

# Developmental stages of the underwater bait setting chute for the pelagic longline fishery

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*Molloy, Walsh, Barnes*

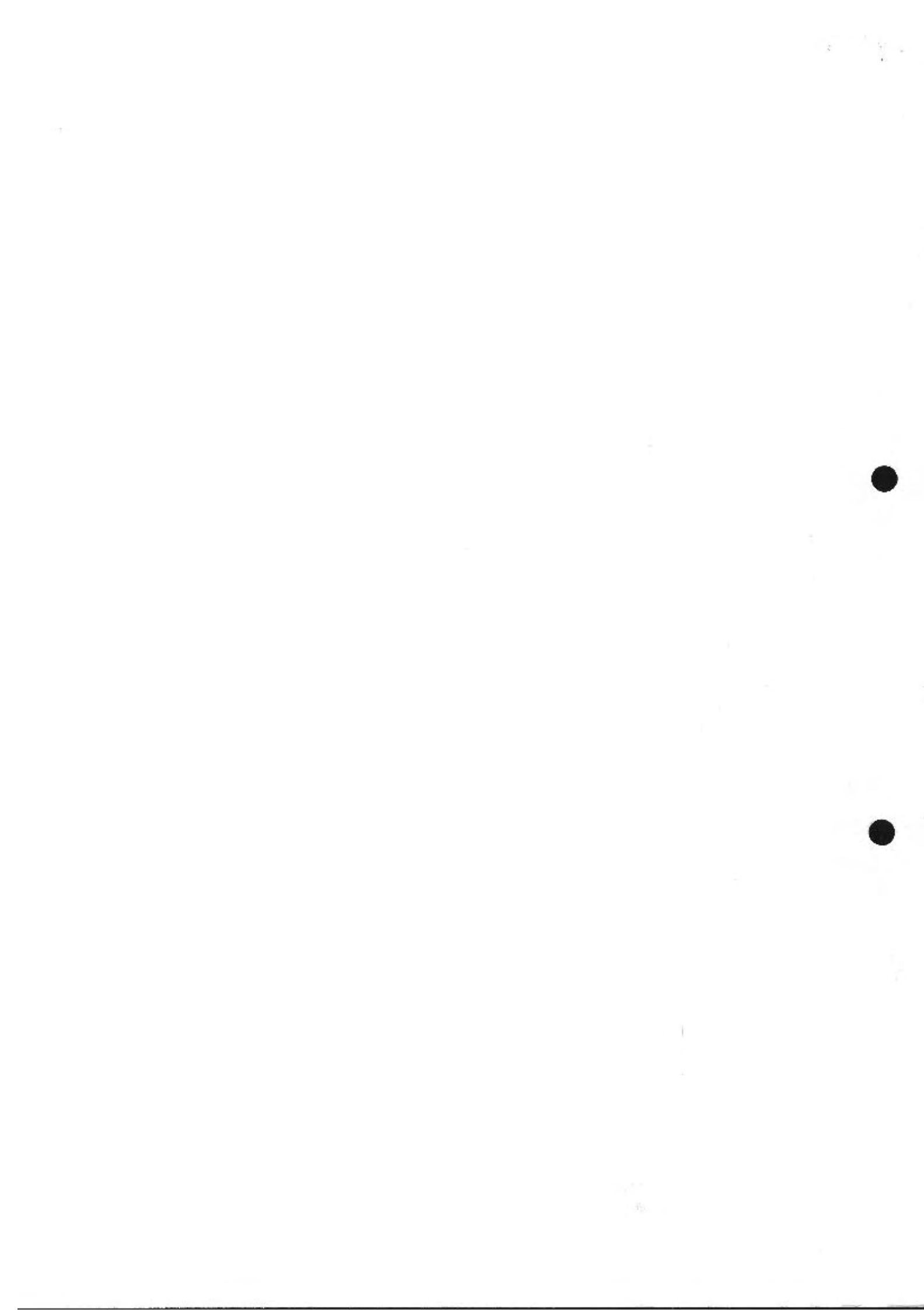
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# Developmental stages of the underwater bait setting chute for the pelagic longline fishery

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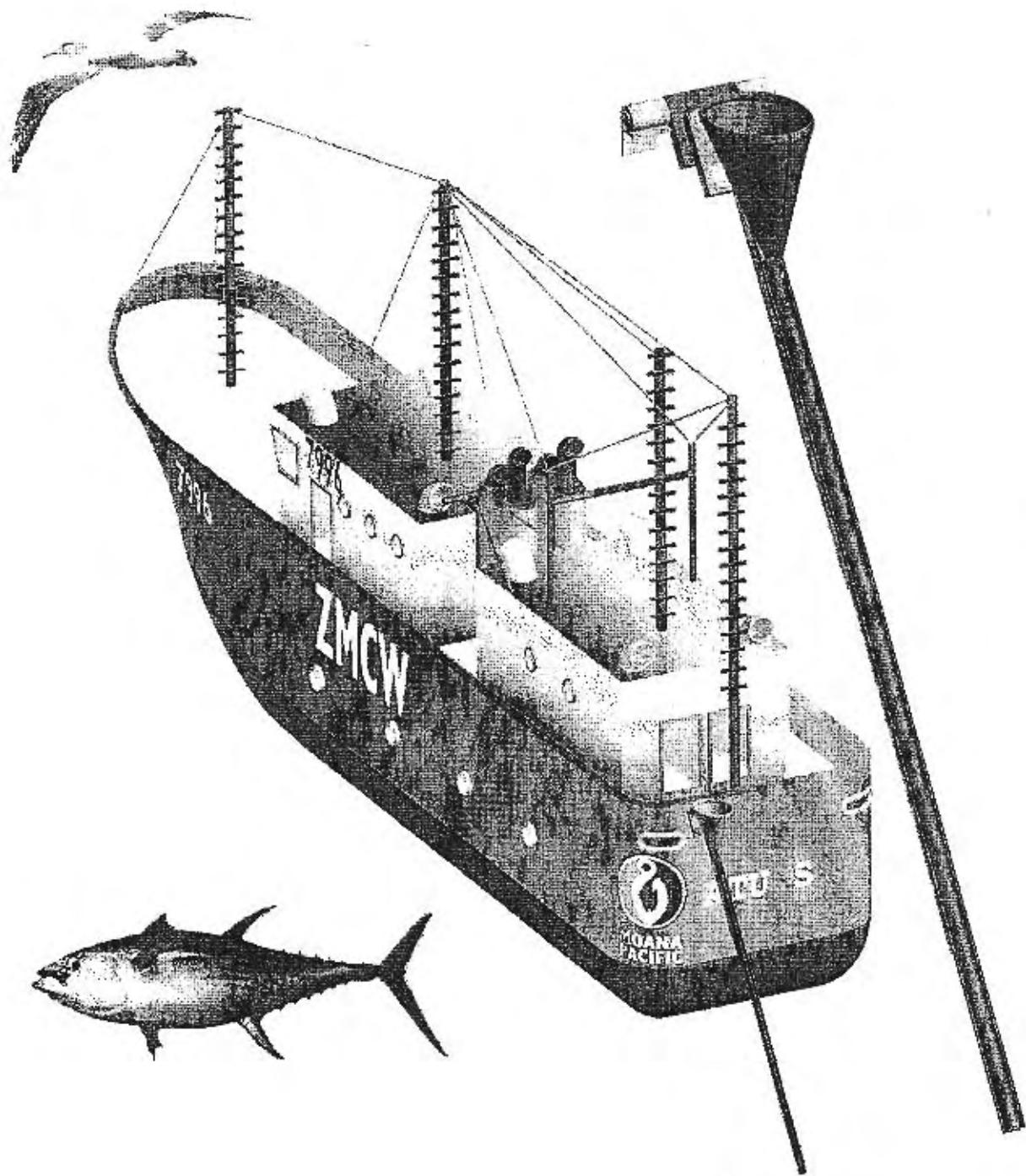
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FRONTISPIECE. DIAGRAM OF AN UNDERWATER BAIT SETTING CHUTE IN PLACE ON A PELAGIC FISHING VESSEL.

# 1. Introduction

*by K. Walshe and P. Barnes*

The incidental capture of seabirds associated with longline fisheries has been recognised as a factor in population decreases in certain seabird species (Croxall et al. 1998; Weimerskirch et al. 1997). A number of different measures are used by fishers to reduce this incidental capture. These include tori lines, placing weights on snoods, restricting the setting to night time, using thawed bait, and using mechanical bait throwers.

Brothers (1991) found that, during the setting operation on pelagic longline vessels, most attempts by sea birds to take the bait occur within the first 100 m behind the vessel and rarely up to a maximum of 250 m. It is during this period that baits are within the diving range of some sea bird species. This report describes the development and testing of a chute that sets the baits at a depth of 3 metres or more below the sea surface. The purpose of this chute is to reduce the amount of time baits are within the diving range of sea birds.

The development of an underwater setting chute (hereafter referred to as the "chute") commenced in 1995, when Akroyd Walshe/Paul's Fishing Kites were contracted to design and build a prototype. The results of this phase of the programme are reported in Barnes & Walshe (1997).

This document reports on each stage of development and sea testing of the chute between October 1997 and February 1998.

## 2. Pelagic longline fishing in New Zealand

*by K. Walsbe and P. Barnes*

The pelagic longline fishery in New Zealand targets albacore, bigeye, yellowfin and southern bluefin tuna (SBT). Of these only SBT has a catch limit - 420 tonnes. According to the Ministry of Fisheries (1997 data), the fleet is composed of approximately fifty domestic vessels and five chartered Japanese vessels.

The fishing operation is a twenty four hour cycle. A 20-60 nautical mile (nm) mainline is usually stored on a hydraulically operated spool, which is positioned in a variety of locations according to the deck layout of individual vessels. The line is run through a series of pulleys or roller guides and set from the stern of the vessel. Longliners vary in length from 10 to 50 metres.

On some vessels the mainline is set by simply driving the vessel forward, and the water resistance pulls it from the mainline spool.

Other vessels use a device known as a line shooter. This pulls the line from the spool at a speed faster than the vessel is travelling through the water. Line setters can be set to pull the line from the mainline spool at different speeds, giving the vessel's skipper flexibility in the depth his fishing gear settles at.

As the mainline leaves the rear of the vessel, a snood line with a baited hook attached at one end is clipped on to the mainline and manually thrown overboard to one side of the vessel. The snood lines are usually between 10 and 20 metres in length. Usually two or more crew are involved in the process. One of the crew is responsible for taking the correct hook from the snood box (which houses the hooked snoods when not in use), places the bait on the hook, and throws the snood over the stern of the vessel. The other crew member takes the other end of the snood and clips it to the mainline after the baited hook has been thrown. Each mainline has anything from 800 to 2600 snood lines clipped to it. The timing between snoods varies between 7 and 9 seconds on the New Zealand vessels.

Radio buoys are attached at each end of the line and at its centre. Floats are placed along the line approximately every 12-25 hooks, and each section between floats is termed a basket.

At the completion of this setting procedure, the line is left to soak for 10-16 hours. It is then retrieved and the cycle is repeated.

### 3. Trials of the underwater setting chute

#### 3.1 TRIAL NO. 1 - F.V. DANIEL SOLANDER

by D Wrightson

The objective of the trial was to test the seaworthiness of a chute on a commercial vessel in open water conditions. Solander Fisheries Ltd provided the vessel F.V. *Daniel Solander* for this purpose.

The vessel was using demersal fishing gear during the period when the chute was tested, which meant it could not be used during fishing. However, because the key objective was to test the seaworthiness of the chute, this could be achieved by towing it behind the vessel on the way to the fishing grounds, and between sets during the fishing period.

#### Specifications of the F.V. *Daniel Solander*

The F.V. *Daniel Solander* is a purpose-built ex-Japanese pelagic longline vessel, with the typical semi-enclosed forward work deck low to the waterline, the wheelhouse midships three levels above the work deck and accommodation aft. This vessel is unusual in that, above the accommodation deck, a helideck pad extends out over the aft stern deck. The specifications are given in Table 1.

TABLE 1. VESSEL SPECIFICATIONS, F.V. DANIEL SOLANDER.

Length	Beam	Draft	Net tonnage	Power	Hull material	Crew
49 m	8.5 m	2.6 m	180.5 t	970 kW	Steel	15

#### Description of the chute

Figure 1 illustrates the chute built for the F.V. *Daniel Solander*.

Its total length, from the top of the trough to the base of the tube was 10.5 m. The tube section differed from previous designs by having a second length of tube welded under the grooved tube for added strength. Both tubes were 60 mm internal diameter.

Three paravanes were trialed: 1. Arrowhead paravane; 2. Flexiwing paravane; 3. Bi-wing paravane (Figure 2).

The chute was attached to the vessel 1.5 metres off the port quarter at the stern of the vessel. A base plate and hinge assembly was used to attach it to the stern. The hinge assembly operated through two arcs (Figure 3). One hinge pin was used to enable the chute to swing to port and starboard, and another to allow the chute to swing toward and away from the vessel. When the chute was fully deployed or recovered, a locking pin secured it in position (Figure 4). A hinged retaining arm secured the chute in the split collar during recovery and deployment.

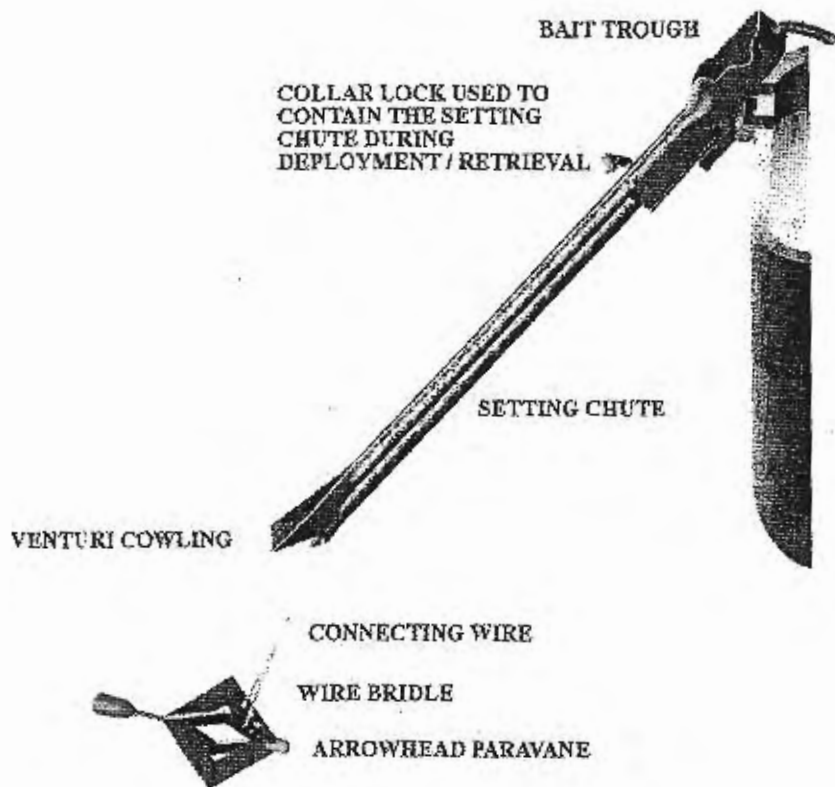


FIGURE 1. UNDERWATER BAIT SETTING CHUTE, SHOWING PARAVANE IN USE.

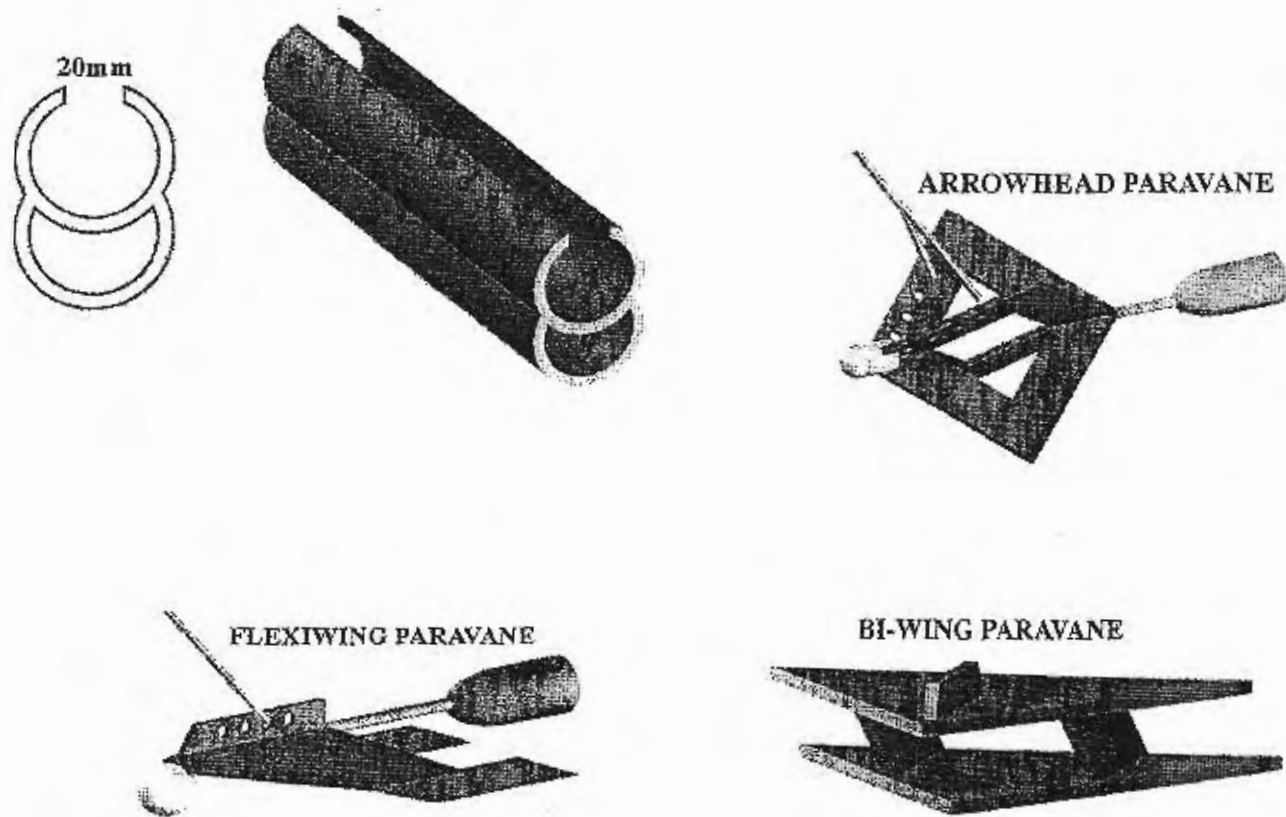
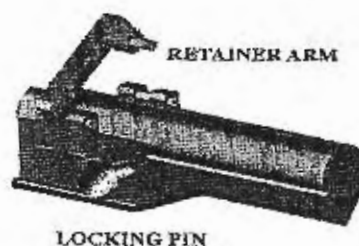


FIGURE 2. CROSS-SECTION OF SETTING TUBE TESTED ON THE FV DANIEL SOLANDER, AND PARAVANES USED: TOP RIGHT, ARROWHEAD ; BOTTOM LEFT, FLEXIWING; BOTTOM RIGHT, BI-WING.

FIGURE 3. HINGE ASSEMBLY FOR THE CHUTE



FIGURE 4. SPLIT COLLAR SYSTEM FOR SECURING THE CHUTE IN POSITION.



### Retrieval and deployment system

The F.V. *Daniel Solander* has a helideck above the aft stern deck, and a hole was cut into this to allow the chute to be winched up and down through it. A 2.9 m high tripod was built on the helideck, and when the chute was fully retrieved, the trough rested directly above this frame (Figure 5). A length of 12 mm angle iron ran from the top of the tripod back to the hole in the helideck at approximately a 30° angle and protruded about 20 cm below to the stern deck. This acted as a guide for the chute as it was deployed and retrieved.

The chute, when fully retrieved, extended from about 1 m over the transom, up through the helideck, along the full length of the angle iron guide to where the trough rested on top of the A frame. It was secured in place by a pin through the lower end of the chute.

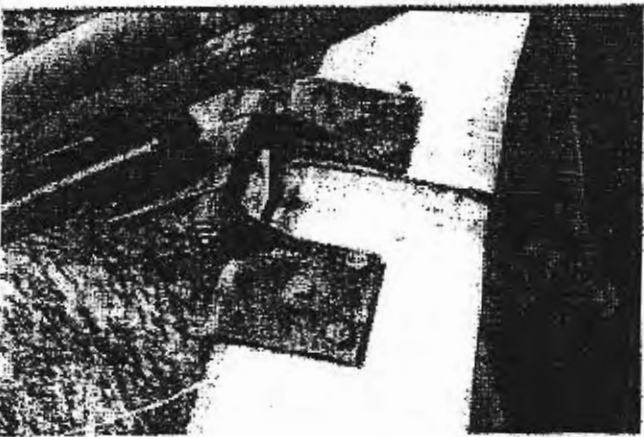
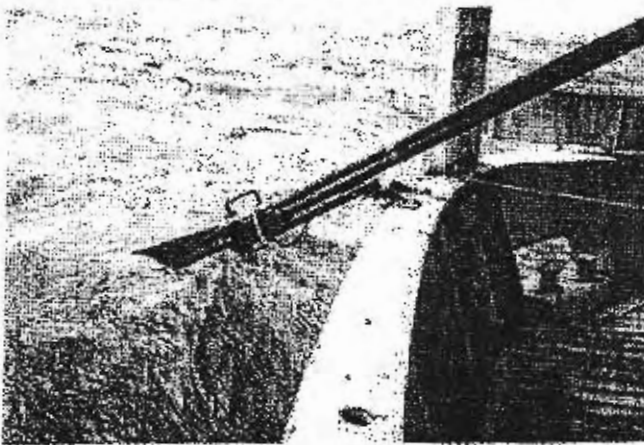
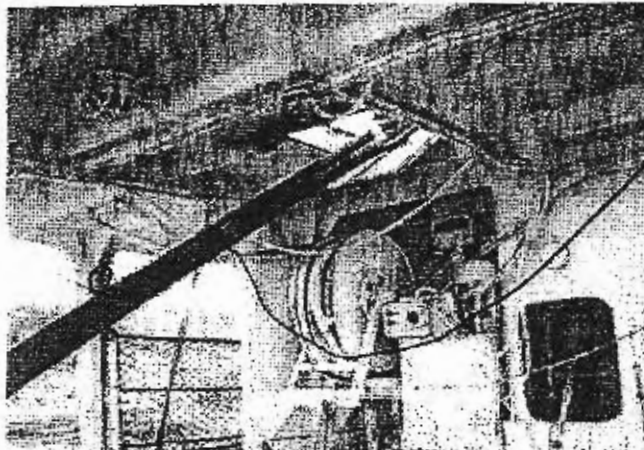
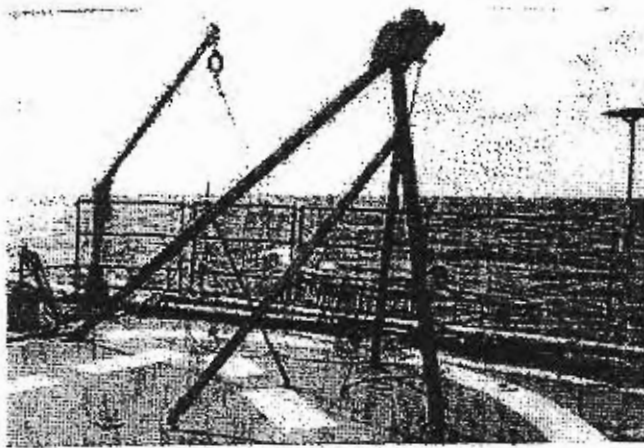
An angle bracket secured the chute to the stern of the vessel.

### Method

During each trial the performance of the chute was observed and recorded. As well as written records of the performance of the chute, a video camera record of the chute's performance was also made. Marks were painted around the chute tube at metre intervals to determine the setting depth of the chute.

A summary of the trials, their locations and environmental conditions are given in Table 2.





## Performance of the chute

### *Bait run times and entanglements*

Baits were trialed through the chute on the third trial on 9 October 1997 while using the Arrow paravane.

The deck hose was connected to the trough to flush baited snoods through the chute. Bait flushing times were three to four seconds. After 14 baits were fed through the chute, a hook-up occurred on the paravane wire, resulting in the abandonment of snood timings.

With so few baits trailed through the chute, this trial could not be considered comprehensive.

### *Paravane operation*

All three paravanes worked at keeping the chute down in the water column. The Arrowhead and Flexiwing were the most effective in terms of the angle of the chute and the setting depth (based on the number of metre marks visible above the water).

All of the October 1997 tests were made at towing speeds of 7 and 10 knots. At 10 knots all three paravanes appeared to be less effective, with the chute riding higher in the vessel's wake. The Bi-wing paravane was the least effective at keeping the chute at the required angle.

At 10 knots towing speed, both the Flexiwing and Arrowhead paravanes (towed from the base of the chute on 5 and 6 m wire strops) made a very audible vibration noise. The vessel's skipper commented that this noise might deter the target species when pelagic longlining.

During the second set of trials, the vessel was travelling at a slower speed because of high seas, and the vibration noise experienced at higher speeds was not heard. After a few minutes' towing, the tail came away from the Flexiwing paravane.

FIGURE 5. RETRIEVAL AND DEPLOYMENT SYSTEM FOR THE CHUTE: (FROM THE TOP) THE TRIPOD ON THE HELIDECK; THE ANGLE IRON GUIDE; THE CHUTE SECURED WHEN FULLY RETRIEVED; ATTACHMENT TO THE STERN.



TABLE 2. DATE, LOCATION, AND CONDITIONS IN CHUTE TRIALS ON F.V. DANIEL SOLANDER.

DATE	LOCATION	TRIAL	CONDITIONS
09.10.97	Otago coast	Three trials when steaming to fishing grounds.	Relatively calm, 5-19 kt, SW swell 1.0 m.
05.11.98	Chatham Rise	Two trials between fishing operations.	Rough seas, SW wind up to 38 kt, SW swell 2.0-2.5 m and breaking.

All three paravanes used in the five trials were affected by the vessel's propeller wash. The propeller rotated clockwise with a pull from port to starboard, and the paravanes were pulled towards the starboard stern quarter. The angle of the chute appeared to vary from 15 to 20 degrees to starboard. With the second set of trials, the length of wire strop was increased in an attempt to clear the paravane from the propeller wash, but the effect was the same.

#### ***Base plate and hinge operation***

The base plate and hinge were effective and did not appear to place excessive force on to the stern transom plating. The chute was observed to flex and show signs of movement, but this appears to be from water resistance rather than force transmitted from the paravanes.

No part of the base plate hinge or chute malfunctioned during the trials. On completion of the trip some obvious rust marks were starting to appear. It may be that a non-rusting material is required if the chute is to be used continuously.

#### **Performance of the retrieval and deployment system**

Difficulties were experienced with the deployment and retrieval system. When the chute was three-quarters deployed, the trough was still protruding through the hole cut through the helideck. The downward pull of the paravane in the water jammed the chute against the edge of the hole in the helideck, and it took up to three crew straining on ropes to clear the hole. Once the chute was fully deployed and contained in the pivot arm with the retaining collar, the main locking pin had to be inserted to connect the chute to the pivot arm by aligning holes drilled into each component. This often required the repositioning of the chute in the pivot arm by the winch person before the holes would align and the locking pin could be inserted.

During the second set of trials, in gale conditions, considerable bending occurred as the chute was retrieved. At the point where two-thirds of the chute were out of the water, the paravane was still working against the crew hauling in, and with a swell of two or more metres, the amount of curve the paravane end of the chute took up was considerable. No damage resulted from this action on the chute.

## Recommendations

Given the very limited sea trials of the chute during this trip, it was still considered to be untested. However, several modifications were recommended.

1. The paravanes should be incorporated into the chute, making it a one-person operation, removing the dangers and difficulties associated with deployment and retrieval of the paravane and wire strop in large seas.
2. Some form of cradle, guide or track could be developed to contain the chute during deployment/retrieval operations, allowing for a one-person operation.
3. The use of a hydraulic winch with hand control at the stern deck, to allow for a one-person operation, creating a smooth and simple deployment/retrieval of the chute.
4. An even longer and stronger tube, to allow deeper bait delivery and clear the vessel's wake more effectively.
5. The chute should be positioned away from the prop wash and the disturbance of the water column, therefore avoiding the prop wash effect while towing the deployed chute.
6. The feed tray should be detachable during retrieval or deployment of the tube.
7. A longer paravane tow strop could be used to enable the chute to be fully set before the paravane need be deployed; this would prevent any pressure or loading on the chute while only half deployed in the water. If this system was used, a way of tripping the paravane would need to be found for the retrieval phase.

### 3.2 TRIAL NO. 2 - F.V. *BRENDA KAY*

*by D. Wrightson*

The objective of this trial was to evaluate the operating performance of a chute on a smaller longline vessel in a range of sea conditions, and to set 4000 hooks through the chute under the normal fishing conditions. It was hoped that during the fishing operations, severe weather conditions would allow the chute to be used in rough water so that its durability and the performance of the attached paravanes could be evaluated.

The F.V. *Brenda Kay* (Tobe International) was selected as a suitable vessel to carry out the sea trials.

#### Specifications of vessel and longlines used

The F.V. *Brenda Kay*'s steel construction and clear deck room made it a suitable vessel for the trial. Other vessels with small stern areas, overhead canopies, aft wheelhouses, or masts of insufficient height to position a block enabling a retrieval angle of forty degrees at the chute would require further modification of the chute set up to operate the chute effectively.

