

Inshore Fishery Observer Programme for Hector's dolphins in Pegasus Bay, Canterbury Bight, 1997/98

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ABSTRACT

An observer programme with the objective of estimating the rate of entanglement of Hector's dolphins in setnet fisheries in Pegasus Bay and Canterbury Bight was run during the 1997-98 fishing year. Some of the observer effort was directed at the inshore trawl fishery operating in the same area to determine if Hector's dolphins were also being captured in this fishery. A total of 125 days of setnet fishing was observed involving 198 setnet fishing events. A total of 188 days of bottom trawl fishing was observed which represented 422 trawl shots. Five entanglement incidents (events) involving Hector's dolphins were observed in the setnet fisheries, three of which involved two animals, for a total of eight animals. Six of these were killed and two were released alive. One event involving a Hector's dolphin was observed in the trawl fishery which resulted in the death of the animal. All events involving Hector's dolphins occurred near shore in shallow depths of less than 30 m.

Keywords: Hector's dolphins, setnet fisheries, entanglement rate, east coast South Island, New Zealand

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1. Introduction

The New Zealand Seafood Industry Council (SeaFIC) was contracted by the Department of Conservation (DOC) to undertake a monitoring programme of the Pegasus Bay/Canterbury Bight (South Island) setnet fishery for the 1997/98 fishing year. This project was part of the required services approved by the Minister of Conservation, funded by the Conservation Services Levies, and was designed to monitor the by-catch of Hector's dolphin (*Cephalorhynchus hectori*) in this area.

Although initially designed to only cover the setnet fishery, which is the fishery which targets shark species in this area, the programme was later extended to include the near-shore trawl fishery. It was considered that fishery interactions with Hector's dolphins were likely to be an area effect, rather than confined to a single fishery. Accordingly, 150 observer days were budgeted for the setnet fishery and a further 150 observer days for the trawl fishery.

2. Sampling programme

2.1 DESIGN

At the outset this programme was confined to the Ministry of Fisheries (MFish) 'Statistical Areas' 020 (Pegasus Bay) and 022 (Canterbury Bight) because these encompassed the areas where the large majority of known commercial fishery interactions with Hector's dolphin species have occurred. These 'statistical areas' are defined by lines of latitude as presented in Table 1 (see Fig. 1 for the locations of these statistical areas relative to east coast South Island features).

The design of the programme was presented to the Department of Conservation prior to the finalisation of the contract, and was based on the distribution of fishing days in the two target statistical areas from the two most recent complete fishing years (see Appendix 1 for a copy of the approved design). The area component of the design stratification could go no smaller than a statistical

TABLE 1. NORTH AND SOUTH LATITUDE BOUNDARIES FOR MINISTRY OF FISHERIES (MFish) STATISTICAL AREAS 018, 020, AND 022.

STATISTICAL AREA	NORTH BOUNDARY LATITUDE	SOUTH BOUNDARY LATITUDE
018	N/A	42° 53'
020	42° 53'	43° 44'
022	43° 44'	45° 05'

N/A = not applicable

area because the Ministry of Fisheries data collection system for the setnet fishery lacks greater detail for the area of fish capture. Another problem encountered in designing this programme was that the fishery is changing with many fishers dropping out the setnet fishery in this area. Consequently it was likely that the number of fishing days available to sample would be decreasing with each successive year. The design number of observer days by month, gear, and statistical area is presented in Table 2.

Examples of the forms filled out by the observers are attached as Appendix 2 (setnet form) and Appendix 3 (trawl form). Each observer was asked to record sufficient information to identify the detailed location of capture in the event of an incident with a Hector's dolphin, including net depth and time of the set. The observer was asked to record the target marine finfish species, but not the actual catch. Information was also collected so that the amount of effort could be quantified.

2.2 EXECUTION OF THE PROGRAMME

Candidate observers were recruited from the Christchurch and Timaru areas. A part-time co-ordinator resident in Christchurch was hired part-way through the season to help with the placement of observers on vessels. Management of the programme was kept at SeaFIC in Wellington and there was some staff turnover during the period of the contract. A total of 11 observers worked on the programme during the year, with many only participating on a few trips. One observer accounted for more than 50% of the observer days.

There was considerable difficulty in placing observers on some of the smaller vessels and the programme co-ordinators had to spend a great deal of time chasing after the fishing companies and vessels to ensure that the observers were taken as planned. Often observers would show up at wharves early in the morning (e.g. 0300 hrs) only to find the vessel had already left.

TABLE 2. DESIGN OF THE 1997/98 PEGASUS BAY/CANTERBURY BIGHT OBSERVER PROGRAMME IN TERMS OF THE EXPECTED NUMBER OF TRAWL AND SET NET OBSERVER DAYS BY MONTH, FISHING METHOD, AND STATISTICAL AREA.

METHOD	STAT AREA	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Trawl	020	5	6	6	7	6	6	6	6	5	4	3	3	63
	022	7	8	6	8	9	7	9	9	8	7	5	4	87
	Total	12	14	12	15	15	13	15	15	13	11	8	7	150
Setnet	020	3	5	5	5	4	4	6	8	3	3	2	2	50
	022	3	15	24	21	13	9	7	3	2	2	2	2	103
	Total	6	20	29	26	17	13	13	11	5	5	4	4	153
Total		18	34	41	41	32	26	28	26	18	16	12	11	303

2.3 DEFINITION OF AN ‘OBSERVER DAY’

A typical setnet vessel trip would consist of an early start, followed by travelling to the fishing location and the deployment of the nets. A period of time would elapse, after which the nets would be retrieved, and then set again. The vessel would then either return to port or shut down for the night. The next day the nets would be retrieved and the cycle would begin again. On the last day, the nets would only be retrieved. Interpretation of effort became difficult when an observer would enter the cycle part-way through and definition of an observer day became problematic at times.

The following conventions were followed in order to define an ‘observer day’ over multiple trips or spanning several areas. It was necessary to differentiate between an ‘observer day’ as a complete event which might entangle a dolphin (which would be comparable across areas and time periods) and an ‘observer day’ for the purposes of remuneration.

