Southern Shark Drop-out Project

Final Report to

Fisheries Research and Development Corporation

(FRDC Project 95/103)

by

Terence I. Walker

June 1997

MARINE & FRESHWATER RESOURCES INSTITUTE

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Summary

- Shark 'drop-out' is a term used by fishermen to describe the phenomenon where sharks fall out of shark gillnets during hauling operations. The term is distinguished from shark 'escapement' which is the phenomenon where sharks struggle to free themselves from gillnets with a high probability of survival.

- Sharks dropping out of gillnets and not surviving is not only a source of wastage but can cause fishing mortality to be under-estimated and natural mortality to be over-estimated in stock assessments. Such biases, if large, can contribute to overly optimistic scenarios for the status of the stocks.

- The FRDC funded 'Southern Shark Drop-Out Project, designed to estimate rates of drop-out through application of a 'remotely operated vehicle' (ROV), was abandoned after preliminary trials of an ROV on board *FV Lincoln* when it became apparent that the approach was impractical.

- It was originally proposed that an ROV be deployed from a shark fishing vessel operating under normal commercial fishing conditions for the purpose of identifying species and estimating the length of captured sharks in gillnets immediately before the nets are hauled off the seabed and aboard the vessel. Subsequently identifying and measuring the sharks after hauling the gillnets would provide appropriate data for determining the rate at which sharks drop-out of the nets and for determining whether the rate of drop-out varied with species of shark, length of shark and mesh-size of the gillnets.

- An alternative method to viewing the gillnets while being hauled was for the ROV to travel the full length of the nets on the seabed to count and estimate the lengths of the captured sharks. This approach was avoided because there would have been too much time between when most of the nets were viewed and when they were hauled. This approach would have underestimated the drop-out rate.

- The original experimental design involved using gillnets of several mesh-sizes for 20 days at sea aboard a commercial shark fishing vessel fishing at various depths in the Great Australian Bight. In addition there was to have been several days of laboratory processing of data on film, statistical analysis of the data and preparation of a report. However because of difficulties associated with deployment of an ROV as proposed, the project was terminated before any quantitative data for estimating rates of 'drop-out' were collected.

- The ROV was tested initially beside the pier in the Thevenard harbour on 26 October and then three times in the vicinity of St Francis Island near Thevenard on 26 and 27 October 1995 with varying lengths of shark gillnet. No sharks were viewed by the ROV during these trials, and because of difficulties operating the ROV under sea conditions of waves less than 1 m and to avoid the risk of damage to the ROV no attempt was made subsequently to deploy the ROV under normal shark fishing conditions.

- From the preliminary trials of this Project, it is concluded that it not practical to use the ROV deployed from the same vessel as the one undertaking the shark fishing. It might be possible to deploy a larger and more powerful ROV, with better position fixing equipment, to determine rates of drop-out. There would need to be a specially designed gantry for retrieval of the ROV and built of materials such that it could collide with a vessel without being damaged.

- An alternative approach to estimating the rate of drop-out would be to deploy a manned submersible vehicle. The operation would involve setting and retrieving the gillnets from a commercial shark fishing vessel and deploying the manned submersible from a second vessel. The submersible would need to be large enough to accommodate two people; one to drive the submersible along the gillnet and the other to mark or tag the dead sharks in the gillnet. The rate of drop-out from the nets could be determined from the number of marked sharks which were not retrieved after hauling the gillnets. The cost of this approach would be several times that of the ROV approach as originally proposed and operating in close proximity to a gillnet might pose an unacceptably high risk to the operators.

Introduction

The rate at which sharks drop-out of gillnets hauled during normal commercial shark fishing operations ('drop-out') could not be determined by the methods proposed in the Application for Grant funded by FRDC. The novel approach of deploying a 'remotely operated vehicle' (ROV) from the fishing vessel operating under normal shark fishing conditions proposed in the application proved difficult to implement and posed an unacceptable risk of damage to the ROV and of injury to the . Operations were abandoned after preliminary trials and no attempt was made to collect appropriate data to meet the two objectives of the project.