The specifications of the vessel and the longlines used are provided in Table 3.

TABLE 3. F.V. *BRENDA KAY* SPECIFICATION AND LONGLINE CONFIGURATION AND DIMENSIONS.

LENGTH	BEAM	DRAFT	GROSS WEIGHT	POWER	HULL MATERIAL	CREW NUMBER
13.8 m	4.8 m	2.3 m	32.0 t	171 kW	Steel	3
CONFIGURATION	MAINLINE	SNOODS	FLOATS	BASKET SIZE		
	30 mm (approx.)	950	58	25 hooks (approx.)		
DIMENSIONS	MAINLINE DIAMETER	SNOOD DIAMETER	BUOY LINE DIAMETER			
	4.0 mm	2.2-2.0 mm	2.2-2.0 mm			

The main line was routed from the longline reel on the port side of the vessel, across to the starboard side, through a block suspended from the wheelhouse roof, then at right angles down to the line shooter. The shooter was not used during the chute sea trials. The longline reel was always set on "free wheel", and the mainline was tight as it fed over the stern.

A buoy and one radio beacon were deployed from the stern and attached to the main line. Once the pole and radio buoys were clear and the mainline was slowly running off the longline reel, two additional floats were clipped on to the mainline before baiting snoods were deployed. One unusual feature of the F.V. *Brenda Kay's* fishing gear was the use of snoods as float lines. This allowed total freedom for the skipper to determine number of snoods in each basket.

Two types of bait were used for all the real-time at-sea trials:

- (1) sanmar (approx. 130 sanmar per carton),
- (2) squid (approx. 160-220 squid per carton).

Cartons of bait were left in the hold until the vessel had reached the start way point for the set. The cartons were then opened and the semi-frozen baits separated and placed into bins at the stern, thawing while the set progressed.

### Description of the chute

The chute trialed was a 5.7 metre length of 6 cm diameter steel pipe (Figure 6) connected to the vessel in the same way as on the F.V. *Daniel Solander*, by a base plate bolted to the aft transom and contained by a pivot-arm and chute locking pins (see Figures 3, 4).

The dorsal section of the tube had 2.5 cm width slot along the full length of the tube. At the base of the tube a section of it was cut away and flared to allow clear movement of the expelled bait. A split cowling was welded around the bait exit point to maximise the tube venturi effect.

On the base of the bait exit cowling a bracket was welded vertically, and through this, four separate holes were drilled, allowing for four different points of connection for the paravane wire strop. The position of the wire strop used

for all the F.V. *Brenda Kay* trials was the hole furthest back from the dorsal snood groove down the length of the chute tube or lowest hole when the chute was fully deployed.

Marks were painted on the chute at one metre intervals from the base. A record of the maximum and minimum number of marks visible above the water line was kept during setting. The angle of the chute in the water was estimated, and the maximum and minimum depth determined from this.

The top end of the tube was welded to the trough. The trough was half a metre in length and oval in shape, with sides approximately 10 cm high. Water was fed in from the top of the trough via a connection point to the deck hose. The water then flowed from the top of the trough down its full length, through the point where the trough neck is welded to the chute tube and on down the tube to the bait exit point at the base of the chute.

Two steel plates were welded horizontally from a point above the weld that connects the chute tube and trough, and extended some 10-15 cm above the trough floor into the trough. These horizontal plates were to act as line guides for the snoods (Figure 6). The trough had a cut out section on the right hand side of approximately 5 cm to allow easier use of the snood line guides.

Bait was fed into the trough allowing the water flow to carry the bait the full length of the tube. Once the bait had entered the tube, the crew member baiting it would allow the snood line to lie under the guide plate, preventing loose or slack line entering the snood groove before the bait had exited the base of the chute via the exit point and clearing the cowling. It was thought necessary for the snood line to exit the snood groove before the bait had cleared the exit and cowling to prevent it from looping out of the groove and tangling at the exit point or lower on the paravane stop. It was also considered undesirable for the snood line to leave the tube before the bait, as its early release could cause a bait to be forced prematurely from the tube, allowing it to be set at a shallower depth than the desired three metres.

A similar flexiwing paravane to that used on the F.V. *Daniel Solander* was used (Figure 2), except that lead weights could be inserted into the nose of the paravane and an additional two attachment points had been drilled in the dorsal section.

The chute was attached to the vessel using a similar base plate, hinge and pivot arm as that used on the F.V. *Daniel Solander* (Figures 3, 4). The chute base plate was attached to the aft transom horizontal stern plate, 80 cm from the port stern quarter, at a height of 50 cm above the deck plating.

### **Retrieval and deployment system**

The chute configuration used on the F.V. *Brenda Kay* is shown in Figures 7 and 8. The retrieval system used for the trials consisted of one double block shackled to the vessel's mast approximately 6.5 metres above the water line. A single block with a shackle was connected to a lug at the base of the chute feed trough. An 8 mm three-strand rope was laced between two blocks and rigged to advantage; this block configuration is known as a "Handy Billy" or "Jigger".

The chute was placed into the pivot arm and secured with the hinged collar with the paravane end of the chute extending over the stern. The paravane was

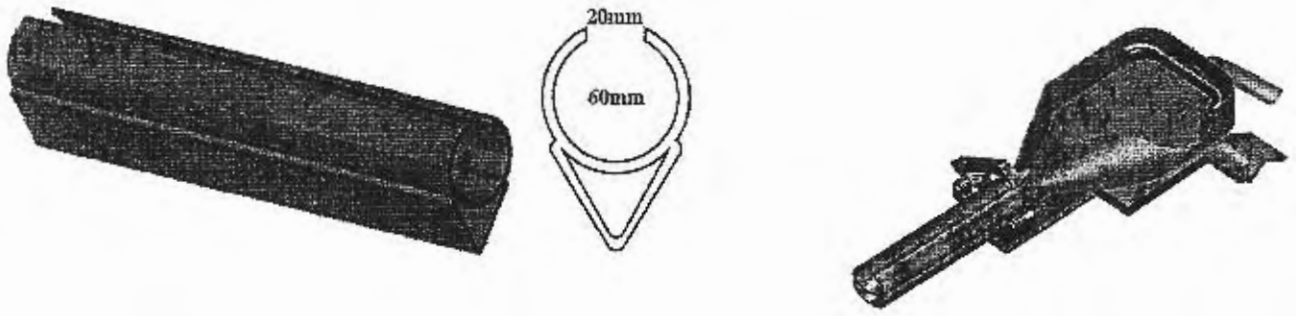


FIGURE 6. (ABOVE LEFT) CHUTE DESIGN AND (RIGHT) TROUGH USED ON F.V. *BRENDA KAY*.

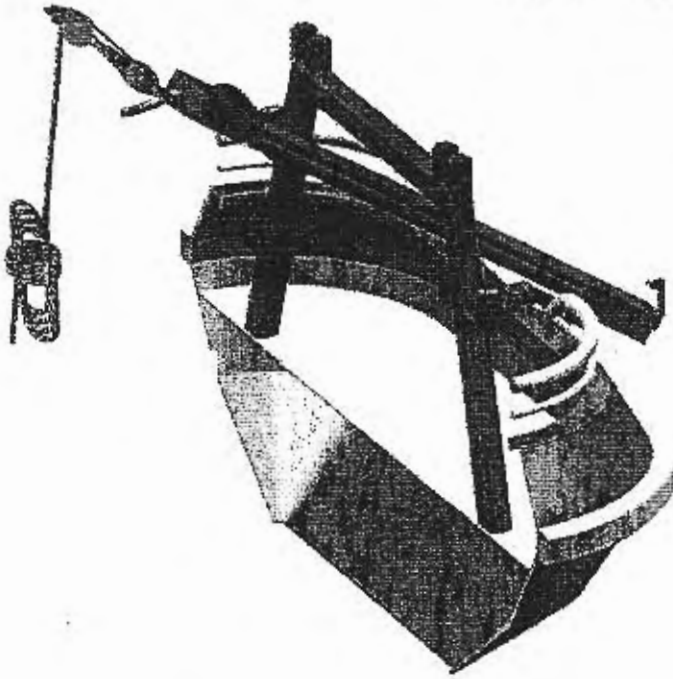


FIGURE 7. DEPLOYMENT AND RETRIEVAL SYSTEM USED ON F.V. *BRENDA KAY*. THE HOISTING GEAR WAS ATTACHED TO THE MAST ABOVE THE WHEELHOUSE. AN EXISTING GANTRY ON THE VESSEL CAUSED SOME OBSTRUCTION TO THE CHUTE.

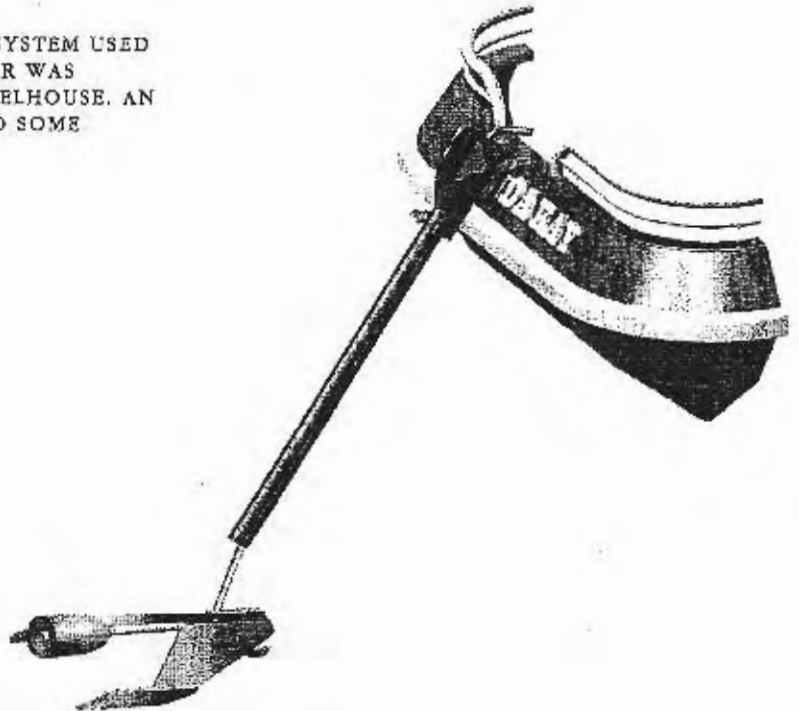


FIGURE 8. CHUTE IN USE ON F.V. *BRENDA KAY*. THE HANDRAIL HAD TO BE RECESSED TO ALLOW FOR IT.



then attached to the wire strop at the third attachment point from the front. The strop attachment to the chute was checked and the shackle tightened if necessary.

The single block was attached to the lug at the feed trough and the chute was hoisted above the deck to about a thirty degree angle. The paravane was then deployed over the stern of the vessel and allowed to trail just below the sea surface in the vessel's wake; at this point the vessel was idling into or with the weather.

One person controlled the descent of the chute with the down haul length of rope from the "Handy Billy" block assembly. Up to three persons would assist by pushing from various positions along the chute length. It was difficult to get the chute moving through the pivot arm, as the steel seemed to bite and grip with friction, due to the paravane's downward pull on the chute.

The position of the stern gantry and the height that the chute was mounted at the stern meant that to haul the chute above the gantry would scrape the bottom of the chute over the gantry surface. It was decided to go under the gantry, which meant that the chute's angle of entry was less than 45 degrees. This made it even more difficult to deploy and retrieve because the paravane was trying to keep the chute at a 45 degree angle.

Once the chute was fully deployed and the pivot arm guide bar had positioned itself between the two brackets welded to the base of the chute feed trough, the locking pin was inserted through all three and secured with a small clip. The chute was now completely secured to the pivot arm and the retaining collar of the pivot arm could be unpinned and folded out of the way. While the pivot arm retaining the collar was in place, it was impossible to apply baited snoods through the chute, as the collar obstructed the snood groove.

### **Fishing procedure using the chute**

Because the first few snoods in the bin were often tangled, it was decided to set the first two or three baskets by throwing the baited snoods out on the port quarter, as would normally be done. This also allowed the crew to get into a routine. The skipper would then fine-tune the vessel's course to see that the chute was running at the correct angle and was towing well. Once these first baskets had been set, the crew started placing the baited snoods into the feed trough and allowing snoods to be set through the chute. This would continue until the completion of the set or until the skipper determined otherwise.

The total number of hooks trialed through the chute was calculated by counting the total number of hooks in the snood bins, and subtracting ten plastic lures (always thrown clear), total numbers of floats set, and total number of baited snoods not deployed through the chute. On occasion, due to problems with the snood tangling on the chute, only a portion of the total available snoods were set through it. An estimation was made of the total snoods remaining and back-calculated for a total set.

### Trial location and timing

There were two one day shake-down sea trials with the F.V. *Brenda Kay's* skipper, crew and chute developer, Paul Barnes, on board. The developer was present to install the chute, fine-tune paravane settings, and answer any questions or concerns the skipper or crew might have. These trials took place on 26 November 1997 and 4 December 1997 and four to five nautical miles seaward of the port of Tauranga. On the second shake-down trial, baited snoods were trialed through the chute.

Commercial fishing trials took place around an area called the Colville Ridge, 100 miles north-east of the port of Tauranga, where the F.V. *Brenda Kay* was based. It was envisaged that two trips of up to five days' fishing would be required to complete the trial requirements of 4000 hooks (through the chute). However, the fishing was considerably better than expected and the longest trip was only three fishing days due to the number of tuna landed and the relatively small hold. The three trial trips took place on: Trip One: 27 November to 1 December 1997; Trip Two: 6-9 December 1997; Trip Three: 11-14 December 1997.

The weather and sea conditions encountered during the two shake-down trials are summarised in Table 4. Both of these trials occurred during daylight hours.

During the trials, setting was conducted at night between 2040 and 0523 hours—in accordance with accepted fishing practices developed to minimise sea bird capture. Table 5 summarises weather and sea information recorded during the commercial fishing sea trials. Weather conditions during the trial sets were more settled than would have been preferred, with only one of the five trial sets undertaken in wind and sea conditions of over 25 knots.

TABLE 4. WEATHER AND SEA CONDITIONS DURING SHAKE-DOWN TRIALS OF THE CHUTE.

DATE	WIND DIRECTION	WIND SPEED (kt)	SWELL DIRECTION	SWELL HEIGHT (m)	CLOUD COVER (%)
26.11.97	SW	25	SW	0.5	90
04.12.97	SW	15	NE	0.5	100

TABLE 5. WEATHER AND SEA CONDITIONS DURING COMMERCIAL FISHING SEA TRIALS OF CHUTE ON F.V. *BRENDA KAY*.

START DATE	TRIAL SET NO.	WIND DIRECTION	WIND SPEED (KT)	SWELL DIRECTION	SWELL HEIGHT (M)
28.11.97	1	NW	15	NW	0.75
07.12.97	2	SW	18	SW	1.5
07.12.97	3	NE	10	SW	0.75
13.12.97	4	ESE	25	ESE	2.5
13.12.97	5	NE	10	NE, SE	1.0-0.5

## Performance of the chute

### Entanglements

Hook entanglements on the chute occurred during four of the five trial sets. Table 6 shows the number of entanglements recorded and, if known, how the entanglement occurred.

TABLE 6. NUMBER AND CAUSES OF ENTANGLEMENT.

TRIAL SET NUMBER	TOTAL SNOODS THROUGH CHUTE	NUMBER OF ENTANGLEMENTS	REASONS FOR ENTANGLEMENTS AND POSITIONS OF ENTANGLEMENTS ON THE CHUTE
1	0	2	Incorrect tail float fitted to paravane making the paravane run at a shallow setting. Two float lines tangled.
2	683	3	1. Snood tangled on paravane wire 2. 360 degrees snood wrap round chute tube 3. Hook-up on exit cowling
3	817	2	1. Unknown 2. Hook-up on exit cowling
4	648	7	1. Float line entanglement 2. Snood hook-up - unknown, cut away 3. Snood hook-up - unknown, cut away 4. 360 degrees snood wrap around chute tube 5. Snood hook-up - unknown, cut away 6. Snood hook-up - unknown, cleared itself. Snood cleared itself 7. Snood hook-up - unknown, cut away.
5	876	0	No hook-ups during this set

In order to confirm where a snood was caught, the chute was retrieved back on board the vessel with the snood still attached to the mainline and the hook still connected to the chute at the fouling point. Because of the time involved and the number of crew required (at least two) it was deemed easier to haul the mainline back to the vessel until the offending snood could be reached. On a number of occasions, particularly with rougher sea conditions, hauling the mainline back removed the pressure from the hook, and the hook came free. On the two occasions when hooks were observed in the entangled position, calm conditions would have contributed to the hooks remaining connected to the chute throughout the chute retrieval operation. The setting operation resumed once the hook was freed and the vessel was up to speed.

### Chute

On the first fishing trip while retrieving the chute, a weld three metres from the feed trough joining two lengths of chute tube together parted. The two lengths continued to be held by the angle-steel backing. The cracked weld prevented any further trials on this first trip. On arrival back at the port of Tauranga, arrangements were made through Moana Pacific's workshop to repair the weld. Alterations were also made to the retaining collar and the pivot arm and base of the feed trough to make alignment a simple operation.

Once these alterations were made, no further problems were experienced with the chute's durability. On the return to the port of Tauranga after completion of



trial trip number two, cosmetic alterations were required to the exit cowling and snood groove at the base of the chute tube, where observed hook-ups were taking place.

On the third fishing trip, during set six, under heavy weather conditions, the vessel was required to reverse back on the set gear five times, responding to individual hook-ups on the chute. During one of these reversals the extension bar of the vertical hinging was bent down about fifteen degrees at the point where the pivot arm's horizontal hinging attached to the extension plate. This in no way damaged the chute or affected its performance during the final set.

On completion of trial trip three and the return to Tauranga, the entire chute was removed from the vessel, including the base plate. No structural damage was noticed around the four bolt holes linking the chute to the vessel, or any surrounding steel work on board.

The chute angle, when fully deployed, was consistently recorded at forty-five degrees to the stern of the vessel, using a plastic angle measuring device taking the form of a protractor with a central measuring arm.

### *Trough*

Sufficient water flow from the vessel's deck hose through the connection at the back of the feed trough was required to deliver baited snoods to sea level. The water flow was directed towards the point where the chute tube joined the neck of the feed trough. However, there was not enough water flushing around the sides of the trough, and baits stuck to the trough base. This was compounded by an additional difficulty of the chute being placed too far to port, requiring the crew person baiting to twist their torso from snood bin and bait to the chute trough. The distance between snood bin and the chute encouraged the crew to lightly toss baited snoods at the chute feed trough rather than placing them in it, allowing the possibility of baits missing the feed trough altogether. While no baits were observed missing the feed trough, this situation cannot be ruled out as a possible cause of entanglement.

### *Paravane*

Only one type of paravane, the Flexiwing, was used during these trial sets. No damage was sustained by the paravane during these trials.

No difference was observed to the effectiveness of the paravane during differing weather conditions. During set six, when the most extreme weather conditions were encountered and the most snood hook-ups recorded, it is possible that the considerable movement of the vessel, both vertical and horizontal, through the sea-way affected the chute and snood interaction and the paravane performance.

During the trials, when the chute was fully extended in the deployed situation, it was noticeable that it had a 10 to 15 degree offset angle to starboard. This was also observed with the chute trialed on the F.V. *Daniel Solander*, and was presumed to have been created by the propeller wash. The skipper of the F.V. *Brenda Kay* was uncertain which way his vessel's propeller turned, as it was difficult to tell from observing the propeller wash. However, as the direction of the offset angle was the same as for the previous F.V. *Daniel Solander* trials, it is assumed that the F.V. *Brenda Kay*'s propeller had a clockwise rotation.

## **Performance of the deployment and retrieval system**

The F.V. *Brenda Kay* was an ideal vessel for these trials, with a large uncluttered stern-deck, an uncluttered mast area with good height, and a hull of steel construction allowing for easy, clean attachment of the chute. There was also an ideal area above the deck to stow the chute when not in use. However, a number of difficulties were experienced during the trial sets.

1. An old, poorly maintained double-block was secured to the mast with a large shackle and then lashed into position pointing aft. A single-block (new) was laced to the double-block with 8 mm polypropylene rope to complete the "billy tackle". Had the double-block been in good working order, this block and tackle would have aided the speed and ease of the chute retrieval and deployment operation.
2. Another problem resulted from the force of the paravane pulling the chute down during deployment and retrieval. The problem arose when the chute feed-trough passed under the stern gantry. With the paravane forcing the chute to a 45 degree angle, the feed-trough had to be pulled down by one of the crew for the chute to clear the overhead gantry as it passed beneath it. During calm sea conditions this was not a problem, but when the vessel was influenced by any sea, the chute became difficult to control, even though it was contained by the pivot arm and collar. Retrieving or deploying the chute above the gantry would have been dangerous in anything but calm seas.
3. After repeated settings, it appeared that there was an increase in friction between the steel of the pivot arm and the angle steel of the chute backing. This increase in friction was possibly due to rust build-up or loss of paint, and was worsened by the loading caused by the paravane. This resulted in the chute "sticking" to the pivot arm during deployment and retrieval.

## **Performance of bait types used**

### ***Squid***

Squid are an ideal bait for the chute as they are incredibly flexible, moulding themselves to any shape without being damaged or affecting the hook placement. Squid baits have the added ability, should they jam at the neck of the trough, to block the water flow, allowing build-up to a volume where the water then forces the bait through the neck of the trough. Owing to the size of the squid, they seemed to stay within the chute until being expelled at the exit point and would not readily clear the chute prematurely through the snood groove.

### ***Sanmar***

Sanmar are an imported, elongated bait fish resembling a garfish. Because of their long and slender shape, difficulties were experienced in getting the baits to move through the feed trough. If the baits were placed either side of the main water flow they had a tendency to remain where they landed because of insufficient water flow. Sanmar were hooked between the eyes and would land with the tail facing towards the neck of the trough. Because of their elongated shape and relative firmness, water would not build up behind them, requiring the person baiting to jerk the snood to reposition the fish into the trough's

water flow. If the sanmar landed directly into the main water flow through the trough, the sharp angle of the trough neck narrowing to meet the same diameter as the chute tube would cause these fish to often jam across the narrow neck, again requiring the snood to be jerked to realign the bait with the water flow. On occasions, three or four attempts would be required to align a bait.

## Discussion

### *Entanglements*

From observations of the trial sets, a number of reasons for the baited snood entanglements came to light:

1. It was assumed that a minimum snood length of ten metres would be trialed. However, snood lengths of approximately six metres and possibly less were present in the snood bins. Snoods are continually cut back because of shark damage or general wear and tear. The shorter snoods created tension on the hook while the hook was still in the chute tube, dragging the eye and shank out through the snood groove, the point, barb and kerb of the hook remaining inside the chute groove. The hook then dragged down the groove edge because of tension in the snood from the pull of the mainline and the vessel's forward momentum, with the hook then jamming on the flaring of the exit cowling at the base of the device.
2. Sanmar baits, being long and thin, were able to wash out of the snood groove if tension came on to the snood before the baited hook had cleared the exit point. If this occurred near the surface, there was a possibility that the forward wash of the vessel's wake could wash the baited hook around the chute tube in a 360 degree turn. This bight of snood could then slide down the chute tube to the flaring and hook up or slide further on to the paravane wire and hook up there. A similar snag would occur if there was too much water from the deck hose travelling down the chute and washing the sanmar baits out of the snood groove.
3. A loop of snood nylon may occur through the snood groove above the point where the chute entered the water. As it is dragged under the water surface this loop is pinned to the underside of the chute tube by water pressure, slides the length of the chute tube and hooks up on the exit cowling or on the paravane wire.
4. During trial set four, with winds of 25 knots or more and an estimated swell of 2.5 metres, five snood hook-ups were recorded. All of these hook-up points in or on the chute were unobserved and can only be guessed at. It is possible that the increased movement of both vessel and the chute, because of the size of the swell, were involved in these additional hook-ups.
5. A factor that influenced the results from these trials was the relative inexperience of the crew. It was their first season with the surface longline fishery. In contrast, trip number three had an experienced crew member who did a relief trip. This person's understanding of timing, baited snood placement and all-round knowledge of the setting operation, had a direct effect on the lack of entanglements and successful outcome of the final set.

### ***Safety issues***

The use of the chute, including deployment and retrieval, its use while deployed, and the need for it to be securely stowed on board on completion of each trial set uncovered a number of safety-related issues:

1. During these trials, retrieval and deployment required three people; one controlling the rope through the blocks and two pushing and straining on the chute tube to move it through the pivot arm and collar. This should be a one-person operation, as other tasks required the crew's attention at this time.
2. For installation of the device on the F.V. *Brenda Kay*, the stern railing had to be removed. It was considered important that adequate railing "surround" the work area at the stern and that minimum amounts of railing be removed.
3. Concern was expressed that, with the chute in the deployed position and with five metres of chute tube and attached paravane trailing in the vessel's wake, the chute would interfere with the rudder or propeller should the skipper want to reverse or stop suddenly. During the trial setting operations, it was necessary for the vessel to be stopped quickly due to snood entanglements on the chute. With reverse momentum, the vessel was pushed back along its own wake, therefore pushing the chute against the vessel's stern. No problems were in fact encountered at these times, although the possibility of damage to the rudder or propeller was constantly considered.
5. There were few hand holds on the wheelhouse roof, and while the chute was being hauled on to the roof with the block and tackle, it could swing from side to side across the deck. This operation was potentially dangerous.

### **Recommendations**

#### ***1. Entanglements***

It is imperative that baited snoods should not miss the feed trough when placed into it. Should this occur, it is possible for the baited snood, on falling into the vessel's wake, to tangle at some point on the chute. The feed trough could be redesigned with higher sides that would catch wayward baits and reposition them into the feed trough.

Shorter snoods result in tension between the snood clip on the mainline and the baited hook in the chute. The tension drags the hook shank out over one side of the snood groove, allowing a hook-up on the snood exit cowling.

Too much water through the feed trough and chute may expel baits where the trough water flow meets the sea surface water level in the chute. The water is forced out through the snood groove, forcing baits out with it. The narrowing of the snood groove would prevent baits being flushed out prematurely.

There needs to be good co-ordination between the person clipping snoods on to the mainline and the person deploying baited snoods through the chute. This prevents strain being applied on the baited snoods in the chute, which has been identified as a cause of entanglement. Floats also need to be deployed in a controlled way to prevent float lines snagging on the device.

## **2. Positioning of the chute**

The chute should be positioned on the stern so that the crew person does not need to stretch or twist their body in order to place baited snoods into the feed trough from their baiting position.

## **3. Water flow through the feed trough**

A consistent, evenly spread water flow must cover the entire base of the feed trough. This would prevent the baits sticking to the base or jamming in the neck of the trough.

## **4. Paravane performance**

With the exception of one trial set in rough sea conditions, only calm sea trials have taken place. The effects of high sea conditions on the paravane's action and the relationship between the paravane and increased hook-ups at the base of the chute under high sea conditions are still not known. The increased vessel movement by large swells may adversely affect the paravane's performance in some way.

## **5. Deployment and retrieval of the chute**

The use of appropriate blocks is necessary to control speed and the ease with which the chute can be controlled through deployment or retrieval. Some form of frictionless pads or rollers positioned on the pivot arm, allowing free movement of the chute backing through the pivot arm and collar, would assist in deployment and retrieval of the chute.

## **6. Varying vessel configurations**

Chute storage, deployment and retrieval systems, and position of deployed chute will need to be tailored to particular vessels because of the existence of aft wheelhouses, canopies, stays, masts, rigging, and additional fishing equipment on different vessels.

### **3.3 TRIAL NO. 3 - F.V. *ATU S***

*by D O'Toole*

The objective of trial number 3 was to set a minimum of 4000 hooks through the modified chute under the normal fishing conditions on a commercial fishing vessel, and evaluate its seaworthiness and ease of use. The trial was undertaken on the domestic longline fishing vessel F.V. *Atu S*, owned by Moana Pacific Ltd.

#### **Vessel specifications**

The F.V. *Atu S* specifications are provided in Table 7, together with a summary of its fishing gear.



TABLE 7. VESSEL SPECIFICATIONS FOR FISHING VESSEL F.V. *ATU 5*.

LENGTH	BEAM	DRAFT	GROSS WEIGHT
32 metres	6.4 metres	4 metres	181 tonnes
<i>Summary of fishing gear</i>			
Mainline	3.5 mm nylon with 450 kg breaking strain - Brand "Tollon"; 74 km of line on board and about 65-70 km used per line.		
Snoods	2.02 mm nylon with 215 kg breaking strain - Brand "Shogun" (Japanese type), each 14.4m long.		
Hooks	Three types: 17/0 Eagle claw, Japanese 3.6, and Mustad 16/0 DR Tuna Circle hooks. An armour spring and crimp used to attach each hook to its snood.		
Clips	2.6 mm x 100 mm with a 6/0 barrel swivel.		
Floats	25 kg buoyancy, 360 mm in diameter. Float line = 14.4 m of 5 mm rope.		
Line shooter	LS4 monofilament line setter (Lindgren-Pittman). Usually sets at 10.5 knots or 325 rpm (main wheel 1m circumference).		
Light sticks	100 mm Big light.		
Setting details	Speed of vessel normally 8.5 knots. Normally 1320 hooks per line; one snood every eight seconds, 12 per basket with 1.5 empty baskets by beacons; 3 beacons per set.		

