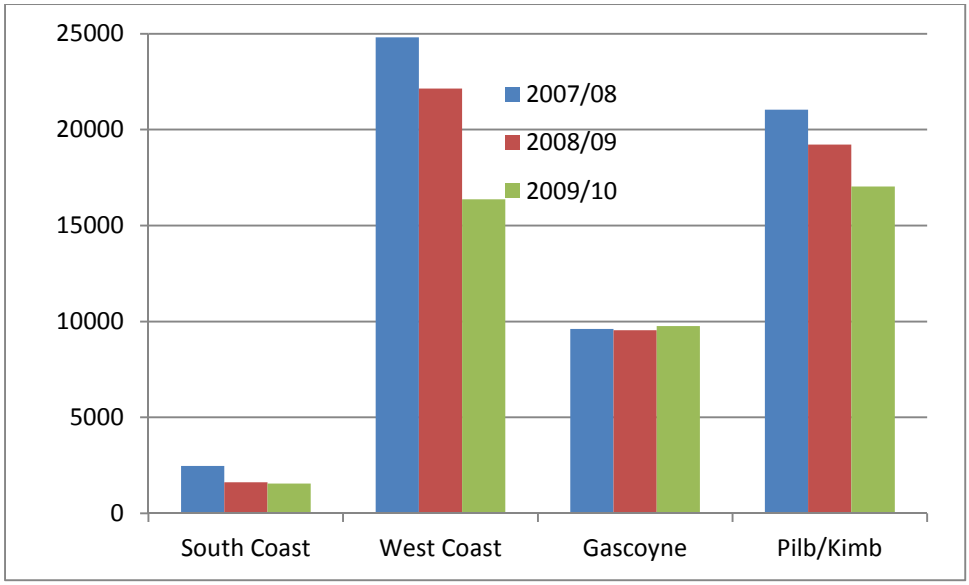


Figure 42 Annual Changes in Fisher Days by Bioregion. *Source DoF and McElroy et al (2011)*

7.19 Impact of Changes on Commercial Operators

The commercial fishery had operated as an open access fishery with potentially more than 1,200 FBLs. Since January 2008 the commercial sector has been managed under the West *Coast Demersal Scalefish (Interim) Management Plan 2007*. This restricts commercial fishing to 60 Interim Managed Fishery Permit holders. Gear and other restrictions apply (in the form of maximum numbers of lines and hooks and arrangements regulating the carriage of lines and fish) and boats are monitored through the Vessel Monitoring System (VMS). Since January 2009 a restriction on the annual hours of fishing time is imposed. Individual entitlements in hours are tradable. Importantly as part of the new measures the maximum number of allowed fishing hours within the with the metropolitan area has been set to zero, meaning that commercial fishing is effectively banned within the metropolitan area.

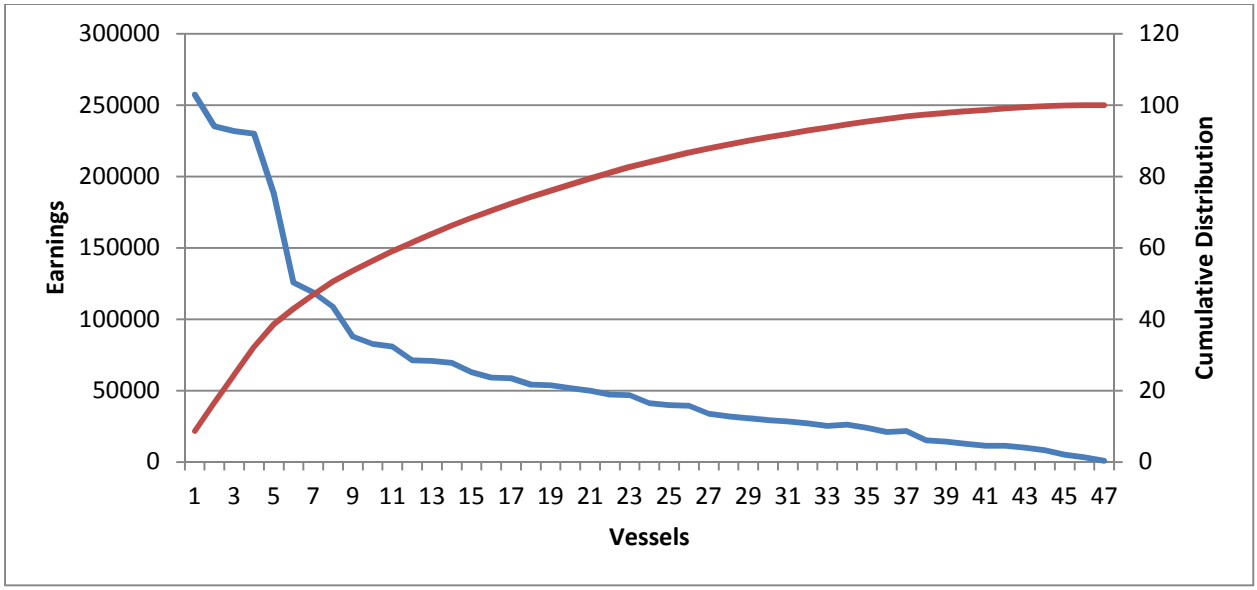
The changes in the West Coast Demersal Scalefish fishery have impacted upon catch, vessel numbers and economic value. In 2006/07 catch in the West Coast Demersal Scalefish fishery was 975 tonnes. Vessel numbers actively fishing were 191 but only 44 were wetline only. On January 1 2008 the open access fishery was closed and thereafter only persons authorized under the West Coast Demersal Scalefish Interim management fishery could fish the fishery. Initially 60 permits were issued.

Thereafter, catch was reduced to 413 tonnes in 2008, 303 tonnes in 2009 and 365 tonnes in 2010. Vessel numbers were 49 in 2008, 47 in 2009 and 50 in 2010. Days fished after the new regime was introduced were substantially reduced compared to the per change level. Days fished were 8,486 in 2006/07, 2,435 in 2008, 1.445 in 2009 and 1,489 in 2010.

Catch value initially fell from $4.8 million in 2006/07 to $2.94 million in 2009 but recovered to $3.54 million in 2010. This is attributable to an increase in beach price, especially prices for Dhufish, Pink Snapper and Baldchin Groper. Person days fishing have been estimated based on fishing hours, vessel numbers and persons per trip. They fell from 5,808 in 2006/07 to 3,027 in 2010. The bulk of vessels in 2010 had 1 crew, but as they fish for around 60 days per year, the total person days the employment effect is far less than 100 (50 vessels with a skipper and 1 crew). In fact the estimated 3,027 person days are equivalent to around 12 full time equivalent jobs. Although the vessel numbers have been

consistent in the last few years, the economic picture reflects a dominance by a few vessels. *Source DoF*

Figure 43 shows the distribution of earnings in 2009 for the vessels operating in the fishery in 2009. The top 10 boats account for more than half the earnings.



Source DoF

Figure 43 Distribution of 2009 Earnings ($) for all Boats in the West Coast Demersal Scalefish Fishery.

Table 70 shows the differences between the larger and smaller vessels across 2008 and 2009. Between 2008 and 2009 the top five boats increased days, catch, total revenue and catch per unit of effort. Boats 6 to 10 experience decreases in catch, total revenue and catch per unit of effort

Table 70 Earnings and Catch 2008 and 2009.

	2008				2009			
	Days	Kg	Revenue	CPUE	Days	Kg	Revenue	CPUE
Top 5 boats 2009	367	96,222	$915,292	262	421	126,081	$1,141,289	299
Top No. 6-10 boats 2009	365	87,539	$817,006	240	254	54,370	$523,092	214
Total (all boats)	2,435	415,350	$4,100,775	171	1,395	303,372	$2,933,346	217
% Top 5 boats 2009/all boats	15.1	23.2	22.3		30.2	41.6	38.9	
% Top 10 boats 2009/all boats	30.1	44.2	42.2		48.4	59.5	56.7	

Source DoF and McElroy (2011)

8 BENEFITS

The beneficiaries of the research are industry and management:

1. The Department of Fisheries, Western Australia
2. Recfishwest
3. Western Australian Fishing Industry Council
4. Fisheries management and fishing organizations in other States.

The research provided a number of benefits based upon improving our understanding of the impact of changes in fisheries management.

The two new recreational fishing surveys have provided data that gives insights into the way recreational fishers have responded to the new management regime and how this compares to their behaviour in a previous survey undertaken before the new rule were introduced.

An important benefit of this data is that it allows an assessment of the consistency of recreational fisher response based upon analysis of responses on catch and trip times using a model of recreational fisher choice. Having an understanding of how consistently fishers behave in response to changes in management regimes is critical knowledge to have in assessing the impact of future rule changes.

A particular feature is that the new data allows an assessment of the way that fishing times and catches have changed but also of the way that the rules have impacted on fisher satisfaction with various aspects of the fishing experience as well as the on the satisfaction with the overall fishing experience. This allows an understanding as to the way that fishers have accepted and assimilated the new management rules.

The surveys allow separate analysis of behavioural changes in the closed season thereby providing insights into the way that this particular initiative has influenced fishers. The fact that two surveys were carried out has allowed an analysis of the pattern behaviour in year 2 of the new regime. This provides insights into any tendencies by fishers to adjust behaviour after experiencing the first season under the new rules.

Data collected on commercial and charter fishers have provided a basis for assessing how these sectors have adjusted to the new management regime. This includes information on how the new regime has affected economic performance and financial viability of operators. It therefore allows managers to assess how well the sectors have coped with the changes.

The differences expenditure by recreational fishers between the first and second surveys highlight any changes in expenditure patterns and allow an assessment of the extent to which the economic impacts of recreational fishing has changed. The changes in vessels and activities in the commercial activities allow an assessment of the extent to which the changes have impacted on employment and economic activity. Together this data allows managers to determine how significant the overall impact on economic activity related to recreational and commercial fishing has been.

9 FURTHER DEVELOPMENTS

Research and other activities that should be undertaken to further develop our understanding of the impact of regulatory changes are particularly focused on recreational fishers.

Disseminate outputs to fishery managers and representatives of the recreational fishing sector. Seminar presentations are planned as part of the extension to this project. However, an ongoing dialogue is needed to involve recreational fishes in the process of utilising the results to improve management.

Extension of Modelling to Other Fisheries and Jurisdictions is required to test consistency of behavioural responses. Notwithstanding the current results, little is still known about how recreational fishers adjust fishing effort in response to changes in fishery regulations used to manage recreational catch, or to other management measures. In particular, a better understanding is needed of the likely influence on the number and location of fishing trips, hours per trip spent fishing, and other aspects of recreational fishing behaviour, of changes in bag limits, changes in size limits, changes in area closures, changes in seasonal closures and stock biomass enhancement. Extending the survey based analysis used in this study to other fisheries and jurisdictions will help build a picture of recreational fisher behaviour that will generate knowledge to better inform recreational fishing organisations as well as fishery managers, about how alternative types of catch regulations affect recreational fishing effort, thereby enabling adjustments that are likely to enhance the value of recreational fishing.

There are two specific areas where further modelling work will be potentially significant for policy.

Collection of Satisfaction Score Data has been of considerable benefit in the current study yet is rarely collected. Collection of more systematic data across different recreational fisheries with different rules will allow a more detailed understanding of fisher behaviour based on an analysis of what drives the satisfaction levels.

Trade-off analysis could be sued to understand the choice trade-offs that fishers are prepared to make in response to changing circumstances. Bag limits, changes in size limits, changes in area closures, changes in seasonal closures and stock biomass enhancement can all be used to different degrees. The current study has shown that they influence a number of behavioural adjustments including the number and location of fishing trips, trip times and hours per trip spent fishing as well as the satisfaction with fishing. Formal trade-off analysis would allow the preferred combinations of these measures to be determined that would simultaneously achieve the desired management outcomes while minimising the loss of satisfaction from fishing. These need to be considered specifically within the analysis.

Mechanisms to improve financial outcomes for charter and commercial fishers need to be further considered. In particular, with fleet stabilization and catch and effort levels set, this study has shown the importance of per unit price in the financial outcome for commercial fishers. Dhufish, Pink Snapper and Baldchin Groper are premium species and prices have risen as supply has contracted. However, it is not clear that prices are achieving the premium consistent with the high quality of these species.

The data for the current study has utilized three recreational fishing surveys. The data bases in MS Excel and Stata formats are maintained by the Principal Investigator at the University of Western Australia. Access can be requested through this arrangement.

10 PLANNED OUTCOMES

With regard to recreational fishing, the project outputs provide a framework for understanding the behaviour of fishers and for assessing their likely response to fisheries management changes. These outputs will contribute toward a better understanding of recreational fishers in the presence of regulation and a stronger basis for implementing future change.

A model of recreational fisher behaviour will allow insights into the likely reaction of recreational fishers to changes in fishing regulations. The model allows for the development and interpretation of the recreational fisher surveys. The two surveys conducted in 2010 and 2011 cover two seasons after the change in the recreational fishing regulations and allow an assessment of changes in fishing behaviour as a consequence of the new fishing rules and the closed season for the West Coast Demersal fishery.

The reference in the model is the unconstrained behaviour of fishers. This acts as reference for predicting the likely reaction to rule changes. The results obtained from a previous survey of recreational fishers undertaken in 2003 when no restraints existed parallel the unconstrained model and can be compared to the 2010 and 2011 surveys to determine the impact of the recreational management changes on fishing behaviour.

The project delivered a model and the analysis of the three surveys to show empirically how fishing behaviour changed, documenting the impact on trip time, fishing time and non fishing time. Fishers express considerable concern when major change to fisheries management rules are implemented. The project delivered estimated of satisfaction with catch and experience attributes across the three surveys to show how these were affected by the changes to fishing rules. By documenting the changes in satisfaction, insight is gained as to which impacts affect fishers most and how the overall level of satisfaction is impacted by fishing rules. The project has delivered insights into the fact that overall satisfaction with the fishing experience is maintained even when the level of satisfaction with trip attributes such as catch and catch rate declines. Bag limits are a central part of reducing recreational fishing effort. Closed seasons are also a potentially important element and have been implemented in the West Coast demersal fishery. The project survey data has delivered insights into the way that the two month closed season has changed fishers' behaviour.