This report describes the preliminary trials and on the basis of those trials speculates on an alternative approach that might be considered to meet the project objectives.

Background

The southern shark fishery produces annually nearly 4000 tonnes, carcass weight, of shark which was valued at $16 million to fishers based in Victoria, Tasmania and South Australia (Walker *et al.* 1996). Whilst there is a substantial database on fishery monitoring data and biological information available there are several areas where information is lacking; one of these areas is drop-out.

Drop-out is a term used by shark fishermen to describe the phenomenon where sharks fall out of shark gillnets during hauling operations. Sharks have been observed from shark fishing vessels dropping out of gillnets either as sharks in gillnets approach the surface or after the shark breaks the surface of the water. Most sharks observed can be gaffed but there might be significant loss of sharks from gillnets in deeper water where the sharks are not visible. Some fishermen report seeing dead sharks lying in shallow clear water near gillnets. The term 'drop-out' is distinguished from 'escapement' which is the phenomenon where sharks struggle to free themselves from gillnets and have a high probability of surviving.

If 'drop-out' occurs extensively throughout the fishery then fishing mortality is likely to have been under-estimated and natural mortality to have been over-estimated. Such biases are likely to produce overly optimistic scenarios for the status of the stocks.

There are several reasons why it is likely that the 'drop-out' rate is higher for school shark than for gummy shark and why escapement is likely to be higher for gummy sharks than for school sharks.

One reason is that sharks are enmeshed either behind the head or somewhere along the snout. Those enmeshed by the snout rather than behind the head are less securely enmeshed and therefore more likely to escape from or drop out of a net. Because school sharks have more pointed snouts than gummy sharks, they are more likely to be enmeshed by snout than head and therefore are more likely to drop-out than gummy shark. The elongated shape of the snout partly explains why the size range of sharks captured by a gillnet of a any particular mesh-size (i.e. width of selectivity curves) is wider for school sharks than it is for gummy sharks.

Another factor which can partly explain the difference in drop-out rates between school shark and gummy shark is the method of gill ventilation. School sharks need to continue swimming for the water to pass through their gills (i.e. ram-jet ventilation) whereas gummy sharks can remain dormant for long periods pumping water from the buccal cavity through their gills. This allows a gummy shark captured by a gillnet to struggle more vigorously and either the gummy shark escapes or becomes more tightly enmeshed which reduces the drop-out rate

Need

It is important for the fishermen, fishery managers and researchers to be aware of the extent of wastage caused by drop-out of dead sharks.

(1) Fishermen might be able to reduce drop-out by altering their fishing practices or construction of their fishing gear.

(2) SharkMAC has raised questions about whether regulating for a maximum or uniform mesh-size for gillnets of 6½ inches across the fishery might exacerbate the problem of drop-out.

(3) Researchers need to account for the component of fishing mortality attributable to lost catch through drop-out. Drop-out might be causing fishing mortality to be under-estimated and natural mortality to be over-estimated in stock assessments. Such biases can contribute to overly optimistic scenarios for the status of the stocks.

Objectives

The project had two objectives.

(1) Determine proportion of sharks dropping out of shark gillnets during commercial hauling operations.

(2) Determine whether drop-out rate varies with species of shark, length of shark and mesh-size of gillnets.

These objectives could not be met by the proposed method of deploying an ROV from a vessel during normal commercial shark fishing operations.

Methods

In the Application for Grant to FRDC it was proposed that an ROV be deployed from a shark fishing vessel operating under normal commercial fishing conditions for the purpose of identifying species and estimating the length of the sharks while the gillnets were on the seabed. Identifying and measuring the sharks after hauling the gillnets would provide appropriate data for determining the rate at which sharks drop-out of the nets and for determining whether the rate of drop-out varied with species of shark, length of shark and mesh-size of gillnets.

The experimental design for this work involved setting gillnets of various mesh sizes (5, 6, 6½ and 7 inches) for 20 days at various depths in the Great Australia Bight. In addition there was to have been several days of laboratory processing of data on film, statistical analysis of the data and preparation of a report. However because of difficulties associated with deployment of the ROV as proposed, only preliminary trials were conducted and the project was then terminated before any quantitative data were collected.