### Description of the chute

A number of new design features were incorporated into the chute constructed for the F.V. *Atu 5* to overcome problems experienced on earlier trials. The changes are described below. The chute was attached to the stern at the centreline (Figure 9).

#### *Chute*

The main section of the chute was 9.5 m long, and tapered along its length. The slot width was milled to two different widths along the length of the chute: 11 mm above the water line and 20 mm below the water line. The decreased width above water level was to help constrain the water flow and trace within the device above sea level. A 3.5 metre length of RHS, a 12 mm x 50 mm M/S flat bar and two 12 mm rounds were welded on the lower side of the chute (Figure 10) to aid deployment and retrieval of the device through the new roller carriage section (see description below) and to increase the strength of the chute.

Two horizontally opposed and partially overlapping brushes were added to the top section of the chute (Figure 11) to retain the snood inside the chute until the force from the mainline pulling the other end of the snood released it from the chute.

A conical trough was used. This had a piece of pipe around the top edge to carry the water to a series of holes placed at 50 mm intervals around the inside perimeter (Figure 11). This was designed to ensure an even water flow inside the trough to help align the bait for entry into the neck of the chute. Unlike earlier designs, this trough was detachable from the chute. A slight curve on the mainline side of the trough was to prevent the traces becoming snagged on any corners.

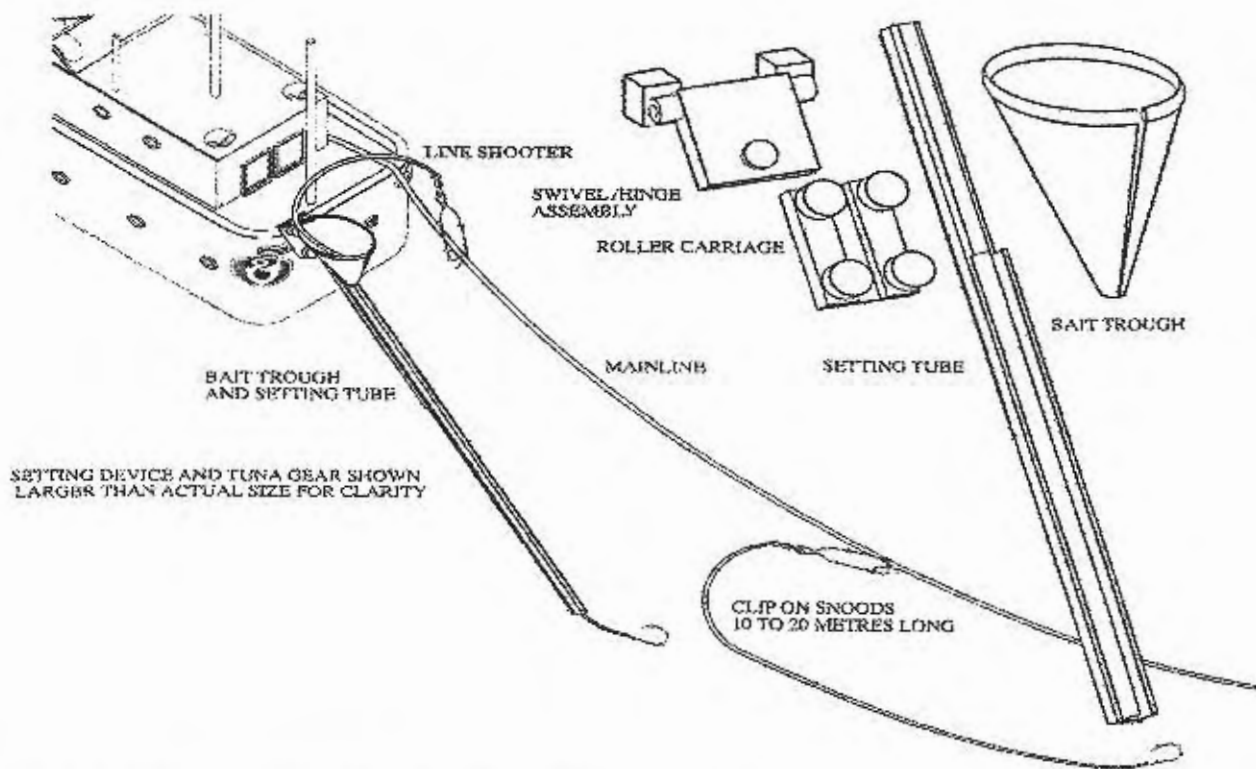


FIGURE 9. UNDERWATER SETTING CHUTE IN USE ON F.V. ATU S.

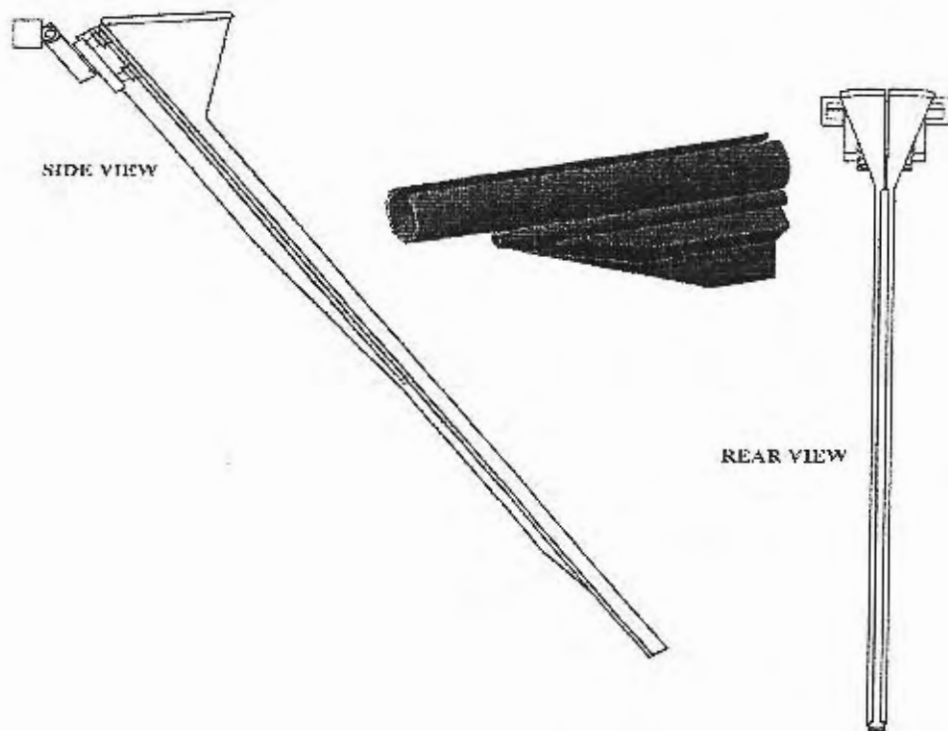


FIGURE 10. VIEWS OF THE CHUTE.

### ***Deployment and retrieval system***

A roller carriage system which significantly improved the ease with which the chute could be retrieved and deployed was developed (Figure 12). The nylon rollers constrained the chute during recovery and deployment without the jamming that occurred with the previous slide system or any need of a locking arm.

On the first trial on the F.V. *Atu S* the chute was fitted in the centre of the stern gunwale. Recovery and deployment were achieved by fitting a pulley system to the top of the stern mast with a locating bracket mounted further down the mast (Figure 14).

### ***Strop attachment***

Because of problems with the paravanes, an alternative system for maintaining the chute at the required angle in the water was devised. This involved a chain and shock absorber system joining the tube to the transom of the fishing vessel (Figure 13). The length of chain dictated the angle of the chute and consequently the setting depth.

### **Results**

On 17 February 1989, while F.V. *Atu S* was steaming to the fishing grounds, the chute was deployed. Deployment was simple and took less than five minutes. The chute was set at an angle of forty degrees from vertical, the angle being measured using a suspended vertical spirit level and adjustable protractor. It performed well during the two hours of steaming at approximately ten knots.

The chute was then deployed and used during a normal setting procedure. After 13 minutes of setting, the mainline carried across the transom to the chute and become tangled around the shackles connecting them. The skipper removed the chute and continued shooting in the normal manner. Details of the trial conditions are provided in Table 8.

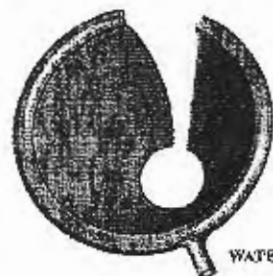
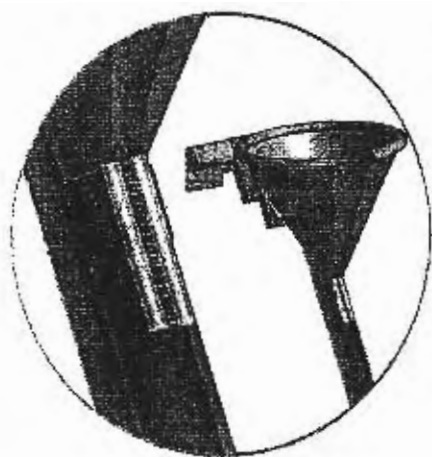
### **Discussion**

During setting, the mainline is ejected from the stern, via a line shooter, at a faster rate than the vessel is steaming. This allows a greater sag in each basket. As a result of this there is an excess of mainline floating in the water just behind the stern during setting. When combined with the propeller wash, wind and swell, it is an easy matter for the line to become tangled around the strop connector.

TABLE 8. DETAILS OF TRIAL OF CHUTE ON F.V. *ATU S*.

Date	Start time	Finish time	Start position	Finish position	Wind speed	Wind direction	Swell height	No. of hooks	Vessel speed	Line speed
17/2/98	1950	2320	35° 17' S 172° 14' E	35° 24' S 172° 26' E	15 kt	N	2.5 m	840	8.5 kt	12.5 kt

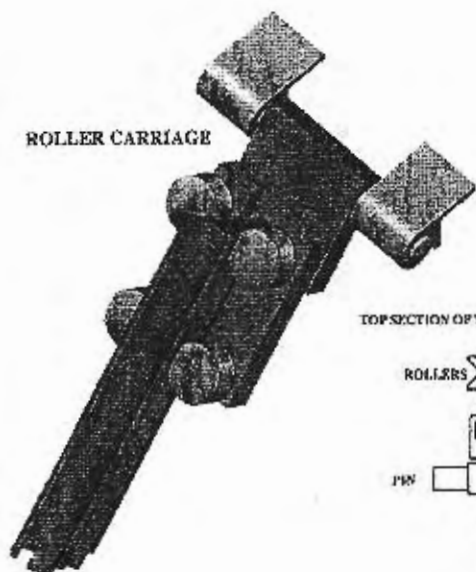




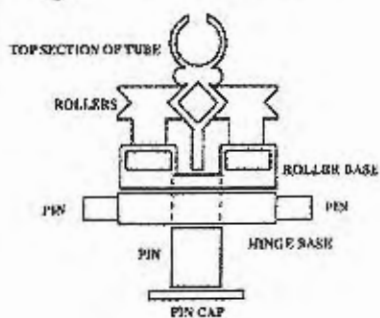
WATER INLET

FIGURE 11. (LEFT) VIEW OF BRUSHES AT TOP OF CHUTE AND (RIGHT) DETAIL OF TROUGH.

ROLLER CARRIAGE



HINGE CROSS-SECTION



TOP SECTION OF TUBE

ROLLERS

ROLLER BASE

PIN

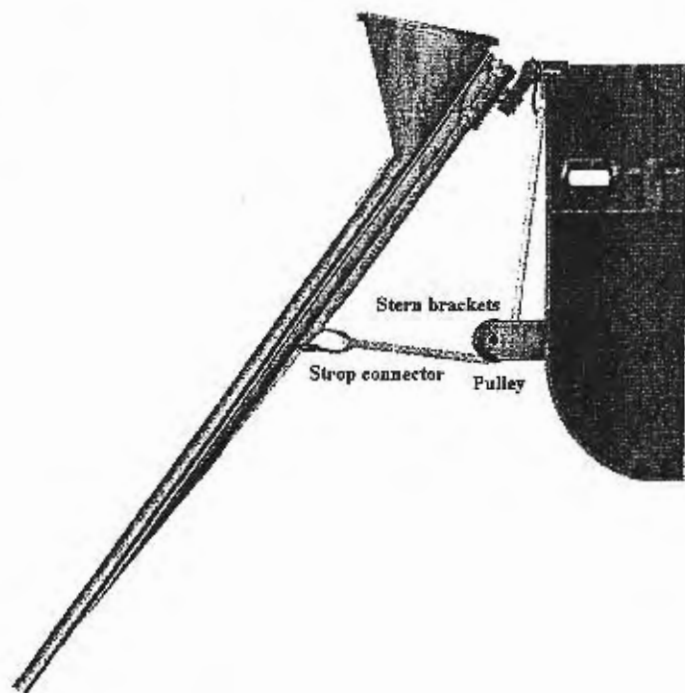
PIN

PIN

HINGE BASE

PIN CAP

FIGURE 12. DETAIL OF ROLLER CARRIAGE SYSTEM FOR DEPLOYING AND RETRIEVING THE CHUTE.



Stern brackets

Strop connector

Pulley

FIGURE 13. STROP ATTACHMENT USED TO CONTROL THE ANGLE OF THE CHUTE.

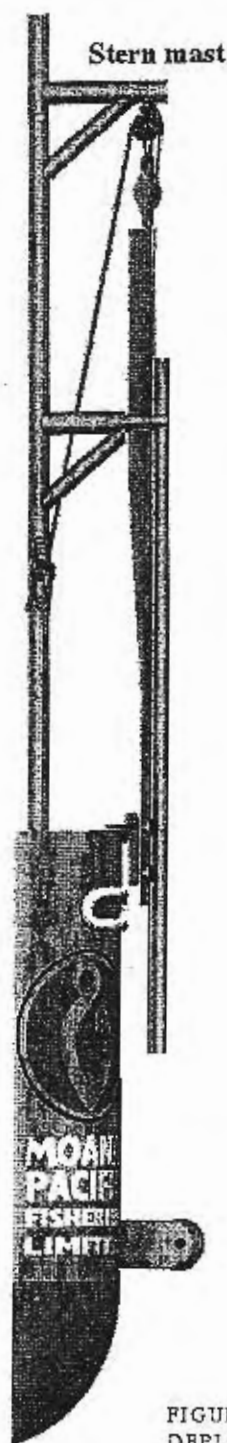


FIGURE 14. FIRST DEPLOYMENT AND RETRIEVAL SYSTEM USED ON F.V. ATU S.

## Design modifications

The skipper on the F.V. *Atu S* suggested the following modification to the chute.

### 1. Attachments at and below the waterline.

Nothing should be in the water at all except the chute, especially if the chute is operating along the vessel's centreline. Any attachments at the base of the transom or on the chute beneath or near the waterline increase the chances of foul-ups.

### 2. Streamlining

With the current design, force on the chute is created by drag through the water. This is exacerbated by its proximity to the prop wash. A potential way to minimise this would be to increase the streamlining of the leading edge of the chute.

### 3. Chute backbone

The square metal support which makes up the leading edge may need to be strengthened.

### 4. Position

The chute would have much less chance of foul-ups if placed on the port side of the vessel. This also minimises the chances of bait loss through the force of the propeller wash. In normal setting circumstances, baits are thrown off the port side. This is to minimise both foul-ups and bait loss. The F.V. *Atu S* has a three-person setting team (minimum) which allows for setting the chute up on the port side.

## Conclusion

During the short period the chute operated, the device successfully deployed bait under the water. The device achieved its purpose and the design performed that function well. What remained to be done was implementation of a deployment method based around the port side and stronger simpler points of attachment. These points should not be construed as a major problem. The chute was very close to achieving its initial objective of a successful 4000 hook trial.

## 3.4 TRIAL NO. 4 - F.V. ATU S

by D. O'Toole

On the previous trial, shackles and chain that coupled the device to the boat tangled with the mainline. To overcome these problems, the connection point was moved 1.5 m up the chute, so that it was well clear of the waterline. A

rubber shock absorber system was incorporated into the connection to minimise direct and sudden impact on the device while maintaining it at an angle which enabled the bait delivery depth of 3 m to be met. This consisted of a size 4 Forsheda mooring compensator spliced on to 24 mm nylon rope. With these devices, one turn on the rope around the compensator gives 200 mm of stretch, two turns give 335 mm of stretch, and three turns (as shown in Figure 15) give 470 mm. Tension of 1100 ft lb was required to achieve full stretch with three turns.

### Methods

One double sheave and one single sheave block were used for recovery and deployment of a 9.5 m device (see Figure 16). The lifting jib was mounted on top of the stern cabins. It was positioned to be as in-line as possible with the streaming position of the setting tube. This allowed the chute to be drawn up to a point beyond the balance point of the tube on the roller carriage/hinge assembly. Once the tube had been drawn up past the section that located the chute in the rollers, it could be lifted clear of them. The quick-release clip attaching the shock connector to the chute was released during recovery and connected during deployment. The trough clipped on and off during these procedures.

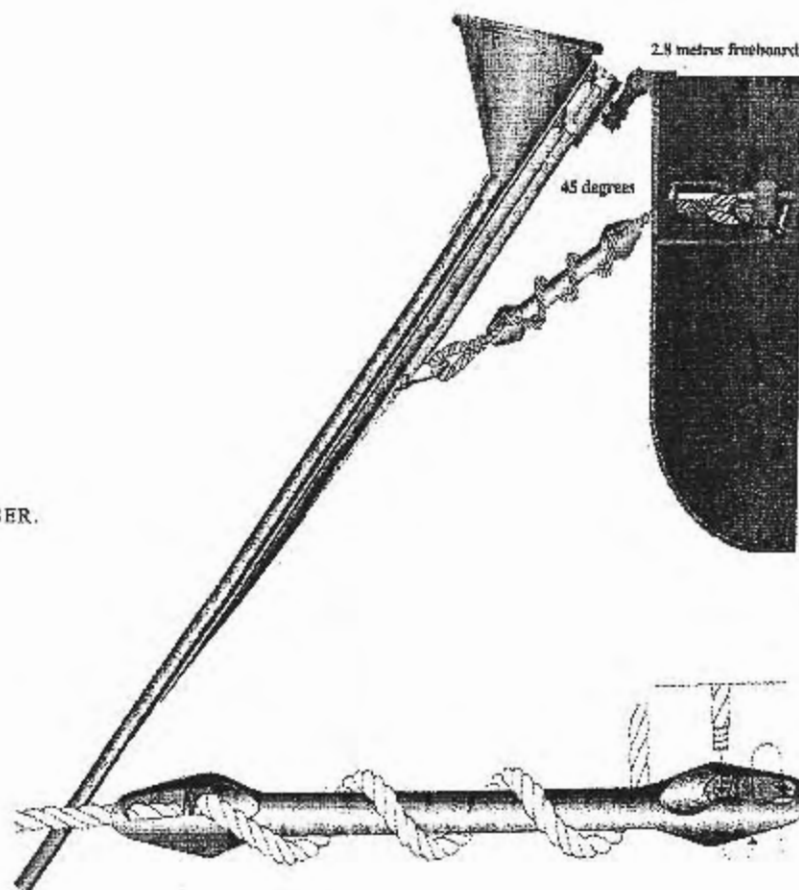


FIGURE 15. VIEW OF THE SHOCK ABSORBER.



FIGURE 16. SECOND METHOD OF DEPLOYMENT AND RECOVERY OF THE CHUTE TRIALED ON F.V. *ATU S.*

The chute was labelled along its length at 0.5 metre intervals, from 3 m above the end of the chute, where the bait exits, to 6 m along its length. From observing which of these labels was at the water line at any given moment, it was possible to determine how deep the chute was delivering the bait. For example, if the first label, at 3 m, was at the water line, it meant that a bait leaving the chute at that moment would be 1.4 m under the water. These depths and related labels on the chute are shown in Table 9.

TABLE 9. BAIT DELIVERY DEPTHS OF CHUTE RELATED TO LABELS ON IT.

Distance (m) from bottom of chute	Label on chute	Depth of bait delivery (m)
3	1	1.4
3.5	2	1.75
4	3	2.1
4.5	4	2.6
5	5	3.2
5.5	6	3.8
6	7	4.7

TABLE 10. LOCATION OF TRIALS, THIRD TRIP F.V. *ATU S*.

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
34° 25' S 174° 09' E	34° 14' S 174° 54' E	34° 26' S 175° 15' E	35° 08' S 175° 69' E	Not recorded

The chute's setting depth was monitored three times in each setting operation. This was done by noting the label closest to the water at five second intervals for a period of five minutes. This gave fifteen minutes of monitoring during each set to determine where the most common setting depth was.

### Results

The new system was tested five times, four times in an actual line setting operation and once while steaming. The trials were conducted off the north-east coast of New Zealand; their location is given in Table 10.

The conditions were mild for all four fishing sets, and the fifth trial during normal steaming. For all the shots the swell was never above 1 m and the wind always from 10 to 15 knots. The vessel speed was always between 8 and 9 knots.

The chute delivered 5270 baited hooks without entanglements during the four sets.

The elasticity of the Forsheda mooring compensator deteriorated over the four sets and this reduced the setting angle and depth of the chute. On the first set the bait exit point was consistently deeper than 3 metres, but by the fourth set the depth of the bait exit point had reduced to around 2 metres.

### Discussion

The chute met the requirements for number of hooks delivered without the entanglement problems of previous trials. One or two light sticks caused minor entanglements, but this was soon rectified by placing the light stick further up the branch line so that it did not come into contact with the chute. The operators of the chute found it simple to use.

However, the chute did not meet its requirement for setting hooks at a depth of 3 m. Initially the setting depth was mainly in excess of 3 m, but by the fifth set more than half of the hooks were being set at a depth less than 3 m. This is most probably due to a stretching of the rubber strop used to govern the setting depth, as it was noticed by the third day that the chute was riding higher in the water because of this. Given the mild conditions in which testing was performed, the crew of the vessel and the observer believed that under strong conditions the rubber would have snapped.

### Conclusion

A stronger and more reliable measure for governing the setting depth was required. The skipper suggested that a strong steel spring in place of the rubber would be more effective.

## Addendum

Since this trial a new method for controlling the setting depth on the chute has been developed and trialed. This system involves a caged spring which is strong enough to withstand the considerable pressures placed upon it by the chute, while still maintaining the required setting depth (Figure 17). Observations over a ten day period during setting confirmed a constant setting depth in excess of three metres.

The spring shock absorber is connected to the chute by a double hook that fits either side of the keel of the chute and over a 20 mm pin which is fitted permanently through the keel section (Figure 18). The weight of the spring and chain and the size of the RHS (square hollow steel tube) that the keel is welded to prevents the hook disengaging while the chute is deployed.

The double hook is designed to be able to pass completely through the roller carriage, and is connected and disconnected with a steel gaff while above it.

This hook can only be connected or disconnected when the chute is in the half deployed or half recovered position. All connection and disconnection operations are done safely without the operator having to lean over the side or the stern.

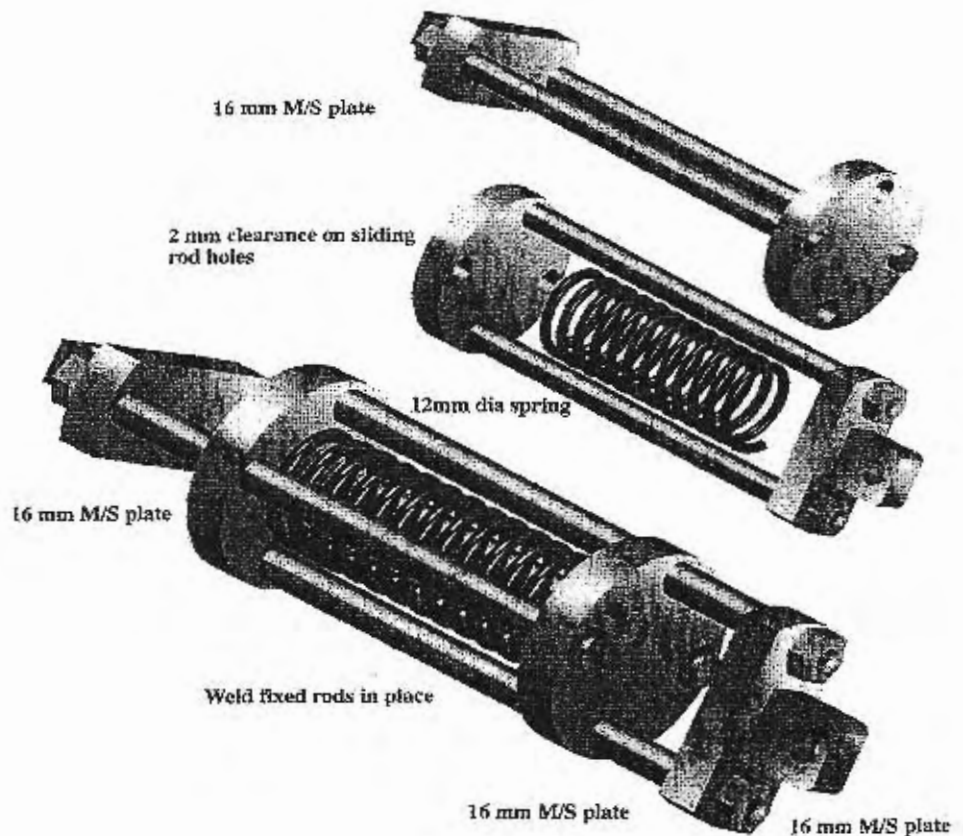


FIGURE 17. IMPROVED SHOCK ABSORBER USING A STEEL SPRING.



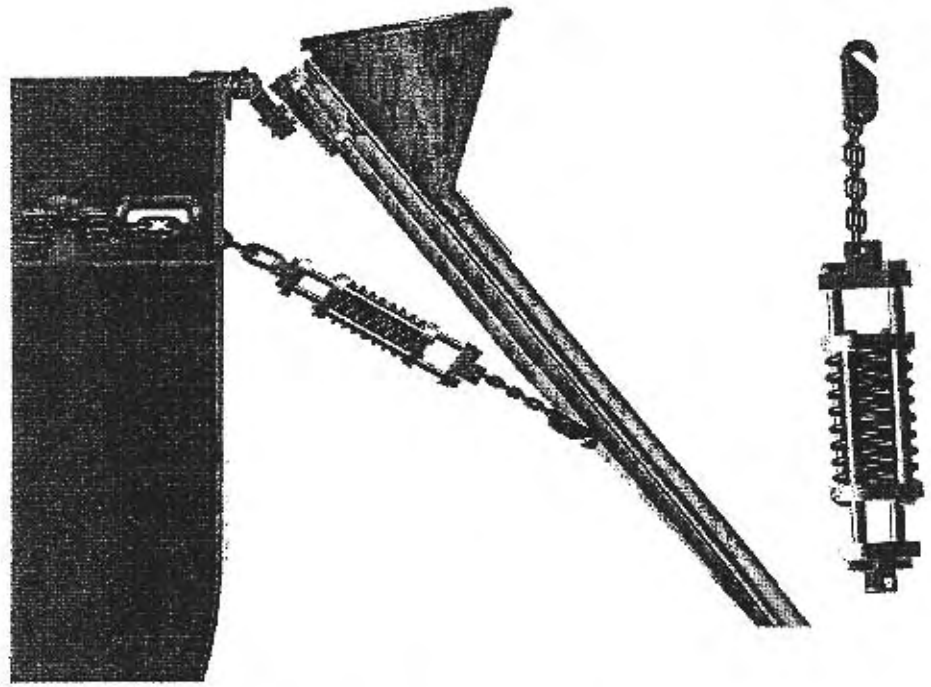


FIGURE 18. SPRING SHOCK ABSORBER CONNECTED TO THE CHUTE.

### 3.5 BAIT SETTING TIMES

*by K. Walshe*

An important operating standard for the chute is speed with which baits can be fed into it. New Zealand vessels set one baited hook between every 7 and 9 seconds. A number of timing experiments were carried out on the various models, and the results are summarised in Table 11.

TABLE 11. RUN TIMES FOR VARIOUS TYPES OF BAIT AND VARIOUS TUBE LENGTHS.

LENGTH OF TUBE	VESSEL SPEED (KNOTS)	BAIT	NUMBER OF TRIALS	MEAN (SD) OF RUN TIMES (SECONDS)
6	6.5-7.5	sanmar (50 g)	23	4.49 (0.57)
6	6.5-7.5	squid (20-30 count)	54	3.93 (0.53)
6	6.5-7.5	squid (40-60 count)	56	4.08 (0.44)
6	6.5-7.5	sanmar (50 g)	49	3.40 (0.27)
6	6.5-7.5	squid (20-30 count)	46	3.16 (0.39)
7	6.5-7.5	sanmar (50 g)	50	3.92 (0.97)
7	6.5-7.5	squid (20-30 count)	50	3.35 (0.42)
9	6.5-7.5	sanmar (50 g)	7	4.01 (0.28)
9	6.5-7.5	squid (20-30 count)	29	4.05 (0.67)

## 4. Conclusions from all commercial trials

### 4.1 CHUTE CONFIGURATIONS

The configurations on three commercial vessels reflected both the incremental design changes from the experience gained during the trial process and requirements of individual vessel layout, fishing practices and skipper/crew requirements. Although the basic design concept remained unchanged, each vessel had unique requirements. If the chute is used widely in the fishery it is likely that a range of options will be necessary to tailor it to each vessel's requirements.