The results from the initial 2010 survey contributed to the evaluation of recreational fishing behaviour for the Western Australian Marine Science Institution (WAMSI) project on recreational fishing in the West Coast Bioregion.

Commercial fisheries adjustment has the potential to produce negative financial impacts on commercial fishers and negative social impacts on communities supporting the industry. The project collected data through direct interviews with commercial fishers, including charter boat operators in the fishery and supplemented this with analysis of log book data. The impact on financial performance and the range of adjustments made by commercial fishers to secure better outcomes under the new

rules have been documented. These results have been incorporated the WAMSI project on commercial fishing in the West Coast Bioregion.

The project has shown how recreational how recreational fishing expenditure has remained virtually unchanged in the face of the new rules and that the employment impact of the changes to the commercial sector are small.

Project results have been communicated through a number of seminars presented to researchers and fisheries managers at the Western Australian Department of Fisheries and at WAMSI research forums.

11 CONCLUSION

The objective of this project was to analyse the impact on recreational and commercial fishers of the management changes that have been introduced into the West Coast Demersal Scalefish fishery. Analysis of the stock in this fishery, including stocks of the iconic dhufish, pink Snapper and baldchin groper indicated that the species in the fishery were under significant threat. The management changes were designed to restrict effort for both commercial and recreational fisheries in order to protect the stocks of the various species in this fishery. The significance of the threat meant that the policies implemented were severe – a ban on commercial fishing, a greatly reduced bag limit for recreational fishers, a two month closed season for recreational fishers and the requirement that a recreational fishing boat licence be held to allow fishing for these species.

Given the severity for the restrictions it is important for managers to get an understanding of the way that recreational fishers react to such management initiatives because this impacts upon the likely success of the polices and on the wider enjoyment of fishing. Perverse reactions, such as shifting spatial fishing effort or fishing harder for other species may undermine ultimate success. Widespread reduction in the satisfaction with fishing may reduce the level of recreational fishing participation with consequent impacts for the associated industry. On the commercial side the reduction of effort will impact commercial performance with potential impacts on the fishers and their associated industries and communities.

The new recreational fishing rules were in place for the 2009/10 season. To measure the impact on recreational fishers, phone surveys of recreational fishers were undertaken in 2010 and 2011. Both these surveys were after the introduction of the new rules. To gauge the impact of the changes these survey results were compared with the results from a previous 2003 survey of individual fishers from the same fishery. The 2003 survey is treated as the pre change case because there were minimal fishing restrictions in place at that time. .Comparison across the surveys indicates changes in behaviour associated with the new fishing regime. To assess the impact on commercial fishers, a combination of log book analysis and face to face surveys were used as the basis of the analysis.

In interpreting the survey results the reference point used is a model of recreational fisher choice that models the recreational fisher as a rational decision maker pursuing a number of trips annually and pursuing a mix of fishing and non-fishing activities so as to maximize the satisfaction obtained from making fishing trips, from catch and keep fishing and catch and release fishing and from participation in non-fishing activities. The mix reflects that fact that the fisher derives satisfaction for the fishing activity per se represented by catch and keep and catch and release and also from the overall trip experience The experience value is a more complex variable influenced by catch variables such as

catch numbers, catch rate and fish species caught and size of fish caught but also by participation in non-fishing activities.

Decisions about the optimal mix of activities influence total trip time and the allocation of trip time to various activities. Time has an opportunity cost for the fisher reflected by the value of activities the fisher could pursue back on shore. Within this framework the fisher has a willingness to substitute between various trip activities in order to achieve optimal satisfaction and responds to the various rules and restrictions (bag limits, closed seasons etc.) by adjusting the key decision variables such as trip time and its allocation between fishing time and non fishing activity time, increased catch and release activity and increased involvement in non-fishing activities that can maintain the experience value of the trip.

Overall the surveys reveal only modest numbers of fishers adjusting their behaviour. In the 2010 survey 84 per cent of respondents indicated that their behaviour had not changed because of the new management rules (licence fee and bag limits). This was still high at 80 per cent of respondents in the 2011 survey. Fishing less often was nominated by only 6 per cent of respondents in the 2010 survey and 11 per cent of respondents in the 2011 survey as their response to the new rules..

For recreational fishers, survey results have highlighted some marked differences and some surprising similarities between the pre and post change situations. Between 2003 (pre change) and 2010 (post change) surveys, the number of trips per annum is not significantly less, but catch per trip is significantly less for the prized and high risk demersal scalefish in the 2010 survey which is consistent with the intent of the new regime, the primary objective of which was to reduce catch of the species at risk.

A key part of the surveys was how satisfied fishers were across the period as regulation changes impacted their recreational activities. This was measured on a 1-5 scale for a set of trip related attributes where 1 was 'very dissatisfied' and 5 was 'very satisfied'. The summary results are shown below, ranked from the higher satisfaction attributes to the lower satisfaction attributes.

	2003	2010	2011
Having an enjoyable time out on the Ocean	4.67	4.78	4.75
Enjoying the fishing experience, regardless of the number of fish caught and kept	4.50	4.69	4.61
The species of fish you keep	3.73	3.85	3.91
Level of congestion at the boat ramp	3.69	3.49	3.58
Catching enough fish for a decent feed	3.65	3.55	3.66
The species of fish you catch	NA	3.53	3.64
The number of fish you keep	3.59	3.34	3.53
The size of the fish you catch	3.67	3.56	3.55
The number of fish you catch	3.47	3.09	3.2
The time it takes to catch the number of fish you expected to	3.54	3.11	3.14

Consistent with the tighter bag limits and reduced catch under the new rules, satisfaction scores for fish caught, species caught, time to catch the fish (catch rate) and size are all significantly lower in the 2010 survey. Mean satisfaction with the number of fish caught and kept in 2011 was higher than in

2010 and back close to the 2003 level. However, on other dimensions satisfaction levels are still lower than in 2003. Both 2010 and 2011 are significantly below the mean satisfaction in 2003 for the size of fish caught. For species caught and retained the mean satisfaction is 3.85 in 2010 and 3.92 in 2011. The mean satisfaction was lower in 2003 with a mean score of 3.73. Catch rate is an important driver of behaviour. Mean satisfaction in this case decreased from 3.54 to 3.11 between 2003 and 2010. It was the least satisfactory aspect of fishing. Between 2010 and 2011 it increased to 3.14 but was still the least satisfactory aspect of fishing.

In contrast to individual attributes of fishing, satisfaction with the overall fishing experience and with time on the ocean is consistently high across 2010 and 2011 and higher than in 2003. By adjusting trip time and other aspects of their trips fishers appear to have adjusted to rule changes and maintained overall satisfaction levels. Achieving the same overall satisfaction with the fishing experience despite lower bag limits is consistent with the new rules increasing the societal benefit derived from the resource.

The results indicate that in both the 2010 and 2011 surveys, only 15 per cent of fishers reported that they stopped fishing on a typical non closed season trip because of the bag limits. More important reasons than bag limits for stopping fishing, were: weather, out of time and not catching the preferred species. The results do show that more skilled fishers are statistically more likely to be stopping because they have reached the bag limit.

Total trip time, ocean time and fishing time all fell under the new rules. Non-fishing time per trip increased significantly in the 2009-10 season all of which is consistent with the recreational choice model included in the report.

The surveys reveal behavioural changes in the closed seasons. For the 2009 closed season, 42 per cent of respondents indicated that there fishing behaviour had changed in the closed season. This increased to 54 per cent for the 2010 closed season. The result is significant and indicates on-going behavioral adjustment to the closed season. In both surveys, only five percent of respondents indicated that they had fished for high risk species such as dhufish, pink snapper and baldchin groper outside of the West Coast Bioregion during the closed season. Of these, less than twenty percent in 2011 indicated that the 2010 closure had prompted their fishing trips outside of the bioregion. Overall the surveys indicate that very few fishers opted to fish outside of the bioregion during the closed season. Instead a large proportion of fishers (45 per cent) simply did not fish from a boat during the closed season. The majority of these cited inability to fish for the designated species as the reason for not going fishing.

Satisfaction scores for catch rate are low across all three surveys. Catch rate is found to be significantly connected to the number of trips per annum. Analysis of catch rate and the number of trips taken in 2003 and 2010 indicates that as catch rate increases the number of number of trips rises but at a decreasing rate. If regulations that reduce effort have the effect of improving catchability and catch rates, then there is likely to a positive trip response. The analysis indicates that the probability of going bottom fishing weekly and fortnightly as opposed to monthly increases significantly with catch rate.

The focus for the charter industry analysis was active holders on Fishing Tour Operators Licences (FTOL) and Recreational Fishing Tour Operators Licences (RFTOL). The analysis concentratd on the change in behavior and performance over the two year period 2008/09 (pre-ban) and 2009/10 which was when the 2 month ban, individual bag limit and new boat limits were introduced. Five distinct

behavioural adjustments were detected as operators sought to maintain viability. There was an accelerated decline of charter boat catch rates and a reduction in total charter fishing effort (down 26.5% in 2009/10). There was an increase in catch - and -release and alternative (non - demersal) fishing activity with Samson fish now a major focus of activity. Another key response was to shift business focus to non-extractive activities including eco tours and corporate functions. Shifting effort outside West Coast Bioregion, in particular to Gascoyne/Pilbara was a strategy used by some fishers. Finally some active Fishing Tour Operators chose to exit the industry and some inactive licences were retired.

Notably these changes are driven by bio-economic and socio economic trends that have been reshaping the industry for the last 10 years. Management responses such as catch-and –release fishing, targeting other species; increasing effort in Gascoyne and Pilbara/Kimberley and the retirement of part of the latent effort exit of active operators and non-renewal of licences are part of the wider adjustment process. Operators who have found ways to adapt to these trends overall have been least impacted, even benefited from recent fisheries management reforms.

For the commercial sector, the changes have reduced the number of boats and employment in West Coast Demersal Scalefish Fishery. The analysis indicates that most remaining boats and crew have experienced reduced earnings from the fishery. However, the size distribution of boats is highly skewed with the top 5 vessels (10 per cent of vessels) accounting for more than forty per cent of earnings. The analysis suggest that these top five boats have improved their performance compared to the rest. In effect the Interim Managed Fishery Status has stabilized the fleet numbers, reduced risk and uncertainty for managers and existing fishermen, and improved catch rates and earnings for the top 5 boats in West Coast Demersal Scalefish Fishery. The allocation of the endowment of the entitlement created a valuable tradable asset. One consequence of the reduced supply since January 2008 has been an increase in unit beach prices, particularly for dhufish but also for pink snapper. Hence industry revenue has not reduced as much as might be expected given the reduction in aggregate catch and vessel numbers. Revenue loss has been around $1.2 million, from $4.8 million in 2005/07 to $3.54 million in 2010.

The socio economic consequences associated with the changes will be conditional on changes in expenditure by recreational fishers, participation and employment reductions in charter and commercial fishing.

An analysis of recreational fishing expenditure indicates that Fishers continue to spend substantial amounts of money on fishing activities. Using only the comparable expenditure categories across the surveys, and allocating fixed cost across the number of trips, the expenditure per trip has increased in the by an estimated 23 per cent between the original survey and the 2010 survey. The CPI for Perth over the period has increased by 25 per cent. The number of trips of course fell slightly over the period, from an average of 12.8 in 2003 to 12.06. Hence it does not appear that the changes have had a major impact on expenditure levels from recreational fishing and therefore have not had a major economic on the socio economic impact of recreational fishing activity.

The commercial fishing sector is relatively small. In revenue terms it was worth $4.8 million in 2005/07 and $3.54 million in 2010. Fishers do not fish every day. It is estimated that based on the days fished, number of vessels and typical employment patterns, the full time equivalent employment is only 12 persons in 2010 and had been 24 in 2005/06. The scale of this adjustment is dwarfed by comparison

to that occurring simultaneously in Western Rock Lobster industry. It is also small compared to the economic growth opportunities opening up for coastal towns in the West Coast Bioregion due to the opening up the Indian Ocean drive which makes Jurien Bay more accessible to Perth residents, the promotion of the 1,100 km of coastline between Cervantes and Exmouth as Australia's Coral Coast and the expansion of the Mid West region around Geraldton as a mining area. Structural changes occurring in the commercial West Coast Demersal Fishery will not have a significant impact on the wider regional economy

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13 APPENDIX 1: INTELLECTUAL PROPERTY

No particular intellectual property has been developed. The research is for the public domain. The report and any resulting manuscripts are intended for wide dissemination and promotion. Survey data has been collected through survey instruments documented in the appendices. Data is held in standard format data files and was analysed with widely available commercial statistics software. All data and statistics presented in the report conform to confidentiality arrangements.

14 APPENDIX 2: STAFF LIST

The following table lists project staff involved in the project.

Person	Organization	Funding
Paul McLeod	University of Western Australia	UWA in kind.
Malcolm Tull	Murdoch University	Murdoch in kind
Joseph Christensen	Murdoch University	Murdoch, WAMSI in kind
Seamus McElroy	University of Western Australia	UWA, WAMSI in kind

15 APPENDIX 3: MATHEMATICAL MODEL OF RECREATIONAL FISHER CHOICE

The detailed recreational fisher choice model that is used in the body of the report is presented in detail below with the full mathematical notation.

15.1 The Basic Model

In the literature a common specification is to have fisher utility defined as follows;

$$U = U(d, x, e(s_k, t_f, l_k)) \quad (4)$$

Where:

U is the utility derived from recreational fishing,

D = number of days fishing per year,

X = "other goods",

and *e* = the overall fishing experience.

The fishing experience is key to understanding behaviour. Once out on the water, the fisher achieves a fishing experience which is a function of the size of fish caught and kept, s_k, the fishing time, t_f, the fish caught and kept, l_k. It is assumed that the fisher can gain benefit from both catch and keep and size and will be better off the larger the fish caught.