Viewing and filming sharks captured in monofilament gillnets of various mesh-size was attempted with an ROV chartered from ROV Systems of the CSIRO Division of Fisheries, Cleveland. A total length of about 4400 m of gillnets and an ROV were deployed during these preliminary trials aboard the *FV Lincoln* (distinguishing mark M209), owned and operated by professional fisherman Mr Robert J. Wilson. The *FV Lincoln* is constructed of timber with the wheelhouse forward and the net drum winch is positioned aft off centre towards the port side of the deck and the bow roller is mounted on the port quarter bow.

A general purpose Sector Scanning Sonar (Imagenex) was mounted in a rack ('video-sonar' rack 54 cm wide x 50 cm deep x 85 cm high) in the wheelhouse and images selected from one of either two cameras mounted in the ROV were viewed on a monitor ('surface unit monitor' 39 cm wide x 50 cm deep x 59 cm high) also mounted in the wheelhouse. The two cameras (one colour camera usually viewing forward and the other black and white camera normally viewing aft) could be rotated vertically through 360°. Sideways control of the cameras was effected through a pair of thrusters placed laterally. In addition, a second monitor for viewing images recorded on video was mounted in the wheelhouse.

The Offshore Hyball ROV (Hydrovision Limited, Aberdeen) weighing 70 kg (with sonar head mounted) is rated at a top speed exceeding 3 knots in waters of depth up to 450 m on an up to 800-m umbilical cord (11.5 mm diameter and 500 kg breaking strain), providing for electrical connection between surface control and the ROV. For the purpose of the project, however, only a 400-m umbilical cord was used which had negative buoyancy for the first 300 m and neutral buoyancy for the last 100 m.

A 75 kg weight was attached to a rope ('clump weight') fastened to the gunwale of the starboard quarter bow of the *FV Lincoln*. The umbilical cord of the ROV was attached to the vertical rope immediately above the 'clump weight' where the section of neutral buoyancy umbilical cord between the 'clump weight' and the ROV was varied from 20 to 50 m to serve as a tether and position the ROV in front of the vessel near where the gillnets lifted from the seabed to pass up over the bow roller and onto the net drum winch on the vessel.

Operated by a specialist technician, Mr Gregory Smith of the CSIRO, the ROV was tested initially beside the pier in the Thevenard harbour on 26 October and then three times in the vicinity of St Francis Island about 50 km from Thevenard on 26 and 27 October 1995 while setting varying lengths of the available 4400 m of shark gillnets at depths up to 60 m. The sea conditions for these trials varied from 0 to 1 m wave height and at times the tidal flow reached nearly 1 knot.

No sharks were viewed by the ROV during these trials, and because of difficulties operating the ROV under relatively calm conditions and to avoid the risk of damage to ROV and of injury to the operators no attempt was made to deploy the ROV under normal shark fishing conditions.

Results

It was not possible to estimate the rates of 'drop-out' from shark gillnets by the method proposed but several conclusions were drawn about the difficulties of estimating drop-out using an ROV.

1 It is difficult to focus the ROV camera on a shark gillnet during hauling. A gillnet lifts from the seabed at least 40 m in front of the vessel as it is tightened onto the drum winch before actual hauling. As hauling begins the tension on the net this 'lift-off distance' increases to well over 50 m. This gives rise to two logistical problems when deploying an ROV. The first problem is that the 'lift-off distance' varies greatly during hauling as the vessel follows the net and as the vessel rises and falls with the swell. Varying 'lift-off distance' makes it extremely difficult to focus the ROV camera on the net at the position of lift-off'. The second logistical problem is caused by the drag of the umbilical cord of the ROV at a distance of 50 m in front of the vessel. This reduces the velocity and manoeuvrability of the ROV which in turn increases the difficulty in focussing the ROV camera on the net.