#### **Setting tube**

The setting tube operated in a range of setting depths from three to seven metres. As the length of the tube increases, so do the weight and strengthening required. Figures 19 and 20 outline some of the modifications in tube design and material under consideration for the development of a 12 metre chute for a 50 metre tuna vessel. As the weight increases, other aspects of the chute (such as the carriage and deployment and retrieval system) will require strengthening as well.

On several trials problems occurred where the snood was pulled out of the setting tube before the baited hook had left the base of the tube. The use of brushes at the top of the tube has overcome this problem.

#### ***Cross-section***

To reduce the tension on the connection between the vessel and chute, it may be advantageous to streamline the underwater cross-section of the chute. A 12.5 m 180 mm D section steel device has been tested behind the DOC vessel M.V. *Hauturu*. Because of the low freeboard on this vessel, the setting depth was in excess of 7 m. Despite the additional drag on the chute due to the excessive length of the setting tube, a setting angle of about 45 degrees was achieved. This has led to concerns that the 180 mm configuration may be too heavy.

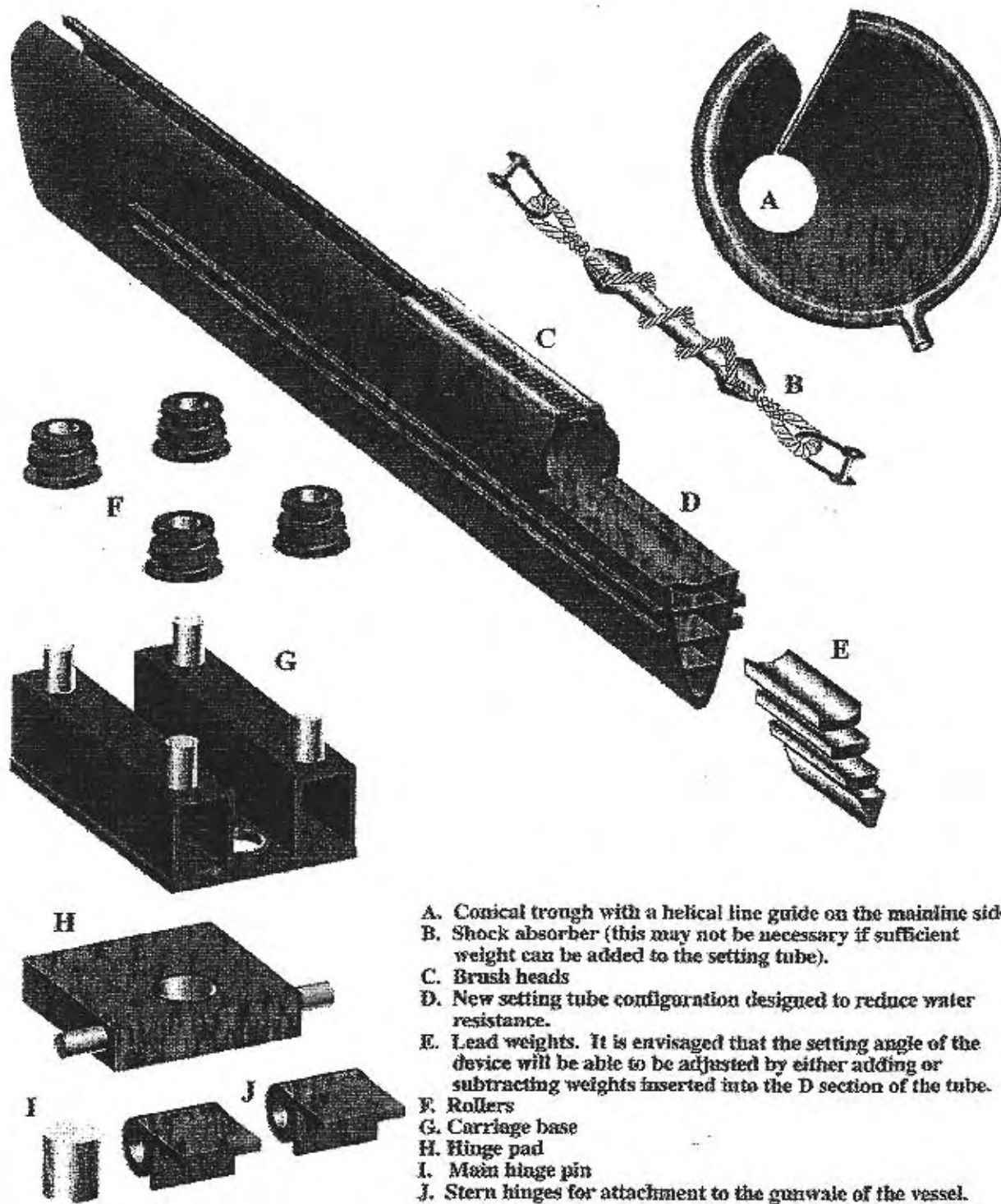
It is proposed that the section be trimmed back to 120 mm as in Figure 20 and re-tested on the same vessel.

It may be economically viable to extrude the device from aluminium (Figure 20). A stainless steel liner could be used to protect the inside of the setting tube from the points of the hooks, and lead weights could be used to adjust the setting angle.

#### ***Bait trough***

The major design requirement for the trough was to ensure adequate and even flushing of the water over the trough surface and the smooth passage of water to the mouth of the setting tube. The devices with multiple water outlets at the top of the trough provided adequate flushing.





- A. Conical trough with a helical line guide on the mainline side.
- B. Shock absorber (this may not be necessary if sufficient weight can be added to the setting tube).
- C. Brush heads
- D. New setting tube configuration designed to reduce water resistance.
- E. Lead weights. It is envisaged that the setting angle of the device will be able to be adjusted by either adding or subtracting weights inserted into the D section of the tube.
- F. Rollers
- G. Carriage base
- H. Hinge pad
- I. Main hinge pin
- J. Stern hinges for attachment to the gunwale of the vessel.

FIGURE 19. PROPOSED DESIGN OF A CHUTE, USING EXPERIENCE GAINED FROM SEA-GOING TRIALS.

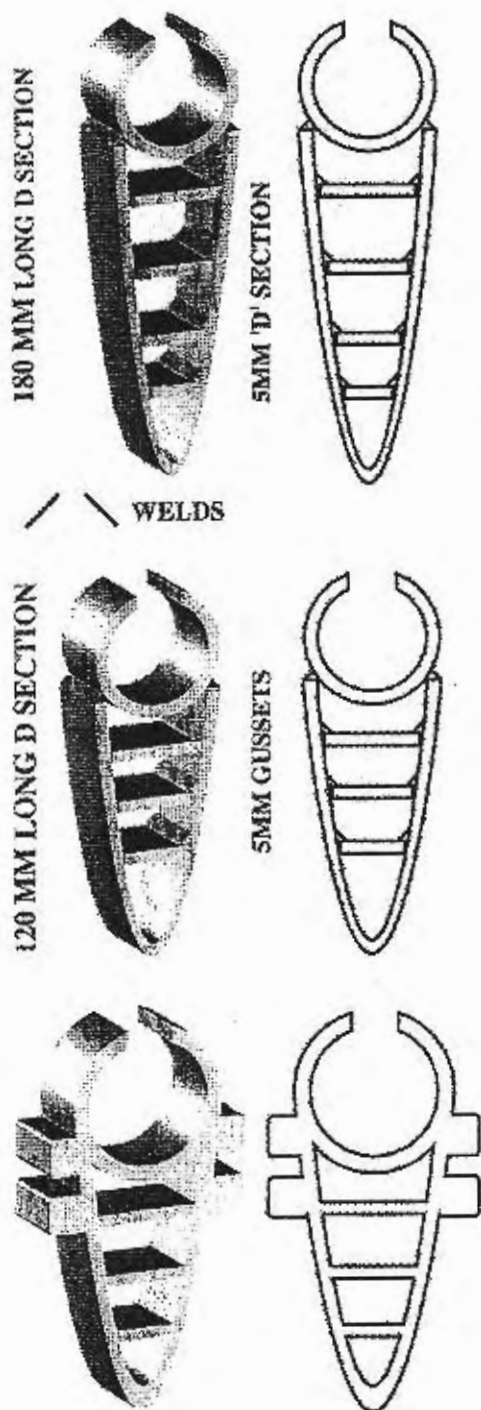


FIGURE 20. PROPOSED IMPROVED CROSS-SECTIONS TO THE CHUTE.

### Hinge assembly

The basic hinge assembly with the use of shock absorbers performed effectively in all trials.

### Carriage system

Problems occurred in moving the tube into and out of the setting position during the trials with both F.V. *Daniel Solander* and F.V. *Brenda Kay*. An improved roller carriage design used on the F.V. *Atu S* second trial has overcome this problem. For the larger 50 metre vessels a hydraulic lift may be necessary because of the increased length and weight of the chute.

### Setting angle devices

#### Paravanes

When paravanes were trialed in the open sea by tuna fishing vessels significant problems occurred. The commercial trials identified three drawbacks in using the paravanes.

1. The paravanes made setting the chute difficult in rough seas. Once the paravane was in the water it created a strong downward force, making retrieval of the device from the water a slow and arduous process. Setting tubes fitted with paravanes were also difficult to deploy and retrieve, particularly in adverse conditions.
2. Larger vessels with vastly greater propeller wash turbulence experienced problems with two of the paravane types, being unable to hold the minimum setting angle required. Although the Arrowhead paravane had the smallest surface area of any of those trialed, it was by far the most powerful and the only one that achieved a correct setting angle when trialed from the F.V. *Daniel Solander* in the Southern Ocean.
3. During the setting process, hooks and snoods were occasionally caught in the paravane, causing delays in the longline setting operation while the chute was retrieved and hooks/snoods removed. Potential causes considered for the problem ranged from operator error to a backwash phenomenon behind the vessel.

#### Shock absorbers

The shock absorber method of angle setting has successfully operated in rough seas over several trips on a 30 metre tuna vessel. The use of a Forsheda mooring compensator may be appropriate for smaller (10-15 metre) vessels, but larger vessels will require a spring shock absorber (see Figures 15 and 18).

#### Weighted tube

An alternative to the shock absorber method may be to add weight to the tube to set the angle of the setting tube. Weights could be added or subtracted to adjust for varying setting speeds and propeller wash conditions (see Figure 19E).

## **Recovery and deployment devices**

The optimal angle for deploying and retrieving the chute is the angle of set when the device is fishing (40 to 50 degrees). Because of vessel configurations, none of the trials was able to deploy and retrieve at this angle. The vertical deployment and recovery device (as used on the first F.V. *Atu S* trial) was the least effective method and potentially the most hazardous if the chute (when vertical) had broken loose from the mounting in a rough sea.

The need for up to five crew to deploy and retrieve the chute (as occurred on the F.V. *Daniel Solander* trial) can be overcome by the use of a modified carriage system (see Figure 19) and a hydraulic retrieval and deployment device. For vessels up to 30 metres in length, a simple block and tackle pulley system would be sufficient to deploy and retrieve the chute.

## **Safety issues**

The early commercial trials identified a number of safety issues related to the operation of the chute. Modifications made for the F.V. *Atu S* second trial ensured adequate safety of the crew during the deployment, retrieval and fishing stages. These modifications included removing the paravanes, reducing the friction of the setting tube on the carriage system, changes in the securing system for the device when not in use, and changing the deployment and recovery system so that crew did not have to lean out over the stern of the vessel.

## 5. Acknowledgements

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# Seabird/fisheries interactions

## Final report of advisory officer

CONSERVATION ADVISORY SCIENCE NOTES: 295 2000

*Keith, C.*

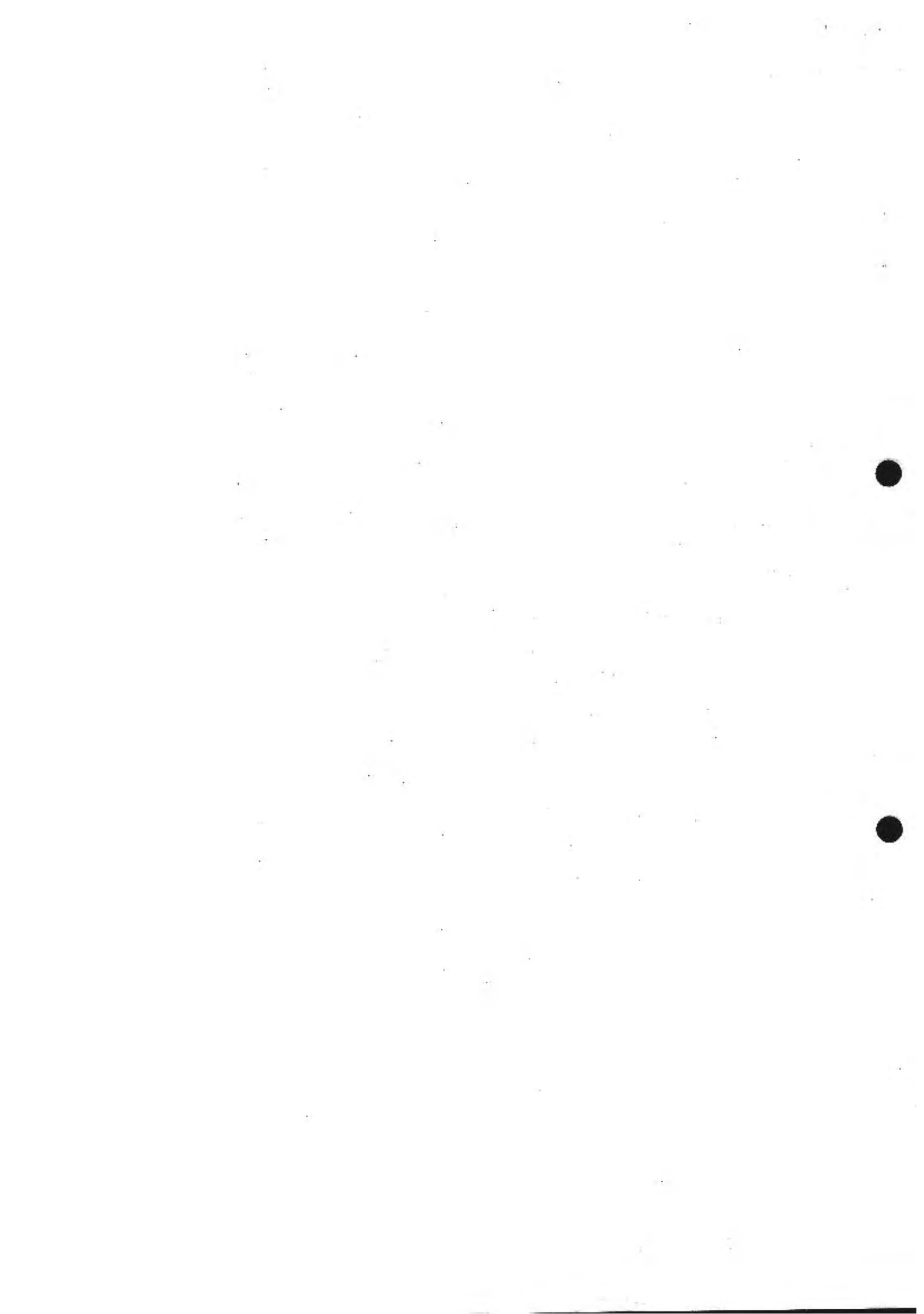
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# Seabird/fisheries interactions

## Final report of advisory officer

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Department of Conservation  
Wellington

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# Abstract

In November 1998 participants of a tuna longline stakeholders meeting recommended that a technical officer be appointed to the domestic tuna fleet in order to meet with fishermen and provide assistance, advice and information on how to minimise seabird bycatch in the pelagic longline industry. This position initially commenced in March 1999, and continued until September 1999. During the course of the project, 41 fishers were successfully contacted, and productive conversations held. Tori lines were constructed for those vessels that required them. Five sea trips were undertaken during which time seabird observations were made, tori lines were tested and modified, and TDRs were deployed to study the sink rate patterns of the longline. An informal information folder was created to provide fishers with a basic reference guide to seabird bycatch mitigation.

## 1. Introduction

### 1.1 BACKGROUND TO THE FISHERY

The history of pelagic longlining in New Zealand is a relatively short one. Japanese longliners have been fishing in the area that is now the New Zealand Exclusive Economic Zone (EEZ) since the 1950s (Duckworth 1995), but it has only been in the last 10 years that there has been a significant increase in the number of domestic vessels fishing using this method.

The domestic fleet is made up of predominantly small vessels varying between 12 and 25 m in length. There are some 60-70 vessels based in ports all over the country, but generally these vessels are concentrated in ports on the east coast of the North Island from Gisborne up to Mangonui, and on the west coast of Auckland.

The pelagic longlining operation in the New Zealand domestic fleet is based on setting a single line ranging from 15 to 40 nautical miles (nm) in length. Most vessels set one line every 24 hours, though some will set 2-3 smaller lines in the same time period. Most fishers in the New Zealand domestic fleet try to set their lines at night, with general setting times dictated largely by the rest of the fleet. Because lines can be set as close as 2 nm apart, fishers must set in unison to avoid gear crosses due to strong tide or current. As a result, vessels fishing as a part of the main fleet will generally commence setting within an hour of each other, and will set parallel to a set of marks provided by the other vessels in the area. (Marks are positions given in latitude and longitude to describe where a given vessel will begin and end the setting of their longline.)

Setting of the longline takes 3-6 hours, dependent on vessel speed, longline length and the number of hooks set. Hooks are baited with either imported

squid or a pilchard-like fish known by the fishers as Sanmar. Snoods may also have a luminous light-stick placed approximately 3m from the hook. (A snood is an 8-14 m length of 1.8-2.0 mm monofilament that is clipped to the backbone at one end and has the baited hook at the other.)

The longline is left to soak for 8-15 hours before it is hauled. Retrieval of the longline takes 5-10 hours dependent on the length of the line and the number of fish caught (the more fish there are the longer the line takes to haul due to the processing requirements of the fish).

The mainline, or backbone of the longline is made of a heavy gauge (3.0-4.0 mm) nylon monofilament. The backbone is suspended between plastic floats at intervals chosen by the vessel master. Between floats, 10-25 snoods are suspended from the backbone, according to preferred fishing depth. Depths targeted are generally between 40 and 200 m, dependent on target species.

Until recently the fishery was concentrated over the summer months, with a slow period over winter when many vessels switched to other fisheries, such as bottom longlining for bluenose or ling. However, as knowledge of tuna movement and behaviour through winter has improved, the fishery has become a year-round operation, with vessel masters and fishing companies becoming much more willing to move their vessels between ports and frequently travelling long distances in order to reach suitable fishing grounds. This has resulted in a fishery where water temperatures dictate a northward trend for the fleet over the winter months.

The domestic tuna fleet targets several species of tuna, but generally the target species will vary by season, water temperature, geographical area, and perceived market value.

The most commonly targeted species in the fishery are southern bluefin tuna, *Thunnus maccoyii*, and bigeye tuna, *Thunnus obesus*. During autumn and early winter months there is a concentration on southern bluefin tuna in more southerly latitudes, while bigeye tuna is caught year round, but moves north with the retreat of warmer water during winter. Lines set to catch one of these species of tuna will often catch the other species, and will often also catch yellowfin tuna, *Thunnus albacares*, northern bluefin tuna, *Thunnus thunnus*, and albacore tuna, *Thunnus alalunga*.

Other species commonly caught as bycatch include swordfish *Xiphias gladius*, moonfish *Lampris guttatus*, oilfish *Ruvettus pretiosus*, and rudderfish *Centralopbis niger*. Although swordfish are not directly targeted, as there is a prohibition on the targeting of swordfish by longliners, these fish can make up a substantial proportion of the catch.

## 1.2 SEABIRD/FISHERY INTERACTIONS IN THE DOMESTIC PELAGIC LONGLINE FLEET

Demersal and pelagic longline fisheries overlap with the foraging zones of a number of seabird species. Seabirds have learnt that fishing boats provide a consistent and predictable supply of food in the form of squid or fish used to

bait hooks, discarded offal from processed fish, used bait returned on the haul, and unwanted bycatch fish species.

The consistent supply of food means that fishing vessels are seldom without the company of seabirds during the fishing operation. Brothers (1991) reports an average of 10.8 albatrosses closely following Japanese longliners during setting off Tasmania, and Duckworth (1995) comments that there can be hundreds of smaller birds such as petrels and shearwaters following vessels in the New Zealand domestic fleet.

Seabirds can potentially become hooked or entangled in the longline during setting; the baited hook can be swallowed by the larger seabirds, such as albatrosses, while smaller seabirds tend to be caught by either becoming foul-hooked or entangled in the line.

While all seabirds are predominantly visual feeders, some species are better adapted to foraging behind fishing vessels than others. Larger seabirds such as albatross generally only conduct food searches from the air or at the surface, so only scraps or baits seen from above the water are likely to be taken, but many of the smaller seabirds search for scraps by swimming on the surface with heads dipped under the water. If a bait or scrap is located, then some of these seabirds are capable of diving very deep to retrieve them. Some smaller species of petrel, such as the sooty shearwater *Puffinus griseus*, have been recorded diving to a maximum depth of 67 metres while foraging for food, though more commonly these seabirds dive to maximum depths between 16 and 40 m (Weimerskirch & Sagar 1996).

Because they are much more proficient at retrieving baits than the larger albatrosses, smaller seabirds may bring the baits that would otherwise be unavailable to the larger species back to the surface. Often when the bait has been retrieved, the larger, more aggressive species, such as black-browed mollymawks and wandering albatross, will chase the smaller species away, and eat the scrap or bait themselves (Brothers 1991).

### 1.3 BACKGROUND TO THE TECHNICAL OFFICER POSITION

In a stakeholders meeting in November 1998 it was suggested that a technical officer be appointed to the domestic tuna fleet in order to meet with fishermen and provide assistance, advice and information on how to minimise seabird bycatch. It was agreed that the appointee would visit each port used by the northern tuna longline fleet and visit with the skippers on each vessel, providing advice on ways to improve the effectiveness of any seabird streamer (tori) lines in use. Where no tori line existed, the advisory officer would assist in the design and construction of one for that vessel.

The person would also discuss other ways to prevent seabirds from accessing baited hooks during the setting and hauling of the line, explain why the capture of seabirds was a concern, and provide the vessel with other information relevant to the fishery. Fishing trips would be undertaken on some vessels, if

required, in order to provide the best vessel-specific advice on seabird bycatch mitigation.

It was hoped that the position would also provide a means of collecting feedback and gaining information from vessel masters and other fishers by listening to their opinions and experience on how to prevent or reduce the problem of seabird bycatch.

#### 1.4 OBJECTIVES FOR PROJECT

The key objectives for the project were based around a liaison/education role within the tuna longline fleet. Key tasks for the project included:

- Meeting with the skippers of as many vessels in the North Island tuna longline fleet as possible.
- Providing vessel-specific advice on how best to address the problem of seabird bycatch.
- Explaining to the skippers why seabird conservation issues are of concern, from both a conservation and fisheries perspective.

Further to these key objectives were the aims of developing good working relationships with as many skippers in the fleet as possible and obtaining a high degree of knowledge of the tuna fishery in order to relate better to the fishers, and to provide the best possible advice.

## 2. Results

During the course of the contract, 41 vessels in ten ports were visited, and constructive conversations were had with the fishers on most of those vessels. Nine other vessels were approached on one or more occasion, but were unoccupied, unwilling, or unavailable to talk.

The majority of fishers were either approached at the vessel berth, met through other fishers or company representatives, or contacted the advisory officer directly themselves. Fishers were given a brief summary of what the project was about and what the project was trying to achieve. Although conversations were free-flowing and often covered a broad range of topics, a key range of questions was covered in any given meeting. These essentially covered the length of time the skipper had been longline fishing, whether or not the vessel held and employed a tori line during the normal fishing operation, and general fishing strategy (set times, haul times, regions most commonly fished). This information was used to gain a better understanding of the fishery as a whole. Other means of seabird bycatch mitigation that the skipper used or had previously used were recorded, as were any opinions or observations that the fishers had made on the behavioural patterns or species presence of



seabirds that were commonly encountered. A Vessel Questionnaire form was used to ensure a degree of consistency for the more salient topics that were covered.

In conversations, the development of the fishery itself was often discussed, as were fishers opinions on subjects such as the Conservation Services Levy (CSL) and the respective roles of the Department of Conservation and the Ministry of Fisheries in the tuna longline industry. Concerns raised by fishers on various issues related to these roles (departmental research priorities, quota and compliance issues, and the growth of the industry without appropriate control mechanisms) were discussed, and referred to more appropriate sources for information if it was required.

The advisory officer was also contacted several times regarding the identification of unusual species of fish that were caught and brought back to port. These were sent to the Museum of New Zealand for identification. On one occasion, the advisory officer was given a tag recovered from a blue shark, and asked to send it to the appropriate place on behalf of the vessel.

## 2.1 FISHER RESPONSE TO THE PROJECT

There has been a range of responses to the advisory officer project and position, though generally, and for the large majority of fishers, response to the project has been very positive. Fishers were often pleased to receive information on seabirds, and showed a great deal of interest in being able to learn more about the species that they encountered every day. Some described the behaviour of some species in great detail, and were genuinely concerned with the public and political perceptions that surrounded their industry. Many pointed to the historical and superstitious relationship between people in the maritime professions and albatrosses as a reason to be concerned with preventing seabird bycatch.

Many fishers conveyed that, although they considered that there was no "seabird problem", they appreciated the provision of a personal approach by the department in the form of an advisory officer. The idea of having a single, approachable and available person who has a working knowledge of the industry and the people involved was well received. Skippers often commented that it was good to be able to talk directly with a representative from the department, rather than receiving correspondence from an anonymous representative somewhere inside the department.

As an extension of this, it was felt that the position of advisory officer has provided fishers with someone whom they can approach to talk about their concerns. This is extremely important to many fishers, who can give their opinions as individuals without having to feel they represent the whole tuna longline fleet.

Fishers who had taken the advisory officer on sea-trips found the information gained from time-depth recorders (TDRs) extremely valuable, as it provided them with knowledge of the behaviour of the longline over the course of a

set. It also provided confirmation on depths fished by hooks in different positions of the longline, and how tide, weather, or gear configuration can affect the depths that the longline will fish. One fisher approached the advisory officer some months after the sea-trip and commented that since he was given the information provided by the TDRs, he had caught more southern bluefin tuna than ever before.

These fishers also greatly appreciated having someone from the Department of Conservation on board who could not only provide information on seabird-fishery interactions, but was knowledgeable about the fishery, and could also function as a part of a working crew. This meant that disruptions to the fishing operation were kept at a minimal level.

Fishers also commented that they appreciated having an advisory officer who was willing to go to sea on the small domestic vessels to observe and learn first-hand the level of seabird-fishery interaction. They also appreciated that the advisory officer was willing to listen to the fishers themselves rather than relying on very high (and possibly inaccurate or inapplicable for New Zealand) figures of seabird mortality used by some Non-Governmental Organisations (NGOs) and the media.

Those fishers who were opposed to the project largely objected because they believed that CSL money should be spent on projects that benefit them directly, and that the position of advisory officer provided them with no visible benefit. As an extension of this, a number of fishers objected to the levy as a whole on the basis that they believed that moneys gathered were being used to fund research in non-longline related issues, and that the levy was simply another method of "revenue gathering" for the government.

Some fishers stated that, although they felt that the advisory officer position was beneficial to the fishery and the relationship between the industry and the Department of Conservation, the likelihood of long-term change as a result of the project was not great. Reasons for this were largely based on the fact that the position of advisory officer was a temporary one, and that, once the project was finished, any impetus created by the person in the position would be lost. Any personal or professional relationship, or indeed, knowledge of the domestic tuna fleet, that is established over the course of a contract period between the advisory officer and tuna fishers would likewise be lost on completion of contract.

A small number of fishers felt that the advisory officer's position was only a token one, and that there would be little chance that, even if they gave them their suggestions, opinions or feedback to the department through the advisory officer would actually get through to anyone who "mattered". The end result would be that public and political perceptions of the fishers and the fishery as a whole would not be changed by the position.

## 2.2 PERCEPTION OF THE PROBLEM

By far the majority of fishers interviewed (98%) did not believe that they had a "seabird problem". When the number of birds caught in the past was asked

for or volunteered, most of the fishers said that they had caught 5 or fewer seabirds in the past year, most of which were "muttonbirds", and many of which were caught on the haul and subsequently released alive.

Fisher perceptions were largely based around the belief that the domestic tuna longliners did not have a seabird bycatch problem as is perceived by the public and that this perception is a result of media and departmental speculation.

### 2.3 SKIPPER OPINION ON FACTORS INFLUENCING SEABIRD CAPTURE

Fishers often offered their opinion on what the major causes of seabird capture were. These can mostly be grouped into generalised categories. These categories are listed by the number of times that each issue was expressed. Percentages indicate the number of mentions, unprompted, by fishers, but these figures may not necessarily accurately reflect the attitudes of all longline fishers. Those categories without percentages given were mentioned less often, but still frequently enough to be included here.

1. Most seabird bycatch problems are associated with setting lines during the day. Most fishers believed that, because they set their lines at night when there are fewer birds present, they had no problem with the bycatch of seabirds, though many did concede that there were more birds active at certain times of the month and in certain conditions. (92%)
2. Other domestic fisheries kill more seabirds than domestic tuna longliners, but are not levied to pay for any related research. Many tuna fishers had experience in other fisheries where they had encountered what they perceived as a much higher rate of seabird capture. Fisheries that were pointed out as having high seabird capture rates (in order of mention) were snapper longliners, other bottom line fisheries, and factory trawlers. (61%)
3. Foreign licensed or joint venture longline vessels catch more seabirds than domestic longline vessels. (56%)
4. The area being fished can affect the rate of seabird catch. In particular, areas mentioned were East Cape, and the fishery on the south-western coast of the South Island.
5. Most seabirds are caught around the full moon when seabird activity is higher.

