

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

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*Molloy, Walsh, Barnes*

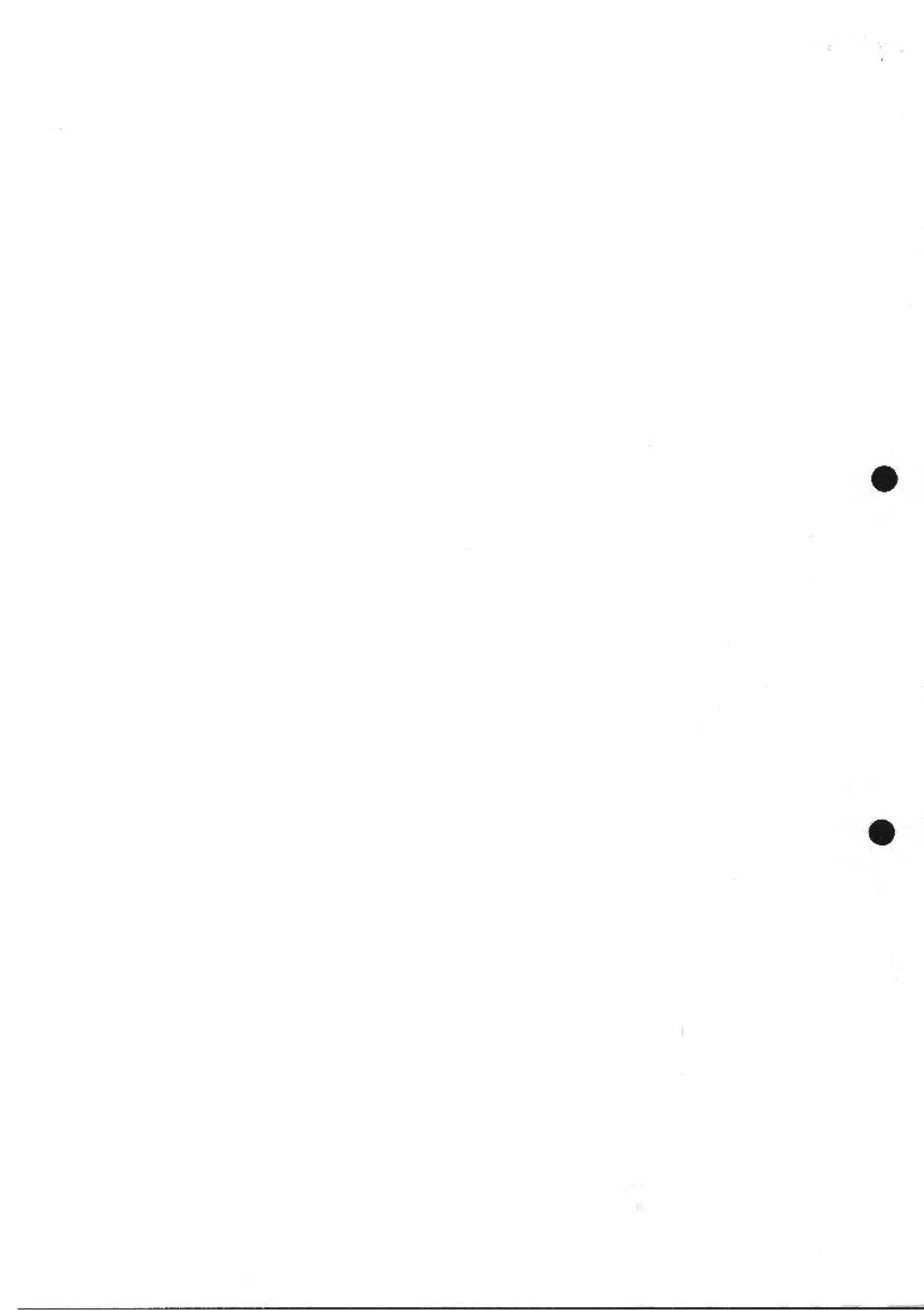
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# Developmental stages of the underwater bait setting chute for the pelagic longline fishery