2 It is difficult to see shark gillnets underwater. The head-ropes and lead-ropes of the gillnets were readily visible but the webbing of the net was almost invisible except when the ROV was very close. It was not possible to determine the distance from the ROV to net or whether the net stood vertically in the water or leaned over from the tide. This increased the probability of the ROV colliding and tanging in the net. The visibility underwater was about 3–4 m but this diminished rapidly at dusk. There was too much sediment in the water to use the ROV's inbuilt 300-watt lights after dark. The gillnet could not be detected by the Sector Scanning Sonar. This could be partly overcome by application of an acoustic underwater tracking system and radio-linked Differential Global Position System.

3 As a result of difficulties (1) and (2) it often took considerable time to initially locate the gillnet on the bottom. When the ROV lost sight of the net during hauling additional time was required to relocate the net.

4 The 75 kg clump weight required for deployment of the ROV on the vessel was difficult to handle and it was too easily tangled with the gillnets and umbilical cord of ROV, particularly when there was tidal flow.

5 The ROV could not be deployed from *FV Lincoln* in seas with waves exceeding 1 m in height without risk of damage to the ROV and risk to the safely of the crew and operators. As commercial shark fishing operations are often conducted in seas exceeding 1 m, an ROV cannot be deployed to measure drop-out under all commercial shark fishing conditions.

Benefits

Estimates of 'drop-out' would improve the predicative capability of stock assessment models used for the fishery and provide information on wastage from sharks falling out of gillnets during hauling operations.

The shark fishing industry of southern Australia and the general community would benefit directly from a better managed fishery through improved information and more reliable stock assessments. The benefits are allocated as 60% Commonwealth, 10% Victoria, 10% Tasmania, 10% South Australia and 10% Western Australia.

Whilst the project failed to provide estimates of 'drop-out', several conclusions are drawn which provide a guide for any future attempts that might be made to estimate rates of drop-out.

Intellectual Property

No intellectual property has arisen from the research that is likely to lead to significant commercial benefits, patents or licences. Intellectual property associated with information produced from the project will be shared equally by the Fisheries Research and Development Corporation and by the Victorian Department of Natural Resources and Conservation.

Further Development

No further work will be undertaken as part of this project. It is concluded that it is not practical to use the ROV deployed from the same vessel as the one undertaking the shark fishing. It might be possible to deploy a larger and more powerful ROV, with better position fixing equipment, to determine rates of drop-out. There would need to be specially designed gantry for retrieval of the ROV and built of materials such that it could collide with a vessel without being damaged.

An alternative approach to estimating the rate of drop-out would be to deploy a manned submersible vehicle. The operation would involve setting and retrieving the gillnets from a commercial shark fishing vessel and deploying the manned submersible from a second vessel. The submersible would need to be large enough to accommodate two people; one to drive the submersible along the gillnet and the other to mark or tag the dead sharks in the gillnet. The rate of drop-out from the nets could be determined from the number of marked sharks which were not retrieved after hauling the gillnets. The cost of this approach would be several times that of the ROV approach as originally proposed and operating in close proximity to a gillnet might pose an unacceptably high risk to the operators.

Staff

Organisation, position, period on the project and percentage of one year of time while on project are listed for each staff member.

Marine & Freshwater Resources Institute			
Terry Walker	Principal Investigator	1 Jul 95-31 Nov 95	5%
Lauren Brown	Marine Scientist	1 Jul 95-31 Nov 95	5%
Natalie Bridge	Technical Officer	1 Jul 95-31 Nov 95	5%
CSIRO Marine Laboratories, Division of Fisheries, Cleveland			
Roland Pitcher	Senior Research Scientist	1 Jul 95-31 Nov 95	5%
Greg Smith	Senior Technical Officer	1 Jul 95-31 Nov 95	5%

Final Costs

A summary of project grant and expenditure are presented in the following table.

Budget item	$
Project grant	
Salaries and oncosts	10,500
Operating expenses	56,500
Travelling expenses	9,500
Capital items	0
Total	76,500
Expenditure	
Salaries and oncosts	8,000
Operating expenses	26,270
Travelling expenses	1,393
Capital items	0
Total	35,664

Distribution

This report is being distributed to researchers who have an interest in shark research, to several libraries and to each of the following organisations.