Many of the factors that are expressed here are the same as or similar to those noted in Nelson (1998) and Duckworth (1998), which would indicate that there have been very few changes in the overall perception of the problem of seabird bycatch in the past few years. Three of the factors identified here (daylight setting, geographical area, and moon phase) have been previously recognised by researchers, but the fact that there has been little movement

to improve the situation, or further research on reducing the impacts of these factors, is indicative of the stasis that is surrounding the matter of seabird bycatch.

#### 2.4 MITIGATION MEASURES SUGGESTED BY FISHERS IN THE DOMESTIC TUNA FLEET

Although there has been little change in overall perceptions of the problem, many fishers had given the situation some thought, and gave suggestions on how they had previously prevented or reduced seabird bycatch on their vessels. Some suggestions were not likely to be effective as mitigation measures, but other ideas were often well thought out and were likely to help reduce seabird bycatch. Many of the fishers had employed these methods, not because of seabird bycatch issues, but because seabirds were thought to be removing a significant number of baits from hooks, thereby reducing the efficiency of the fishing operation. The ideas are listed below with an explanation or comment on their effectiveness.

1. Night setting. This was by far the most common mitigation measure used by the domestic tuna fleet. Night setting has been shown to significantly reduce capture of seabirds (Duckworth 1995) although its effectiveness around the full moon period is reduced (FAO 1999).
2. Bait thawing. Thawed baits sink faster than frozen baits (Brothers et al. 1995), meaning that the baited hook is available to seabirds for a shorter time.
3. Reduction of deck lighting during setting. This measure reduces the amount of light on the water thereby making it more difficult for seabirds to see baits that would otherwise be hidden by darkness.
4. Dropping baited hooks into the wash of the vessel. Essentially the idea is that a baited hook dropped into the down-cycle of the propeller wash will be rapidly pulled down to a depth that will be safe from foraging seabirds. There is some evidence to suggest a "sweet-spot" in the propeller wash of longline vessels (Okazaki 1998), but information gathered from TDRs on domestic tuna longliners during this project suggests that, while baited hooks may initially sink very rapidly in the propeller wash, they will almost always be caught in the turbulence created by the wash, and very quickly be spun back up to within 1-2 m of the surface. Baited hooks have been recorded at these very shallow depths more than 60 seconds after leaving the vessel. Results of these trials will be described in a separate report (Keith in prep (a)). This method is not recommended as a means of reducing seabird bycatch.
5. Line guides. These work on the opposite principle of the previous method. Essentially a length of monofilament is run from the stern quarter, then the baited hooks are cast over this line, which holds the hooks outside of the propeller wash, ensuring they are not caught in turbulence. Although there have been no tests done on the effectiveness of



this method, it is likely to have a positive effect on the sink rate of baited hooks.

6. The stern quarter water spray. This idea has been trialed by a number of skippers in an attempt to prevent seabird capture during the hauling of the longline. A deck-hose is set up to spray water out from the stern quarter on the side of the vessel on which the gear is being hauled. The most common approach used by seabirds during the haul of the vessel is generally from the stern quarter (pers. obs.), so a strong spray of water may discourage seabirds from pursuing baited hooks that trail at the side of the vessel during the haul.

## 2.5 TORI LINES CONSTRUCTED FOR THE PROJECT

A high proportion of fishers visited during the course of the project were not interested in the tori lines being offered by the department. Reasons for this included the belief that, because they set at night, there was no need for a tori line, or the fact that they already had a tori line on board.

Many had used tori lines in the past, but had experienced difficulties in the use of them. The risk of entanglement in fishing gear was often given as a major reason for discontinuing their use in the past, or hesitation in employing one now. Tori lines were also refused because fishers had found that these they had used previously were too complicated to use easily as a part of the normal fishing operation, particularly on retrieval. A small proportion of fishers believed that tori lines simply did not work, and that there were other more effective ways of preventing seabird bycatch (predominantly night setting).

Most were aware that tori lines were compulsory, but not all were aware that the use of tori lines was compulsory for every set, instead thinking that it was compulsory only to carry a tori line on the vessel.

As a result, tori lines were made up for only 6 vessels during the project, with additional requests for 2 lines received at the end of the project. Some vessels had their own tori lines that appeared to be acceptable, or would be with a few minor or moderate changes. The appropriate suggestions were made to the skippers of these vessels.

It is hoped that with the continued relationship between an advisory officer and the domestic tuna fishers, a greater awareness of the legal requirements for the use of tori lines will be promoted. In addition, the introduction of tori lines that are increasingly easy to use and safe from the potential for entanglement should reduce the opposition that many fishers hold against using tori lines. From this point, education will be the key to promoting a more widespread use of tori lines.

### Tori line design

The tori lines constructed for each vessel differed according to the requirements of the skipper, or the limitations of the individual vessel, such as the

availability of a superstructure that provides a suitable attachment point for the line. Despite these differences, the make-up of the tori lines remained relatively consistent between vessels. The design used was based on a tori line developed in Keith (1999), though with the benefit of on-vessel trials, it was possible to further refine and develop the design.

A description of key issues in the development, design and construction of tori lines is given in Keith (1999):

In designing a tori line there are some basic conditions that [have] to be met in order for the line to be both useful and utilised by the fisher. Firstly there has to be minimal opportunity for entanglement with the fishing gear. If a fisher considers that there is a risk of losing expensive fishing gear and valuable fishing time due to entanglement problems with the tori line, there is an immediate disincentive to deploy the tori line. The tori line must also be simple to construct and repair.... An extension of this concept is that the construction materials need to be readily available to the fisher. Streamers must be constructed so that they move freely and unpredictably and do not wrap around the backbone of the tori line, rendering themselves useless for their purpose of scaring birds.

The tori line must also comply with legislative requirements. An essential facet of the legislative requirement is the attachment point at the stern of the vessel. By law this shall be approximately 4.5 m above the water at the stern. This height is critical because it essentially dictates the length of the aerial section of the tori line which is the part of the tori line that provides the bird scaring effect over the longline. Any attachment point lower than this restricts aerial coverage over baited hooks and thus substantially reduces the effectiveness of the tori line. A high attachment point has the further advantage that it also lessens the risk of entanglement with wayward branchlines as they are thrown out of the boat after baiting. The tori line must be attached at a point that suspends the tori line directly above where the baited hooks enter the water.

### **Construction materials**

A number of different tori line designs were constructed and tested over the course of the project. The greatest difference in construction materials was the use of alternative backbone material. Tori lines were constructed and trialed using 4.0 mm orange twine, 4.0 mm nylon green danline, and white 3.5mm monofilament. Red monofilament was trialed for visibility in low light conditions, but was not as visible as white. Final tori line designs were constructed using white 3.5 mm nylon monofilament, predominantly as this appeared to be the most visible material in low light conditions. Also a monofilament backbone reduces the chances of becoming caught or entangled with a stray hook or float. Lastly, replacement or repair of tori lines constructed using a monofilament backbone can be done using materials that are largely already on the vessel.

The lines were constructed to be between 150 and 220 m in length, dependent on the requirements of the vessel, and, as previously stated, were coloured white for better visibility in low light conditions. (If the skipper did



not approve of other methods as a means of increasing drag to create a longer aerial section, a longer line was provided, as increasing the length of the line in the water provides a greater degree of drag.) Between 8 and 12 streamers of varying length were attached to the backbone at 5 m intervals. Streamers were constructed using lengths of 3 mm luminous rubber tubing with a small (30 cm) section of 2.02 mm monofilament crimped inside the trailing end of each streamer to increase rigidity and reduce the chance of them wrapping around or tangling with fishing gear. Each tori line used 12-30 rubber washers to improve drag while providing little opportunity for tangling with a hook.

Each tori line was provided to vessels pre-wound on to a plastic hose reel for easy deployment, retrieval and storage. Including the hose reel, the cost of constructing a tori line using new materials was approximately \$110; a more detailed breakdown of costs is provided in Appendix 1. More details on the design and at-sea testing of tori lines developed during this project are provided in a further paper (Keith, in prep (b)).

### 3. The tuna fishers folder

Because not all the necessary information can always be passed on effectively in the course of one of two meetings, a folder was prepared for distribution amongst the domestic tuna fleet. The folder includes a wide range of subject matter on issues and subjects that affect the domestic tuna fleet and perhaps provides a more full description of the advisory officer's role in that fleet.

Information covered in the folder included a basic identification guide for the most common seabirds that are likely to be seen around fishing vessels in the domestic tuna fleet, the research that the department is doing in the area of seabird bycatch mitigation, and suggestions and instructions for tori line construction and regulations. Some information on the fishery itself was included, as was a basic description of the use of archival tags on longline gear as a method of understanding its behaviour over the course of a set.

The response to the folder to date has been extremely positive, with fishers finding it informative and useful. The seabird identification sections have been found useful for those fishers interested in improving their knowledge of seabirds that are often encountered.

### 4. Sea trips

During the course of the contract, five sea trips were undertaken on four small domestic tuna vessels. Trips averaged six days in length and included the setting and retrieval of, on average, four longlines. Several primary reasons existed for these sea trips:

1. To gain a comprehensive understanding of the operation of a small domestic longliner in the North Island tuna fleet.
2. To gain a better knowledge of seabird/fisheries interactions in this fishery, and to develop a better understanding of what the potential is for seabird capture in different situations.
3. To provide, manufacture, prepare and test tori lines for the vessel. If the vessel already had a tori line, advice was given on how it could be improved.
4. To provide the fishers with a description of the depth of their longlines over the course of the whole soak period, and to gain information for the Department of Conservation on the sink rate of baited hooks using information gathered from timed-depth recorders (TDRs) attached to snoods.

In order to understand the fishery more completely, one trip was taken in every main region fished by the North Island tuna fleet. Fishing trips were carried out from the western coast of Auckland up to Cape Reinga, with two trips corresponding to the same latitudes on the eastern coast, one based from Auckland, one from Tauranga. In the more southerly latitudes on the east coast, one trip was spent fishing between East Cape and Gisborne, and another was undertaken in the Bay of Plenty.

Twenty sets were observed in full or in part, with five sets containing a part or full daylight component. It should be noted that this is not a normal proportion of sets done during daylight hours. The skippers of these vessels were kind enough to shoot their gear during daylight hours so that the advisory officer could make observations on seabird behaviour, abundance, and seabird interaction with the fishing vessel and the tori line.

These observations are discussed more fully in a further paper (Keith, in prep (c)).

## 5. Timed-depth recorder results

Initial TDR results indicate that there is wide variation in the sink rate of baited hooks, but that these variations are relatively consistent between vessels. According to data collected from TDRs, a baited hook may sink at a rate that results in the hook reaching a depth of 5 m by the end of the aerial section of the tori line. This translates to approximately 50 m, or 15 seconds after the baited hook is thrown clear of the vessel. In other situations, such as if the bait is not cast clear of the vessel wake, the bait may be as shallow as 1 m at a distance of 200 m, or approximately 1 minute after the snood has been thrown clear of the vessel.

Preliminary results, however, show that a typical baited hook (on a 14 m snood using 2.02 mm nylon monofilament and a 17/0 Eagle claw hook baited with

approximately 150 g squid) attached to a backbone being spooled directly off the longline reel (no line shooter) will sink at a rate of 0.092 m/s (n=22), which puts the baited hook at a depth of approximately 1.4 m by the end of the aerial section of the tori line (50 m). Aerial section of tori lines varies from vessel; if the minimum height of attachment as set in legislation is adhered to (4.5 m), an aerial section of around 35 m is achieved. This figure is markedly increased on vessels with the scope for higher attachment of the tori line. Again, it needs to be stressed that there is a very high degree of variation in these results, as a direct result of a large number of factors. Much of this variation can be attributed to such factors as weather effect, and particularly crew performance while casting the baits outside the vessel wake. Sometimes a mistimed casting of the snood can result in the baited hook being dragged back into the propeller wash. These factors and the general variation expressed in these results are discussed more in depth in Keith (in prep (a)).

## 6. Discussion

The advisory officer project has provided a good base for a better understanding and better relationship between the domestic tuna longline fleet and the Department of Conservation. Longline fishers have long felt that they were being unfairly targeted by the department with the CSL, without contributing much to the problem itself. Of particular concern are a small number of fishers who state (whether in jest or otherwise) that the amount paid in conservation levies not only justifies the capture of seabirds, but in some situations may promote it.

It needs to be stated that this opinion represents a very small minority of fishers in the industry, and that the great majority of fishers are concerned with accidental seabird capture and take at least some steps to avoid it. Certainly, from observations made and discussions held during the course of this project, it does not appear that there is any single vessel among the domestic fleet that could be considered as a "problem" vessel. It is true, however, that there is a relatively consistent low level of seabird capture within and between domestic vessels, which means that seabird bycatch is still an issue for the fleet as a whole.

Fishers mostly accept this explanation, but still feel that they pay too much for the number of seabirds that they personally catch. They also understand that other fisheries, such as the driftnet fishery, have closed because they could not find a satisfactory solution for their problem, and do not want the same to happen to their fishery.

A large factor in the success of this position is the development of trust through familiarity, which by definition cannot exist within the framework of an ephemeral or temporary position that is passed around from contractor to contractor. The development of trust means that a greater understanding of the industry can be gained on a personal level with fishers who might not

otherwise be involved in negotiations or meetings with other parties, or with the department.

Often, during organised or more formal gatherings, fishers do not feel that they can express their opinions freely and without opening themselves to criticism or condemnation by their peers. They do not want to be seen as saying something that may be taken as anti-industry, or pro-department, or taking a stand that may be considered as representative of the industry as a whole.

## 7. Conclusions

The need for the development of a better relationship between fishers and the department has been highlighted several times in this report. As a function of this, there needs to be a degree of consistency in maintaining the relationships that have been developed as a part of this project. A good working relationship is the key to better understanding the needs of the industry when it comes to conservation issues, and this can only be developed if there is consistency and continuity with the people that are developing the relationships.

A very high proportion of fishers expressed a desire to have more feedback on research being done in relation to their CSL moneys. Fishers are genuinely interested in what is going on with issues related to their industry, and have a real desire to understand more of what is going on around them. It was expressed that perhaps an advisory officer was a good means of providing this feedback.

The position of advisory officer, seabird/fisheries interactions was essentially created to provide the domestic tuna longline fleet with someone who could act in an education/liason capacity for the Department of Conservation. The position allowed the development of a good working relationship with a number of fishers in the fleet, and has provided others with an understanding of the issues that the department is trying to address. Overall response to the project from fishers has been very positive, and in order for the progress that was achieved in the project to be maintained, there needs to be continuity. This can be achieved by contact on a regular basis so that relationships and contacts that have been developed are maintained.

## 8. Acknowledgements

Thanks go mostly to all the fishermen who have helped make this project a success. I could not have achieved what I did without their input, advice, and their humour. I hope I can help them as much as they have me. Special thanks go to all the skippers and crew on the boats that I went to sea on. Big

thanks also to Brent Marshall and Frank Tong of Moana Pacific, and Lane Tito of Tobe International for their support and input. Huge thanks once again go to Janice Molloy for help and advice during the project, and for support and encouragement during the tougher times. Thanks go to all the other people who have contributed to this project in some way, shape or form, who are too numerous to mention here.

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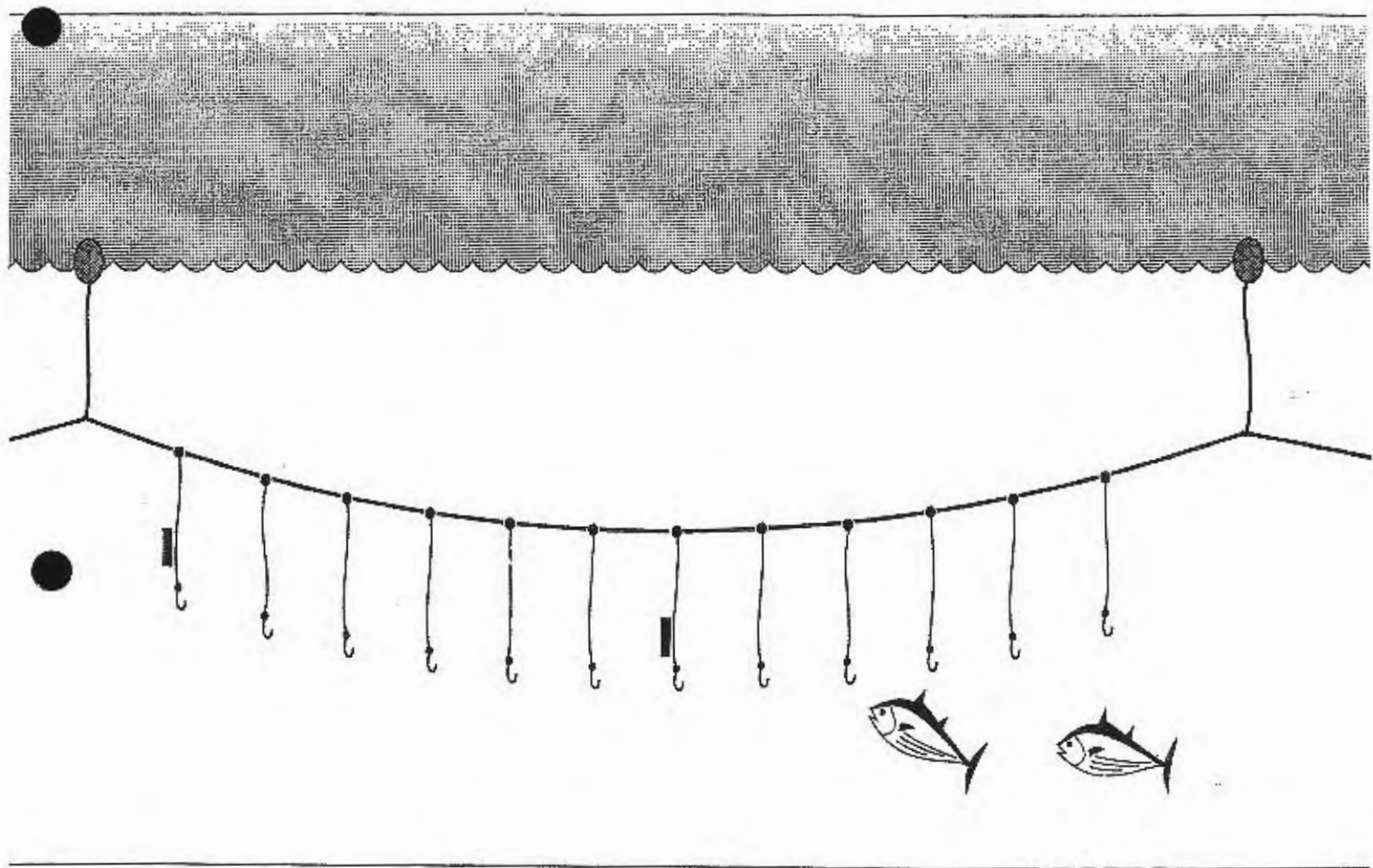
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Appendix 1. Cost approximation for tori line design

Materials	Units	Unit price	Total
3.5 mm monofilament	Approx. 150 m	\$0.185/m	\$27.75
Plassay garden hose reel	1	approx	\$40.00
4.2 mm Sleeve w. 5/0 crane swivel	10	\$0.50	\$5.00
4.5 mm aluminium double sleeve	2	\$0.18	\$0.36
3.9 mm aluminium stopper	26	\$0.16	\$4.16
3.0 mm luminous rubber tubing	approx. 20 m	\$1.08	\$21.60
2.02 mm nylon monofilament	approx 3.0 m	\$0.92	\$2.76
20 mm rubber tap washers	12	\$0.60	\$7.20
Total (\$NZ)			\$108.83



# THE TUNA FISHERS FOLDER



Department of Conservation  
*Te Papa Atawhai*



# The tuna fishers folder



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MOANA  
PACIFIC  
FISHERIES  
LIMITED

This folder is provided to you as part of a project that represents an advance in the relationship between tuna fishers of New Zealand and the Department of Conservation. It is hoped that through this project that there can be a greater level of understanding of the seabird bycatch problem by both the tuna fishers and by DoC. It is hoped that this project will provide ideas and information that will help to minimise seabird bycatch using sensible, economic, and practical, measures.

The employment of an advisory officer offers us not only a chance to hear of new developments in minimising seabird bycatch, but also to enable us, as fishers, to present our own ideas on, and solutions to the problem. As individuals who make a living in close association with the marine environment, you will be able to provide valuable feedback from your own experiences.

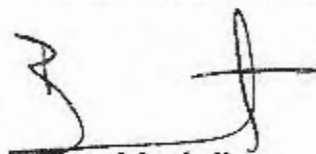
There is increasing pressure on the fishing industry both internationally and at home to continually review it's operating standards to ensure environmentally responsible practices are developed and that where possible implemented. New Zealand has lead the way internationally and much has already been done by the industry and government officials in New Zealand to achieve this. This project gives us an additional opportunity to demonstrate that ours is a responsible fishery that provides an environmentally friendly product based upon reasonable harvest rules and sound economic practices.

Solutions to the seabird bycatch issue are becoming available, and these are solutions that could benefit tuna fishers financially. This has not been the case for others, such as driftnet fishers, who lost their industry because they could not find an effective solution to their environmental problems.

We must ensure that our fishery remains competitive at an international level and that conservation measures do not burden the fishery with a level of cost that destroys the economics of the fishery. This fishery produces jobs and export earnings for New Zealanders.

It is your decision as a fisher to accept the challenges posed by the problem of seabird bycatch, and take steps to prevent this problem putting you out of business.

We need your commitment and your energy to find effective solutions that the industry can accept and will adhere to with integrity - that way the longline fishers will have a viable business to pass onto future generations.



Brent Marshall



# Introduction



This folder was put together for you as an introduction to a 12-month project which has been undertaken by the Department of Conservation's Science & Research Unit in association with members of the pelagic longlining industry.

Essentially the project employs an "advisory officer" who will attempt to contact all skippers in the tuna fleet working out of the various ports in the North Island, and consult with them on how they can minimise their seabird bycatch. It is hoped that this will be a two-way process, with the fishers having an important role to play in giving advice and opinions on how they feel they can prevent seabird bycatch. After all, most of the fishers have had a lot of experience with seabirds and their behaviour around fishing boats.

One of the aims of this project is to get some feedback from the fishers involved, as there is a real feeling that something needs to be given back to the fishing industry, and we need some ideas on how we can best help you out. We have some ideas of our own which are discussed later on in the folder: some of our research has been using archival data recorders to find out what happens to longline gear once you set it, and what happens once a fish takes your bait. More about that later.

At the end of this project, we hope that we will have provided you with ideas and information that will help you minimise your seabird bycatch, and maybe even help you catch more fish while you are at it. At least it will provide you with information that may be useful or interesting to you, or teach you something more about the birds that you encounter on every trip.

Cheers

Dave Kellian, Advisory Officer, Seabird/Fisheries Interactions





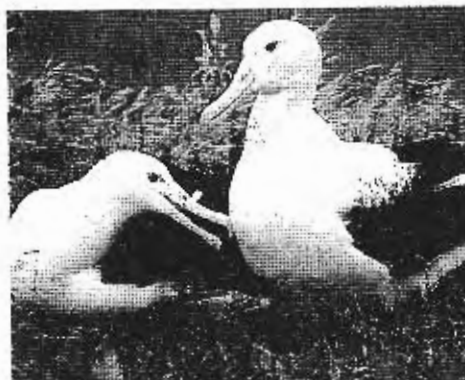
LIGHT-MANTLED SOOTY ALBATROSS

### LIGHT-MANTLED SOOTY ALBATROSS

(*Phoebastria palpebrata*)

This slender albatross has relatively long narrow wings and a very long pointed tail. It is dark grey, except that the head, tail and main flight feathers are sooty-brown. Each eye has an incomplete white eye-ring, and the bill is black with a blue line along the lower mandible. Juveniles are similar in appearance, but have brown scolloping over the neck and back. The light-mantled sooty albatross has a circumpolar distribution, nesting on many subantarctic islands, including the Antipodes, Auckland and Campbell Island groups in the New Zealand region. The world population is estimated at 23,000 pairs. Light-mantled sooty albatrosses are biennial breeders, returning to Campbell Island in October to start nesting. Pairs nest solitarily or in small groups. Nest sites include coastal cliff edges or a terrace of an inland peak. The nest consists of a shallow bowl atop a small pedestal of soil and vegetation. The single egg, which is white with reddish-brown speckling at the broader end, is laid during late October-early November. Incubation takes about 10 weeks, and the chick flies off to sea when about 20 weeks old. (80 cm)

NATIVE



ROYAL ALBATROSS (torae)

### ROYAL ALBATROSS (*Diomedea eximiosa*)

This endemic seabird has a circumpolar distribution over the southern oceans. It is massive, weighing about 9 kilograms, and is readily distinguished from wandering albatrosses at close quarters by having a black margin along the cutting edge of the upper mandible. The wings are usually black above, but occasionally have some white along the leading edge of the inner wing. The rest of the plumage is white, except that juveniles have black flecking over their crowns, backs, flanks and tails. The eyes are dark brown, and the legs and feet pink to bluish-white. The northern subspecies, *D. e. sonfordi*, has completely black upper wings, and the southern subspecies, *D. e. eximiosa*, has areas of white along the leading edge and towards the centre of the inner part of the wing. About thirty pairs of northern royal albatrosses breed at Tatarua Head, Otago Peninsula. The rest of the approximately 6500 pairs of northern royal albatrosses nest at the Chatham Islands. The southern royal albatrosses, of which there are about 14,000 pairs, nest on the Campbell and Auckland Islands. (115 cm)

ENDEMIC



WANDERING ALBATROSS (torae)

### WANDERING ALBATROSS (*Diomedea exulans*)

The wandering albatross has a variable plumage which differs between subspecies and with age. The lack of the black cutting edge of the upper mandible distinguishes the wandering albatross from the royal. Other features that help to distinguish it are the usually black or mottled black leading edge of the inner upper wing on all but the whitest birds, and the black-tipped tail. Juveniles start out dark brown, except for white over the face and much of the under wings. Gradually the plumage whitens over the next 10-15 years, firstly over the belly and later over the back and upper inner part of the wings. There are about 32,000 breeding pairs of wandering albatrosses, of which about 17,000 nest in the New Zealand region. Two of the four subspecies breed in the New Zealand region. *D. e. antipodensis* breeds on the Antipodes and Campbell Islands (c. 9000 pairs), and *D. e. gibba* on the Auckland Islands (c. 8000 pairs). Wandering albatrosses can be seen in coastal waters of New Zealand throughout the year, particularly around Stewart Island and in Cook Strait during winter. Their diet consists of squid, fish, octopuses, crustacea and fishing boat offal taken from the surface or by diving to one to two metres. (115 cm)

NATIVE



BLACK-BROWED MOLLYMAWK (torae)

### BLACK-BROWED MOLLYMAWK

(*Diomedea melanophrys*)

The distinctive features of the adult black-browed mollymawk are the broad black margins of the under wings and the yellow-orange bill. The upper wings are black, the tail tip grey-black and each eye has a distinct black brow running through and above the eye, the rest of the plumage being white. Immatures are evident by their grey plumage over the crown and hindneck, grey-black under wings, and greyish-green bill with darker tip. The black-browed mollymawk is the most numerous species of the albatross-mollymawk group, numbering about half a million pairs, of which about 25,000 nest in the New Zealand region. There are two subspecies, both of which nest in the region and breed annually. The subantarctic black-browed mollymawk (*D. m. melanophrys*) nests in small numbers at the Antipodes, the Snares and Campbell Island groups, while the New Zealand black-browed mollymawk (*D. m. immoides*) nests only on Campbell Island. The New Zealand subspecies is distinguishable from the subantarctic form by its more distinct eyebrow, more extensive black edges on the under wings, and yellowish eye. Black-browed mollymawks are attracted to fishing boats to eat offal. (90 cm)

NATIVE

PAGES 14, 15, 17 AND 23 FROM: NEW ZEALAND'S NATIVE SEABIRDS. PENGUIN POCKET GUIDES, 1998. TEXT BY RALPH POWLESLAND (REPRODUCED WITH PERMISSION).

# The birds

New Zealand and its dependent territories are home to some 93 species of breeding seabird, one of the biggest collections of seabirds in the world. Many of these breed on the mainland or on the inshore islands surrounding the coastline. Human modification and the introduction of land-based predators, such as rats and cats, have meant that in the last 150 years several of New Zealand's seabirds have disappeared or have reduced in number to the extent that there is a danger that some of these species will not recover. With the removal of predators from the island homes of these seabirds, there is a good chance that something can be done about reducing the mortalities during nesting and the breeding season.

These control measures, however, are useless once the birds go back to sea, and this is the area of greatest concern. Most of the seabirds that we come across when we are out on fishing boats are natural scavengers, and will instinctively take anything that resembles their natural food: squid, small fish such as pilchards and sanmar. The baits used in longlining obviously overlap with the natural foods of these birds, but not only that: the birds have learned that fishing boats provide a consistent and predictable supply of food.