- A vessel may enter and make a set in more than one of the statistical areas in a single day. Every day or part day of fishing in a statistical area counted as a separate observer event as many trips often only consisted of one set in a single statistical area. The statistical area of a set or shot was determined by the location of the beginning of that set or shot (Table 1).
- When a trip spanned multiple days, the last day was not counted as a separate observed event. Effectively, a three-day trip which placed nets on the first two days, with the last day devoted to hauling, would only count as two events. The principle followed was that a complete fishing event involved both the deployment and retrieval of a net because both actions offered an opportunity for dolphin entanglement which were not independent.
- It was not counted as a valid complete observation if the observer only saw the placement of the net but not the hauling. Such an observation event would not be comparable with other events because it did not cover the retrieval of the net, the period during which dolphins appear to be most vulnerable to entanglement. However, if only the hauling of the net were observed, then this was counted as a complete event as an entanglement which occurred during deployment would still be observable during the retrieval (unless the carcass fell out of the net, a situation which was considered unlikely due to the degree of entanglement that usually occurred).

3. Results

3.1 NUMBER OF OBSERVER DAYS

The number of observer days achieved is presented in Table 3. Comparison between the achieved number of days and the number of days allocated in the design (Table 2) indicates that more trawl observer days and fewer setnet days were achieved than were specified (Table 4). This disparity occurred for two reasons:

- The number of available setnet days appeared to be very limited. Observers were placed for as many fishing days as possible, given the availability of observers and vessels. There seems to have been a considerable reduction in the number of setnet days in these 'Statistical Areas' 020 and 022 during this fishing year relative to previous fishing years, but this cannot be confirmed until the overall fishery is analysed in the context of the previous fishing years. Analysis of the total fishing effort during the study period will be presented in a separate report.
- As the number of available setnet days diminished towards the end of the fishing season, it was decided that it would be better to use the remaining observer days on the trawl fishery rather than let them go unused. These remaining days unfortunately were expended somewhat more rapidly than expected and the total number of available observer days were fully depleted by the end of July 1998.

A number of trips were observed in Statistical Area 018. While this was not part of the design, it turned out to be unavoidable as a vessel fishing in Statistical Area 020 would often also fish in the southern portions of Area 018 during the same trip. Note that one of the observed dolphin mortalities occurred in Statistical Area 018.

3.2 VESSEL COVERAGE

A total of 25 individual vessels were observed during this programme, 7 were setnet vessels and 22 were trawl vessels. Several vessels converted from setnet to trawl gear over the course of the season, accounting for the disparity in

TABLE 3. DISTRIBUTION OF THE NUMBER OF DAYS OBSERVED (BASED ON STANDARDS PROVIDED IN SECTION 2.3) IN THE PEGASUS BAY/CANTERBURY BIGHT TRAWL AND SET NET FISHERY BY MONTH, FISHING METHOD, AND STATISTICAL AREA DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME IN THE 1997/98 FISHING YEAR.

METHOD	STAT. AREA	MONTH												TOTAL
		OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998	AUG 1998	SEP 1998	
Trawl	018		1	1			2							4
	020	5	7	10	12	9	6		15	17	25			106
	022	6	7	9	14	12		1	6	14	9			78
	Total	11	15	20	26	21	8	1	21	31	34			188
Setnet	018	4				5	1			2	1			13
	020	2	1		5	5	3	11		12	8			47
	022	2	9	7	22	8	5	6	2	1	3			65
	Total	8	10	7	27	18	9	17	2	15	12			125
Total		19	25	27	53	39	17	18	23	46	46			313

TABLE 4. DEVIATIONS FROM THE ALLOCATED NUMBER OF OBSERVER DAYS IN TABLE 3 (ACHIEVED LESS ALLOCATED DAYS) IN THE PEGASUS BAY/CANTERBURY BIGHT TRAWL AND SET NET FISHERY BY MONTH, FISHING METHOD AND STATISTICAL AREA DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME IN THE 1997/98 FISHING YEAR.

METHOD	STAT. AREA	MONTH												TOTAL
		OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998	AUG 1998	SEP 1998	
Trawl	018	0	1	1	0	0	2	0	0	0	0	0	0	4
	020	0	1	4	5	3	0	-6	9	12	21	-3	-3	43
	022	-1	-1	3	6	3	-7	-8	-3	6	2	-5	-4	-9
	Total	-1	1	8	11	6	-5	-14	6	18	23	-8	-7	38
Setnet	018	4	0	0	0	5	1	0	0	2	1	0	0	13
	020	-1	-4	-5	0	1	-1	5	-8	9	5	-2	-2	-3
	022	-1	-6	-17	1	-5	-4	-1	-1	-1	1	-2	-2	-38
	Total	2	-10	-22	1	1	-4	4	-9	10	7	-4	-4	-28
Total		1	-9	-14	12	7	-9	-10	-3	28	30	-12	-11	10

TABLE 5. NUMBER OF INDIVIDUAL VESSELS OBSERVED DURING THE 1997/98 HECTOR'S DOLPHIN OBSERVER PROGRAMME BY GEAR TYPE AND STATISTICAL AREA*.

STAT. AREA	SETNET	TRAWL
018	2	2
020	3	10
022	6	18

* Note: for reasons described in the text, the same vessel could fish using both trawl and setnet gear.

totals. Table 5 provides the distribution of number of individual vessels observed by gear type and statistical area. Further detail regarding the number of vessels by gear type and time period has not been provided in order to provide confidentiality to the participants in the programme.

3.3 TRAWL FISHERY

3.3.1 Observer coverage

A total of 434 bottom trawl shots were observed during the programme. However, for 12 of the observed trawl shots, the start or end time was not recorded, preventing the determination of their duration. These trawl shots have not been included in subsequent analyses presented in this report; no Hector's dolphins were caught in them.

TABLE 6. DISTRIBUTION OF THE NUMBER OF TRAWL SHOTS OBSERVED IN THE PEGASUS BAY/CANTERBURY BIGHT TRAWL FISHERY BY MONTH AND TARGET SPECIES DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME IN THE 1997/98 FISHING YEAR (EXCLUDING TRAWL SHOTS WITHOUT START/END TIME RECORDED).

TARGET SPECIES	MONTH										TOTAL
	OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998	
Flatfish	6	15						32	44	51	148
Mixed	6		5		3						14
Red cod	12	21	31	58	64	19	3	16	17	1	242
Tarakihi	4									6	10
Unknown			5						3		8
Total	28	36	41	58	67	19	3	48	64	58	422

The inshore trawl fishery in Pegasus Bay/Canterbury Bight predominantly targets red cod and flatfish (Table 6). These two fisheries attracted most of the observer coverage, accounting for 57% and 35% of observed trawl shots, respectively. A small number of trawl shots were observed in the tarakihi fishery. Red cod is also likely to constitute an important component of the trawl shots which are designated as targeting a 'mix' of species.