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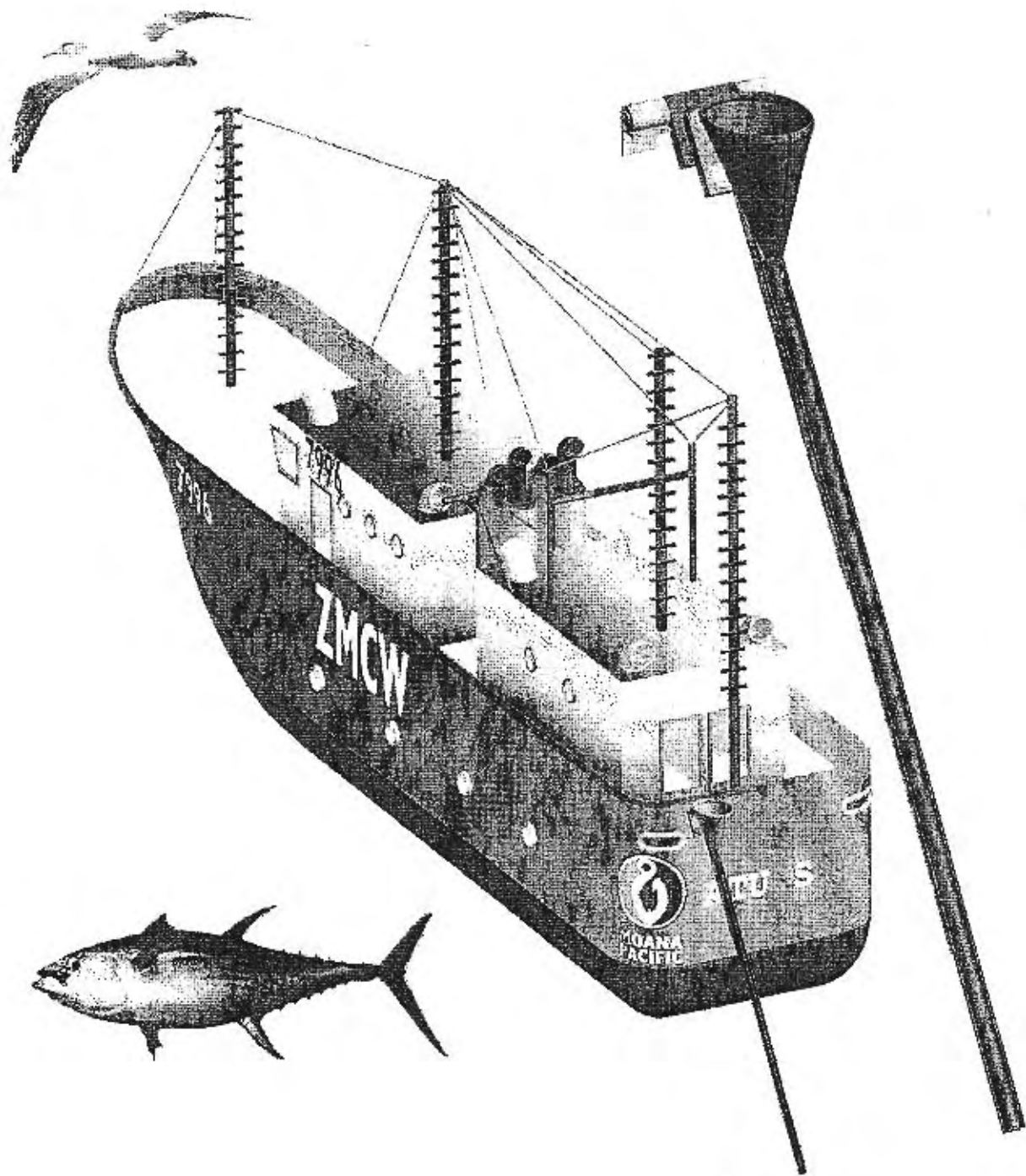
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FRONTISPIECE. DIAGRAM OF AN UNDERWATER BAIT SETTING CHUTE IN PLACE ON A PELAGIC FISHING VESSEL.