The simplest approach to understanding behaviour is to assume that all water time is fishing time, and that there is no formal allowance for catch and keep. Woodward (2003) and Anderson (1993) use a model of this general form. In addition in most models there is, either explicitly or implicitly, only one species. If the fishery is multi species, the model assumes that all species are equally vulnerable to fishing effort, and equally valuable to the fisher.

Each fisher must access the fishing areas by boat and has a cost per trip that consists of boat costs, c_b and fishing costs c_f. Hence the individual fisher as a consumer faces the budget constraint:

$$c_b + c_f + x \leq M \quad \ldots\ldots\ldots \tag{5}$$

This means that fisher can think about the number of trips and what they do on each trip only within the context of the cost of each trip and how it relates to their income and the competing demands for that income from other goods and services. The fisher could spend time in other activities if not fishing. Hence the fisher also incurs an opportunity cost for the time spent on a fishing trip. The starting assumption is that each trip costs the same no matter which boat ramp or location are used for fishing.

The biology impacts the fisher through stock abundance. Abundance will influence the catchability of the fish for the fisher and will therefore impact upon the time (and cost) to catch fish. We assume that the fisher takes the biology as given. That is, the fisher experiences the biology as a harvest that depends on the biomass or stock at any given time.

The variables *d*, *e* and *x* work directly on utility and are assumed to have a positive marginal impact upon the utility of fishing as follows:

$$\frac{\partial U}{\partial d} > 0, \frac{\partial U}{\partial e} > 0, and \frac{\partial U}{\partial x} > 0 \ldots\ldots\ldots \tag{6}$$

The variables, $t_f, l_k, s_{k,} h$ all impact utility indirectly through the fishing experience. The marginal impacts on the fishing experience are assumed to be positive as follows;

$$\frac{\partial e}{\partial t_f} > 0, \frac{\partial e}{\partial s_k} > 0, \frac{\partial e}{\partial l_k} > 0, \frac{\partial e}{\partial h} > 0 \ldots\ldots\ldots \tag{7}$$

Different fishers will assign different marginal values to size, catch and time and will have a different willingness to tradeoff between catch and size.

As is usual for consumer choice, all the relevant second derivatives are negative.

We can use this basic model to consider various “scenarios’ and how the fisher would behave in each. Relevant scenarios to consider are:

- No bag or size limits

- Bag limits
- Bag limits and size limits.

The key questions are:

- Are there distinct fisher types?
- How does fishing time (effort) respond to bag and size limits?
- How does catch (keep and release) respond to bag and size limits?
- How does the annual number of days fishing respond to bag and size limits?
- What role does price (cost) play in supporting bag and size limits?

15.1.1 No restrictions (no size or bag limits)

If there are no restrictions, the fisher has the task of optimizing *d, h,* t_f,, l_k and s_k based on maximizing utility subject to the budget constraint.

There are two points to note about this case. First, without any bag limits no distinction needs to be made between the harvest, *h*, and fish kept, l_k as all fish caught can be kept. Moreover, at this point, catch and release is not a variable in the utility function, so we must assume that fish caught will be kept.[12] Second the number and size of fish caught will depend on the biomass or abundance, and fishing effort measured as fishing time t_f. We can write this as:

$$l_k = h = h(t_f : A) \text{ .....} \quad (8)$$

Under this option of no fishing restrictions there are no discards so we can follow Woodward (2003) and assume that the angler's average catch size would be a reflection of the "quality" of the biomass. This can be expressed as:

$$s = s(A) \text{ .....} \quad (9)$$

This average size will be the average for the relevant size distribution. The size distribution of fish caught can be represented as; $f(s|A)$. This can be assumed to be uniform (0, 1) in which case the smallest fish caught is size 0, the largest is size 1 and the average size of the fish harvested is 0.5. This assumption is one which needs to be tested against the actual data.

The tradeoffs inherent in the fisher's decision making process will drive their behaviour. Without restrictions, on any given trip the fisher is free to optimize the catch and can trade off size and catch. That is they can catch more to secure the preferred size.

For this to occur there must be (a) a marginal willingness to substitute between catch and size and (b) an ability to do it. The first arises because we assume a positive marginal utility from both size and from catch so there is a marginal rate of substitution defined by; $\frac{\partial e}{\partial s_k} / \frac{\partial e}{\partial l_k}$. The second arises because fishers can mix the fishing activity between catch and keep or discard. This offers the potential

[12] This assumption is relaxed in subsequent analysis,

to adjust the average size of the catch and keep component by 'discarding' fish into the catch and release activity. Again different fishers will behave differently in this regard.

At this point it is convenient to treat the fisher decision as a two stage process. At one level, the fisher must determine the number of trips per year, *d*. Then for any given trip the fisher must determine t_f, l_k, *h* and s_k.[13]

It is assumed that the fisher will maximize the fishing experience *e* = $e(s_k, t_f, l_k)$. It is assumed that there are positive marginal benefits from each argument in *e* such that: $e_{s_k} > 0, e_{l_k} > 0, e_{t_f} > 0$. At this point a question arises as to the interaction across these variables. We assume that they are independent so that all cross derivatives are zero. This means for example that a higher catch has no impact on the marginal value of size.

The primary function of the trip is assumed to be to catch and retain fish. In optimizing the fisher can therefore be considered as choosing the optimal combination of catch and keep and size of fish kept, s_k^*, l_k^*. The catch or harvest is determined by the fishing effort of t_f, and the abundance, *A*. Total catch is $l = h(t_f : A)$ and the assumption is that: $l = l_k$.

For every level of fishing time the fisher will optimize catch and size. The fisher also needs to optimize fishing effort or fishing time t_f.

At the margin the value of fishing time is $\frac{\partial U}{\partial e}\frac{\partial e}{\partial t_f}$

However, although time is conceptualized as "fishing time", it can be thought of as having a direct and indirect effect on the fishing experience. The direct effect arises through fishing time resulting in a harvest that allows the fisher to optimize catch and size. The indirect effect arises because the process of fishing adds value to the experience over and above that which is accounted for by fishing outcomes measures and catch and size.[14] The marginal value of fishing time can therefore be written as:

$$\frac{\partial e}{\partial t_f} + \frac{\partial e}{\partial l_k}\frac{\partial l_k}{\partial h}\frac{\partial h}{\partial t_f} + \frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h}\frac{\partial h}{\partial t_f} = \frac{\partial e}{\partial t_f} + (\frac{\partial e}{\partial l_k}\frac{\partial l_k}{\partial h_k} + \frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h})\frac{\partial h}{\partial t_f} \text{.....} \quad (10)$$

The fisher will optimize by pushing to the point where the marginal value of additional time is zero. In this case we have the following condition for optimizing fishing time:

$$-\frac{\partial e}{\partial t_f} = (\frac{\partial e}{\partial l_k}\frac{\partial l_k}{\partial h} + \frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h})\frac{\partial h}{\partial t_f} \text{.....} \quad (11)$$

[13] Technically we assuming a separable utility function.

[14] One interpretation is that it is an experiential value. This value may a reflect a variety of dimensions. In a previous study of the West Coast demersal fishery, Nicholls and McLeod (2004) found that attributes such as "spending time with the family" were an important aspect of the fishing experience and appeared to be independent of the actual fishing outcomes.

The relationship can be illustrated in the following diagram. The optimal fishing time is t_f* where the marginal benefit of fishing time (time only) is equal to the marginal benefit of fishing time (catch and size). Clearly anything that reduces (increases) the marginal benefit of fishing time (catch and size) will have a tendency to reduce (increase) fishing or trip time.

The marginal benefit of additional trip time per se declines according to D. The marginal benefit of additional harvest from trip time declines according to F. At t_f* additional time benefit is negative and equal to the positive marginal benefit from harvest. At this point the fisher ceases fishing.

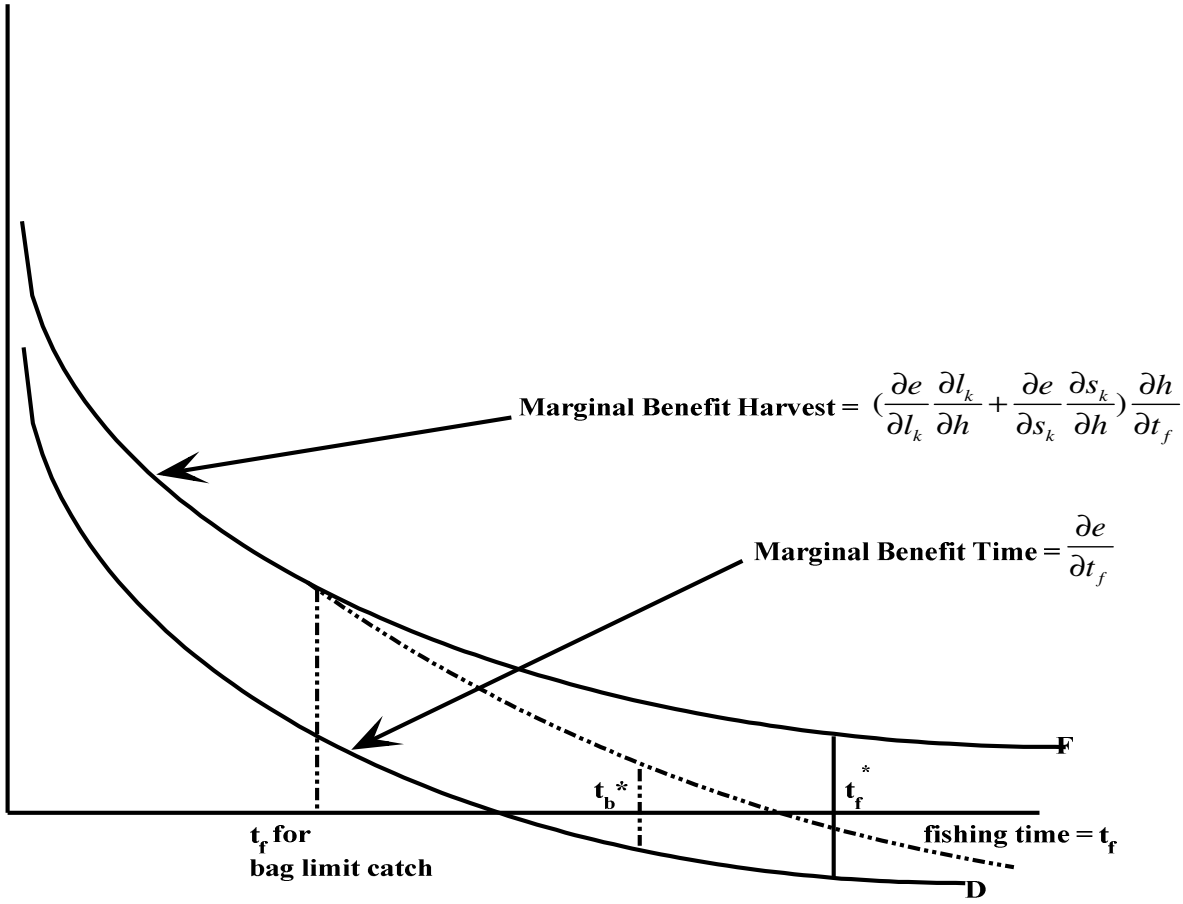

Figure 44: Determination of Optimal Trip Time

The fisher harvests from a given biomass. The biomass is represented by a standard growth equation as follows;

$$\Delta A = G(A) - \sum_{i=1}^{n} l_{k_i} \text{ .....} \quad (12)$$

Where G(A) is the natural growth rate, net of natural mortality, l_{ki} is the catch for each fisher. In equilibrium we have;

$$G(A) = \sum_{i=1}^{n} l_{k_i} \text{ .....} \quad (13)$$

15.1.2 Restrictions -Bag Limits

A bag limit can only restrict effort if it is binding. In Nicholls and McLeod (2004) survey results for fishers in the West Coast demersal fishery indicated that for a majority of fishers the recreational bag limits at that time were not binding. This can be taken to be an approximation of the no restriction case. However the new tighter limits are expected to be binding and have a consequent impact on fisher behaviour.

In the presence of binding bag limits, the consequences for behaviour and therefore for fishing outcomes (catch and size) depend on how fishers react to bag limits in terms of compliance.

The bag limit is a mandatory restriction that places an upper limit on the number of fish that an angler can retain during a fishing trip. The bag limit is defined in this model as l_k^b and means that $l_k \leq l_k^b$ for every angler.

There are a number of ways that a fisher can react to the bag limit in the fishery. First, the fisher may comply by stopping fishing for the particular fish (e.g. Dhufish) when the bag limit is reached. Second, fishers may actively "high-grade". In this case they hold fish caught and then dispose of smaller fish only if larger fish are caught later in the day if a later larger catch takes the fisher over the bag limit. Whereas catch and release will have mortality commensurate with release procedures followed, high grading is likely to have higher mortality, perhaps 100%.

In the extreme case fishers may simply cheat on the bag limit and this would then result in no discernible impact on the harvest and therefore on the fishing mortality. However there are well known penalties for non-compliance and fishers are therefore expected to comply with the limit and not be in blatant breach.

At this stage with no catch and release in the model, we assume discards from high grading have a release mortality of $\rho = 100\%$.

15.1.3 Absolute Compliance

With absolute compliance, l_k is reduced to comply with the bag limit. Without the bag limit, mortality is total harvest $l_k = h = h(t_f : A)$. The bag limit restricts catch and keep and so actual catch is reduced from the harvest level to the bag limit level. The change in catch is therefore $h(t_f : A) - l_k^b$. If compliance is absolute, fishers will fish to the bag limit and then stop. In this case the previous expression also captures the reduction in mortality. There would be no change in size of fish caught. If fishers' choose to high grade then fish caught earlier in the day are "released" in order to increase average size of fish kept. In this case, mortality is greater than l_k^b because total catch exceeds the bag limit to allow for high grading.

Clearly, because absolute compliance reduces *h*, it would reduce t_f. The bag limit reduces harvest, reduced retained catch, reduces trip time and has the desired effect on reducing mortality.

However, absolute compliance ignores the marginal value of size as reflected in equation (1) where trip experience depends on s_k, which depends on the harvest via fishing time, t_f.

The extent to which actual catch exceeds the bag limit will depend on the way in which size is affected by fishing time and abundance and the nature of the individual fisher's trade-off between catch and size.