The observer coverage of the trawl fishery was spread relatively evenly throughout the 1997/98 fishing year, with the exception of low coverage in April 1998 (Table 6). The Pegasus Bay area (Statistical Area 020) and the Canterbury Bight area (Statistical Area 022), accounted for 58% and 41% of the total observed trawl shots respectively (Table 7). The remainder were off the North Canterbury coast in the southern part of Statistical Area 018. There is no indication of a seasonal trend in the distribution of observer coverage between statistical areas (Table 7).

Table 8 summarises the observed trawl fishing effort (number of trawl shots and trawl duration) by statistical area, target species and month. For all observed

TABLE 7. DISTRIBUTION OF THE NUMBER OF TRAWL SHOTS OBSERVED IN THE PEGASUS BAY/CANTERBURY BIGHT TRAWL FISHERY BY MONTH AND STATISTICAL AREA DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME IN THE 1997/98 FISHING YEAR (EXCLUDING TRAWL SHOTS WITHOUT START/END TIME RECORDED).

STAT. AREA	MONTH										TOTAL
	OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998	
018		1	2			4					7
020	12	17	21	30	35	15		36	32	45	243
022	16	18	18	28	32		3	12	32	13	172
Total	28	36	41	58	67	19	3	48	64	58	422

trawl shots, average trawl duration was 3.6 hours, although duration varied with respect to target species. Average duration of trawl shots targeting red cod and flatfish was 3.1 and 4.4 hours respectively (Table 8).

3.3.2 Target trawl fisheries

Red cod

The major concentration of observed trawl shots targeting red cod were in an area extending northwards into Pegasus Bay from the eastern end of Banks Peninsula (Fig. 1). The remainder were distributed fairly evenly throughout Canterbury Bight and Pegasus Bay. Most of the observed trawl shots targeting red cod were in the 20–50 m depth range, with a few extending into deeper water up to 200 m (Fig. 2).

TABLE 8. DISTRIBUTION OF THE NUMBER AND DURATION OF TRAWL SHOTS OBSERVED IN THE PEGASUS BAY/CANTERBURY BIGHT TRAWL FISHERY BY STATISTICAL AREA, TARGET SPECIES AND MONTH DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME IN THE 1997/98 FISHING YEAR (EXCLUDING TRAWL SHOTS WITHOUT START/END TIME RECORDED).

STAT. AREA	TARGET SPECIES	FISHING EFFORT	MONTH											
			OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998		
018	Mixed	Hours fished			5.5									
		No. of trawls			2									
	Red cod	Hours fished		3.5				15.0						
		No. of trawls		1				4						
	Total	Hours fished		3.5	5.5			15						
		No. of trawls		1	2			4						
020	Flatfish	Hours fished	8.6	8.6						144.7	118.7	164.8		
		No. of trawls	2	2						32	26	39		
	Mixed	Hours fished			3.5		9.6							
		No. of trawls			1		3							
	Red cod	Hours fished	17.8	50.1	62.4	75.2	82.5	52.8		16.7	13.0			
		No. of trawls	6	15	20	30	32	15		4	3			
	Tarakihi	Hours fished	13.9										31.7	
		No. of trawls	4										6	
	Unknown	Hours fished									6			
		No. of trawls									3			
	Total	Hours fished	40.3	58.7	65.8	75.2	92.0	52.8		161.3	137.7	196.5		
		No. of trawls	12	17	21	30	35	15		36	32	45		
022	Flatfish	Hours fished	18.5	44.4							94.8	41.2		
		No. of trawls	4	13							18	12		
	Mixed	Hours fished	21.6		5.8									
		No. of trawls	6		2									
	Red cod	Hours fished	21.4	12.0	42.9	88.0	96.8		8.5	38.5	48.9	2.5		
		No. of trawls	6	5	11	28	32		3	12	14	1		
	Unknown	Hours fished			19.7									
		No. of trawls			5									
	Total	Hours fished	61.5	56.4	68.4	88.0	96.8		8.5	38.5	143.6	43.7		
		No. of trawls	16	18	18	28	32		3	12	32	13		

Figure 1. Distribution of observed trawls by target species. (FLA=mixed flatfish species; MIX=mixed species; RCO=red cod; TAR=tarakihi; UNK=unknown). The star marks the position of the trawl catching a Hector's dolphin. The solid line represents the 200 m depth contour. The dotted line represents the 1000 m depth contour.