This problem has increased due to the dumping of used baits and offal during hauling. The birds are now so used to this consistent food supply that they will follow fishing boats in preference to finding their own food (put yourself in the same situation—what would you rather do!). Because the birds are now used to taking their food from behind fishing boats, it is becoming a lot harder to discourage them from the baits.

What this means is that the only thing coming between these seabirds and your fishing gear is the seabird control measures that you have put in place on your vessel. The two primary seabird bycatch reduction measures are night setting and the use of a bird scaring (tori) line, but several other bycatch reduction measures have been trialed and are still under investigation as potentially useful preventative tools. For example, you may have heard of the work done recently with underwater setting. Most of these measures are only in the early stages of development, and all are voluntary except for the tori line which has been required by legislation since 1993 on pelagic longliners.



GREY-HEADED MOLLYMAWK

### GREY-HEADED MOLLYMAWK

(*Diomedea chrysastris*)

The head, neck and mantle of the adult grey-headed mollymawk are grey, but feathers are paler on the forehead and darker around the eye. There is a narrow white crescent of feathers below and to the rear of each eye. The upper wings and back are blackish, and the under wings white with broad black margins, the front margin being wider than the rear one. The chest, belly and rump are white, and the tail is grey. Adult grey-headed mollymawks have strikingly marked bills, with black sides, yellow top and bottom, and a pinkish tip. Immatures have darker grey heads, black under wings or with a narrow grey or white central stripe, and dark grey bills with blackish tips. This species nests on many subantarctic islands around the world, but only on Campbell Island in the New Zealand region. It is a biennial breeder - those pairs that rear their chicks miss a year before recurring to nest again. The population on Campbell Island has declined since the 1940s. Since few are killed during fishing operations, it is suspected that changed food supplies as a result of ocean warming has caused the decline. (80 cm)

NATIVE



BULLER'S MOLLYMAWK

### BULLER'S MOLLYMAWK (*Diomedea bulleri*)

The adult Buller's mollymawk has a grey head, neck, mantle and tail, with the forehead and crown being lighter in colour. The upper wings and back are blackish-grey, and the under wings are white with black margins, the leading margin being slightly broader. The bill is black with yellow along the top, bottom and tip. There are two subspecies; the northern Buller's mollymawk (*D. b. platei*) which nests at the Three Kings and Chatham groups, and the southern Buller's mollymawk (*D. b. bulleri*) which nests on The Snares and Solander Islands. The southern subspecies has a finer bill and lighter coloured forehead. The northern subspecies nests from October to January and the southern from January to October. The natural diet of the Buller's mollymawk consists of squid, fish, krill, octopuses, tunicates and carrion. Fishing boat discards probably dominate the diet of many individuals these days. Many Buller's mollymawks have been killed accidentally during fisheries operations in southern New Zealand waters. Even so, the population at The Snares has increased by 78 per cent during 1969-92. In contrast, the population at the Chathams seems to have declined since the 1970s, probably related to a deterioration in nesting habitat. (80 cm)

ENDEMIC

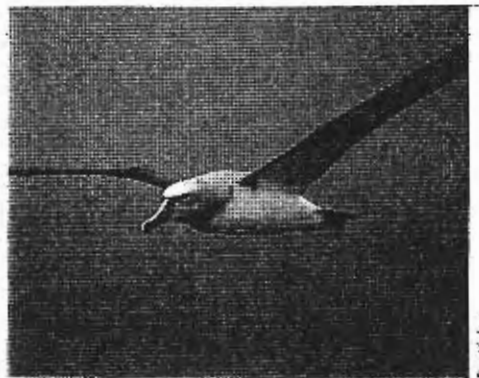


WHITE-CAPPED (SHY) MOLLYMAWK

### WHITE-CAPPED (SHY) MOLLYMAWK

(*Diomedea cauta*)

There are four subspecies of the white-capped mollymawk, of which three nest in the New Zealand region. The diagnostic feature of the species is a white under wing with narrow black borders and a small black triangular patch at the base of the leading edge. All subspecies have white chests, bellies and rumps, and dark grey-black tails. The main differences between them are in the head and bill colouration. The New Zealand white-capped mollymawk (*D. c. steadi*), of which there are about 65,000, nests on the Auckland and Antipodes Islands. This subspecies has a white head and neck, a black patch from eye to bill, and grey cheeks. Its bill is bluish-brown with a yellowish tip, especially at the tip. Immatures have darker bills, and the grey of the cheeks extends from the crown to the blackish back. The Sabin's mollymawk (*D. c. sabini*) numbers about 77,000 pairs and nests on the Bounty Islands and at The Snares. Its head, neck and mantle are grey, with a paler forehead. Its bill is green-grey, being paler on the top and bottom, and the lower mandible has a dark tip. Immatures have darker bills than adults, especially at the tip. The Chatham Island mollymawk (*D. c. everetti*) numbers just 4000 pairs and nests only on Pyramid Rock in the



Chathams. This subspecies has a dark grey head, neck and mantle, with a slightly lighter forehead. Its bill differs markedly from those of the other two subspecies, being yellow-orange with a dark spot at the tip of the lower mandible. Immature Chatham Island mollymawks have bluish-grey bills with dark tips. Birds of all three subspecies are seen in New Zealand coastal waters, particularly in winter and spring. The fourth subspecies, the shy mollymawk (*D. c. cauta*), breeds on islands of Tasmania and occasionally visits New Zealand waters. The diet of the species consists of squid, fish, krill, salps and carrion, particularly offal from fishing boats. (90 cm)

NATIVE

Don Hodder



PAGES 24-27 FROM: NEW ZEALAND'S NATIVE SEABIRDS. PENGUIN POCKET GUIDES, 1998. TEXT BY RALPH POWLESLAND (REPRODUCED WITH PERMISSION).

## The birds (continued)

Many seabirds travel huge distances when they are at sea. Satellite tracking on Wandering Albatross has shown that these birds can travel huge distances in a relatively short period of time. A copy of some recent satellite tracking has been provided for interest, see opposite page. Note the track all the way up the East Coast, and then back again, with some extra time thrown in around East Cape and the Bay of Plenty.

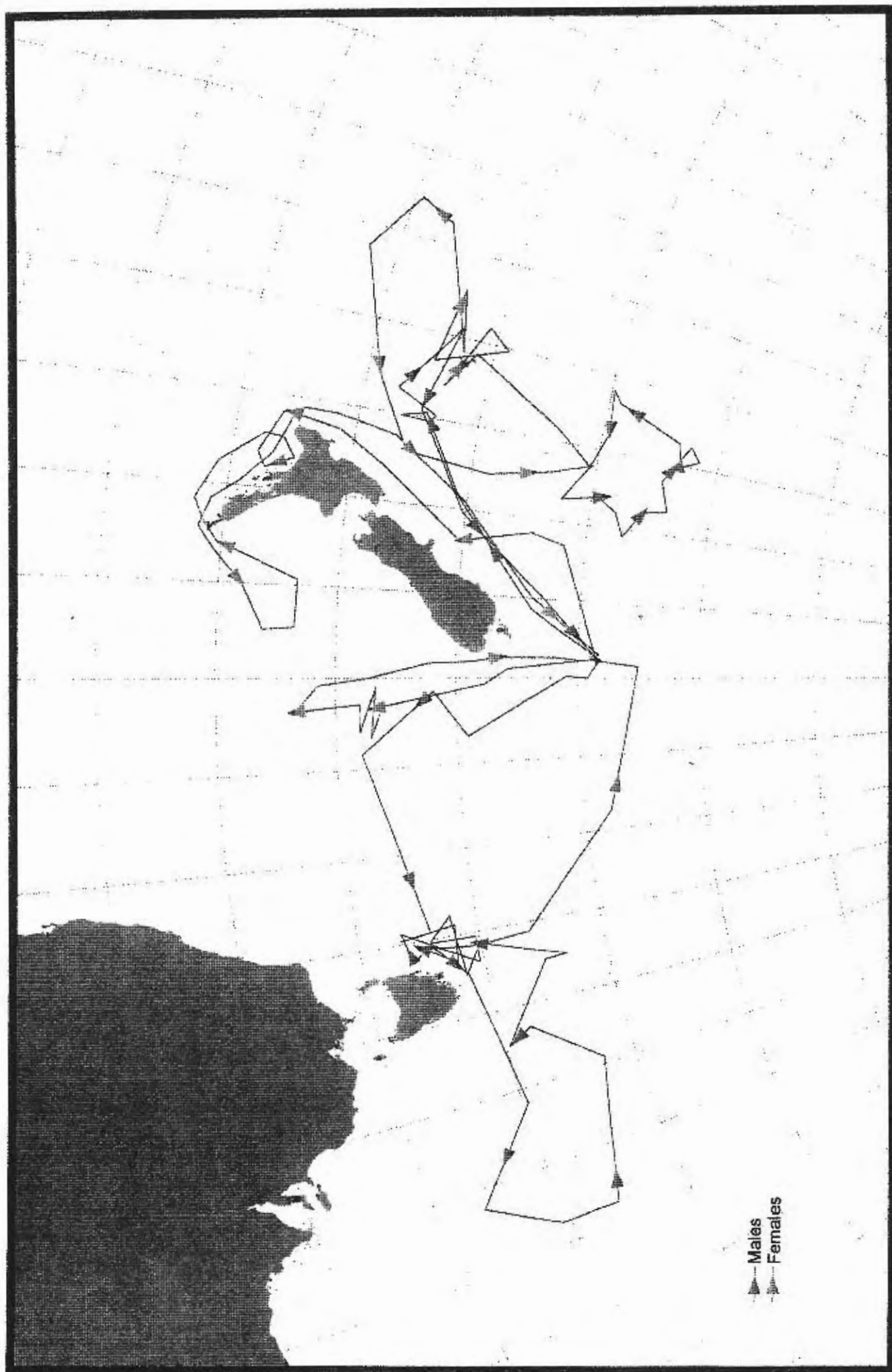
As can be seen by these tracks, seabirds such as Wandering Albatross, and even many of the smaller species, such as Black Petrels and Sooty Shearwaters, are not restricted to just New Zealand waters, but can (and often do) travel to many other parts of the world.

Their amazing ability to travel long distances makes it difficult to keep track of our seabirds, and also means that they can be exposed to fisheries where the operators are not as conscientious or under the same obligations as fishers in New Zealand. There is currently an agreement between New Zealand, Australia and Japan, which attempts to address the differences in what is expected of tuna fishers in our shared waters. For example, Japanese vessels are now required to use tori lines at all times during setting on the high seas.

It has been estimated that an **effective** tori line can reduce seabird mortality by up to 75%. Instructions for the construction of an effective tori line are available in many places. This folder includes an article that appeared in seafood magazine, written by a tuna fisher, on how to construct an effective tori line for your vessel. Legislative requirements for tori line construction in New Zealand are also included.

Within this project, the advisory officer hopes to discuss with you in person the best strategy for your vessel and, as a part of this, will construct a tori line tailor made for your vessel.





Foraging flights of incubating Wandering Albatrosses from the Auckland and Antipodes Islands tracked using satellite transmitters. The flights are of 10-30 days duration and are made between incubation shifts. These tracks were recorded in February and March 1999.

## What difference will a couple of birds make?

So you catch a couple of birds in a year—what's the big deal? The major problem with just catching a couple of birds is the number of boats that there are fishing. For starters, in our waters alone there are around 200 surface and bottom longline vessels. Even if these boats catch (on average) only a couple of birds a year, this starts to become quite a large pile of dead birds! Not only this, but because our seabirds are such great travellers they can move to fisheries all over the world, so the actual number of fishing boats that our seabirds are exposed to becomes very large.

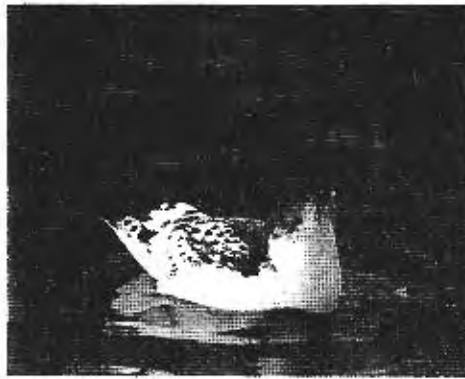
So the biggest problem with only catching a couple of birds is the fact that there are a lot of vessels out there fishing. Even if they only catch a couple each, this adds up to quite a number of birds caught every year.

When the numbers of some of the seabird species can be counted in tens (Macquarie Island Wandering Albatross has only seven breeding pairs), or thousands (e.g. New Zealand's Black Petrel), just a few can represent a significant number of the total population.

The problem is compounded by the way seabirds grow and breed. They are slow breeders, with some, like the Wandering Albatross producing only one egg every two years. Seabirds like albatrosses are slow to mature, reaching between 5 and 12 years before they can start breeding.

Often, breeding birds are the ones that are caught. They follow the boats in search of an easy feed for their young ones. Catching breeding birds can mean the death of two birds for every one caught, as there is often a dependent chick waiting for a feed, back at the nest. If mum doesn't turn up, dad can't feed the chick on his own, so the chances are quite high that the young one will die too.





CAPE PIGEON

**CAPE PIGEON** (*Daption capense*)

The cape pigeon is a medium-sized petrel with a distinctive black and white checkered pattern over the back and rump. The head, neck and mantle are black, the upper wings are black with two white patches each, and the tail is white with black blotches and a broad black tip. The underparts are white, except that the borders of the wings are black. The rather broad bill is black as are the legs and feet. There are two subspecies; the southern cape pigeon (*D. c. capense*) which nests on Antarctica, its coastal islands (including the Ballery Islands and Scott Island of the Ross Dependency) and many subantarctic islands, and The Snares cape pigeon (*D. c. australe*) which nests on New Zealand subantarctic islands (The Snares, Bounty, Antipodes, Auckland, Campbell and Chatham Island groups). The latter subspecies is smaller and has less white over the upper wings than the southern subspecies. During autumn and winter many southern cape pigeons move into New Zealand coastal waters resulting in an intermingling of the two subspecies. Cape pigeons feed on krill, amphipods, squid, fish and fishing boat offal. They feed mainly by floating on the sea and pecking rapidly, much like a pigeon, for small items. (40 cm)

NATIVE



AUSTRALASIAN GANNET (*Morus serrator*)

**AUSTRALASIAN GANNET** (*Morus serrator*)

The gannet is a distinctive species because of its appearance and foraging habits. It is a streamlined bird with long narrow wings and a pointed tail. Adults are white with an orange-yellow head, most wing flight feathers are black, and the central four tail feathers are black. It has a conical grey bill and its grey-black feet have blue-yellow lines along the legs and toes. Juveniles are grey-brown with white spots above, white with some brown streaks below, and have brown-black bills. Most juveniles quickly disperse to the eastern and southern coastal waters of Australia after flying from their colonies, and so sightings of juveniles about New Zealand are uncommon. They return to the coastal waters of the North and South Islands when three to seven years old. Australasian Gannets feed on fish and squid which they catch by diving into the sea from heights of up to thirty metres. Just before they enter the water, the wings are extended backwards, and as they enter the water the neck and breast cushion the shock of entry. Large flocks of gannets are a spectacular sight diving into schools of fish forced to the surface by predatory fish or dolphins. (89 cm)

NATIVE



SOUTHERN GIANT PETREL

**SOUTHERN GIANT PETREL**

(*Macranectes giganteus*)

Southern giant petrels occur in two colour phases, dark and white. Adults and juveniles of the dark phase are almost identical to northern giant petrels, except that the head, neck and mantle are paler, and the bill tip is greenish rather than brown. Adult and juvenile southern giant petrels of the white phase are white with a few brown feathers giving a flecked appearance. The eyes of most southern giant petrels are brown, but a few are greyish. This species has a circumpolar breeding distribution. In the New Zealand region, one pair has bred at Cape Crozier, Antarctica. However, the nearest colony to New Zealand is that of about 4000 pairs on Macquarie Island. Most southern giant petrels remain near Antarctica and in the subantarctic zone during summer and autumn. However, in winter and spring some adults and many immatures disperse into New Zealand waters. They are scavengers of dead seabirds and marine mammals, and are predators of penguins, albatrosses and other seabirds as well as crustaceans, squid and fish taken from the sea surface. (90 cm)

NATIVE



NORTHERN GIANT PETREL

**NORTHERN GIANT PETREL** (*Macranectes nesi*)

The giant petrel, also known as the stinkbird or nelly, is characterised by its robust form and massive bill with prominent nasal tubes. Adult northern giant petrels have brownish-grey plumage with much of the head greyish, and greyish-yellow eyes. The bill is a distinctive horn colour with a brownish tip. Juveniles have a dark brown plumage. Northern giant petrels breed on many subantarctic islands. In the New Zealand region they nest on islands in Port Pegasus of Stewart Island, and on the Chatham, Antipodes, Auckland and Campbell Islands, and number about 2000 pairs. Northern giant petrels lay a single white egg during August-September. The chick hatches after two months of incubation. It is brooded for about three weeks and then guarded for a further two before being left on its own while both parents forage. The chick flies off to sea when nearly four months old. (90 cm)

NATIVE

PAGES 45, 46, 39 AND 40 FROM: NEW ZEALAND'S NATIVE SEABIRDS. PENGUIN POCKET GUIDES, 1998. TEXT BY RALPH POWLESLAND (REPRODUCED WITH PERMISSION).

## What are the other benefits of a tori line?

Okay, so we know that tori lines are good for the birds, but have you considered what a tori line can do for you? For starters, aren't you sick of hearing about how bad the fishing industry is for birds, and how little you are doing to prevent the slaughter of thousands of defenseless birds?

Is this the sort of image that is giving the industry a fair go?

No! Not at all, and the only way to change the public view of the situation is by showing that you as fishers are acting responsibly. Using a tori line is a pretty good defense against public criticism, and will certainly go a long way towards reducing the chances of catching birds.

What do you think when you see birds taking your baits? Do you ever think about how much bait you are losing, and wonder whether those baits that are taken off your line could be costing you valuable fish? The baiting in a longlining operation is the key to successful fishing; after all, how many fish would you catch if you didn't bait any hooks? Silly question, isn't it? Yet, by not protecting your baits from birds, some of the hooks you set are essentially going out unbaited; and while you are at it, you are throwing away the baits for those hooks. How much bait do you think you lose to seabirds over the space of a year? How many fish do you not catch as a result?

It is a tough equation to work out, because much is speculation. But the reality is, if you are not doing everything you can to ensure that baiting is as good as it could possibly be, then your fishing operation is not being run as efficiently as it could be.

It's pretty easy to get a tori line properly set up for your boat. Research has shown that an effective tori line can reduce bait loss by up to 69%; that translates to a substantial number of baits that remain on your line, fishing.

For free advice on how to set your vessel up with an effective tori line, contact the advisory officer.



Don Lindsay

BLACK PETREL

**BLACK PETREL** (*Procellaria parkinsoni*)

The plumage of this petrel is blackish-brown, and its legs and feet are black. Apart from the black bill tip, the bill plates are cream coloured, and the skin between the plates is black. Today black petrels nest only on Little Barrier Island (about 100 pairs) and Great Barrier Island (about 800 pairs), the total population numbering 3000-4000 birds. Formerly it nested on inland ranges of the North and South Islands. Black petrels are summer breeders, returning to their ridge-top burrows in October-December. Before egg-laying in November-January, the birds clean out their burrows and line the nest chamber with leaves. The single white egg hatches after nearly two months of incubation. The chick is left unguarded at about ten days old, with each parent returning once a week to feed it. Chicks fly to sea in April-June when about fifteen weeks old. Black petrels must scramble up sloping trees or on to cliff tops in order to get airborne from the nesting islands, some birds walking 100 metres or more from their burrows to reach suitable take-off sites. During the breeding season they forage mainly around the North Island and in the Tasman Sea, but spend winter and spring in the eastern tropical Pacific. (46 cm)

ENDEMIC



Don Lindsay



Don Hoskin

WHITE-CHINNED PETREL

**WHITE-CHINNED PETREL**

(*Procellaria equinoctialis*)

The white-chinned petrel has an entirely black plumage, except for some white chin feathers. The legs and feet are black, and the bill is pale cream or horn coloured with black in front of the nostrils. It is the bill colouration and the white chin that distinguishes this species from the very similar Westland petrel (*P. westlandica*) and black petrel (*P. parkinsoni*). The white-chinned petrel has a circumpolar distribution over deep waters between 30°S and 65°S. It breeds on many subantarctic islands, including the Antipodes, Auckland and Campbell Islands in the New Zealand region. Some islands outside the New Zealand region have over a million pairs nesting on them. White-chinned petrels are summer breeders, with egg-laying in November-December. This is the largest burrow-nesting seabird. Because their burrows are dug in peaty soils they are sometimes wet, hence the nest is built on a short pedestal to keep the egg dry. The chick is brooded for about five days, but for the rest of its 14 week life in the burrow it is left unguarded, the adults returning at one to six day intervals to feed it. (55 cm)

NATIVE



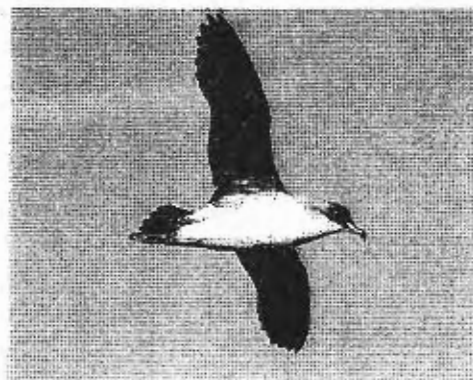
Don Hoskin

WESTLAND PETREL

**WESTLAND PETREL** (*Procellaria westlandica*)

The Westland petrel has an entirely blackish-brown plumage, and black feet and legs. The bill plates are cream coloured, except that the bill tip is black, as is the skin between the plates. Thus, apart from being slightly larger, this species looks the same as the black petrel (*P. parkinsoni*). The Westland petrel is endemic to New Zealand, breeding only in the coastal forest between Barrytown and Punakaiki of the West Coast. The population is estimated at about 14,000 birds. This species is a winter breeder, with each pair nesting in a one to two metre long burrow situated in the steep side of a valley. The single white egg is usually laid in May and hatches after two months of incubation. The chick is guarded for its first fortnight, after which both parents are away by day foraging, and it is fed about every third night. The chick leaves the burrow when about four months old, and must then forage and fend for itself. Although the diet of the Westland petrel includes squid, fish and crustacea, the bulk of its food during the breeding season is offal from fishing boats. (48 cm)

ENDEMIC



Don Hoskin

GREY PETREL

**GREY PETREL** (*Procellaria cinerea*)

This species is a robust-bodied petrel. Its crown, sides of the head, mantle, back, rump, tail and wings are varying shades of grey, with the chin, chest and belly being white. The bill is greyish-green, with the nostrils and skin between the plates being black. The legs and feet are greyish-pink, and their webs are yellowish-pink. The grey petrel's flight consists of glides interspersed with rapid shallow flaps. It has a circumpolar distribution, nesting on many subantarctic islands, including Campbell and Antipodes Islands in the New Zealand region. Most nest at the Antipodes because feral cats and Norway rats on Campbell Island have virtually exterminated the species there by killing almost all chicks. Grey petrels nest in winter, the single egg laid in April-June and the chicks fledge in September-December. Birds from the Antipodes Islands forage to the east of New Zealand, particularly off the east coast of the North Island during the nesting season. Grey petrels are attracted to the offal discarded from boats working in this rich fishery, and many drown after being accidentally hooked on longlines. At present, it is not known what impact this mortality is having on the population. (48 cm)

NATIVE

PAGES 47, 20, 42 AND 41 FROM: NEW ZEALAND'S NATIVE SEABIRDS. PENGUIN POCKET GUIDES, 1998. TEXT BY RALPH POWLESLAND (REPRODUCED WITH PERMISSION).

# The muttonbirds

For many of us, the term "muttonbirds" just refers to that group of little brown or black birds that sometimes appear in large numbers around boats. The clowns of the seabird world, sometimes they put on a great show, squabbling and carrying on, or diving down to pinch baits before we can even see them on the haul, and generally bludging baits and scraps. But muttonbirds are actually a complex group of 15 species known as "petrels" and "shearwaters". Some of these species are extremely common, and some are not, but look common because they always hang out around fishing boats. The purpose of this next section is to let you know a little more about our wee mates, the mutton-ducks.

The reason that they all look the same is that they are all closely related, and all live very similar lifestyles. Most of their lives are spent at sea, generally only going to land in order to breed. Look at the seven separate species of muttonbird on these pages, and you may start to realise that despite how similar they all are, there are more than just a couple of kinds.

New Zealand's "real" muttonbird is the Sooty Shearwater. This bird breeds all through our outlying islands, except for the Kermadecs and the Bounty Islands. This is the species on which the muttonbird industry is based. The adults are not taken as a part of this industry, but rather the young chicks, who can eat as much food as is provided to them, and when there is plenty around they can become extremely fat.

Sooty Shearwater Photo:P.Reese



Flesh-footed shearwater  
Photo: P.Reese



The species we most often see around are Flesh-footed Shearwaters. They can be identified by their pale pink beak with a dark tip (see photo), and their pinkish legs (the name "flesh-footed" refers to the fact that the colour of the legs is similar to a European's skin). Some flesh-foots breed on offshore islands around northeastern New Zealand such as the Hen and Chicken Islands, but mostly they breed on Lord Howe Island. These little birds migrate up to Korea and Japan during our winter





Fluttering Shearwater  
(Photo:P.Reese)

every year. So if you ever thought that muttonbirds were more common in summer, and seem to mostly disappear in the winter, you are right! The only muttonbirds left once the Flesh-footed shearwaters disappear are less common, or more shy around fishing boats, like Black Petrels, Fluttering Shearwaters and Little Shearwaters.



Black Petrel (Photo DOC)

Grey Petrel (Photo:P.Reese)



The most common muttonbird you will be seeing during the winter months will probably be the Grey-faced Petrel, which, as you can see in this photograph, has a distinctive grey face. These birds tend to be shyer than Flesh-footed Shearwaters, and will generally stay quite a way from the boat during setting or hauling, but they sometimes come in for a closer look.



White-chinned Petrel  
(Photo:P.Reese)



Grey-faced Petrel  
(Photo R.Slack)

## Black Petrel—Seabird of concern

One of the seabirds reported caught in the northern domestic fishery is the black petrel. Like other "muttonbirds" the black petrel breeds in burrows in the ground. Before the spread of rats, cats, stoats and dogs, large populations of this seabird would return each year to breed under the forest canopy of many of the coastal and some inland ranges of the North and South Island. Because they nest in the ground, these seabirds are easy prey for such introduced predators. The mainland populations were gradually eaten out and have now disappeared. The black petrel now only breeds on Little Barrier and Great Barrier Islands, and there are about 4,500 breeding adults remaining. This is one of New Zealand's most threatened seabirds, and has been rated as "vulnerable" using an international system which assesses the status of plants and animals.

The black petrel is often seen feeding in waters north of about East Cape between October and June. This is the breeding season. Once breeding is over the birds migrate across the Pacific Ocean and forage off Central and South America over our winter months. They begin to breed from six years of age, and live for about 20 years.

The black petrel looks quite similar to another muttonbird called the flesh-footed shearwater which is common in New Zealand waters. Both are blackish-brown birds, but the black petrel generally looks blacker and bulkier, has black legs and a yellowish beak. The flesh-footed shearwater has pink legs (its legs are the colour of a European's legs thus the name) and a more pinkish white and narrower beak. Both have dark tips to the beak.

Black Petrel  
(Photo: C.R. Vettech)



The black petrel is a very good diver, so it is important that baits sink quickly behind the vessel and a good quality tori line is used to protect the bait. They feed on jewel squid which live along the shelf break zone from East Cape to North Cape. Black petrels feed during both the day and night.



## More information on the Black-browed Mollymawk

The Black-browed Mollymawk is quite a misunderstood bird. Despite being one of the most common sights around fishing vessels, many people don't know much about them. They are one of our smallest albatrosses (yes they are albatrosses, mollymawk is the name given to the smaller species) and this has led to some confusion between similar looking birds, such as Black-backed Gulls, and even Australian Gannets. What makes the situation even more complicated is the fact that the young ones and the old ones look different anyway!



Juvenile Black-browed Mollymawk

Young ones have darker beaks and may have some grey colouring around their neck and head, where the adults have a yellow beak with a pink or red tip, and no grey around their head or neck. On this page we have included pictures of a young blackbrow, an adult blackbrow and a Black-backed Gull for comparison. As you can see, young blackbrows can look quite different from their adults.

Compared to Black-backed Gulls they are larger, with much longer and narrower wings. In flight, the gulls flap almost constantly, whereas the albatross will glide most of the time.



Adult Black-browed Mollymawk



Black-backed Gull

Black-backed Gulls also look different when they are young, being a speckled grey-brown rather than their normal adult black and white.

# Underwater Setting—Update

You may have heard that kiwi ingenuity has been put to use over the past few years to find a way to set baited hooks underwater. The idea was initially put forward by a group of skippers and fishing industry reps during the first year of the Conservation Services Levy programme. Since then there have been mixed reactions, from total rejection to enthusiastic support!! Here is an update on the two types of devices that have been developed.

## UNDERWATER SETTING CHUTE

The chute is now fully developed and has been extensively sea tested for operational faults. The recent sea testing and refinement has been carried out on a vessel fishing around Tasmania and western Australia. The Australian government has made funding available to build 10 chutes and these are currently being fitted to vessels for a 6 month trial. Each vessel will carry an observer and detailed observations of seabird bycatch and seabird behaviour will be recorded. If the trials are successful, a chute will be tested in Hawaiian waters.