# 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.

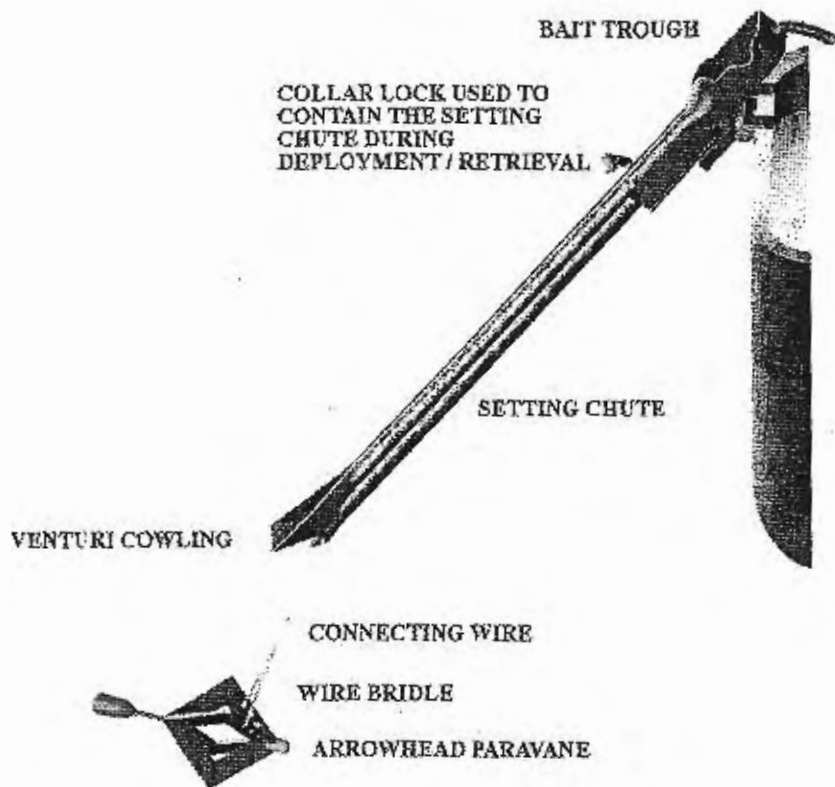


FIGURE 1. UNDERWATER BAIT SETTING CHUTE, SHOWING PARAVANE IN USE.

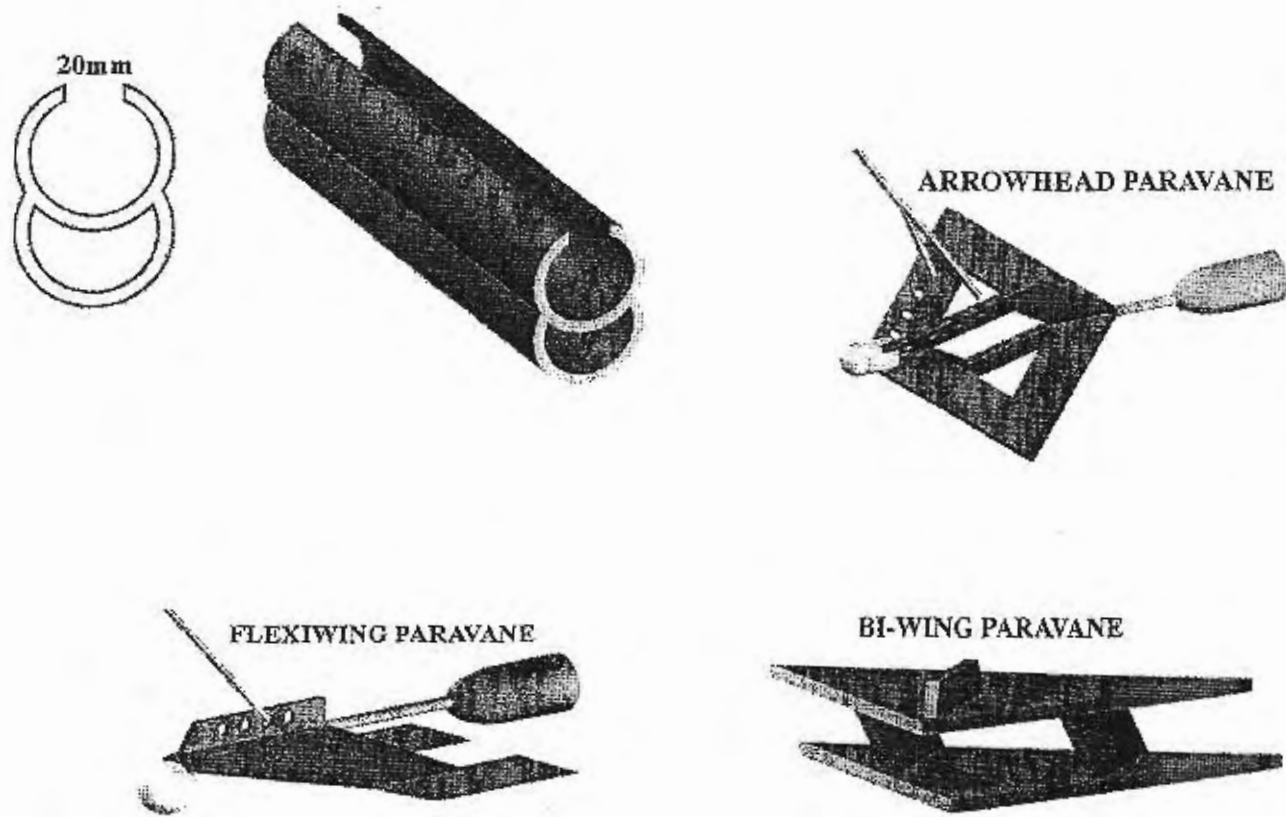


FIGURE 2. CROSS-SECTION OF SETTING TUBE TESTED ON THE FV DANIEL SOLANDER, AND PARAVANES USED: TOP RIGHT, ARROWHEAD ; BOTTOM LEFT, FLEXI WING; BOTTOM RIGHT, BI-WING.