Australian Bureau of Agricultural and Resource Economics
Macarthur House, Macarthur Avenue, Lyneham ACT 2602

Australian Fisheries Management Authority
Burns Centre, 28 National Circuit, Forrest ACT 2603

Australian Institute of Marine Science
PMB No 3, Townsville QLD

Australian Maritime College
Beauty Point, TAS 7270

Bureau of Resource Sciences, Fisheries Resources Branch
Curtin House, 22 Brisbane Avenue, Barton ACT 2601

CSIRO Marine Laboratories, Division of Fisheries
Castray Esplanade, Hobart TAS 7001

Marine Resources Division, Department of Primary Industry and Fisheries
GPO Box 619F, Hobart TAS 7001

Australian Seafood Industry Council
Unit 1, 6 Phipps Place, Deakin ACT 2600

New South Wales Fisheries Research Institute
PO Box 21, Cronulla NSW 2230

Primary Industries (Fisheries) South Australia
GPO Box 1625, Adelaide SA 5001

Shark Tri-State Industry Body
c/o Brian Bailey, PO Box 37, St Helens TAS 7216

South Australian Fishing Industry Council
c/o Adrian Fletcher, 9 Angas Street, Port Lincoln SA 5606

South Australian Research and Development Institute
GPO Box 1671, Adelaide SA 5001

South Australian Shark Fishermen's Association
c/o Rob Wilson, PO Box 256, Little Hampton, SA 5250

Southern Shark Fishery Assessment Group
(Distributed to all members: Tony Battaglene, Horst Fischer, Kevin McLoughlin, Jeremy Prince, André Punt, Peter Riseley, John Stevens, David Johnson, Bruce Taylor, Terry Walker, John Wallace, and Yongshun Xiao).

Southern Shark Fishery Management Advisory Committee
c/o Ian Freeman, Executive Officer, 7 Boniwell Street, Higgins, ACT 2615

Southern Shark Industry Research Liaison Committee
(Distributed to all members: Brian Daff, David Johnson, Peter Riseley, Terry Walker and John Wallace)

Tasmanian Fishing Industry Council
c/o Bob Lister, PO Box 960, Sandy Bay TAS 7006

Tasmanian Sea Fisheries Research Laboratories
Crayfish Point, Taroona TAS 7053

Victorian Fisheries
Department of Natural Resources and Conservation
Sixth Floor, 240 Victoria Parade, East Melbourne VIC 3002

Victorian Fishing Industry Federation
Suite 7, 20 Commercial Road, Melbourne VIC 3004.

Western Australian Department of Fisheries
SGIO Atrium, St Georges Terrace 6001

Western Australian Marine Research Laboratories
West Coast Drive, Waterman WA 6020

Acknowledgments

Special thanks are due to South Australian shark fisherman Rob Wilson, the owner and skipper of the *FV Lincoln*. Installation of equipment associated with the ROV required removal and subsequent reinstallation of several pieces of equipment from the wheelhouse. The patience and participation of Mr Wilson and his crew Mark Carey and Jake Bowyer in the setting and retrieval of both the ROV and the fishing gear are greatly appreciated.

Special acknowledgments are also due to two Victorian shark fisherman. Horst Fischer kindly loaned two gillnets of 6-inch mesh-size and Steve Broeckwell loaned appropriate head-ropes and lead-ropes to construct a gillnet of 5-inch mesh-size.

I am also grateful to three members of the CSIRO Division of Fisheries: Greg Smith for undertaking the field trials associated with the use of the ROV aboard the *FV Lincoln*, Roland Pitchard for technical advice associated with use of the ROV, and Yongshun Xiao for discussions and computer simulations associated with development of an experimental design for the project.

Finally I wish to thank Lauren Brown and Natalie Bridge of the Marine and Freshwater Resources Institute for preparations associated with the field work.

References

Walker, T. I., Stone, T., Battaglene, T., and McLoughlin, K. (1996). 'Fishery Assessment Report, the Southern Shark Fishery 1995'. 55 pp. (Australian Government Printing Service: Canberra.)