## UNDERWATER SETTING CAPSULE

This device has undergone a re-design after a trial on the F.V. Daniel Solander found that the device was unsafe in heavy seas. The original inventor (Dave Kellian) and the skipper of the Daniel Solander have come up with a new way to deliver the capsule below the waterline. The capsule is now transported on a track attached to the stern. This means there are no flying parts that could endanger crew. A number of other improvements have been made to make the device easy to use. Limited sea testing of the new design has been carried out, but further sea time is needed to fully test the device.

For further information on either device, contact the Advisory Officer.

# Tori line regulations

In 1993, a regulation was passed requiring commercial fishermen taking tuna to use a bird-scaring device (tori line) when lines are set. The Ministry of Fisheries set a minimum standard which vessels are required to comply with. The details of this are:

- The streamer line is to be suspended at the stern from a point approximately 4.5 m above the water.
- The streamer line must be attached to the vessel such that the line is directly above the point where the bait hits the water.
- The streamer line must be a minimum length of 150 m and the diameter of the streamer line must be approximately 3 mm.
- There must be a minimum of 5 branch streamers attached to the main streamer line between the vessel and where the main streamer line enters the water. Each branch streamer should comprise 2 strands of approximately 3 mm diameter cord.
- The interval between branch streamers must be a maximum of 5 m.
- Swivels must be incorporated at the towing point and before and after the point of attachment of each branch streamer
- The length of the branch streamers should range between approximately 3.5 m nearest to the ship to approximately 1.25 m for the fifth streamer.

The Ministry of Fisheries will also consider approving alternative designs, if vessel owners provide details to:

Manager  
Operational Policy  
Ministry of Fisheries  
PO Box 297  
Wellington.

# What makes a good tori line?

A lot of what makes a good tori line is common sense - something which is effective, inexpensive, easy to construct and repair, and made from materials that are easily and commonly available. A good tori line must be designed so that the chances of catching the gear as it goes past are minimised.

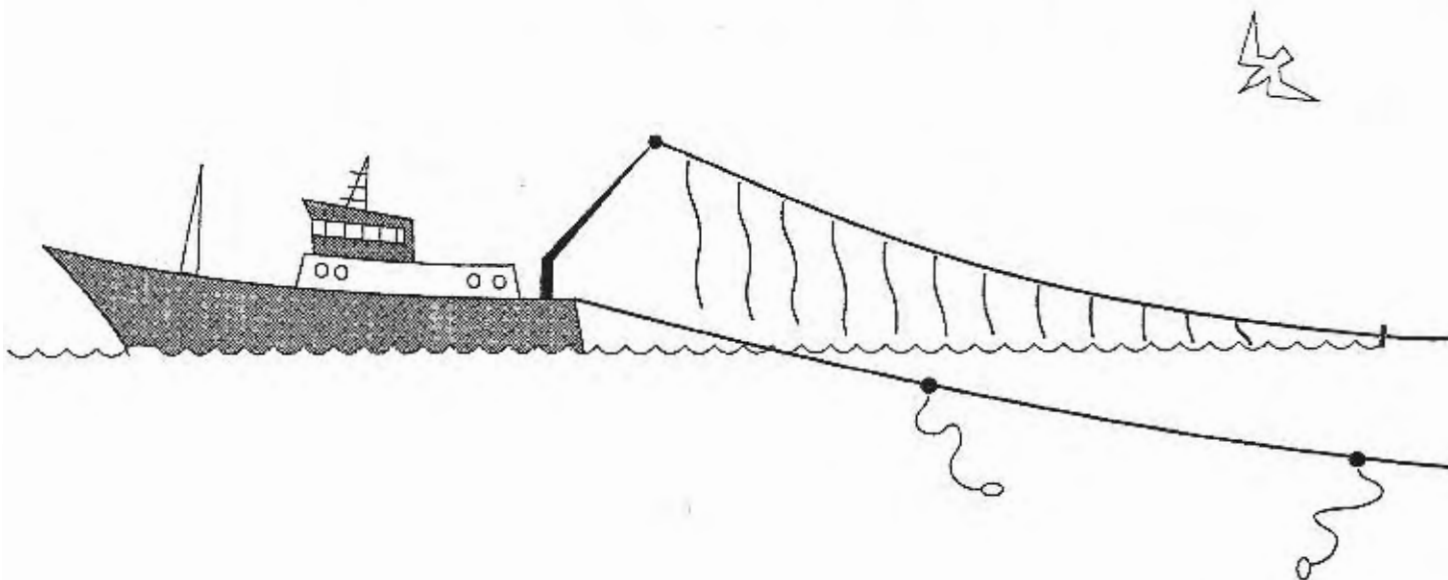
Really, the tori line design is up to you, but if you follow the simple guidelines set out in this folder, then you can be pretty much assured that you will be making a good tori line. Keep in mind that a tori line DOESN'T have to be a hassle. It's really up to you. Following this section is an article written by Mike Wells from the FV Kariqa, and Kim Duckworth, a scientist from SeaFIC, which describes a couple of designs for effective tori lines.

Firstly, the line needs to be at least 150m long. This may seem like it is much too long, but baited hooks have been recorded at the surface (or just under) up to 200m behind the boat. So basically, the longer the better. Having a longer tori line also gives a better drag in the water, with less risk of getting caught than a windy buoy.

Secondly, the line needs to be attached at a point that is as high as possible. A line attached to the highest point possible on the mast with a lazy line down to the gantry at the stern will ensure that you will get the best coverage from your tori line. This will also ensure that the line is high enough to prevent a snood accidentally being thrown over it.

In Australia and Japan they commonly use a "tori pole" to attach the tori line to. This can be attached to the stern, or on the gantry, to achieve even greater height advantage.

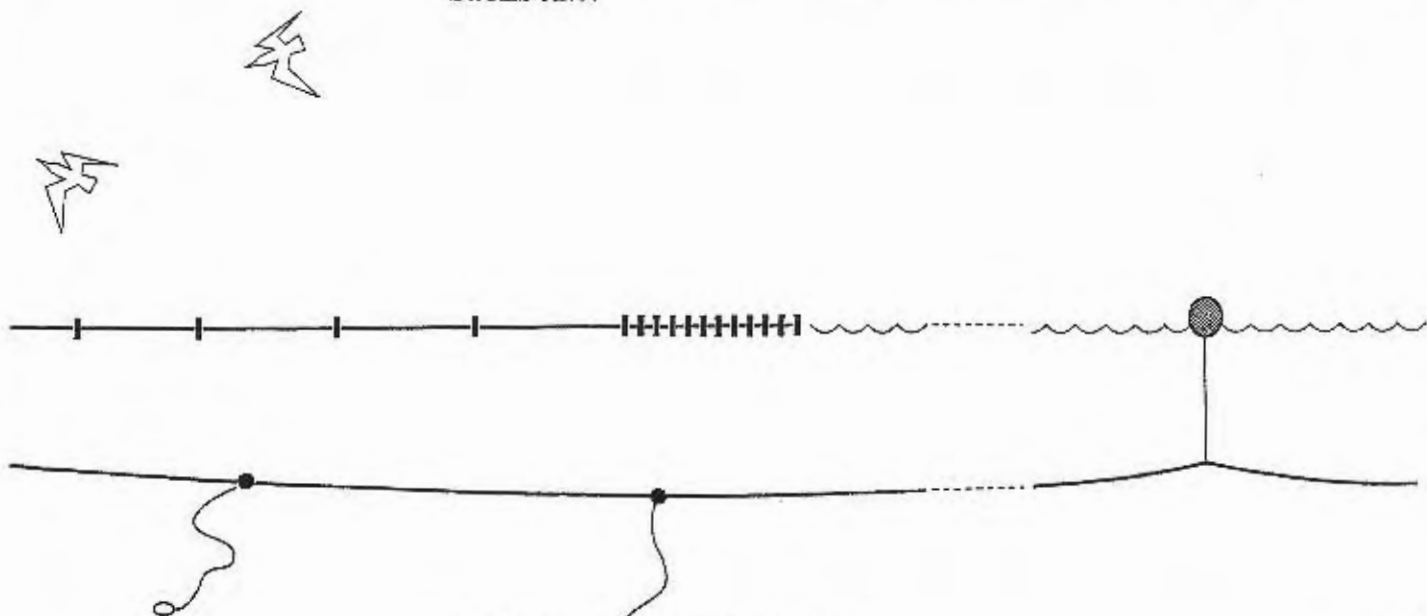
This is a long pole, bent at the base and set on a swivel, allowing the pole to be swung to port or starboard, meaning the tori line can be placed according to where the wind is coming from.



This is important because the streamers should be hanging over, or close to the area in the water where your baits land. If you send your baits out both sides, then you should use two tori lines. If this is not possible, set your tori line so that the streamers are over the opposite side from where the wind is coming from. This leaves the windward side baits uncovered, but because seabirds will tend to approach into the wind, they will be less likely to attempt to land on that side.

Thirdly, the drag section on your tori line should be enough to hold a good amount of the line out of the water. With a good high attachment point and an effective drag, you should be able to get around 70m of tori line out of the water behind your vessel. It is important that the drag section that you use is not likely to catch on a stray hook, or more likely, a float, as it travels past. A section of heavy rope is quite good, though hooks have been known to catch in knots, or in the lay of the rope itself. Another idea is to have a length (about 5m should do it) of moderate sized rope (say 9-12mm), with lots of strands of the same rope fed loosely through the lay. What you end up with is a big straggly bit at the end of your tori line. The strands eventually tease themselves out, and you end up with a big drag section that will not catch anything, because the strands are only loosely fed through the lay, they simply pull themselves out if they do catch a hook. If you do use rope, make sure that you use a couple of swivels in your design.

Finally, and also important, are the streamers that are attached to the tori line. Ideally these streamers need to be cut to a length that allows them to be just above the surface of the water, preventing birds from flying underneath them. They also need to be flexible enough that they flick around and act unpredictably, but not so light that they are easily wrapped around the backbone of the tori line. A good example of what is about the right weight is rubber or plastic tubing (like the luminous rubber tubing you can get) with sekiyama or 1.8mm monofilament fed through it. If possible they should be attached to the backbone using some kind of a swivel mechanism. This stops the streamers getting tangled with the backbone.



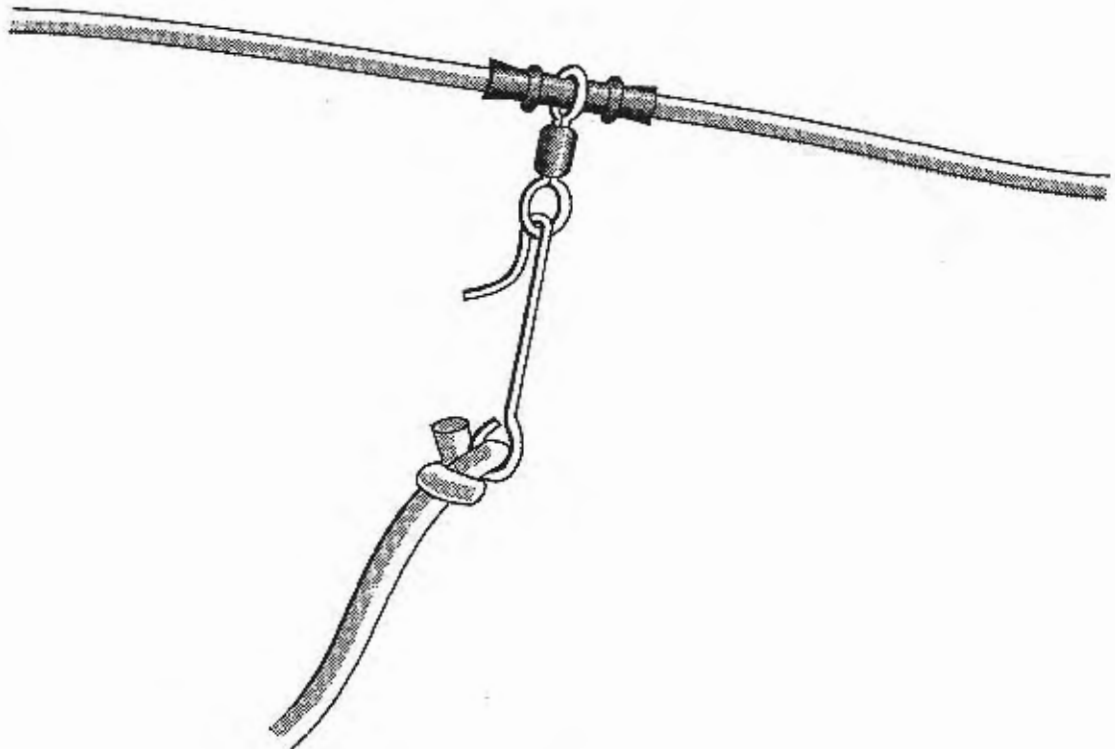
# More tori lines!

Here are a couple more ideas that have been recently developed to provide a light, strong tori line that has very little chance of catching a stray hook or a float.

I have recently been developing a tori line made of monofilament. This is a good material to use because it is light and strong, and does not have much chance of being caught in your gear. It is also pretty likely that you will have some on board. A good way of using up that couple hundred metres of backbone from the tangle which has been wrapped around that fish bin for a couple of trips, ay?

## WHAT YOU'LL NEED

- 150+ metres of monofilament backbone
- 15-20 metres of luminous rubber tubing
- a similar amount of 1.8 mm/2.02 mm monofilament
- stopper crimps
- 10 or so 5/0 sleeves with crane swivels, or whatever fits your backbone.
- 20 odd 18-20 mm rubber tap washers
- 10 or so longline/set line clips
- a good swivel





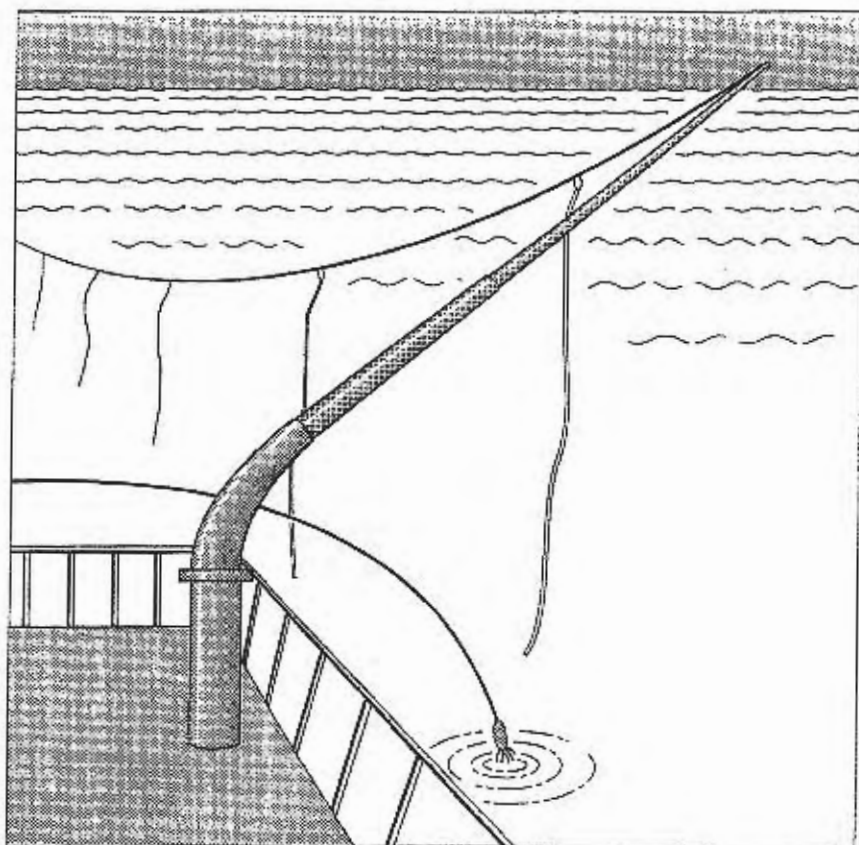
## HOW IT'S PUT TOGETHER

At the end that will be attached to the boat, crimp the sleeves with crane swivels on to the backbone at roughly 5 m intervals. These are your streamer attachment points. For your drag section, make two cuts in each rubber washer. This creates a weak point in the washers, so that if there is a tangle with a float or a hook, the washers simply rip off (this works, I've tried it). After making the cuts, feed your rubber washers onto the other end of your tori line. Between each washer feed on a stopper crimp (see picture). Spread your washers so that the last 12 or so washers are crimped at 1/2 m intervals at the end of the line, but the rest of the washers are spread evenly to within 20 m of your last streamer. The splashing of these washers in the water can act as a deterrent to seabirds as well.

For your streamers, feed the monofilament through the rubber tubing. You can do the rubber in pieces, then crimp the final sections at either end after you have threaded the attachment clip on. This means you have removable streamers, which lets you store the backbone of the tori line on a reel (try an electric fence reel, or a hose reel), keeping it out of the way when you don't need it.

If you set up a lazy line system where you set the tori line, clip on the streamers as you need to, then attach the tori line to a separate line already attached up the mast, you will find this a simple system to use. To retrieve the line, stop or slow the boat, reel in the backbone, unclip the streamers, and you're away laughing.

TunaLine Tori Pole



## and finally...

If the last one still seems like a bit of a hassle, try this tori line. It's extremely cheap, and can be quite effective if set properly.

### YOU'LL NEED

- 150-180 m of 4 mm danline
- 20 m of 8 mm rope
- 20 m of 20 mm rope
- a couple of good swivels

### HOW TO MAKE IT

It almost makes itself. Using the 4 mm danline, make up enough streamers to attach to the backbone rope at 5 m intervals from where the line meets the stern of the vessel. Make sure the streamers close to the boat are long enough that they nearly touch the water. This should be around 4 m, the next, 3 m, then 2.5 m, 2 m, 1.5 m, and several at around 1 m. Depending on your preference, you can either splice the rope streamers through the backbone, or you can make the streamers removable by using shark clips to attach the streamers. Be careful when you use the shark clips though, they are the most likely things to catch if something goes wrong, and you have to slow the boat down during the set.

At the end of your 4mm danline, splice the next size rope into the 4mm, and do the same for the next section. Make sure you include a swivel or two in the design (one after your streamers, one before them) because the lay of the rope causes the whole lot to spin in the water. Easy! Attach it to a high point on your mast, with a lazy line system for retrieval, then coil whatever is left over into a fish bin to keep it out of the way. Try to make the tori line sit over the area where your baits will be landing. The easiest way to do this is by using a tori pole.

That was a quick guide to on how to make a good tori line. However each boat is different, and these ideas may not work for you. For more assistance or ideas, contact the Advisory Officer.

# Reduce your catch

## KIM DUCKWORTH AND MIKE WELLS OFFER ADVICE ON HOW TO NOT CATCH SEABIRDS

*The following advice on how to avoid hooking seabirds during long line setting comes from three sources. Practical experience gained during long lining operations by the FV "Kariqa", an analysis of the circumstances under which Japanese tuna long liners operating within the EEZ caught seabirds, and the comments made by scientists and fishermen at an international conference on Albatross conservation held in Hobart in August 1995. Most of the ideas are pretty obvious and you've probably heard of them all before. Give them a try and see which are practical and work for your vessel.*

### Set your lines at night

Seabirds hunt by looking for their prey. What they can't see they can't get. The more light there is falling on your bait the more likely they are to go for it. Try to keep line setting entirely within the hours of darkness. Keep vessel lights falling on the water astern of the vessel to a safe minimum. You may still catch a few birds around the time of the full moon but you'll catch far fewer than if you'd set during the day.

### Get your baits to sink quickly

Some petrels can dive a long way but most of the birds you'll encounter won't bother going for a bait which is more than a couple of metres under the surface.

Make sure that all bait is thawed before it is used. Thawed baits sink faster than frozen baits.

Keep baits out of the vessel's wake. The turbulence of the wake will return baits to the surface well behind the vessel. This gives seabirds a second chance to grab them. The FV "Kariqa" tows a 20 metre length of monofilament line attached to the port side of the stern hand rail. Baited hooks are thrown over this and slide down its length. This helps reduce the chance that the bait will be sucked into the wake. Make sure that the crew member throwing the bait isn't so tired that he can't throw it clear of the wake (or buy a bait thrower).

Attach extra weight to snoods. The more weight it has attached to it the faster a bait will sink. The FV "Kariqa" uses 75 gm swivels attached 5 metres from the bait.

### Use a high quality tori line

"Tori" is the Japanese word for bird. The purpose of a tori line is to deter birds from flying through the airspace underneath it.

Probably the most common type of tori line used in New Zealand is a 100m long length of rope with plastic packing straps woven through it every few metres. This design may work for a few days but the birds quickly get used to it. There are far more effective designs available.

In order to be effective a tori line must be positioned above

the location where the bait is landing in the water.

The effectiveness of a tori line is strongly influenced by how much of it is out of the water. Because tori lines stop birds from flying underneath them, if a tori line falls into the sea too soon it will only protect a small area behind the vessel. On a flat calm day at normal line setting speed a good tori line will not contact the sea until in excess of 60 metres behind the vessel. The "sag" of a tori line is determined by the height from which it is towed, the vessel's setting speed, the weight of the tori line and how much drag is on the line. Because of this light materials make better tori lines.

A tori line should be towed from a point which is high enough up that the crew aren't accidentally throwing baited hooks onto it. Two and a half metres above the stern deck is about right. The attachment point will have to be a pole so that the line can be held over the point where the bait lands in the sea (which should be outside the vessel's wake).

The line should be constructed from a material that won't break if a crew member accidentally throws a baited hook over it.

To increase the drag on the line you could feed out more line or attach a windy buoy to the end. The problem with the latter is the increased chance of snags.

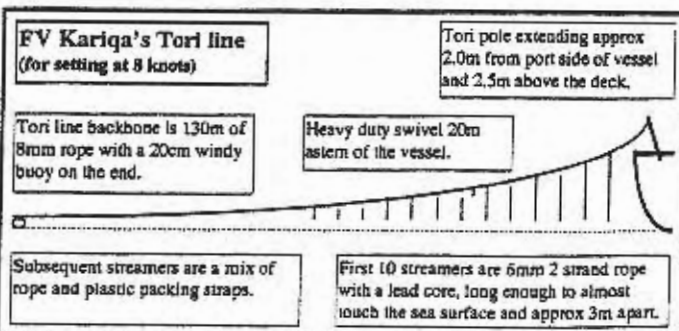
Some swivels will need to be included in the forward 50 metres of the tori line to lessen the chance that the spinning motion generated by dragging the line through the water will tangle the side streamers.

Except in rough conditions, tori lines don't move around much and birds eventually become less wary of them. Because of this a tori line should have side streamers which thrash around. It's important that the side streamers have enough weight that they aren't easily blown aside by the wind but not so much weight that they don't flap around at all. Side streamers should be slightly weighted.

If the side streamers are too far apart then birds will simply fly between them. Put your side streamers about 3 metres apart if you set at 6 knots, or 6 metres apart if you set at 12 knots.

This is also the distance that the first side streamer should be behind the stern of the vessel.

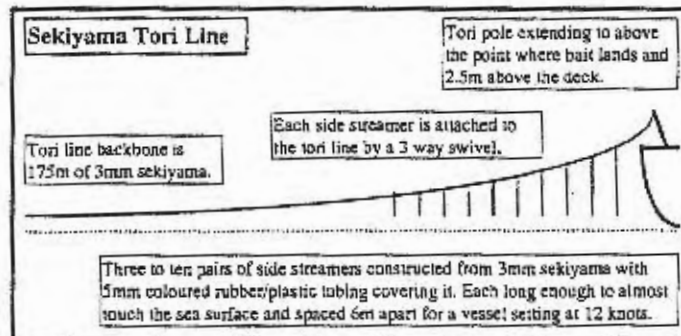
You will need enough side streamers to cover at least the first 30 metres behind the vessel.



If the side streamers aren't long enough then birds will fly underneath them. If side streamers are too long then they will hang in the water and not flap about. On a flat calm day when towing a tori line at line setting speed the tips of your side streamers should be skimming along about 40cms above the sea surface. This is important and along with getting the weighting of streamers correct is almost always overlooked.

It may sound complicated but it's not. And to prove it here are two examples.

The materials required are therefore 130 metres or more of 8mm rope, 30 metres of 6mm two strand lead cored rope, one 20cm windy buoy, one heavy duty swivel and some old rope or plastic packing straps. Any QFDH should be able to make this tori line in under an hour.



If you want to go one step further you could construct a tori line from Sekiyama. This is a light and strong 3mm cord used by Japanese Southern Bluefin Tuna vessels. Because it is so light it doesn't contact the water until it is a long way behind the vessel. Its one disadvantage is that being so thin it's pretty unpleasant to deploy and retrieve by hand. If you do have a spare winch which you could use for this purpose then this design is probably the "state of the art" (until someone proves differently).

The materials required for the Sekiyama tori line (with 5 paired side streamers) are 215 metres of 3mm Sekiyama, 35 metres of 5mm coloured rubber or plastic tubing, five 3 way swivels and a packet of aluminium crimp fittings.

No one is claiming that these ideas will work for everyone. Different solutions will work for different vessels. But the ideas given here have worked in the past under a wide range of conditions. The FV "Kariqa" didn't catch any seabirds while longline setting in the 1995 season despite fishing everywhere from the Snares to Westport. In the end it's a matter of you trying some of these ideas and seeing what works for you.

Whether fairly or unfairly, seabird bycatch is now an issue for long liners in New Zealand. This article isn't making any assumptions about whether or not you have a bird bycatch problem. If you don't catch any seabirds then you should probably tell the rest of us the secret of seabird-safe long lining. But be prepared to prove what you are saying. If you do catch seabirds then there are a variety of reasons why you should reduce the number you catch. They may be financial reasons. If you are losing baits to seabirds then you're catching less fish and taking less money home. Maybe you don't want to give environmental groups any excuse to complain. Maybe the idea of the sea without seabirds doesn't appeal.

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Skipper of the FV "Kariqa"  
Nelson, New Zealand





# Do you know what your line is doing?

## ARCHIVAL DATA RECORDERS—HOW THEY CAN HELP YOU OUT

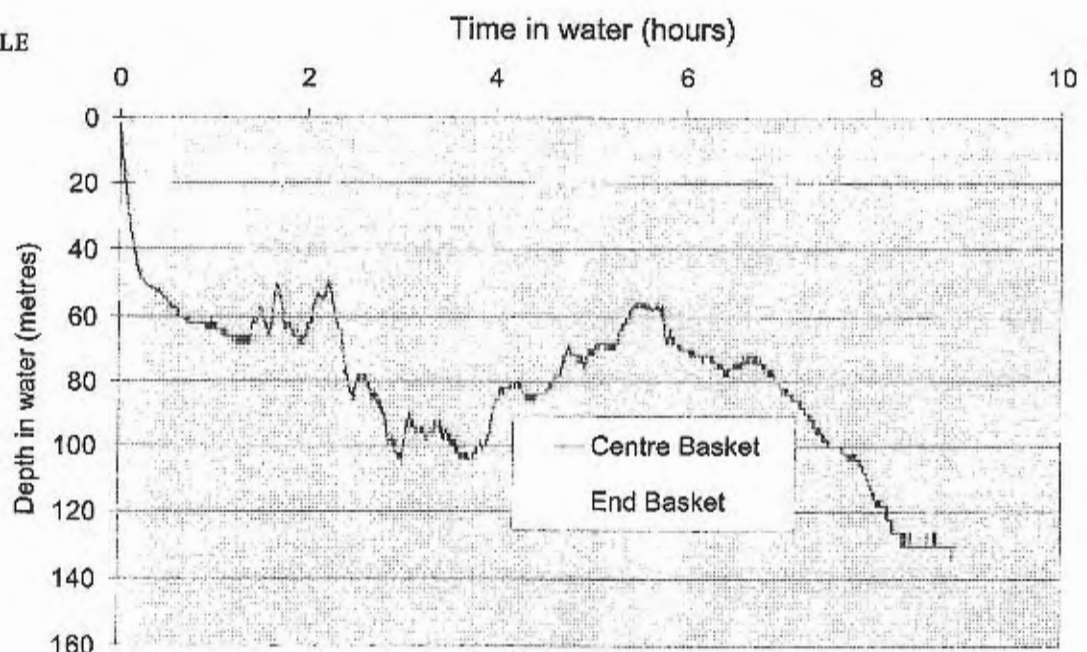
You may have heard something about archival tagging of bluefin tuna, and later on in this folder we provide some information on some of the projects that involve this tagging. We know how these tags can record what is happening to bluefin as they migrate through our oceans, and can determine where the fish are in the water column, when they feed, and even their whereabouts by satellite tracking.

We can now learn more about tuna than ever before. But do we know enough about how we catch them? Are you sure you know where your gear is going when you set it? If the thermocline is sitting at 50 m, can you be sure that your gear is set to cover the most effective depth range? Tides and surface weather conditions can affect your longline considerably.

We have archival data recorders, known as TDRs (or Time-Depth Recorders), which can determine where your gear sinks to after it leaves your boat. The use of TDRs to determine line-sink-rate and line-set-profiles is a useful way of learning more about your fishing.