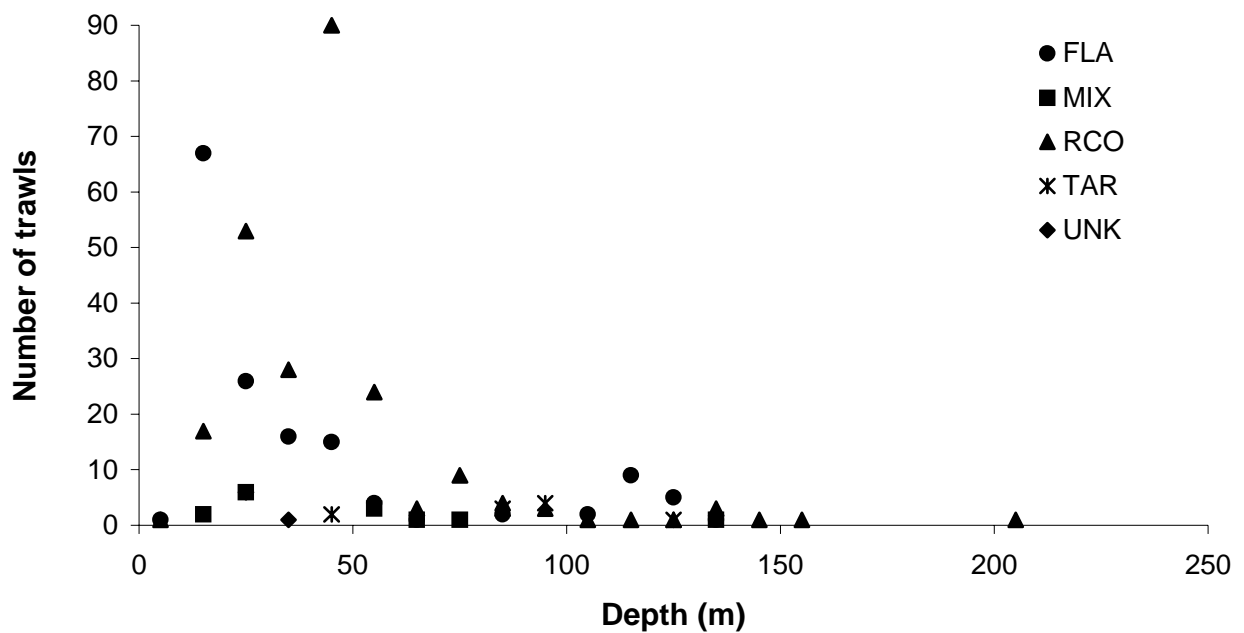
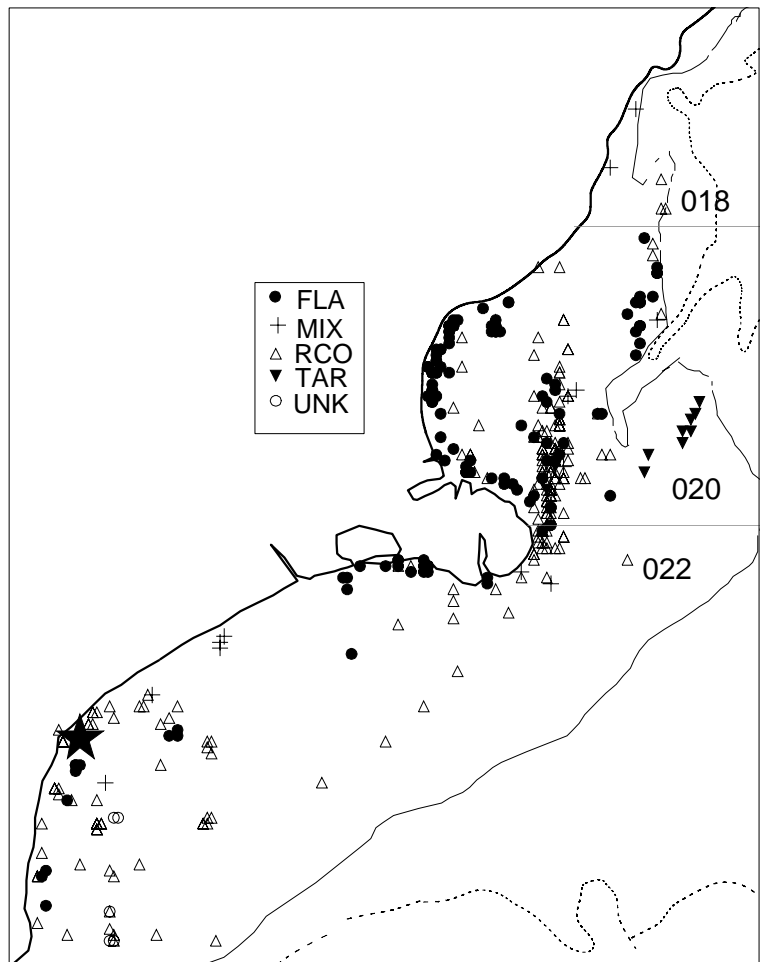


Figure 2. Distribution of observed trawls by depth (rounded to nearest 10 m) and target species (FLA=mixed flatfish species; MIX=mixed species; RCO=red cod; TAR=tarakihi; UNK=unknown).

Flatfish

Most of the observed trawl shots targeting flatfish were within the shallow reaches of Pegasus Bay and along the south coast of Banks Peninsula around Lake Ellesmere (Fig. 1). These trawl shots were in depths less than 30 m (see Fig. 2). A few trawl shots were also made in shallow depths in the southern Canterbury Bight. There were also a number of areas where flatfish were targeted in deeper water, e.g. in central Pegasus Bay, where red cod are also targeted, and towards the shelf edge in northern Pegasus Bay.

Tarakihi

Only a small number of trawl shots targeting tarakihi were observed. These were clustered in the outer Pegasus Bay, north-east of the Banks Peninsula.

3.3.3 Dolphin bycatch

A single capture of a Hector's dolphin was observed from the 434 observed trawl shots. The dolphin was caught on 17 February 1998 in a trawl targeting red cod in shallow water (20 m) in southern Canterbury Bight (44.3° S, 171.3° E) (see Fig. 1). The dolphin was dead when the trawl gear was retrieved by the vessel.

3.4 SETNET FISHERY

3.4.1 Observer coverage

A total of 214 setnet events were observed during the programme, using the definitions provided in section 2.3. The setnet fleet typically makes daily fishing trips in the Pegasus Bay/Canterbury Bight area. Setnets are either set and retrieved on the same day or set and then recovered on the following day. For a fishing trip where a net was deployed over-night, it was necessary for the observer to be present on the following day to observe the recovery of the net (see section 2.3). For 16 sets, an observer was on board the vessel for the recovery of the nets only. While the retrieval of these sets was observed, and therefore met the definition for inclusion in the programme, there is no information concerning the duration of the set. Consequently, these records have not been included in the analysis of fishing effort reported in Tables 9 to 11. However, one of these 16 sets caught a Hector's dolphin and this record is included in Table 12.

Observer coverage of the Pegasus Bay/Canterbury Bight setnet fishery was distributed throughout the period from October 1997 to July 1998, although coverage was limited during December 1997 and May 1998 (Table 9). Almost all the coverage was for sets which designated the target species to be shark (52%), school shark (24%) or rig (21%). Setnets declared to be targeting shark would likely be targeting either school shark or rig. A small number of sets targeting elephant fish were observed at the beginning of the 1997/98 fishing year. There is no indication of a seasonal trend in the observer coverage of the rig and school shark fisheries (Table 9).

TABLE 9. DISTRIBUTION OF THE NUMBER OF SETNETS EVENTS OBSERVED IN THE PEGASUS BAY/ CANTERBURY BIGHT SETNET FISHERY BY MONTH, AND TARGET SPECIES, DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME IN THE 1997/98 FISHING YEAR (EXCLUDING SETNETS WHERE THE SETTING OF THE GEAR WAS NOT OBSERVED).

TARGET SPECIES	MONTH										TOTAL
	OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998	
Elephant fish	2	2	1								5
Mixed				2							2
School shark				6	4				12	24	46
Shark	16	5	3	12	14	21	28	3			102
Rig		4	4	14	4				16		42
Unknown		1									1
Total	18	12	8	34	22	21	28	3	28	24	198

The observer coverage of the setnet fishery included Statistical Areas 018, 020, and 022. The Canterbury Bight area (Statistical Area 022) accounted for 48% of the total number of observed sets, while 38% were observed in Pegasus Bay (020). A small proportion of the total observed sets were from the southern area of Statistical Area 018 (Table 10).