The optimality condition in equation (8) now needs to be modified to allow for the fact that the fisher is on the bag limit and can only adjust the fishing experience at the margin by adjusting s_k. A rearrangement of (8) to allow for this would give:

$$-\frac{\partial e}{\partial t_f} = \frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h}\frac{\partial h}{\partial t_f} \text{ .....} \quad (14)$$

The marginal return to fishing or trip time now is confined to the ability to increase the average fish size within the bag limit. The average size goes up with fishing time but the marginal value of size goes down. The marginal catch is now set at whatever the marginal value of catch is at the bag limit. Catching more fish adds to value based only on the marginal value of size, not catch, so at the bag limit harvesting more fish adds less to the experience value than it did under an unrestricted regime. If the unrestricted optimal catch/size combination yields e* then:

$$\frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h}\frac{\partial h}{\partial t_f} < \frac{\partial e*}{\partial h}\frac{\partial h}{\partial t_f} \text{ .....} \quad (15)$$

Than is the marginal value of time harvesting is reduced because of the bag limit. In effect, because of the bag limit the fisher is only harvesting for size.

This can be illustrated using

Figure 1. Once the fishing time t_f, needed for the bag limit catch is reached, further time rewards the fisher only through increased fish size and so the overall marginal benefit from harvest falls to the dashed line. Assuming the marginal value of time (time only) is unaffected, then the optimal fishing time is now t_f^{b*} which is less than the unrestricted fishing time t_f^*. Therefore a utility maximizing fisher will pursue fish beyond that required to simply fill the bag limit but the trip time will still be less than for the unrestricted case. With harvest related to fishing time as per equation (5), this reduction in trip/fishing time means that overall harvest will fall, relative to the unrestricted case.

In mortality terms we have: unrestricted mortality $l_k = h(t_f^* : A)$; absolute compliance mortality $l_k = l_b$ and optimal bag limit mortality $l_k = h(t_{bf}^* : A)$.

If the fishers in the West Coast demersal fishery behave according to the above model then the key to understanding the mortality consequences of bag limits is to understand the marginal value of size as opposed to the simple catch quantum and to understand the proportion of fishers who will be "absolute compliers" versus "self-interested optimizers".

However, before we take this analysis further there are a number of further sophistications that need to be considered for the model.

15.2 Extending the Model

There are two important ways in which the above model may fail to capture the detail of a recreational fishery like the West Coast demersal fishery. First, catch and release as a positive component of the overall fishing experience is not allowed for in the above model. Discards with 100 percent mortality are included only as a way to achieve higher size within the given bag limits. However, catch and release can have a positive value as part of the fishing activity. To some extent this is recognized within the new management regime. A release weight is to be used when fish are released to help with reducing the mortality rate. Second the fishery is a multi-species fishery with a variety of fish and a variety of bag and size limits. Second, fishers may not fish for the entire trip time, as the previous model assumed, and may be willing to substitute between non-fishing and fishing time. Non fishing time in this context yields benefits unconnected to fishing outcomes. Third, like many recreational fisheries, the West Coast demersal fishery is multi-species. Fishers can switch/substitute between species. Each of these possible variations needs to be considered to make the model better approximate what actually happens in the fishery.

15.2.1 Non fishing time and catch and release

If we allow for non-fishing time, then we must have trip time broken down between fishing time, t_f and water time, t_w where the latter exceeds the former by the amount of non-fishing time, t_{nf}. Similarly, if we allow for voluntary catch and release then we must have total catch l, broken into retained catch, l_k, and released catch, l_r. The utility function consistent with this can be expressed as;

$$U = U(d, x, e(s_k, t_f, t_{nf}, l_k, l_r)) \ldots\ldots\ldots \quad (16)$$

U is the utility derived from recreational fishing, d= number of days fishing per year, x= "other goods", and e = the fishing experience. Once out on the water the fisher achieves a trip experience which is a function of the harvest of fish , h, size of fish kept, s_k, the fishing time, t_f, the fish caught and kept, l_k, fish caught and released, l_r, and non fishing time t_{nf}.

It is assumed that the fisher can gain benefit from catch and keep and will be better off the larger the fish caught.

As previously, the fisher optimizes with a budget constraint:

$$c_b + c_f \leq M \ldots\ldots\ldots \quad (17)$$

As previously, the effect on utility of each variable is positive. Therefore we have;

$$\frac{\partial U}{\partial d} > 0, \frac{\partial U}{\partial e} > 0, and \frac{\partial U}{\partial x} > 0 \ldots\ldots\ldots \quad (18)$$

And

$$e_{s_k} > 0, e_{l_k} > 0, e_{t_f} > 0, e_{t_{nf}} > 0, e_{l_r} > 0 \ldots\ldots\ldots \quad (19)$$

Fishing time impacts the fishing trip experience, e, through the harvest, h, and fish caught and kept and caught and released. Non fishing time directly contributes to e.

15.2.2 No restrictions (no size or bag limits)

If there are no restrictions then the fisher has the task of optimizing *d, h, t_f, $t_{nf.}$* Within the fishing time the fisher optimizes l_k, s_k and l_r and s_k.

In the previous case, without bag limit we assumed that was no distinction to be made between the harvest, *h*, and fish kept, l_k as all fish caught could be kept. In this model specification catch and release offers a positive contribution to *e* and so some voluntary catch and release is feasible at the equilibrium.

The number and size of fish caught will depend on the biomass or abundance, and fishing effort measured as fishing time t_f. We can write this as:

$$l = l_k + l_b + h = h(t_f : A) \quad (20)$$

The fisher's average catch size would be a reflection of the "quality" of the biomass. This can be expressed as:

$$s = s(A) \ldots\ldots\ldots \quad (21)$$

This average size will be the average for the relevant size distribution. The size distribution of fish caught can be represented as $f(s|A)$. This can be assumed to be uniform (0, 1) in which case the smallest fish caught is size 0, the largest is size 1 and the average size of the fish harvested is 0.5. This assumption is one which needs to be tested against the actual data.

As with the previous specification, the tradeoffs inherent in the fisher's decision making process will drive behaviour. Without restrictions, on any given trip the fisher is free to optimize the catch/keep, catch/release and can trade off size and catch, fishing time and non fishing time. It is assumed that fishers would be willing to trade off between average fish size and catch, between catch and keep and catch and release and between fishing and non fishing time. Different fishers will have different marginal willingness to substitute between these.

It is again convenient to treat the fisher decision as a two stage process. At one level, the fisher must determine the number of trips per year, *d*. Then for any given trip the fisher must determine, t_f, t_{nf}, l_r, l_k, *h* and s_k.

It is assumed that the fisher will maximize the fishing experience $e(s_k, t_f, t_{nf}, l_k, l_r)$. It is assumed that there are positive marginal benefits from each argument in *e* so that $e_{s_k} > 0, e_{l_k} > 0, e_{t_f} > 0, e_{t_{nf}} > 0, e_{lr} > 0$. At this point a question arises as to the interaction across these arguments. We assume that they are independent so that all cross derivatives are zero. This means for example that a higher catch has no impact on the marginal value of size or a higher non fishing time has no impact on the marginal value of catch and keep.

The primary function of the trip is assumed to be to catch and keep. In optimizing the fisher can therefore be considered as choosing the optimal combination of catch and keep, catch and release

and size of fish retained, s_k^*, l_k^*, l_r^*. Total catch is $l = h\ t_f : A$ and the harvest is allocated across $l_r + l_k$.

In optimizing catch and size the fisher optimizes effort or fishing time t_f. The fisher also optimizes non fishing time, t_{nf}. At the margin the value of fishing time is $\frac{\partial u}{\partial e}\frac{\partial e}{\partial t_f}$, the value of non-fishing time is $\frac{\partial u}{\partial e}\frac{\partial e}{\partial t_{nf}}$.

The marginal value of fishing time can written as:

$$\frac{\partial e}{\partial t_f} = \frac{\partial e}{\partial l_k}\frac{\partial l_k}{\partial h}\frac{\partial h}{\partial t_f} + \frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h}\frac{\partial h}{\partial t_f} + \frac{\partial e}{\partial l_r}\frac{\partial l_r}{\partial h}\frac{\partial h}{\partial t_f} = (\frac{\partial e}{\partial l_k}\frac{\partial l_k}{\partial h_k} + \frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h} + \frac{\partial e}{\partial l_r}\frac{\partial l_r}{\partial h})\frac{\partial h}{\partial t_f} \quad \text{....(22)}$$

The fisher will optimize the allocation of trip time by adjusting fishing and non fishing time to keep their marginal values the same, that is: $\frac{\partial e}{\partial t_f} = \frac{\partial e}{\partial t_{nf}}$. Total time will then be determined by the opportunity cost of time. If we assume that this is ω then the optimal amount of trip time, optimally allocated occurs where $\frac{\partial e}{\partial t_f} = \frac{\partial e}{\partial t_{nf}} = \omega$.

$$\frac{\partial e}{\partial t_{nf}} = (\frac{\partial e}{\partial l_k}\frac{\partial l_k}{\partial h} + \frac{\partial e}{\partial s_k}\frac{\partial s_k}{\partial h} + \frac{\partial e}{\partial l_r}\frac{\partial l_r}{\partial h})\frac{\partial h}{\partial t_f} \quad \text{.....} \qquad (23)$$

Or

$$\frac{\partial e}{\partial t_{nf}} = (e^*)\frac{\partial h}{\partial t_f}$$

The relationship can be seen in

Figure 2. The optimal total time is t_w^* which is split between the optimal fishing time, t_f^* and optimal non fishing time, t_{nf}^*. Clearly anything that reduces (increases) the marginal benefit from fishing time will tend to reduce (increase) fishing and trip time. Anything that increases (decreases) the trip cost will tend to decrease (increase) overall trip time as well as decreasing both fishing and non fishing time. For a given opportunity cost, tighter restrictions such as those imposed in the West Coast Demersal fishery will reduce the marginal benefit from fishing time and will tend to reduce fishing time and increase non-fishing time.

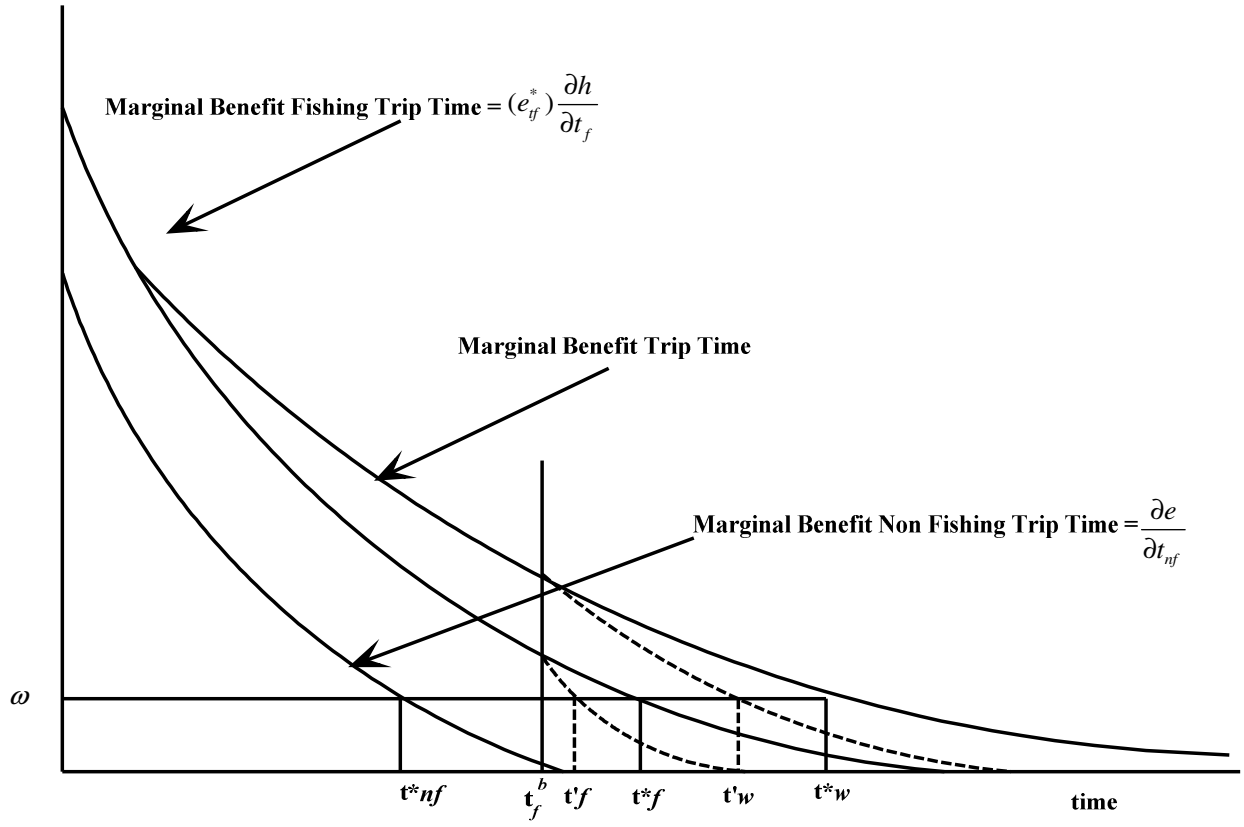

Figure 45: Determination of Optimal Trip Time when Fisher has Both Fishing and Non Fishing Trip Time

The fisher harvests from a given biomass.

The biomass is represented by a standard growth equation as follows;

$$\Delta A = G(A) - \sum_{i=1}^{n} l_{k_i} \text{ .....} \quad (24)$$

Where G(A) is the natural growth rate, net of natural mortality, $l_{ki\,is}$ the catch and kept. In equilibrium we have;

$$G(A) = \sum_{i=1}^{n} l_{k_i} \text{ .....} \quad (25)$$

15.2.3 Restrictions -Bag Limits

A bag limit restricts effort if it is binding. In the previous model specification, the bag limit, if strictly adhered to, reduces catch and keep to the bag limit. In the current specification catch and release is a positively valued fishing activity, so while the bag limit now restricts catch and keep, catch and release is still valuable at the margin.