The skipper of the vessel from which the set profile was taken (see figure) estimated that the snoods from the end of a basket, next to a

GEAR SET PROFILE  
FOR A PELAGIC  
LONGLINER



SPECIES	DAILY VERTICAL MOVEMENT	PREFERRED: TEMPERATURE RANGE	DEPTH RANGE
Broadbill Swordfish	Surface during night, deep during day	10-22°C (sst)	0-600 m (from literature)
Southern Bluefin Tuna	Shallow at night, deep during day	12-18°C	0-400 m (archival tags)
Bigeye Tuna	Surface at night, deeper during day	10-16°C	0-400 m
Yellowfin Tuna	Surface at night, deeper during day	18-28°C	0-150 m (sonic tracking)
Marlin (Black)	Surface more at night	23-27°C	0-120 m (sonic tracking)

After Whitelaw, W. and Campbell, R. 1997 *Longline Fishing - Where Are We Fishing and For What?* Asia Pacific '97 Fishing Papers pp. 21-24.

float, would settle at around 40 m, while the centre basket would settle around 60-80 m. As you can see, the gear moves around a lot over the course of the whole set, and is definitely not settling at the presumed depths. If the thermocline is sitting at around 45-50 m, or if the target species is shallow, does this mean that you are not fishing as efficiently as you could be? You be the judge!

Our Archival Data Recorders also record temperature changes at depth, which could prove a valuable source of information on temperature change at the thermocline and temperature gradients beyond the sea-surface-temperature plots that are commonly used in this fishery. This information could be extremely valuable to you as a fisherman. All over the world—Hawaii, Eastern United States, Australia, even Indonesia—fishermen are gaining information on the behaviour of their line in relation to the behaviour of fish.

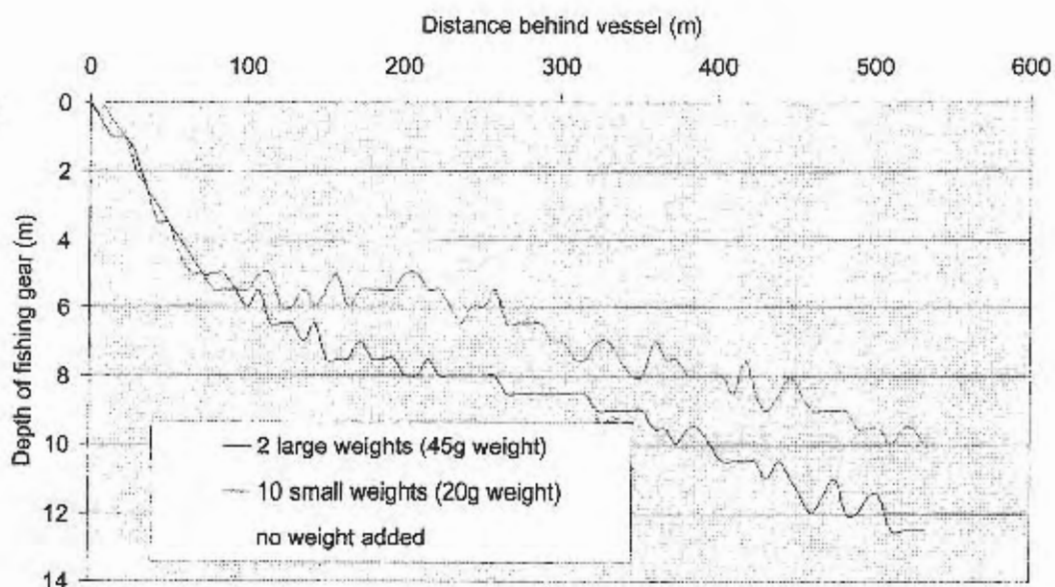
The table above includes descriptions of preferred depth and temperature ranges for several of the key species targeted in the New Zealand tuna fishery. How well are you targeting your fish? In the second table, hook depth by position and size of basket are given. Please note that these figures are for Australian longliners operating out of Cairns. No allowances are made for differences in setting, gear configurations, snood length or environmental conditions. Hook depths change a great deal over the course of a set due to current or wind pushing buoys closer together or further apart. The figures in the above table do not account for these changes, but do present a general guide to depths reached by hooks in baskets of different sizes.



NUMBER OF HOOKS IN BASKET	HOOK NUMBER	AVERAGE DEPTH OF HOOKS (m)
10	1	40.4
	3	64.9
	5	81.1
	6	84.4
12	1	52.6
	3	71.8
	4	118.7
	6	115.4
	7	120.6
	8	91.9
14	10	89.8
	1	39.4
	3	71.8
	4	83.5
	6	107.2
18	7	124.5
	9	94.2
20	10	210.5

After Whitelaw, W. and Campbell, R. 1997 *Longline Fishing – Where Are We Fishing and For What?* Asia Pacific '97 Fishing Papers pp. 21-24.

SINK PROFILE  
CHART, CREATD  
FROM TIME-DEPTH  
RECORDER DATA  
(SEE OVERLEAF).



# TDRs are for the birds!

## BIRD BEHAVIOUR AND DIVING ABILITY

As you are no doubt aware, there are several species of seabird that are very good divers. Have you seen the way muttonbirds swim around, sticking their heads underwater until they see something interesting, then disappear underwater? Some species of muttonbird have been recorded diving to depths of 34 m, while many others can dive to shallower, but still impressive, depths. Even those Wandering Albatrosses with their big wings can make it down a couple of metres, and some species of albatross, such as the Light-mantled Sooty (probably not a species you will see very often) have been recorded diving to a depth of 12 m. Next time you see a Black-browed Mollymawk dive under the water, count the number of seconds that it is down for. Normally it is only around a couple of seconds, but sometimes it can be for much longer.

## SINK PROFILES AND SINK RATES

What this means is that it is difficult to keep your baited hooks entirely out of the reach of a hungry bird on the set or the haul. The most important information that we get from TDRs is how quickly your hook is sinking, and therefore how long it is within diving range of seabirds. From the information we get back from the TDRs, we can tell how deep your hooks are relative to the position of the boat, and importantly, how deep they are in relation to the length of your tori line.

Using Time-Depth Recorders we are also starting to discover the sort of depth ranges that hooks are likely to be at in various conditions, using different gear configurations.

You can see the sort of information we can gather using TDRs on the Sink Profile Chart on the previous page.

## Weighting the snoods

You will probably have an opinion about the use of weights on snoods. Your opinion is likely to contain the word "dangerous", and possibly rightly so. As you may already know, the number of accidents in the last few years that have been related to lead swivels has led to many skippers deciding not to use weights at all.

Unfortunately some important things during the haul have been lost: from the seabird perspective, the best method for sinking your hooks fast has gone; and from the fishermen's perspective, the best way of preventing snoods wrapping around the backbone during a particularly rough soak!

But in some other parts of the world, the use of 60 g lead swivels is standard practice. The bigeye fishery in Hawaii, for example, uses a wire trace and lead weight combination at the hook as standard fishing practice for daylight setting. Using this setup, after some 986 sets there were only 15 seabird mortalities in total. And that was all-day setting!

Having said this, we recognise that the dangers of a large lead weight under tension are real, and recently we have started investigating safer methods of weighting a snood. Two ideas are being developed at this stage. The first of these have used sliding weights that will get left behind when the monofilament is bitten or broken (see diagram, right). The second idea also uses the sliding weight concept, but also spreads the weight using small, sliding lead beads (diagram, left) so that the weight is not concentrated into one or two hard, heavy, and potentially dangerous lumps.



Another approach used by at least one vessel in New Zealand is to use a damper ring on the haul. This is a heavy ring, or weight on a rope, which is slid over a snood and dropped in the water if there is a large shark, or a lively fish on the line. It means that even if there is a line break, the snood is held in the water, and the weight is prevented from flicking back.

Have you had any thoughts about how to tackle this problem? Or do you weight your lines using any other methods? If you have, and you want to share your idea, give the advisory officer a call!

# The other ideas pages

We have covered several areas of investigation that we have been making into how to resolve the problem of seabird bycatch. But there are many other methods that have been trialed and tried. Some have promise, others not so much, but all show signs that all over the world people are thinking about how to solve this problem. See what you think!

## DYED BAIT S

As silly as it may sound, the practice of bait dying is widely used in some parts of the world, such as Hawaii, as a way of reducing seabird bycatch. Baits in a basket are lowered into a bin containing a non-toxic blue dye during the set (just like a bait-bin strapped to your stern-rail), and then attached to the hooks as normal. The colouration of the baits makes them harder for birds to see, so there are fewer attempts to get the baits, which translates to fewer birds caught on the set.

The colouration of the bait apparently lasts for the whole set, which means that fewer birds are caught on the haul, too. In Hawaii, scientific studies have suggested that the colouration of baits does not reduce the catch-rate of target or marketable fish, but in fact may even increase it! This is because the colouration of the baits appears to make the baits easier for fish to see from below, even though it reduces their visibility to seabirds.

## THAWED BAIT S

This is a very well-used technique. Baits that are frozen do not sink as fast as those that are thawed (think about the icecube in a drink—it doesn't sink!), so get your bait out several hours before your set. It only takes a small amount of planning, and is a very effective way of getting your baits to sink faster.

## SONIC CANNON

This idea stems from the noise-cannon used in orchards to scare birds away from the fruit. The cannon are gas-powered and produce a loud boom at random intervals from their position on, or near the stern. There are mixed reports of their success, because seabirds can become quickly accustomed to the sound of the cannon. But skippers on the *Daniel Solander* have found that the cannon can be

useful in some circumstances, such as when the boat is turning during the set and baits are not being protected by the tori line, or to clear birds away before the set begins.

In short, though the idea of a sonic cannon may appeal because of its simplicity, the usefulness of the device is probably quite limited.

#### THE STERN-QUARTER WATER SPRAY

This technique is used during hauling to prevent birds from getting too close to the baited hooks that are being hauled in. The deck-hose or fire hose is propped at the starboard stern-quarter, so that the spray or water jet shoots out to the side of the vessel. This creates a curtain of water that birds cannot see the baits through. The jet of water itself also acts as a deterrent, preventing access to the baits for birds approaching from behind the vessel (the most common bird approach).

#### ELECTRO-MAGNETIC FIELD DISTORTION

This sounds particularly complicated, and it is. Basically, what this technique tries to do is disrupt the electromagnetic impulses that are used by seabirds to navigate as they fly. The theory is that with these impulses disrupted, the birds will be confused and frightened, and will avoid the area where their navigational sources are being disrupted.

Nice idea. Unfortunately it doesn't work.

#### NIGHT SETTING

This method is already used by the New Zealand domestic fleet. Birds rely on their eyesight to find food, therefore it makes sense that most of a birds' foraging (looking for food) is done during daylight hours. This does not mean that birds do not feed at night, but activity is much less than during the day. So if you have a choice, choose to set at night. You will avoid most contact with birds, and will keep more of your baits on the hooks where they belong.

On brightly lit nights when the moon is full, or close to it, you will see many more birds around your boat. And because you can see them, it is probably bright enough for them to see your baits. So use a tori line at night too, just to be sure.

## DRAG LINES

These are like tori lines, but with the whole thing in the water except for the first few metres. The line is designed so that it can not tangle with the fishing gear, but washers down the length of the line create splashing as they are dragged through the water. The theory is that birds will not land near the fishing line with objects being dragged through the water close by. There is still a lot of research to be done with this method.

## LINE GUIDE


The FV *Kariqa* uses a system where a 20 m length of mono is attached to the port-side stern rail during the set. The baited hooks are thrown over this line, and the snood slides down this as it is released, preventing the baits from being dragged back into the prop-wash behind the boat. Because it is mostly the turbulence from the prop-wash that holds the baited hooks at the surface for so long, your baits will sink much faster, and have less chance of catching the eye of a hungry bird.

Why not give it a try?

## HOLDING OFFAL

A number of New Zealand vessels are holding offal and used baits on board until the haul is finished. This reduces the attraction of seabirds around the boat, and therefore lessens their chances of getting caught.





# INTERNATIONAL FISHERS FORUM

ON SOLVING THE INCIDENTAL  
CAPTURE OF SEABIRDS IN  
LONGLINE FISHERIES

As explained earlier in the folder our seabirds do not necessarily stay inside NZ waters. Many species make huge migrations across to South America and the north Pacific. So even if we solved seabird bycatch in all fisheries in New Zealand, this would not mean our seabirds would be safe. Fishing fleets from other countries have reported catching NZ seabirds, so it is important that we ensure these fleets start using seabird friendly fishing practices.

This is one of the reasons DOC, Ministry of Fisheries and representatives of the NZ fishing industry organised an international meeting of skippers and fishing industry reps from the main longline fishing countries. Eighty-one people registered for and took part in the four day Forum held in Auckland in November 2000. Representatives from Australia, Argentina, Brazil, Canada, Chile, China, England, Falklands, France, Indonesia, Japan, Italy, New Zealand, South Africa, Taiwan (China), USA, and Uruguay took part.

The main focus of the forum was sharing of ideas on ways to avoid catching seabirds. Participants committed to doing a number of tasks in their own countries and reporting back at a second International Fishers Forum to be held in late 2002 in Hawaii. The commitments participants made are shown below. If you would like to see a copy of the report from the forum, it is available on the DOC website at:

[http://www.doc.govt.nz/whats/issues/fishers\\_forum.htm](http://www.doc.govt.nz/whats/issues/fishers_forum.htm)

COMMITMENTS MADE BY PARTICIPANTS FOR WORK TO BE UNDERTAKEN BEFORE THE END OF 2002.

Fishing entity	Commitments from participants
<b>Alaska</b>	<ul style="list-style-type: none"> <li>➤ publicise names of non-complying vessels and ask regulatory bodies to detail non-compliance in reports</li> <li>➤ recommend that training workshops for skippers and crew in the use of effective seabird bycatch mitigation measures be provided</li> <li>➤ revise and improve the seabird bycatch mitigation measures that are currently required</li> <li>➤ work collaboratively with Canada</li> <li>➤ organise seminar or panel discussion of stakeholders for Fish Expo 2001</li> <li>➤ develop a plan for monitoring seabird bycatch in the halibut fishery</li> <li>➤ produce and distribute video of effective seabird bycatch mitigation measures tested in Alaska</li> <li>➤ arrange port visits to disseminate new information</li> <li>➤ work on retention of black-footed albatross (<i>Phoebastria nigripes</i>) caught on longlines and collect data on captures of this species from other fishing entities in the North Pacific</li> <li>➤ work with Hawaii to develop a North Pacific Albatross Working Group</li> </ul>
<b>Argentina</b>	<ul style="list-style-type: none"> <li>➤ disseminate information from this forum to government officials</li> <li>➤ develop relationships with local fishers to educate them about seabird bycatch mitigation measures</li> </ul>
<b>Australia</b>	<ul style="list-style-type: none"> <li>➤ implement Threat Abatement Plan</li> <li>➤ test underwater setting chute further and disseminate results</li> <li>➤ develop education strategy</li> <li>➤ finalise recovery plan for albatrosses and petrels (a draft has been developed and made available for public comment)</li> <li>➤ recommend reporting of vessels that comply with mitigation regulations</li> <li>➤ report back from the forum to management advisory committees and industry</li> </ul>
<b>Brazil</b>	<ul style="list-style-type: none"> <li>➤ develop National Plan of Action</li> <li>➤ select seabird bycatch mitigation measures to be tested, based on information shared at the forum and undertake testing programme</li> <li>➤ ensure involvement of local fishers</li> </ul>
<b>Canada</b>	<ul style="list-style-type: none"> <li>➤ work collaboratively with Alaska</li> <li>➤ bring USA fishers to Canada to talk to advisory boards and share information</li> </ul>
<b>Chile</b>	<ul style="list-style-type: none"> <li>➤ present information from the forum to ship owners</li> <li>➤ propose seabird catch limits for 2001</li> <li>➤ attempt to find incentives to encourage voluntary participation</li> <li>➤ develop a plan to collect seabird bycatch data from small inshore longliners</li> <li>➤ seek funding from FAO</li> <li>➤ strengthen links with other South American nations for regional planning</li> </ul>

Fishing entity	Commitments from participants
<b>China</b>	<ul style="list-style-type: none"> <li>➤ disseminate information from the forum</li> <li>➤ collect data from distant water fleets through fishing companies</li> <li>➤ seek financial resources from FAO for data collection from Chinese fleets</li> </ul>
<b>Falkland Islands</b>	<ul style="list-style-type: none"> <li>➤ relay feelings and impressions from the forum to industry</li> <li>➤ pressure Spanish joint-venture vessels to attend next forum</li> <li>➤ develop a chat web page</li> <li>➤ share information with the South Americans on seabird bycatch mitigation measures</li> </ul>
<b>Hawaii</b>	<ul style="list-style-type: none"> <li>➤ support continued participation in the Hawaii Pelagic Longline Fishery Protected Species Workshop</li> <li>➤ test the underwater setting chute</li> <li>➤ ensure exchange of information with other fleets</li> </ul>
<b>New Zealand</b>	<ul style="list-style-type: none"> <li>➤ continue to upgrade data collection on bycatch in all longline fisheries</li> <li>➤ continue research and development of line weighting and underwater setting measures in demersal fleet.</li> <li>➤ ensure compliance with mitigation measures through vessel and skipper contracts in demersal fleet</li> <li>➤ ensure all new entrants to the tuna fishery are given information kits</li> <li>➤ include a module on seabird bycatch mitigation in the tuna longline manual</li> <li>➤ report on the global bycatch of sooty shearwaters (<i>Puffinus griseus</i>) by December 2001</li> </ul>
<b>Taiwan</b>	<ul style="list-style-type: none"> <li>➤ collect more detail for the National Plan of Action</li> <li>➤ compile educational information for captains and crew</li> <li>➤ ask government to fund technical experimentation for the distant water fleet</li> <li>➤ enhance research to investigate level of seabird bycatch</li> <li>➤ seek further information from other fishery entities</li> </ul>
<b>Uruguay</b>	<ul style="list-style-type: none"> <li>➤ integrate fishers into the seabird bycatch work underway</li> <li>➤ reward seabird band returns with Mustad caps</li> <li>➤ gain support from the National Institute of Fisheries for seabird bycatch research</li> <li>➤ host a similar forum for South American fisheries representatives in May 2001</li> </ul>
<b>Southern Ocean</b>	<ul style="list-style-type: none"> <li>➤ investigate access to CCAMLR observer database as part of the establishment of an international seabird bycatch database</li> <li>➤ disseminate information from the forum into fishers' journals and magazines</li> <li>➤ provide relevant material to the European Community to assist prompt action against IUU fishing and to improve practice by vessels of European Community countries in their and external Exclusive Economic Zones</li> <li>➤ update proposal for the global risk assessment of seabirds in relation to longline fishing, consider approaches to the World Conservation Union (IUCN) &amp; FAO</li> <li>➤ investigate with Spanish-system fishers the feasibility of adapting vessels to use underwater setting devices</li> <li>➤ continue to experiment with line weighting regimes for Spanish system</li> <li>➤ further discussion with Norwegian vessel builders on the development of through-the-hull line setting</li> </ul>

## Some references that might interest you

The following are articles found in various journals and publications that have not been included in the folder. This is not meant to be a full description of any of these papers or a complete list of papers that I have come across, but more a guide to some good ones, which are quite easily available and have relevance to the tuna fishery. In order to get a hold of these articles, you should go through your local library, using their "Interloan" service. Chances are that there will be a small library charge for the service.

### ARTICLES

*Longline Fishing – Where Are We Fishing and For What?*  
*Wade Whitelaw and Robert Campbell (1997)*  
*Asia Pacific '97 Fishing Papers, pp. 21–24*

This article discusses how new technology allows longliners to accurately target specific depths and temperatures using hook monitors (HMs), which are essentially the same as the TDRs which we have been using during this project. This paper describes average depths reached by hooks in various positions in baskets of varying sizes. It also gives tables describing the depth and temperature preferences for different species of tuna and billfish by night and day. This is an Australian paper, so things like gear setup are possibly different, but the paper gives some really interesting facts and figures about tuna fishing. Be warned: the effects of tide, current and weather often make very large differences in where your gear ends up, so the figures in this paper may not be comparable in every situation.

*Horizontal and Vertical Movements of Yellowfin and Bigeye Tuna Associated with Fish Aggregating Devices*  
*Kim N. Holland, Richard W. Brill, and Randolph K.C. Chan (1990)*  
*Fishery Bulletin 88(3), pp. 493–505*

Using ultrasonic transmitters attached to the fish, yellowfin and bigeye tuna movements were tracked in relation to Fish Aggregating Devices (FADs). This paper provides some really interesting information about where, and how far away tuna travel from FADs. It also details some interesting depth data on where yellowfin and bigeye tuna move to, over the course of the experiment.

*Hooking Time and Depth of Longline Caught Southern Bluefin Tuna Observed by Micro-BT*

*M. Okazaki*

*CCSBT-ERS/9806/10 (Convention for the Conservation of Southern Bluefin Tuna – Ecologically Related Species paper 9806/10).*

This is actually a very interesting paper, despite some translation boo-boos. Again it shows the sorts of data that can be collected using Time-Depth Recorders (they call them Micro-Bathy-Thermographs in this paper for some reason). In any case, the paper details some interesting information on where Southern Bluefin Tuna prefer to feed, and the depths that they appear to prefer at night and during the day.

*Southern Bluefin Tuna—What We Know and What We Are Doing*

*CSIRO Division of Fisheries, Australia*

*Seafood New Zealand, Nov 1995, pp. 51–54*

An excellent little article giving an overview of the major research activities, including conventional and archival tagging (like the TDRs that we use, but stuck on or in the fish themselves), sexing and aging and reproduction of the fish. There is some great information in this article, and in fact the whole November 1995 issue of Seafood New Zealand would be well worth getting hold of: it includes a tuna fishing supplement containing, among other interesting articles, the New Zealand Longline Tuna Fishery Code of Practice 1995. The issue also includes some interesting notes on the seabird conference of the same year, and also the tori line article that is included in this folder.

## WEB PAGES

These are sites that may be of interest to you. If you do not have a computer and internet connection of your own, the local library or cyber-café will probably be able to help you out.

Firstly, the Department of Conservation website. From here you can find regular updates of what projects we are working on, and information on why conservation of our native plants and animals is so important.

<http://www.doc.govt.nz>

There is truly a huge amount of information to be found on the internet on the subject of tuna fishing, unfortunately, not much of it comes from New Zealand.

The Ministry of Fisheries website is the place to go and learn more about how the fishing industry is controlled, what the long-term plans are for the industry, who controls what, and information on



everything from the QMS to permits. Probably a good place to get to know, if you want to learn more about how the industry works from the inside.

<http://www.fish.govt.nz>

The seafood industry council is a good place to get an industry perspective of what is happening. This website includes links to the Seafood New Zealand Magazine site.

<http://www.seafood.co.nz>

The Tuna Research and Conservation Centre site has some interesting information about satellite tagging of Atlantic bluefin tuna on the eastern coast of the United States. This is the site that provided the article on satellite tagging and tracking that is included in the folder:

<http://www.tunaresearch.org>

This site also provides an incredibly detailed, full scientific paper (free!) on data recovered from the archival tagging programme so far. Some amazing information here:

<http://www.tunaresearch.org/tagagiant.html>

<http://www.tunaresearch.org/popuptuna.html>

<http://www.tunaresearch.org/popup.html>

For the paper detailing findings using archival tagging:

<http://www.tunaresearch.org/9384.pdf>

The CSIRO tuna pages (based in Australia) give some interesting information about projects occurring a little closer to home.

<http://www.nexus.edu.au/schools/plhs/PLHSTUNA.HTM>

CCSBT Home page (Convention for the Conservation of Southern Bluefin Tuna): among other things this site details the agreement between New Zealand, Australia and Japan.

<http://www.home.aone.net.au/ccsbt/>

For an American perspective on the tuna industry, try the NOAA site (roughly the American equivalent of NIWA here)

<http://www.sefsc.noaa.gov/>



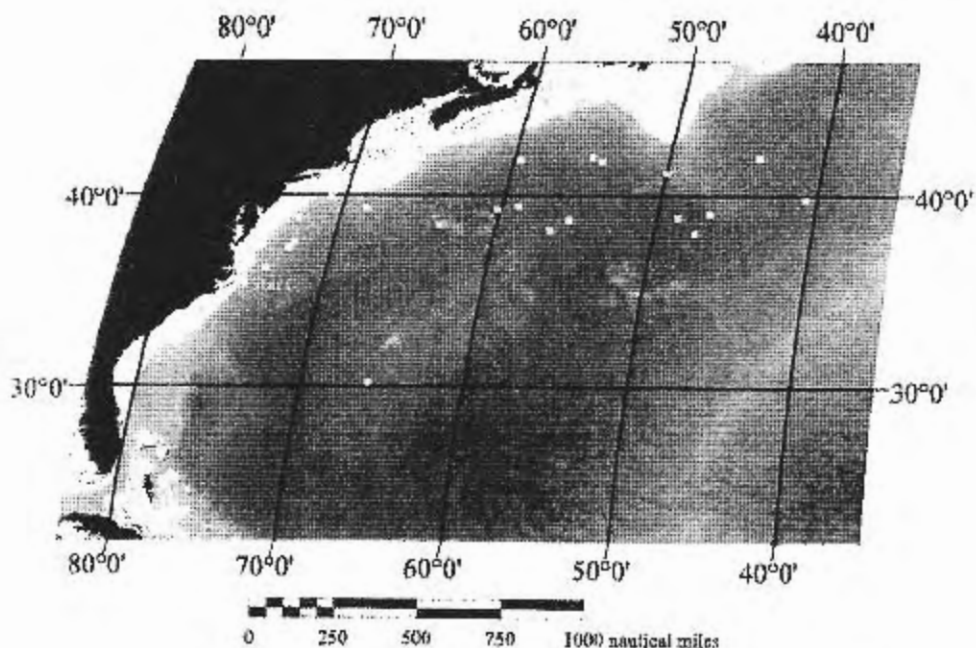


## Appendix 1: New Satellite Tags track movements of Atlantic bluefin tuna

(Article from Tuna Research & Conservation Centre)

A new satellite tagging technology has proven that it can help resolve the mysteries of tuna migration at a time when management strategies for these remarkable and commercially valuable fish are in dispute and their breeding population is in sharp decline.

The microprocessor tags, deployed in 1996 and 1997 by scientists from Stanford University, the Monterey Bay Aquarium and the National Marine Fisheries Service, revealed that tunas tagged off Cape Hatteras, N.C., were able to move as far as 1,670 nautical miles in 90 days - and that some fish crossed the line separating eastern and western management zones for the bluefin fishery.



"The results of our work indicate that pop up technology works, and that survivorship is high. The fact that the bluefin spread out in 90 days across the western Atlantic and into the western margins of the eastern Atlantic management zone indicates these fish are on the move," said Dr. Barbara Block of the Tuna Research and Conservation Center (TRCC), a collaborative effort between Stanford University and the Monterey Bay Aquarium. The findings

appear in the Aug. 4 issue of the Proceedings of the National Academy of Sciences.

The new tags, called satellite pop-up tags, pop free of the fish at a preprogrammed time, float to the surface and beam their accumulated data via satellite to scientists in the lab, revealing where the fish moved and what ocean temperatures they favored.

Giant bluefin tuna, often fetch between \$3,000.00 and \$45,000.00 apiece in the Tokyo seafood market, currently are managed as two separate Atlantic stocks with limited mixing between the western and eastern Atlantic. Using this management strategy, breeding stocks in the western Atlantic have declined by more than 80 percent over the past 22 years, and eastern Atlantic bluefin of similar ages have fallen by 50 percent during the same period.

Western Atlantic tuna are managed under a strict annual quota; eastern Atlantic bluefin have been managed under catch quotas only since 1995, with a 25 percent reduction to be fully implemented this year. "It's now possible - and imperative - to make use of satellite tag technology to determine the extent of transatlantic migrations," Block says. "In that way, management strategies can reflect fish behavior in the real world. With this technology it will be possible to manage giant bluefin tuna so mature breeding stocks could recover in our lifetime." A 1994 report by the National Research Council recommended that fisheries scientists test the stock structure theories to confirm whether bluefin tuna are one or two stocks in the Atlantic Ocean. "We believe that the advanced tagging technologies currently being applied to Atlantic bluefin tuna could provide essential information for resolving questions about the existence of one or two management units," added Eric Prince, chief of the migratory fishery biology division of the National Marine Fisheries Service in Miami, Florida.

According to Block, the satellite tags can be used to provide similar information about other pelagic fish species whose lives are equally mysterious. To date, she and her colleagues have put the tags on bluefin and yellowfin tuna, blue and striped marlins and salmon sharks. What sets the satellite tags apart from other fish-tagging methods is the fact that scientists can recover the data without relying on tagged fish being caught and the tags voluntarily turned in to their labs by fishermen.

Historically, about 13 percent of conventional bluefin tags; have been recovered. In the 1996 and 1997 experiments, data were recovered from 35 of 37 satellite tags. Importantly, this indicates high survivorship of the tag-and-release fish.

The tags were developed in collaboration with Paul Howey of Telemetry 2000, Inc. Tagging took place in a collaboration among the TRCC, the National Marine Fisheries Service and the recreational fishing community off Cape Hatteras. The research was financed by

the National Marine Fisheries Service, the Packard Foundation, the MacArthur Foundation, and the National Science Foundation.

Wild fish up to 234 kg were tagged at Cape Hatteras with techniques developed using captive yellowfin tuna at the TRCC. Extensive work with captive tunas demonstrated that the tags can be attached without harm to the fish, either in the lab or in the field.

Data from the 1997 study found that two out of the 37 bluefin tuna crossed between management zones and four additional bluefin were within 5 degrees longitude of the stock boundary meridian.

Researchers with the TRCC and NMFS plan to tag between 600 and 1,000 giant Atlantic bluefin tuna by the year 2000. This will enable them to rigorously test the stock structure hypothesis.