Table 11 summarises the distribution of observed setnet fishing effort during 1997/98. The average duration of each observed setnet was 9.8 hours, 13.5 hours, and 14.6 hours for nets targeting rig, shark, and school shark, respectively. The average length of net deployed for each of the target species categories was 1546 m, 918 m, and 1240 m, respectively. The differences in fishing effort between the target fisheries are likely to reflect the practices of individual fishermen as much as differences in techniques for targeting each species or species mix.

TABLE 10. DISTRIBUTION OF THE NUMBER OF SETNET EVENTS OBSERVED IN THE PEGASUS BAY/ CANTERBURY BIGHT SETNET FISHERY BY MONTH AND STATISTICAL AREA DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME IN THE 1997/98 FISHING YEAR (EXCLUDING SETNETS WHERE THE SETTING OF THE GEAR WAS NOT OBSERVED).

STAT. AREA	MONTH										TOTAL
	OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998	
018	12				6	4			2	3	27
020	4			5	8	3	18		23	15	76
022	2	12	8	29	8	14	10	3	3	6	95
Total	18	12	8	34	22	21	28	3	28	24	198

TABLE 11. DISTRIBUTION OF SETNET EVENTS AND FISHING EFFORT OBSERVED IN THE PEGASUS BAY/ CANTERBURY BIGHT SETNET FISHERY BY STATISTICAL AREA, TARGET SPECIES, AND MONTH DURING THE HECTOR'S DOLPHIN OBSERVER PROGRAMME (EXCLUDING SETNETS WHERE THE SETTING OF THE GEAR WAS NOT OBSERVED).

STAT. AREA	TARGET SPECIES	FISHING EFFORT*	MONTH										
			OCT 1997	NOV 1997	DEC 1997	JAN 1998	FEB 1998	MAR 1998	APR 1998	MAY 1998	JUN 1998	JUL 1998	
018	School shark	Hrs fished										33	51
		No. sets										2	3
		Length										1281	1921
	Shark	Effort										20809	32816
		Hrs fished	145.8				98.9	26.8					
		No. sets	12				6	4					
	Length	10976				5488	3659						
	Effort	133334				90494	24468						
020	Mixed	Hrs fished				25.3							
		No. sets				2							
		Length				1829.4							
		Effort				23097							
	School shark	Hrs fished										100.4	265.7
		No. sets										7	15
		Length										4482	9604
		Effort										64297	170106
	Shark	Hrs fished	39.4			71.2	153.4	22.4	391.0				
		No. sets	4			3	8	3	18				
		Length	3659			1500	9074	3029	12732				
		Effort	36008			35583	178391	18470	257153				
Rig	Hrs fished										230.5		
	No. sets										16		
	Length										17600		
	Effort										253551		
022	Elephant fish	Hrs fished	17.3	18.5	9.8								
		No. sets	2	2	1								
		Length	8000	9000	4500								
		Effort	69000	83250	44250								
	School shark	Hrs fished				58.5	31					43.3	90.9
		No. sets				6	4					3	6
		Length				21990	12000					1921	3842
		Effort				214405	99000					27693	58215
	Shark	Hrs fished		45.7	19.5	75.4		139.8	113.9	31.8			
		No. sets		5	3	9		14	10	3			
		Length		4574	3300	8232		14635	10062	2744			
		Effort		41771	21450	68969		154750	116471	29088			
	Rig	Hrs fished		19.9	25.7	112.5	23.8						
		No. sets		4	4	14	4						
		Length		6629	9110	25500	6100						
		Effort		32822	51561	205350	36175						
	Unknown	Hrs fished		5.8									
		No. sets		1									
Length			1600										
Effort			9200										

* Fishing effort is presented by four different measures: (a) number of hours set nets were deployed; (b) the number of sets made; (c) the total length of net set (in metres); and (d) the length*duration for each setnet (Effort), i.e. sum of hours fished per metre of net.

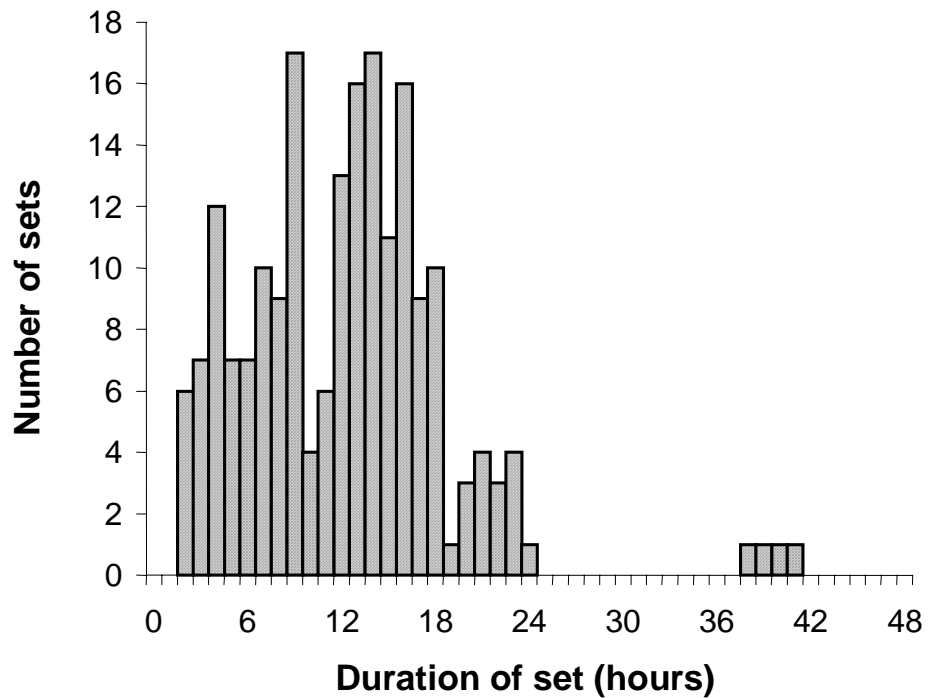


Figure 3. Frequency histogram of the duration of deployment of all observed setnets.