The consequences for behaviour and therefore for fishing outcomes depends on how fishers react to bag limits in terms of compliance and their willingness to substitute catch and release for catch and keep.

The bag limit is a mandatory restriction that places an upper limit on the number of fish that an angler can retain during a fishing trip. The bag limit is defined in this model as l_k^b and means that $l_k \leq l_k^b$ for every angler.

As previously, fishers may simply cheat on the bag limit. There would be no impact on the catch and keep harvest and therefore on the fishing mortality. However, as explained previously, there are penalties for non-compliance and fishers are therefore expected to comply with the limit and not be in blatant breach.

There are a number of ways that a fisher can react to the bag limit in this model. First, the fisher may comply by stopping fishing for the particular fish (e.g. Dhufish) when the bag limit is reached and terminate all fishing at this point. Second, fishers may actively "high-grade". In this case they hold fish caught and then dispose of smaller fish only if larger fish are a caught later in the day if a later larger catch takes the fisher over the bag limit. Third they may continue to fish for catch and release. This could be done in strict compliance with the bag limit or with some high grading involved. Catch and release will have mortality commensurate with the release procedures followed, with $\rho < 100\%$. High grading is likely to have higher mortality with $\rho = 100\%$.

15.2.4 Absolute Compliance

With absolute compliance, l_k is reduced to comply with the bag limit. Without the bag limit mortality is total kept harvest plus a proportion of the release harvest. The harvest is $l = h = h(t_f : A)$. Mortality is $l_k + \rho l_r$.

The bag limit restricts catch and keep and so actual catch and keep is reduced from the harvest level to the bag limit level. The change in catch is therefore: $h(t_f : A) - (l_k^b + l_r^b)$

If compliance is absolute, fishers will fish to the bag limit and then stop. In this case the reduction in mortality is: $l_k + \rho l_r - l_k^b - \rho l_r^b = (l_k - l_k^b) + \rho(l_r - l_r^b)$.

The effect on fishing time, harvest, catch and release and non fishing time will depend on the extent to which the fisher sees catch and release as a substitute for catch and keep.

If catch and keep and catch and release are independent, then the restriction of the bag limit has no impact on catch and release. This is illustrated in Figure 2 by the dashed lines.

Fishing time t^b_f is the time required to catch the bag limit. Fi8shing beyond this time delivers lower marginal benefit from fishing because it is only catch and release fishing. Fishing time falls from the unconstrained t_f^* to t'_f . The marginal benefit from non-fishing activity is unchanged so non-fishing time stays as previously at t_{nf}^* . Total trip time falls to t'_w.

If fishers choose to high grade then fish caught earlier in the day are "released" in order to increase average size of fish kept, but this is high grading as opposed to positive catch and release. In this case the effect may be to increase the mortality rate associated with catch and release.

If catch and keep and catch and release are interdependent they may be substitutes or complements. Either way a change on the bag limit will influence catch and keep.

If they are substitutes then:

$$\partial(\partial e / \partial l_r) / \partial l_k < 0 \ldots\ldots\ldots \quad (26)$$

In this case, as l_k falls, l_r increases, with the exact response depending on the shape of the fisher's indifference curve.

If they are complements then:

$$\partial(\partial e / \partial l_r) / \partial l_k > 0 \ldots\ldots\ldots \quad .(27)$$

In this case, as l_k falls, l_r decreases, again the exact response depends on the shape of the fisher's indifference curve.

16 APPENDIX 4 TABLES OF SKILL RATING AND REASONS FOR STOPPING FISHING

Out of time – other commitments

	Out of time – other commitments		
Skill	**NO**	**YES**	**Total**
Unskilled	5	0	5
	100.00	0.00	100.00
Below Average	13	8	21
	61.90	38.10	100.00
Average	211	60	271
	77.86	22.14	100.00
Above Average	145	49	194
	74.74	25.26	100.00
Very Skilled	57	19	76
	75.00	25.00	100.00
Total	**431**	**136**	**567**
	76.01	23.99	100.00
	likelihood-ratio chi2(4) =5.5343 Pr = 0.237 gamma =0.0327 ASE = 0.082 Kendall's tau-b =0.0159 ASE = 0.040		

Not catching preferred species

	Not catching preferred species		
Skill	**NO**	**YES**	**Total**
Unskilled	4	1	5
	80.00	20.00	100.00
Below Average	19	2	21
	90.48	9.52	100.00
Average	250	21	271
	92.25	7.75	100.00
Above Average	183	11	194
	94.33	5.67	100.00
Very Skilled	74	2	76
	97.37	2.63	100.00
Total	**530**	**37**	**567**
	93.47	6.53	100.00
	likelihood-ratio chi2(4) = 4.5486 Pr = 0.337 gamma = -0.2752 ASE = 0.136 Kendall's tau-b = -0.0748 ASE = 0.037		

Caught the bag limit

	Caught the bag limit		
Skill	**NO**	**YES**	**Total**
Unskilled	5	0	5
	100.00	0.00	100.00
Below Average	21	0	21
	100.00	0.00	100.00
Average	235	36	271
	86.72	13.28	100.00
Above Average	166	28	194
	85.57	14.43	100.00
Very Skilled	55	21	76
	72.37	27.63	100.00
Total	**482**	**85**	**567**
	85.01	14.99	100.00
	likelihood-ratio chi2(4) = 17.1083 Pr = 0.002 gamma = 0.2889 ASE = 0.090 Kendall's tau-b = 0.1193 ASE = 0.040		

Weather

	Weather		
Skill	**NO**	**YES**	**Total**
Unskilled	4	1	5
	80.00	20.00	100.00
Below Average	15	6	21
	71.43	28.57	100.00
Average	215	56	271
	79.34	20.66	100.00
Above Average	146	48	194
	75.26	24.74	100.00
Very Skilled	65	11	76
	85.53	14.47	100.00
Total	**445**	**122**	**567**
	78.48	21.52	100.00
	likelihood-ratio chi2(4) = 4.3062 Pr = 0.366 gamma = -0.0416 ASE = 0.084 Kendall's tau-b = -0.0192 ASE = 0.039		

Spent as much time as I wanted to

	Spent as much time as I wanted to		
Skill	**NO**	**YES**	**Total**
Unskilled	3	2	5
	60.00	40.00	100.00
Below Average	17	4	21
	80.95	19.05	100.00
Average	203	68	271
	74.91	25.09	100.00
Above Average	157	37	194
	80.93	19.07	100.00
Very Skilled	63	13	76
	82.89	17.11	100.00
Total	**443**	**124**	**567**
	78.13	21.87	100.00
	likelihood-ratio chi2(4) = 4.5130 Pr = 0.341 gamma = -0.1540 ASE = 0.085 Kendall's tau-b = -0.0708 ASE = 0.039		

Caught as many fish as I wanted to

	Caught as many fish as I wanted to		
Skill	**NO**	**YES**	**Total**
Unskilled	5	0	5
	100.00	0.00	100.00
Below Average	20	1	21
d			
Average	249	22	271
	91.88	8.12	100.00
Above Average	173	21	194
	89.18	10.82	100.00
Very Skilled	66	10	76
	86.84	13.16	100.00
Total	**513**	**54**	**567**
	90.48	9.52	100.00
	likelihood-ratio chi2(4) = 3.7370 Pr = 0.443 gamma = 0.2036 ASE = 0.112 Kendall's tau-b = 0.0686 ASE = 0.039		

17 APPENDIX 5: 2003 SURVEY FORM

Introduction

Hi, I'm _____ from __ and we're conducting research into recreational fishing. Can I please speak to _____?

You would have received a letter from the Department of Infrastructure and Planning about this recently. This survey is about fishing experiences, particularly in the West Coast Wetline Fishery offshore between Augusta and Kalbarri, and should take about 15 minutes. Your answers are strictly confidential and will be reported in aggregate. ***Nothing in this survey should be taken to be current or intended policy of government or the opposition parties.***

Bottom Fishing Offshore in the West Coast Wetline Fishery Between Augusta and Kalbarri

Q 1 To start with, do you go 'bottom fishing' (from a boat) in the West Coast Wetline fishery offshore between Augusta and Kalbarri for such species as Dhufish, Baldchin Groper and Pink Snapper?

Yes 1
No **(Terminate interview)** 2
Don't know **(Terminate interview)** 3

Q 2 Over the past twelve months, about what percentage of your boat's use was offshore between Augusta and Kalbarri bottom fishing for such species as Dhufish, Pink Snapper or Baldchin Groper?

____ % **(If '0%', terminate interview)**

Q 3 In the last twelve months, how many times have you been bottom fishing offshore between Augusta and Kalbarri for such species as Dhufish, Baldchin Groper and Pink Snapper?

____ times **(If '0 times', terminate interview)**

Q 4 In the last twelve months, how long on average per trip did you spend bottom fishing offshore (from a boat) between Augusta and Kalbarri?

_____ days **or** _____ hours

Q 5 In the last twelve months, where did you go bottom fishing offshore between Augusta and Kalbarri for such species as Dhufish, Baldchin Groper and Pink Snapper? (Accept multiples) (Probe for departure point and distance offshore, e.g. 5km off Hillary's boat ramp)

_____ ..... ( )
_____ ..... ( )
_____ ..... ( )
_____ ..... ( )

Q 6 In the last twelve months, which of these species did you specifically target when you went bottom fishing offshore between Augusta and Kalbarri? (Read out) (One answer for each species)

	Yes	No
a) Dhufish	1	2
b) Pink Snapper	1	2
c) Baldchin Groper	1	2
d) Other species	1	2

Q 7 In the last twelve months, on average per trip, how many of the following species did you catch and keep when you went bottom fishing offshore between Augusta and Kalbarri? (Read out) (One answer for each species)

a) Dhufish ..... _____ fish
b) Pink Snapper ..... _____ fish
c) Baldchin Groper ..... _____ fish
d) Other species ..... _____ fish

Q 8 In the last twelve months, on average per trip, how many of the following species did you catch and release when you went bottom fishing offshore between Augusta and Kalbarri? (Read out) (One answer for each species)

a) Dhufish ..... _____ fish
b) Pink Snapper ..... _____ fish
c) Baldchin Groper ..... _____ fish
d) Other species ..... _____ fish

Q 9 How did you find out what places were likely to be the best for bottom fishing of such species as Dhufish, Pink Snapper or Baldchin Groper? (Accept multiples) (Do not read out) (Do not prompt)

I don't find out - just take pot luck..... 1
Word of mouth 2
Always go there / I just know / habit 3
Newspapers, magazines and publications 4
Angling/Fishing Club 5
Other **(specify)** _____..... ( )

Survey of Recreational Fishing in the West Coast Wetline Fishery, 2003
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Q 10 I am going to read out factors about bottom fishing for such species as Dhufish, Pink Snapper or Baldchin Groper offshore between Augusta and Kalbarri. As I read out each one, please tell me how important a role it plays in a successful fishing trip, and how satisfied you are with each factor. (Read out each statement.) (One importance rating and one satisfaction rating per statement.)

		Not at all important	Not very	Quite	Very important	Very dissatisfied		Neutral		Very satisfied	NA
a.	No congestion at the boat ramp.....	1	2	3	4	1	2	3	4	5	9
b.	Catching as many fish as you expect to.....	1	2	3	4	1	2	3	4	5	9
c.	The number of fish you catch and keep	1	2	3	4	1	2	3	4	5	9
d.	The size of the fish you catch and keep.....	1	2	3	4	1	2	3	4	5	9
e.	The species of the fish you catch and keep	1	2	3	4	1	2	3	4	5	9
f.	The time it takes to catch the number of fish you expected to	1	2	3	4	1	2	3	4	5	9
g.	The time it takes to catch the number of fish you want to keep	1	2	3	4	1	2	3	4	5	9
h.	Catching enough fish for a decent feed.....	1	2	3	4	1	2	3	4	5	9
i.	Enjoying the fishing experience, regardless of the number of fish caught and kept.....	1	2	3	4	1	2	3	4	5	9
j.	Having an enjoyable time out on the ocean	1	2	3	4	1	2	3	4	5	9

Most Recent Offshore Bottom Fishing Trip in the West Coast Wetline Fishery Offshore Between Augusta and Kalbarri for Such Species as Dhufish, Pink Snapper and Baldchin Groper

Q 11 When was the last time you went bottom fishing offshore in the West Coast Wetline fishery between Augusta and Kalbarri for such species as Dhufish, Pink Snapper or Baldchin Groper?

_____ (date/month or # weeks ago)

Q 12 Where was the boat launched? (Probe for boat ramp, pen or mooring) (One only)

_____..... ( )

Q 13 Roughly how far did you go offshore? (Probe for rough location or distance)

_____..... ( )

Q 14 How long did it take you travel (on the ocean from the boat ramp to the fishing spot back to the boat ramp) on the fishing trip?

_____ hours

Q 15 How long did you spend actually bottom fishing offshore between Augusta and Kalbarri trying to catch such species as Dhufish, Pink Snapper or Baldchin Groper?

_____ hours

Q 16 How far did you travel (from home to the boat ramp and back again) to go on the offshore bottom fishing trip? (Include any side trips related to the fishing trip, e.g. getting petrol for boat, getting bait, picking up mates, etc. Exclude travel in the boat on the water.)

_____ kms

Q 17 And how long did it take you to travel that far?

_____ hours or _____ days

Q 18 How long were you away from home on your fishing trip?

_____ hours or _____ days

Q 19 What percentage of the time on the ocean did you spend: (Read out each statement first, then record percentage against each)

a) Fishing (either from the boat or diving from the boat) ..... ____ %
b) Recreational diving..... ____ %
c) Cruising (excluding travelling to fishing spot)
.... ____ %
d) Other **(specify)** _____..... ____ %

TOTAL **(check)** 100 %

Q 20 What species did you target to catch on that offshore bottom fishing trip? (Accept multiples)

Dhufish 1
Pink Snapper 2
Baldchin Groper 3
No species in particular 4
Other **(specify)** _____..... ( )

Q 21 Including yourself, how many people were in the fishing group on that trip?