There are two broad modes in the distribution of the frequency of the duration of all observed setnet events (Fig. 3). The mode which corresponds to a set duration from 3 to 10 hours is the result of nets set and retrieved during the same day, while the other mode, from 10 to 18 hours, is from nets set overnight and which are recovered on the next day. There were a number of sets where the gear could not be recovered until several days after the net was set (Fig. 3).

3.4.2 Setnet target fisheries

Observed setnets targeting rig were located in the south Canterbury Bight and in three discrete locations within Pegasus Bay (Fig. 4). Most were set in depths less than 50 m, although a small number were set in deeper water in an area around the canyon in north-east Pegasus Bay (Fig. 5).

Setnets targeting school shark were distributed throughout Pegasus Bay, off Banks Peninsula, and in the south Canterbury Bight. School shark was targeted throughout the 10-100 m depth range.

Observed sets targeting shark were distributed throughout the study area from Timaru north to the southern area of Statistical Area 018. Most of the sets targeting the mix of shark species were within the 10-70 m depth range.

The small number of sets targeting elephant fish were all located in the southern Canterbury Bight in depths less than 50 m (Figs 4 and 5).

Figure 4. Distribution of observed set nets by target species (ELE=elephant fish; MIX=mixed species; SCH=school shark; SHA=mixed shark; SPO=rig). The stars mark the positions of set net events which caught Hector's dolphin. The solid line represents the 200 m depth contour. The dotted line represents the 1000 m depth contour.

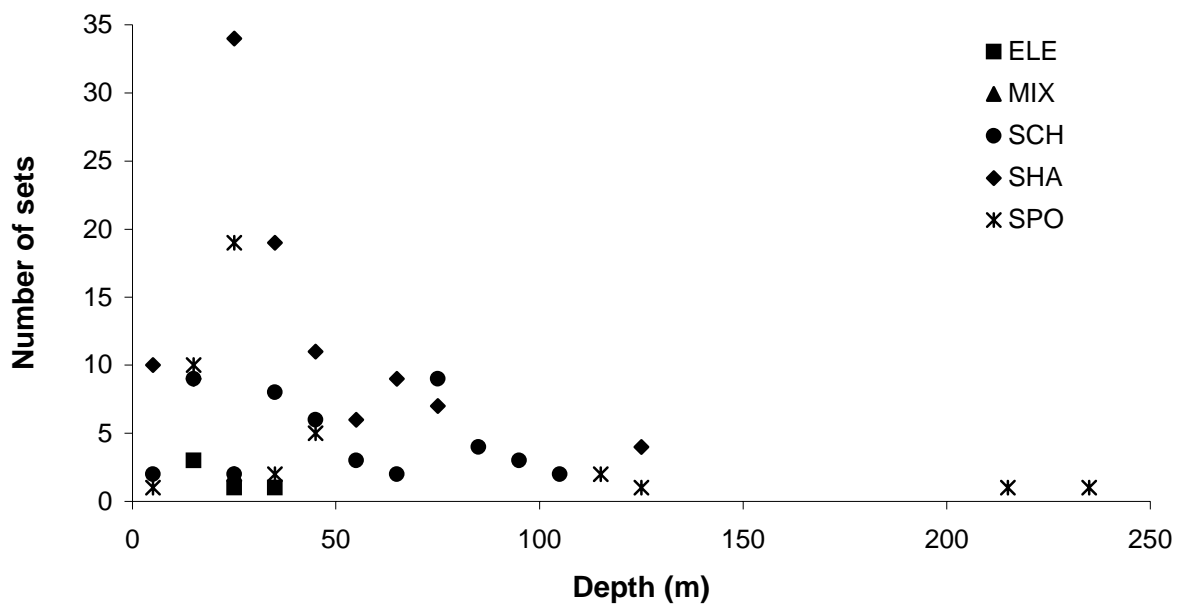
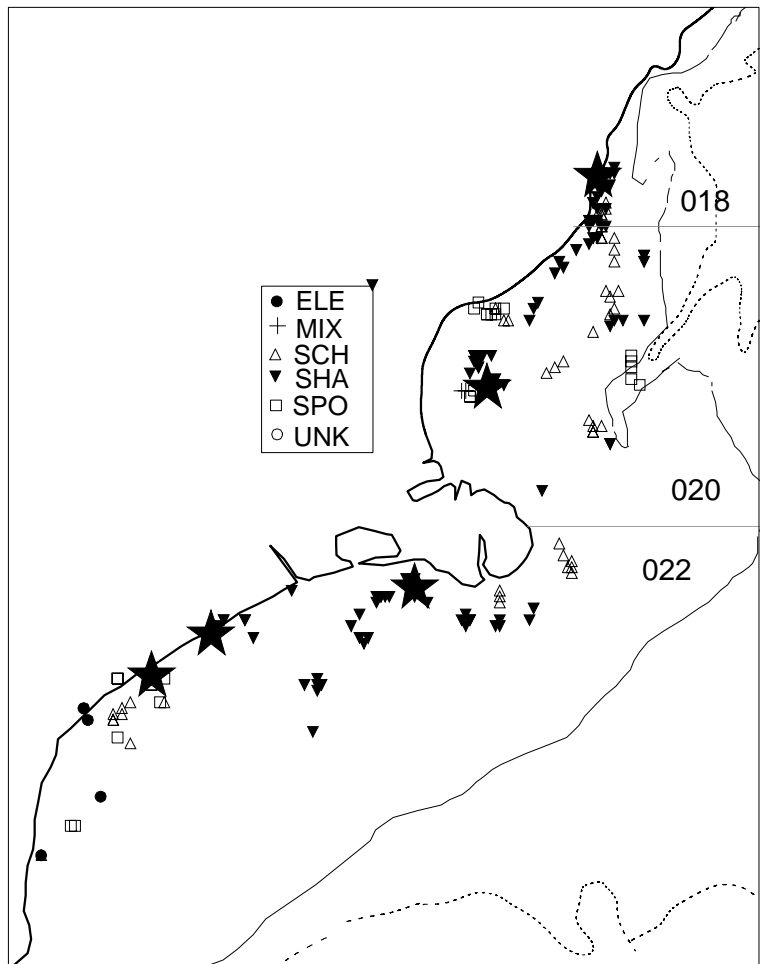


Figure 5. Distribution of observed set nets by depth (rounded to nearest 10 m) and target species (ELE=elephant fish; MIX=mixed species; SCH=school shark; SHA=mixed shark; SPO=rig).