_____ people **(If = 1, SKIP to Q23)**

Q 22 What was the relationship of the other people to you? (Accept multiples)

Friend(s) 1
Spouse, partner or 'significant other' 2
Parent(s)..... 3
Children 4
Extended family 5
Other **(specify)** _____..... ( )

Q 23 On that trip, how many Dhufish did you personally: (Read out)

a) catch and release? _____ Dhufish
b) catch and keep? _____ Dhufish

Q 24 (On that trip) how many Pink Snapper did you personally: (Read out)

a) catch and release? _____ Pink Snapper
b) catch and keep? _____ Pink Snapper

Q 25 (On that trip) how many Baldchin Groper did you personally: (Read out)

a) catch and release? _____ Baldchin Groper
b) catch and keep? _____ Baldchin Groper

Q 26 (On that trip) how many other species of fish did you personally: (Read out)

a) catch and release? _____ other species
b) catch and keep? _____ other species

Q 27 On that trip, did you personally: (Read out) (One only)

Catch and keep the limit of Dhufish, Pink Snapper or Baldchin Groper? 1

Catch as many of these fish as you wanted within the limit? 2

Not catch as many of these fish as you wanted? 3

(None of these) 4

Q 28 Were you happy with the number of fish you personally caught (and not necessarily kept) that trip? (One only)

Yes 1

No 2

Q 29 Were you happy with the number of fish you personally kept that trip? (One only)

Yes 1

No 2

Q 30 Were you happy with the size of fish you personally caught (and not necessarily kept) that trip? (One only)

Yes 1

No 2

Q 31 Were you happy with the type of fish you personally caught (and not necessarily kept) that trip? (One only)

Yes 1

No 2

Q 32 Were you happy with the type of fish you personally kept that trip? (One only)

Yes 1

No 2

Q 33 Did you catch as many fish as you thought you would? (One only) (If no, ask if they thought they'd catch more or less)

No, thought I'd catch more 1

No, thought I'd catch less 2

Yes, caught as many as I thought I would 3

Q 34 Did you keep as many fish as you thought you would? (One only) (If no, ask if they thought they'd catch more or less)

No, thought I'd keep more 1

No, thought I'd keep less 2

Yes, kept as many as I thought I would 3

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Costs of Fishing

Q 35 Do you still own your registered boat?

Yes 1
No **(SKIP to Q39)** 2

Q 36 How long is your boat?

_____ feet or _____ metres

Q 37 What is the current market value of your boat including the motor? ***(round to the nearest $10)***

$ _____

Q 38 In the last twelve months, how much money did you spend on: ***(round to the nearest $1)*** (Read out.)

a. Boat and trailer licence fees? $_____
b. New equipment such as GPS or sounder or motor? $_____
c. Parts for the boat, motor or trailer? $_____
d. Boat, motor or trailer maintenance? $_____
e. Insurance for boat, motor or trailer? $_____
f. Boat club membership and pen fees? $_____

Q 39 In the last twelve months, how much money did you spend on: ***(round to the nearest $1)*** (Read out)

a. Fishing-related equipment for a motor vehicle such as roof racks or a tow bar? $_____
b. Life jackets and safety gear? $_____
c. Recreational fishing club membership? $_____
d. Rods, reels or other fishing equipment? $_____
e. Books, magazines, videos etc on boat fishing, locations, fishing gear, etc to help you find and catch fish $_____
f. Angling Club membership fees $_____

Q 40 On a typical offshore bottom fishing trip for such species as Dhufish, Pink Snapper or Baldchin Groper between Augusta and Kalbarri, how much did you spend on the following? ***(round to the nearest $1)*** (Read out)

a. Accommodation? $_____
b. Food, drink and refreshments? $_____
c. Transport - petrol for vehicle? $_____
d. Petrol for boat? $_____
e. Parking and boat launching fees? $_____
f. Special clothing, hats, footwear or sunglasses for fishing? $_____
g. Bait and ice? $_____

Q 41 A recent fisheries survey shows that many people on recreational fishing trips in the West Coast Wetline fishery for species such as Dhufish, Pink Snapper and Baldchin Groper return without any of these fish. When people return with a catch, it is usually with less than 3 of these species, whilst 6 is exceptional.

A fishing management strategy could be considered for the West Coast Wetline fishery to sustain the fishery and increase the chances of more reliable recreational catches of these prized species. The strategy would be funded by an annual recreational licence fee, which would entitle you to fish in the West Coast Wetline fishery and to catch and keep these and other species within daily catch and size limits.

All money collected would be paid into a dedicated fund to be used to improve coastal recreational fishing.

The alternative to the strategy is to leave things as they are. However, the locations, number and size conditions applying to these species may still need to be tightened to sustain the fishery.

Are you willing to buy an annual recreational fishing licence for [$*] that entitles you to go fishing in the West Coast Wetline fishery and to catch and keep up to [x] Dhufish, [y] Baldchin Groper and [z] Pink Snapper per trip within existing size limits, and any other species within the existing catch and size limits? (One only)

Yes (**Skip to Q42**).....1

No (**Skip to Q43**).....2

* Randomly assigned fees of $20, $30, $40, $50 and $60.

x, y, z: Assign values from a look up table of fish baskets (see end of questionnaire).

Q 42 (If 'yes' to Q41) Are you willing to buy an annual recreational fishing licence for $**? (Increase the start price by using the $5 intervals below and ask until a 'no' response is received. Record the price given for the last 'yes' response.)

*** $25 $30 $35 $40 $45 $50 $55 $60 $65 $70 $75 $80 $85 $90 …*

Last 'Yes' Price $_____

Q 43 (If 'no' to Q41) Are you willing to buy an annual recreational fishing licence for $***? (Decrease the start price by using the $5 intervals below and ask until a 'yes' response is received. Record the price given for the 'yes' response.)

****** $55 $50 $45 $40 $35 $30 $25 $20 $15 $10 $5 $0***

'Yes' Price $_____

Demographics

Q 44 Gender (record automatically)

Male	1
Female	2

Q 45 Which of these age categories do you belong to? (One only) (Read out)

15 to 19 years	1
20 to 29 years	2
30 to 39 years	3
40 to 49 years	4
50 to 59 years	5
60 to 69 years	6
70 years or older	7
(Refused)	99

Q 46 Which of the following best describes your situation? (One only) (Read out)

Full time employment	1
Full-time student (not in paid employ)	2
Part time or casual employment	3
Unemployed	4
Home duties	5
Retired	6
Pensioner (disability, illness, age, etc.)	7
Other **(specify)** _____	( )
(Don't know)	98
(Refused)	99

Q 47 What is your personal weekly income before tax? ***(annual income indicated in brackets)*** (One only) (Read out)

Negative income	01
Nil income	02
$1–$79 ($1–$4,159)	03
$80–$159 ($4,160–$8,319)	04
$160–$299 ($8,320–$15,599)	05
$300–$499 ($15,600–$25,999)	06
$500–$699 ($26,000–$36,399)	07
$700–$999 ($36,400–$51,999)	08
$1,000–$1,499 ($52,000–$77,999)	09
$1,500 or more ($78,000 or more)	10
(Don't know)	98
(Refused)	99

That concludes the interview. Thank you for your time. (Standard Interview Closing Spiel.)

Survey of Recreational Fishing in the West Coast Wetline Fishery, 2003
Questionnaire ID: <<id>. Interviewer ID: <<idcode>. Date of Survey:<date>

Fish Baskets

The baskets are the numbers of Dhufish, Pink Snapper and Baldchin Groper that people can catch on each fishing trip. Use the answers to Q6 and Q20 (prized species targeted when bottom fishing in the West Coast Wetline Fishery) to make sure that the basket offered to the respondent includes a minimum of one fish for each of the species they target.

For example:
If they target Dhufish only (of the three prized species), randomly select a proposed basket with at least 1 Dhufish.
If they target Pink Snapper and Dhufish, randomly select a basket with at least 1 Dhufish, at least 1 Pink Snapper.
If they target all three of the prized species, randomly select a proposed basket with at least 1 Dhufish, at least 1 Pink Snapper and at least 1 Baldchin Groper.
If they don't target any of the prized species, randomly select any of proposed baskets.

Basket	Dhufish (x)	Baldchin Groper (y)	Pink Snapper (z)
1	1	0	0
2	0	1	0
3	0	0	1
4	0	0	2
5	2	0	0
6	0	2	0
7	1	1	0
8	0	1	1
9	1	0	1
10	1	1	1
11	3	0	0
12	0	3	0
13	0	0	3
14	2	1	0
15	0	2	1
16	1	0	2
17	4	0	0
18	0	4	0
19	0	0	4
20	2	2	1
21	1	2	1
22	1	1	2
23	3	1	0
24	0	3	1
25	1	0	3
26	2	2	0
27	0	2	2
28	2	0	2
29	4	1	0
30	0	4	1
31	1	0	4
32	3	2	0
33	0	3	2
34	2	0	3
35	3	1	1
36	1	1	3

Basket	Dhufish (x)	Baldchin Groper (y)	Pink Snapper (z)
40	1	2	2
41	4	2	0
42	0	4	2
43	2	0	4
44	2	2	2
45	3	1	2
46	2	3	1
47	1	2	3
48	4	1	1
49	1	4	1
50	1	1	4
51	3	3	0
52	0	3	3
53	3	0	3
54	4	3	0
55	0	4	3
56	3	0	4
57	4	1	2
58	2	4	1
59	1	2	4
60	2	2	3
61	3	2	2
62	2	3	2
63	3	3	1
64	1	3	3
65	3	1	3
66	4	4	0
67	0	4	4
68	4	0	4
69	2	2	4
70	4	2	2
71	2	4	2
72	3	2	3
73	3	3	2
74	2	3	3
75	1	3	4

37	1	3	1
38	2	1	2
39	2	2	1

76	4	1	3
77	3	4	1

Survey of Recreational Wetline Fishing between Augusta and Kalbarri, 2010
Questionnaire ID: <<id>. Interviewer ID: <<idcode>. Date of Survey:<date>

18 APPENDIX 6 2010 SURVEY FORM

INTRODUCTION

*Hello, I'm _____ from West Coast Field Services. We have been asked by the Department of Fisheries to conduct research into recreational fishing. Can I please speak to _____? **Reintroduce if necessary, then:***

You recently purchased a new Fishing From Boat License and I would like to ask you some questions about your fishing activities, particularly if you fish in the recreational offshore bottom fishery off the West Coast between Augusta and Kalbarri. This survey will take about 15 minutes and all responses will be held in the strictest confidence. Do you have the time to do it now or would you prefer I called back at a more convenient time? Two prizes of A200 each will be drawn from those people who take part in the survey.

Federal Privacy laws protect the confidentiality of any comments you make in relation to this survey. Your responses will be used solely for research purposes and while we prefer you to answer all the questions in the survey, you do not have to.

PART I: BOTTOM FISHING OFFSHORE IN THE WEST COAST WETLINE FISHERY BETWEEN AUGUSTA AND KALBARRI IN THE LAST 12 MONTHS

Q 1 To start with, do you go fishing from a boat between Augusta and Kalbarri for species such as Dhufish, Baldchin Groper, Pink Snapper and other bottom fish?

Yes..... 1
No **(Terminate interview)** 2
Don't know **(Terminate interview)** 3

Q 2 In the past 12 months, how much of your boat-based fishing was offshore between Augusta and Kalbarri bottom fishing for species such as Dhufish, Baldchin Groper and Pink Snapper? (Probe)

0 (None) **(If '0%', terminate interview)**
1-25% A Quarter or less
26-50% More than a Quarter but less than Half
51-75% More than Half but Less Than Three Quarters
76-99% (More Than Three-quarters)
100% (All)
Don't know **(Terminate interview)**

Q 3 In the last 12 months, how many times did you go bottom fishing from a boat between Augusta and Kalbarri? (Probe)

0 times (If '0 times', terminate interview)

1-2 (rarely)
3-6 (a few times)
7-12 (once a month)
13-24 (twice a month)

25-50 (weekly)
>50 (more than weekly)
Don't know **(Terminate interview)**

Q 4 In this same 12 month period, how much of your boat-based fishing was spent fishing elsewhere in the state?

0 (None)
1-25% A Quarter or less
26-50% More than a Quarter but less than Half
51-75% More than Half but Less Than Three Quarters
76-99% (More Than Three-quarters)
100% (All)
Don't know

Q 5 Again, in the past 12 months, how many times did you fish from the shore between Augusta and Kalbarri? (Probe)

0 (none)
1-2 (rarely)
3-6 (a few times)
7-12 (once a month)
13-24 (twice a month)
25-50 (weekly)
>50 (more than weekly)
Don't know

Q 6 In the last twelve months, ON AVERAGE PER TRIP, how many of the following species did you catch and keep when you went bottom fishing offshore between Augusta and Kalbarri? (Read out) (One answer for each species)

a) Dhufish..... _____ fish
b) Pink Snapper..... _____ fish
c) Baldchin Groper ..... _____ fish
d) Other high risk
bottom species ..... _____ fish
d) Other species..... _____ fish
Don't know

Q 7 In the last twelve months, ON AVERAGE PER TRIP, how many of the following species did you catch and release when you went bottom fishing offshore between Augusta and Kalbarri? (Read out) (One answer for each species)

a) Dhufish..... _____ fish
b) Pink Snapper..... _____ fish
c) Baldchin Groper ..... _____ fish
d) Other high risk

bottom species ..... _____ fish

d) Other species..... _____ fish

Don't know

Q 8 I am now going to ask you about THE LAST TIME you went bottom fishing for Dhufish, Pink Snapper between Augusta and Kalbarri. How long did it take you to travel from home or the place you were staying to the boat ramp/marina?

_____ hours _____ mins Don't know

How far did you travel to this boat ramp/marina?

_____ km Don't know

Q 9 Approximately how long was the trip at sea? (Probe)

____hours _____ mins Don't know

What proportion of the time on the boat did you spend fishing for bottom fish?

_____ hours _____ mins or _____ % Don't know

What proportion of the time on the boat did you spend fishing for other species?