3.4.3 Dolphin bycatch

Five incidents were observed of Hector's dolphins entangled in setnets during the 1997/98 monitoring programme (Table 12). Of these five observations, multiple captures of dolphins were recorded from three sets and accounted for six of the eight dolphins caught. Two of the dolphins caught were recovered alive and were safely released from the net.

The five incidents of dolphin capture occurred close to the coast within the study area (Fig. 4) and were all in depths less than 30 m. The sets catching dolphins were made during the period late November 1997 to late March 1998 and were targeting either shark or school shark.

TABLE 12. DETAILS OF INDIVIDUAL SETNETS WHERE HECTOR'S DOLPHINS WERE OBSERVED TO BE CAUGHT DURING THE 1997/98 OBSERVER PROGRAMME.

STAT. AREA	DATE OF SET	TIME OF SET	TARGET SPECIES	POSITION*		DEPTH (m)	TIME OF HAUL	DURATION OF SET (hr)	NET LGTH (m)	DOLPHINS CAUGHT	
				LAT.	LONG.					DEAD	ALIVE
020	26/11/97	unknown	SHA	43.3	172.0	29	07:45	unknown	500	1	0
022	11/01/98	19:55	SHA	43.9	172.7	22	22:22	2.5	915	2	0
022	18/01/98	05:00	SCH	44.2	172.6	13	14:00	9.0	4500	2	0
018	1/03/98	15:40	SHA	42.8	173.4	7	19:05	3.4	915	1	0
022	24/03/98	02:30	SHA	44.0	171.9	9	12:25	9.9	915	0	2

* The position of capture is given in decimal degrees, rounded to the nearest tenth of a degree.

4. Discussion

The results from this observer programme indicate that the trawl fishery in Statistical Areas 020 and 022 has a low incidence of interactions with the Hector's dolphin population, given that only one dolphin capture was observed from 434 trawl shots. However, the interpretation of this interaction is difficult because it needs to be placed in the context of the total amount of effort expended by this fleet in these areas. But the extrapolation of the observation to the total fleet will be difficult, as the one observed capture occurred in shallow water (about 20 m, similar to the depths at which the setnet entanglements occurred). Therefore, there is likely to be a depth effect which should be incorporated into the calculation of the effect of this fishery on the population, but which may not be possible as a significant fraction of the trawl fleet does not report the depth of every trawl shot made. It would be helpful if this fleet could switch to reporting its effort on a voluntary logbook or on the Ministry of Fisheries 'Trawl Catch/Effort Processing Returns' (TCEPR) so as to capture the distribution of effort by depth in this area.

A higher entanglement rate was observed in the setnet fishery, with 8 captures observed from 214 sets. The results also show that all these dolphin encounters were in depths of less than 30 m. The relative dolphin entanglement rate for the two fishing methods (trawl and setnet) probably reflects the amount of fishing effort in shallow and deep water as well as the different characteristics of the two fishing methods.

To estimate the effect of these fisheries on the resident population of Hector's dolphins in Statistical Areas 020 and 022, it will be necessary to compare the distribution of observed fishing effort with the total fishing effort for each of the fisheries by method, target species, month, statistical area, and depth. This work is beyond the scope of this project and will be undertaken in a subsequent project. The extent to which this can be done is dependent on the level of definition of the catch and effort data collected from the commercial fishery. In the case of the setnet fishery, catch and effort data are collected only to the level of statistical area, without any accompanying depth information. It will therefore not be possible to investigate the distribution of the total commercial fishery on a very fine scale. A higher level of resolution of analysis may be achievable for a part of the trawl fleet as some vessels complete detailed catch and effort returns for each individual trawl shot.

While the execution of this programme failed to deliver all of the designed number of observer days for the setnet fleet in the two statistical areas (compare Tables 2 and 3), it succeeded in providing the full number of observer days for the entire period by increasing the number of observed days in the trawl fishery operating in the same areas. The failure to deliver the full number of setnet observer days was due to an apparent decrease in setnet fishing effort during the 1997/98 fishing year along with a possible reluctance of the fishermen to become involved in the programme. This reluctance, combined with the small physical size of the vessels which operate in this fishery, make the execution of an observer programme in this fishery extremely difficult and susceptible to failure.

5. Acknowledgements

This report originated as CSL 97/3020 of the Inshore Observer Programme for protected species in fisheries Statistical Areas 020 and 022 and is part of White Paper Project CSL 1a.

Appendix 1

HECTOR'S DOLPHIN OBSERVER PROGRAMME EXPERIMENTAL DESIGN

10 September 1997

Introduction

Three hundred (300) observer days have been allocated to monitor Hector's dolphin entanglements in Statistical Areas 020 and 022 during the 1997/98 fishing year. This programme is required to provide 150 days observer coverage in the inshore setnet fishery and a further 150 days in the trawl fishery.

Setnet fishery

All analysis has been undertaken using Ministry of Fisheries CELR (Catch/Effort Landing Returns) data collected over the last six years. These data were used to determine average fishing effort because for the programme to be statistically valid observer coverage needs to be roughly proportional to effort. Number of days fished and metres of net set were considered to be an appropriate measure of effort. Both factors are closely correlated therefore either of these variables provides a suitable index of effort. It was considered inappropriate to use total setnet effort as some fisheries are unlikely to have an impact on Hector's dolphins. For example, the Lake Ellesmere eel fishery is unlikely to encounter dolphins. The following target species (outlined in Table A1.1) comprise most of the setnet fishery in Statistical Areas 020 and 022.

TABLE A1.1. PERCENTAGE DAYS SETNET FISHED IN STATISTICAL AREAS 020 AND 022 BY TARGET SPECIES*.

AREA	YEAR	ELE	SCH	SPD	SPO	KAH	TOTAL [†]
020	1990/91	1	1	36	19	24	81
	1991/92	1	3	46	13	12	75
	1992/93	0	0	42	5	43	90
	1993/94	1	7	22	4	46	80
	1994/95	0	19	7	21	50	97
	1995/96	13	38	23	19	0	93
	Mean	3	11	29	14	29	86
AREA	YEAR	ELE	SCH	SPD	SPO	FLA	TOTAL
022	1990/91	5	1	1	1	67	75
	1991/92	10	4	4	8	36	62
	1992/93	23	17	8	14	15	77
	1993/94	15	12	7	20	26	80
	1994/95	6	7	2	8	45	68
	1995/96	5	7	5	8	71	96
	Mean	11	48	5	10	43	76

* ELE= elephantfish; SCH= school shark; SPD= spiny dogfish; SPO= rig; KAH= kahawai.