_____ hours _____ mins or _____ % Don't know

Q 10 Was your time spent fishing for bottom fish cut short or limited in any of the following ways?

1. Ran out of time - other commitments …….. 1

2. Couldn't catch preferred species …….. 2

3. Caught the bag limit……. …….. 3

4. Weather 4

5. Other **……(Specify**)…… 5

6. No 6

If Yes to more than one, which was the main reason (**One only**) ....

Q 11 Where was the boat launched from on this bottom fishing trip?

_____ **(Refer Checklist for Name) Include Don't know**

Q 12 Including yourself, how many people joined you on your last bottom fishing trip?

_____ people Don't know

Q 13 On this fishing trip, how many of the following species did you catch and keep and catch and release?

(Read out) (One answer for each species)

1) Catch and Keep

a) Dhufish ……_____fish

b) Other high risk bottom fish species
such as Pink Snapper, baldcin groper,
breaksea cod, emperors, red snapper
....._____fish

c) Other species……_____fish

Don't know = 98

2) Catch and Release

a) Dhufish …….._____fish

b) Other high risk bottom fish species
such as Pink Snapper, baldcin groper,
breaksea cod, emperors, red snapper
....._____fish

c) Other species……_____fish

Don't know = 98

Q 14 Depending upon season, do you ever fish for any of the following? (Read out) (Accept multiples)

	Target 1= Yes, 2= No
a) Nearshore species such as Trevally ('Skippy'), King George whiting	
b) Pelagic species such as Samson fish	
c) Western rock lobster	
d) Crabs	

Q15 I am going to read out some factors about fishing offshore between Augusta and Kalbarri. As I read out each one, please tell me how satisfied you are with each of these factors. (Read out each statement.) (One satisfaction rating per statement.)

Now on a scale of 1 to 5, where 1 is Very Dissatisfied, 2 is (interviewer reads list)…How satisfied are you with:

	Very Dissatisfied	Moderately Dissatisfied	Neutral	Moderately Satisfied	Very Satisfied	NA
Level of congestion at the boat ramp	1	2	3	4	5	9
The number of fish you catch	1	2	3	4	5	9
The number of fish you keep	1	2	3	4	5	9
The size of the fish you catch	1	2	3	4	5	9
The species of fish you catch	1	2	3	4	5	9
The species of fish you keep	1	2	3	4	5	9
The time it takes to catch the number of						
fish you expected to	1	2	3	4	5	9
Catching enough fish for a decent feed	1	2	3	4	5	9
Enjoying the fishing experience, regardless						
of the number of fish caught and kept	1	2	3	4	5	9
Having an enjoyable time out on the						
Ocean	1	2	3	4	5	9

PART 2: FISHING TRIPS ANYWHERE IN THE STATE FOR A RANGE OF TARGET SPECIES BETWEEN OCTOBER 15 AND DECEMBER 15, 2009. (NEW BEHAVIOURS DUE TO NEW REGS – CLOSURE, ETC)

Q 16 The first closure for a number of high-risk offshore bottom fish species occurred between October 15 and December 15, 2009 in the West Coast Bioregion (Between Kalbarri and Augusta). During this two month period before Christmas, was your fishing behaviour DIFFERENT IN ANY WAY to your usual fishing behaviour?

Yes

No

Q 17 Did you go fishing for species such as Dhufish, Pink Snapper or Baldchin Groper OUTSIDE OF THIS BIOREGION during this two month period?

Yes
No **(Go to Q 20)**
Don't know **(Go to Q 20)**

Q 18 How many times did you go bottom fishing for species such as Dhufish, Pink Snapper or Baldchin Groper OUTSIDE OF THIS BIOREGION during this period?

0 times **(Go to Q 20)**
1 (once)
2 (once a month)
3-4 (twice a month)
5-9 (weekly)
>10 (more than weekly)

Don't know

Q19 What was the main reason for fishing OUTSIDE of the area between Augusta to Kalbarri? (One only)

On holidays ……..1
Working in the area……..2
Fishing is better ……..3
Due to the closure in the West Coast Bioregion……4
Other**……(specify).……**5
Don't know 6

Q20 How many times did you go fishing from a boat between Augusta and Kalbarri during the 2 months from October 15th to December 15th, 2009?

0 times **(Go to Q 24)**

1 (once)
2 (once a month)
3-4 (twice a month)
5-9 (weekly)
>10 (more than weekly)
Don't know

Q21 During the two months between October 15th and December 15th 2009, which species group did you target?

	Target 1= Yes, 2= No
a) Bottom species	
b) Nearshore species such as Trevally (Skippy), King George whiting	
c) Pelagic species such as Samson fish	
d) Western rock lobster	
e) Crabs	

* Don't know = 98

Q 22 Again on this your last trip during this two month period, were you satisfied with the number of fish you caught? (One only)

Yes, caught at least as many as I thought I would 1
No, thought I'd catch more……..... 2

Q 23 Where was the boat launched from on you last boat-based trip in this period? (Probe for boat ramp/marina/town or suburb) (One only)

_____ **(Refer Checklist for Name) Include Outside the region, Don't know**

Q 24 How many times did you go fishing from the shore between Augusta and Kalbarri during this 2 month period?

0 times **(Go to Q 26)**
1 (once)
2 (once a month)
3-4 (twice a month)
5-9 (weekly)
>10 (more than weekly)
Don't know

Q 25 Where were you fishing from the shore? (Probe for town or suburb) (One only)

_____ **(Refer Checklist for Name)** **Include Don't know (Go to Q27)**

Q 26 What was your primary reason for NOT going fishing from a boat and/or the shore in the West Coast Bioregion during this period? (Read out Options) (Accept One only)

Other commitments (no time) ……..1
Couldn't catch preferred species due to the closure…….2
Not a regular fisher ……..3
General cost of fishing ……..4
Other ……(Specify)……..5
Don't know ……..6

PART 3: FISHING IN THE WEST COAST BIOREGION BETWEEN AUGUSTA AND KALBARRI IN THE MONTHS AFTER DECEMBER 15, 2009.

On December 15, the closed season ended and you could resume fishing for offshore bottom fish in the region between Kalbarri and Augusta. I am now going to ask you some questions about your fishing activities over the four month period since December 15, 2009.

Q 27 Have your fishing activities changed in the period since December 15th 2009 in comparison to your typical fishing behaviour IN PREVIOUS YEARS?

Yes

No **(Go to Q29)**

Q28 How have your fishing activities changed? Do you (Accept multiple answers)

1. Fish more frequently (Yes=1 No=2)
2. Fish in a different location (Yes=1 No=2)
3. Fish for a longer period of time on each trip (Yes=1 No=2)
4. Target different species (Yes=1 No=2).

If Yes, which of the following do you target more often now?

	Target 1= Yes, 2= No

a) High risk demersal species such as Dhufish, Pink Snapper, Baldchin Groper, breaksea cod, emperors and queen snapper	
b) Other bottom species	
c) Nearshore species such as Trevally (Skippy), King George whiting	
d) Pelagic species, such as Samson fish	
e) Western rock lobster	
f) Crabs	

* Don't know = 98

5. Other (Yes=1 No=2**)……(Specify)…….**

COSTS OF FISHING

Q 29 Approximately how much did you personally spend in the last 12 months on the following items of fishing gear?

$

1. Rods, reels, pots, etc. _____
2. Special clothing, incl hats, footwear, for fishing _____
3. Diving gear (incl. hire) _____
4. Boat and other equipment hire _____
5. Fishing club membership fees _____
6. Other (specify) – (not ice & bait) _____

Q 30 Do you or anyone in your household own a registered boat which is used for fishing?

No **(Go to Q 37)** 1

Yes..... 2

If Yes, Can I ask you a few details about the boat ?

Yes = 3,

No = 4 **(Go to 37)**

Q 31 What type of boat is it?

Powerboat – moored or penned 1

Powerboat – transported on trailer 2

Sailboat – moored or penned 3

Sailboat – transported on trailer 4

Other (**Specify**)..... 5

Don't know 6

Q 32 On average, how many times has this boat been used for any purpose during the past twelve months?

Don't know **(Go to Q 34)**

0 **(Go to Q 34)**

1-2 (rarely)

3-6 (a few times)

7-12 (once a month)

13-24 (twice a month)

25-50 (weekly)

>50 (more than weekly)

Q 33 Of the total time that the boat was in use over the past 12 months, approximately what percentage of the time was the boat used for each of the following purposes? (Probe)

1. Recreation/entertaining _____
2. Diving (not fishing) /swimming _____
3. Fishing _____
4. Racing _____
5. Other (specify) _____

_____
100%

6. Don't know

Q 34 Are you the person responsible for the boat's expenses?

Yes..... 1

No **(Go to Q 37)** 2

Q 35 What is the current market value of your boat including the motor? ***(round to the nearest $1000)*** (Probe)

$ _____

Don't Know = 98

Q 36 In the last twelve months, how much money did you spend on: ***(round to the nearest $10)*** (Read out.) (Probe)

g. New boat or equipment such motor, GPS or sonar? $_____
h. Parts for the boat, motor or trailer? $_____
i. Maintenance for boat, motor or trailer? $_____
j. Insurance for boat, motor or trailer? $_____
k. Boat and trailer licence fees? $_____
l. Boat club membership and pen fees? $_____
g. Other $_____

Q 37 On a typical offshore fishing trip for such species as Dhufish, Pink Snapper or Baldchin Groper between Augusta and Kalbarri, how much did you spend on the following? ***(round to the nearest $1)*** (Read out) (Probe)

h. Accommodation? $_____
i. Food, drink and refreshments? $_____
j. Fuel for boat? $_____
k. Parking and boat launching fees? $_____
l. Bait and ice? $_____
f. Other $_____

LICENSES

Q 38 You recently purchased a new Recreational Fishing From Boat License. Have you been fishing since?

Yes

No **(Go to Q41)**

Q39 Since obtaining the new license, do you think your fishing activities have or will change in any of the following ways? Do you/will you (Accept multiple answers, except for No Change)

- Fish more often……1
- Fish less often……2
- Fish from the shore……3
- Fish for rock lobster or abalone from a boat 4
- Other**……[specify]** 5
- No Change 6

Q 40 Since purchasing your new Fishing From Boat License, how many people including yourself were fishing under your license on your last boat trip?

……..people

Q 41 Which of the following recreational licences do you currently hold?

- Umbrella licence ……..1 (**Got to Q 42**)
- Rock lobster ……..2

- Abalone ……..3
- Marron……..4
- South West freshwater angling…. 5
- Net fishing…….. 6
- None 7

DEMOGRAPHICS

Q 42 Gender (record automatically)

Male	1
Female	2

Q 43 Which of the following best describes your situation? (One only) (Read out)

Full time employment	1
Full-time student (not in paid employ)	2
Part time or casual employment	3
Unemployed	4
Home duties	5
Retired	6
Pensioner (disability, illness, age, etc)	7
Other **(specify)** _____	( )
(Don't know)	98
(Refused)	99

Q 44 What is your personal weekly income before tax? ***(annual income indicated in brackets)*** (One only) (Read out)

Nil or Negative income	01
$1–$499 ($1–$25,999)	02
$500–$999 ($26,000–$33,799)	03
$1,000–$1,699 ($52,000–$88,399)	04
$1,700–$1,999 ($88,400–$103,999)	05
$2,000–$2,499 ($104,000–$129,999)	06
$2,500–$2,999 ($130,000–$155,999)	07
$3,000–$3,999 ($156,000–$207,999)	08
$4,000 or more ($208,000 or more)	09
(Don't know)	98
(Refused)	99

Thank you for your time. That completes the actual survey. You may be called back in case my supervisor needs to check my work. Apart from the checking process, you will not be contacted again after this survey, nor will your name be recorded on a separate database. Etc to be provided by WCFS.

Survey of Recreational Wetline Fishing between Augusta and Kalbarri, 2011
Questionnaire ID: <<id>. Interviewer ID: <<idcode>. Date of Survey:<date>

19 APPENDIX 7 2011 SURVEY FORM

INTRODUCTION

*Hello, I'm _____ from West Coast Field Services. We have been asked by researchers funded by the Fisheries Research Development Corporation to conduct research into recreational fishing. Can I please speak to _____? **Reintroduce if necessary, then:***

As a holder of a Fishing From a Boat License I would like to ask you some questions about your fishing activities, particularly if you fish in the recreational offshore bottom fishery off the West Coast between Augusta and Kalbarri. This survey will take about 15 minutes and all responses will be held in the strictest confidence. Do you have the time to do it now or would you prefer I called back at a more convenient time? Two prizes of A200 each will be drawn from those people who take part in the survey.

Federal Privacy laws protect the confidentiality of any comments you make in relation to this survey. Your responses will be used solely for research purposes and while we prefer you to answer all the questions in the survey, you do not have to.

PART I: BOTTOM FISHING OFFSHORE IN THE WEST COAST WETLINE FISHERY BETWEEN AUGUSTA AND KALBARRI IN THE LAST 12 MONTHS

Q 1 To start with, do you go fishing from a boat between Augusta and Kalbarri for species such as Dhufish, Baldchin Groper, Pink Snapper and other bottom fish?

Yes..... 1
No **(Terminate interview)** 2
Don't know **(Terminate interview)** 3

Q 2 In the past 12 months, how much of your boat-based fishing was offshore between Augusta and Kalbarri bottom fishing for species such as Dhufish, Baldchin Groper and Pink Snapper? (Probe)

0 (None) **(If '0%', terminate interview)**
1-25% A Quarter or less
26-50% More than a Quarter but less than Half
51-75% More than Half but Less Than Three Quarters
76-99% (More Than Three-quarters)
100% (All)
Don't know **(Terminate interview)**

Q 3 In the last 12 months, how many times did you go bottom fishing from a boat between Augusta and Kalbarri? (Probe for exact number)

_____ **times** (If '0 times', terminate interview)

..... Don't know **(Terminate interview)**

Q 4 In this same 12 month period, how much of your boat-based fishing was spent fishing elsewhere in the state?

0 (None)
1-25% A Quarter or less
26-50% More than a Quarter but less than Half
51-75% More than Half but Less Than Three Quarters
76-99% (More Than Three-quarters)
100% (All)
Don't know

Q 5 Again, in the past 12 months, how many times did you fish from the shore between Augusta and Kalbarri? (Probe)

_____ **times** (zero is legitimate)

..... Don't know

Q 6 In the last twelve months, ON AVERAGE PER TRIP, how many of the following species did you catch and keep when you went bottom fishing offshore between Augusta and Kalbarri? (Read out) (One answer for each species)

a) Dhufish..... _____ fish
b) Pink Snapper..... _____ fish
c) Baldchin Groper ..... _____ fish
d) Other high risk
bottom species ..... _____ fish
d) Other species..... _____ fish
Don't know

Q 7 In the last twelve months, ON AVERAGE PER TRIP, how many of the following species did you catch and release when you went bottom fishing offshore between Augusta and Kalbarri? (Read out) (One answer for each species)

a) Dhufish..... _____ fish
b) Pink Snapper..... _____ fish
c) Baldchin Groper ..... _____ fish
d) Other high risk
bottom species ..... _____ fish
d) Other species..... _____ fish
Don't know

Q 8 Depending upon season, do you ever fish for any of the following? (Read out) (Accept multiples)

	Target 1= Yes, 2= No

a) Nearshore species such as Trevally ('Skippy'), King George whiting	
b) Pelagic species such as Samson fish	
c) Western rock lobster	
d) Crabs	

Now I want you to think about a typical fishing trip made in the past 12 months, offshore between Augusta and Kalbarri bottom fishing for species such as Dhufish, Baldchin Groper and Pink Snapper?

Thinking about a typical fishing trip, I am going to ask you about your fishing activities and the non fishing activities that you undertake whilst on a typical fishing trip.

Q9 Where do you launch the boat from for a typical bottom fishing trip?

_____ **(Refer Checklist for Name) Include Don't know**

Q 10 Including yourself, how many people join you on a typical bottom fishing trip?

_____ people Don't know

Q11-. On an typical fishing trip during the last 12 months, how long were you away from home? (including travel time to and from home)

....._____days or **____**hours or Don't know

Q12. How long did it take you to travel from home or the place you were staying to the boat ramp/marina?

_____ hours or _____ mins Don't know

Q13. How far did you travel to this boat ramp/marina?

_____ km Don't know

Q 14 Approximately how long was spent at sea? (Probe)
____hours or _____ mins Don't know

Q15. **Of this time at sea, how much was spent:**

(a)**Travelling out to and back from to the fishing grounds ____**hours or _____ mins Don't know

(b)**at the fishing grounds ____**hours or _____ mins Don't know

Q16. On an typical fishing trip during the last 12 months, what other activities did you undertake on your trip?

Did you	**Yes or No**	**Importance Rank**
a) .Dive or snorkel	**Yes=1, No=2**	**_____**
b) Surf or swim	**Yes=1, No=2**	**_____**
c) Water-ski, wakeboard, or another similar activity	**Yes=1, No=2**	**_____**

d)	**Undertake any wildlife photography or nature watching, outside of fishing**	**Yes=1, No=2**	**_____**
e)	**Go camping or sleeping out for one night or more**	**Yes=1, No=2**	**_____**
f)	**Have a picnic, bbq or substantial prepared meal**	**Yes=1, No=2**	**_____**
g)	**Engage in any family activities, outside of fishing**	**Yes=1, No=2**	**_____**
h)	**Entertain friends, outside of fishing**	**Yes=1, No=2**	**_____**
i)	**Any other activity (record answer)**		

For the activities you said yes to I would like you to indicate their level of importance on a scale of 1 to 5, where 1 is not at all important and 5 is very important.

Q17. On an average fishing trip, what other activities or experiences do you deliberately seek to experience and enjoy at the time that you are fishing? Do you

	Yes or No	Importance Rank
a). Spend time with family	**Yes=1, No=2**	_____
b). Spend time with friends	**Yes=1, No=2**	_____
c). Test new fishing tackle and equipment	**Yes=1, No=2**	_____
d). Participate in an organised fishing competition	**Yes=1, No=2**	_____
e). Pass on your skills and knowledge to others	**Yes=1, No=2**	_____
f). Relax and unwind	**Yes=1, No=2**	_____
g). Enjoy solitude and tranquillity	**Yes=1, No=2**	_____
h). Get some exercise or improve fitness	**Yes=1, No=2**	_____
i). Experience wilderness and the outdoors environment	**Yes=1, No=2**	_____
j.) Consume alcohol	**Yes=1, No=2**	_____
k) Any other activity or experience (record answer)		

For the activities you said yes to I would like you to indicate which is most important. [re read the "Yes" items and ask respondent to rank them 1= most important, 2= next most important etc]

Q18. Thinking about the activities you were involved in and the total trip time of (insert time from Q10) how much time did you spend in each of the following activities (Read out each statement first, then record time against each) (c-k displayed only if selected in Q16)

a)	Fishing for bottom fish	_____hours
b)	Fishing for other species	_____hours
c)	Dive or snorkel	_____hours
d)	Surf or swim	_____hours
e)	Water-ski, wakeboard, or another similar activity	_____hours
f)	Undertake any wildlife photography or nature watching, outside of fishing	_____hours
g)	Go camping or sleeping out for one night or more	_____hours
h)	Have a picnic, bbq or substantial prepared meal	_____hours
i)	Engage in any family activities, outside of fishing	_____hours
j)	Entertain friends, outside of fishing	_____hours
k)	Any other activity (record answer)	_____hours

Q 19 On a typical fishing trip which of the following is the main reason that you stop fishing?

1. Out of time - other commitments	**1**
2. Not catching preferred species	**2**
3. Caught the bag limit	**3**
4. Weather	**4**
5. Spent as much time as I wanted to	**5**
6.Caught as many fish as i wanted to	**6**
7.Other ……(Specify)… ……	**7**

Q20 I am going to read out some factors about fishing offshore between Augusta and Kalbarri. As I read out each one, please tell me how satisfied you are with each of these factors. (Read out each statement.) (One satisfaction rating per statement.)

Now on a scale of 1 to 5, where 1 is Very Dissatisfied, 2 is (interviewer reads list)…How satisfied are you with:

	Very Dissatisfied	Moderately Dissatisfied	Neutral	Moderately Satisfied	Very Satisfied	NA
Level of congestion at the boat ramp	1	2	3	4	5	9
The number of fish you catch	1	2	3	4	5	9
The number of fish you keep	1	2	3	4	5	9
The size of the fish you catch	1	2	3	4	5	9
The species of fish you catch	1	2	3	4	5	9
The species of fish you keep	1	2	3	4	5	9
The time it takes to catch the number of						
fish you expected to	1	2	3	4	5	9
Catching enough fish for a decent feed	1	2	3	4	5	9
Enjoying the fishing experience, regardless						
of the number of fish caught and kept	1	2	3	4	5	9
Having an enjoyable time out on the						
Ocean	1	2	3	4	5	9

Survey of Recreational Wetline Fishing between Augusta and Kalbarri, 2011
Questionnaire ID: <<id>. Interviewer ID: <<idcode>. Date of Survey:<date>

PART 2: FISHING TRIPS ANYWHERE IN THE STATE FOR A RANGE OF TARGET SPECIES BETWEEN OCTOBER 15 AND DECEMBER 15, 2010. (NEW BEHAVIOURS DUE TO NEW REGS – CLOSURE, ETC)

Q 21 The closed fishing season for a high risks species occurred betweeb October 15 and December 15, 2010 in the West Coast Bioregion (Between Kalbarri and Augusta). During this two month period before Christmas, was your fishing behaviour DIFFERENT IN ANY WAY to your usual fishing behaviour?

Yes

No

Q 22 Did you go fishing for species such as Dhufish, Pink Snapper or Baldchin Groper OUTSIDE OF THIS BIOREGION during this two month period?

Yes

No **(Go to Q 24)**

Don't know **(Go to Q 24)**

Q 23 How many times did you go bottom fishing for species such as Dhufish, Pink Snapper or Baldchin Groper OUTSIDE OF THIS BIOREGION during this period?

_____ **times** (If '0 times', go to Q25)

..... Don't know

Q24 What was the main reason for fishing OUTSIDE of the area between Augusta to Kalbarri? (One only)

On holidays ……..	1
Working in the area……..	.2
Fishing is better ……..	3
Due to the closure in the West Coast Bioregion……	4
Other**……(specify)……**	5
Don't know	.6

Q25 How many times did you go fishing from a boat between Augusta and Kalbarri during the 2 months from October 15th to December 15th, 2009?

_____ **times** (If '0 times', go to Q26)

..... Don't know

Q 26 How many times did you go fishing from the shore between Augusta and Kalbarri during this 2 month period?

_____ **times** (If '0 times', go to Q28)

.....Don't know **(Terminate interview)**

Q 27 Where were you fishing from the shore? (Probe for town or suburb) (One only)

_____ **(Refer Checklist for Name)** **Include Don't know (Go to Q28)**

Q 28 What was your primary reason for NOT going fishing from a boat and/or the shore in the West Coast Bioregion during this period? (Read out Options) (Accept One only)

Other commitments (no time) ……1
Couldn't catch preferred species due to the closure…….2
Not a regular fisher …… ……3
General cost of fishing ……4
Other ……(Specify)……5
Don't know ……6

LICENSES

The Recreational Fishing From a Boat Licence is now in its second season.

Q 29 Since the introduction of the new licence system have your fishing activities changed in any of the following ways? Do you/will you (Accept multiple answers, except for No Change)

- Fish more often…… 1
- Fish less often…… 2
- Fish from the shore…… 3
- Fish for rock lobster or abalone from a boat …… 4
- Other**……[specify]** …… 5
- No Change …… 6

Q 30 Since purchasing your new Fishing From Boat License, how many people including yourself were fishing under your license on your last boat trip?

_____people

Q 31 Which of the following recreational licences do you currently hold?

- Umbrella licence …… 1 (**Got to Q 42**)
- Rock lobster …… 2
- Abalone …… 3
- Marron…… 4
- South West freshwater angling 5
- Net fishing 6
- None …… 7

COSTS OF FISHING

Q 32 Approximately how much did you personally spend in the last 12 months on the following items of fishing gear?

$

1. Rods, reels, pots, etc _____

2. Special clothing, incl hats, footwear, for fishing _____

3. Diving gear (incl. hire) _____

4. Boat and other equipment hire _____

5. Fishing club membership fees _____

6. Other (specify) – (not ice & bait) _____

Q 33 Do you or anyone in your household own a registered boat which is used for fishing?

No **(Go to Q 37)** 1
Yes..... 2
If Yes, Can I ask you a few details about the boat ?
Yes = 3,
No = 4 **(Go to 37)**

Q 34 What type of boat is it?

Powerboat – moored or penned 1
Powerboat – transported on trailer 2
Sailboat – moored or penned 3
Sailboat – transported on trailer 4
Other (**Specify**)..... 5
Don't know 6

Q35 On average, how many times has this boat been used for any purpose during the past twelve months?

Don't know **(Go to Q 34)**

0 **(Go to Q 34)**

1-2 (rarely)

3-6 (a few times)

7-12 (once a month)

13-24 (twice a month)

25-50 (weekly)

>50 (more than weekly)

Q 36 Of the total time that the boat was in use over the past 12 months, approximately what percentage of the time was the boat used for each of the following purposes? (Probe)

1. Recreation/entertaining _____
2. Diving (not fishing) /swimming _____
3. Fishing _____
4. Racing _____
5. Other (specify) _____
_____

100%

6. Don't know

Q 37 Are you the person responsible for the boat's expenses?

Yes..... 1

No **(Go to Q 37)** 2

Q 38 What is the current market value of your boat including the motor? ***(round to the nearest $1000)*** (Probe)

$ _____

Don't Know = 98

Q 39 In the last twelve months, how much money did you spend on: ***(round to the nearest $10)*** (Read out.) (Probe)

m. New boat or equipment such motor, GPS or sonar? $_____
n. Parts for the boat, motor or trailer? $_____
o. Maintenance for boat, motor or trailer? $_____
p. Insurance for boat, motor or trailer? $_____
q. Boat and trailer licence fees? $_____
r. Boat club membership and pen fees? $_____
g. Other $_____

Q 40 On a typical offshore fishing trip for such species as Dhufish, Pink Snapper or Baldchin Groper between Augusta and Kalbarri, how much did you spend on the following? ***(round to the nearest $1)*** (Read out) (Probe)

m. Accommodation? $_____
n. Food, drink and refreshments? $_____
o. Fuel for boat? $_____
p. Parking and boat launching fees? $_____
q. Bait and ice? $_____
f Other $_____

Q41. How would you describe your fishing skills?

Very skilled 1
Above average..... 2
Average 3
Below average..... 4
Unskilled..... 5

DEMOGRAPHICS

Q 42 Gender (record automatically)

Male	1
Female	2

Q 43 Which of the following best describes your situation? (One only) (Read out)

Full time employment	1
Full-time student (not in paid employ)	2
Part time or casual employment	3
Unemployed	4
Home duties	5
Retired	6
Pensioner (disability, illness, age, etc)	7
Other **(specify)** _____	( )
(Don't know)	98
(Refused)	99

Q 44 What is your personal weekly income before tax? ***(annual income indicated in brackets)*** (One only) (Read out)

Nil or Negative income	01
$1–$499 ($1–$25,999)	02
$500–$999 ($26,000–$33,799)	03
$1,000–$1,699 ($52,000–$88,399)	04
$1,700–$1,999 ($88,400–$103,999)	05
$2,000–$2,499 ($104,000–$129,999)	06
$2,500–$2,999 ($130,000–$155,999)	07
$3,000–$3,999 ($156,000–$207,999)	08
$4,000 or more ($208,000 or more)	09
(Don't know)	98
(Refused)	99

Finally, could I ask

Q45.How long have you been an active fisher for bottom species such as Dhufish, Pink Snapper or Baldchin Groper

_____year

Thank you for your time. That completes the actual survey. You may be called back in case my supervisor needs to check my work. Apart from the checking process, you will not be contacted again after this survey, nor will your name be recorded on a separate database. Etc to be provided by WCFS.