[†] Total of target species as a percentage of all days fished in each area.

Although kahawai caught in Area 020 accounts for 29% of mean setnet effort in this area it should be excluded from the design as these figures represent one fisher who is no longer fishing for this species. Similarly, flatfish caught in Area 022 accounts for 43% of mean setnet effort in this area but should be excluded as most of the catch for this species in this area is restricted to Lake Ellesmere. The design of the sampling programme is therefore restricted to the four shark species in both areas.

Over the last six years, on average, 30% of the number of days fished has occurred in Area 020. However, based on knowledge of this fishery and the fact that effort has fluctuated in this fishery, it is probably appropriate to allocate $\frac{1}{3}$ (50 days) observer coverage to this area. The remaining 100 days has been allocated to Area 022 (Table A1.2).

TABLE A1.2. NUMBER OF DAYS SETNET FISHED FOR THE FOUR SHARK SPECIES IN STATISTICAL AREAS 020 AND 022.

YEAR	020	022	% IN 020	% IN 022
1990/91	222	141	61%	39%
1991/92	187	214	46%	54%
1992/93	89	185	32%	68%
1993/94	107	229	32%	68%
1994/95	91	292	24%	76%
1995/96	185	261	41%	59%
Mean %*			32%	68%
No. obs. days allocated	50	100		

* Mean % is from the most recent 3 years as previous data appear to be atypical of what is currently occurring in the fishery.

The next step is to relate the days in each area to monthly effort. Table A1.3 outlines the observer allocation for each area by month.

It was also considered important to determine when and where Hector's dolphins are most likely to be entangled so that coverage could be concentrated during this period. Unfortunately, only limited data are available from DOC reports of beachcast and entangled dolphins. These data indicate that a large proportion of the dolphin catches occur over the summer months in the Timaru area. However, given the limited nature of these data, along with the fact that beachcast dolphins may be more likely to be encountered during the summer months (when greater numbers of people visit beaches) limited weight has been placed on these findings. Furthermore, because setnet effort tends to be concentrated in the Timaru area between November and March there will be greater observer coverage in this area during the summer period.

TABLE A1.3. OBSERVER COVERAGE ALLOCATION FOR THE SETNET FISHERY BY MONTH. THIS ALLOCATION PLACES A MINIMUM OF TWO OBSERVER DAYS IN ANY MONTH/AREA.

MONTH	STATISTICAL AREA 020	STATISTICAL AREA 022
Oct	3	3
Nov	5	15
Dec	5	24
Jan	5	21
Feb	4	13
Mar	4	9
Apr	6	7
May	8	3
Jun	3	2
Jul	3	2
Aug	2	2
Sep	2	2
	50	103

Trawl fishery

This analysis has been undertaken using Ministry of Fisheries TCEPR (Trawl Catch/Effort Processing Returns) and CELR data collected over a five-year period. These data were used to determine average fishing effort which has been defined as number of days fished and number of tows made. These two variables are closely correlated, therefore either one will provide a good index of effort. It was considered inappropriate to use total trawl effort as some fisheries, such as the deepwater orange roughy and oreo fisheries, will not encounter Hector's dolphins. Analysis has been restricted to inshore trawl fisheries.

Over the last five years, on average, 42% of the number of days fished has occurred in Statistical Area 020. It is therefore reasonable to allocate 63 days observer coverage to this area. The remaining 87 days have been allocated to Area 022 (Table A1.4). All five years' data have been used as there appears to have been little change in the distribution of effort during this period.

TABLE A1.4. NUMBER OF DAYS TRAWL FISHED FOR INSHORE FINFISH IN STATISTICAL AREAS 020 AND 022.

YEAR	020	022	% IN 020	% IN 022
1990/91	2453	3409	42%	58%
1991/92	2650	3440	44%	56%
1992/93	2545	3840	40%	60%
1993/94	2515	3044	45%	55%
1994/95	2369	3355	41%	59%
Mean %			42%	58%
No. obs. days allocated	63	87		

The next step is to relate the number of days fished in each area to monthly effort. Table A1.5 outlines the observer allocation for each area by month.

TABLE A1.5. OBSERVER COVERAGE ALLOCATION FOR THE TRAWL FISHERY BY MONTH.

MONTH	STATISTICAL AREA	
	020	022
Oct	5	7
Nov	6	8
Dec	6	6
Jan	7	8
Feb	6	9
Mar	6	7
Apr	6	9
May	6	9
Jun	5	8
Jul	4	7
Aug	3	5
Sep	3	4
	63	87

Observer data collection forms

Two draft forms have been designed—one for setnet and one for trawl vessels. These forms are included as Appendix 2 and Appendix 3, and will be used by observers to record the necessary data for each trip.

Appendix 2

EXAMPLE OF OBSERVER FORM FOR SETNETS

(See next page)

HECTORS DOLPHIN INCIDENTAL CATCH REPORTING FORM - SETNET

Note: Complete one form for each day fished

Vessel Name: _____ Observers Name: _____

Date: _____ Skippers Name: _____

CELR No. _____ Target Species: _____

SET NUMBER	TIME STARTED BETTING NET	START POSITION	NET LENGTH (m/yd)	START DEPTH (m/m)	TIME FINISHED HAULING NET	NUMBER OF ALIVE DOLPHINS	NUMBER OF DEAD DOLPHINS
1	:				:		
2	:				:		
3	:				:		
4	:				:		
5	:				:		
6	:				:		
7	:				:		
8	:				:		
9	:				:		
10	:				:		

Observers Signature: _____

Skippers Signature: _____

Appendix 3

EXAMPLE OF OBSERVER FORM FOR TRAWL

(See next page)

HECTORS DOLPHIN INCIDENTAL CATCH REPORTING FORM - TRAWL

Note: Complete one form for each day fished

Vessel Name: _____ Observers Name: _____

Date: _____ Skippers Name: _____

CELR No. _____ or TCEPR No. _____ Target Species: _____

TOW NUMBER	TIME STARTED TOWING NET	START POSITION	START DEPTH (m/m)	TIME FINISHED TOWING NET	NUMBER OF ALIVE DOLPHINS	NUMBER OF DEAD DOLPHINS
1	:			:		
2	:			:		
3	:			:		
4	:			:		
5	:			:		
6	:			:		
7	:			:		
8	:			:		

Observers Signature: _____

Skippers Signature: _____