FIGURE 3. HINGE ASSEMBLY FOR THE CHUTE

PORT AND STARBOARD HINGE PIN

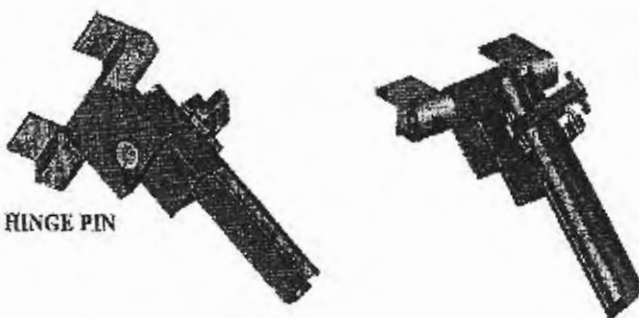
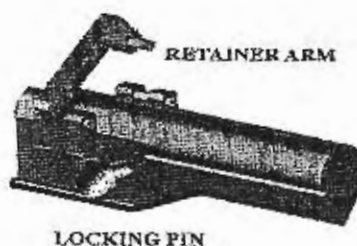


FIGURE 4. SPLIT COLLAR SYSTEM FOR SECURING THE CHUTE IN POSITION.



### 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.

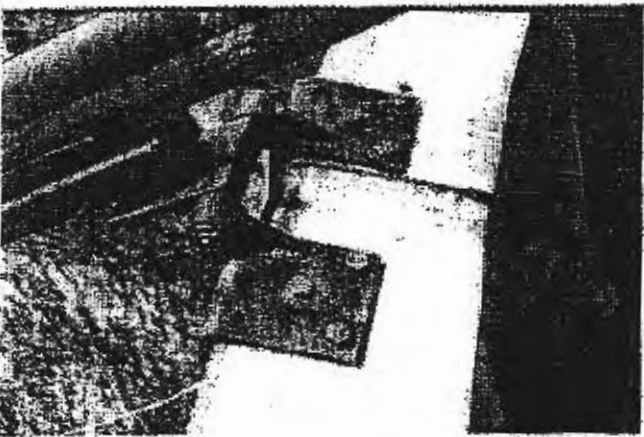
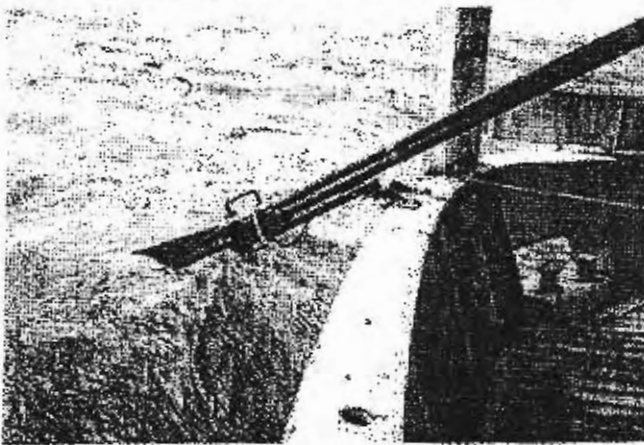
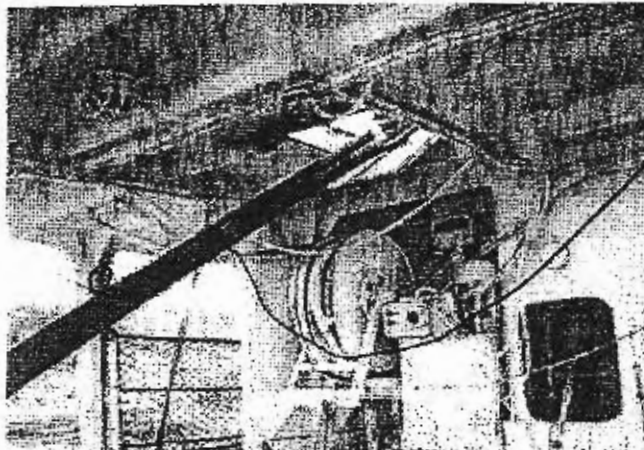
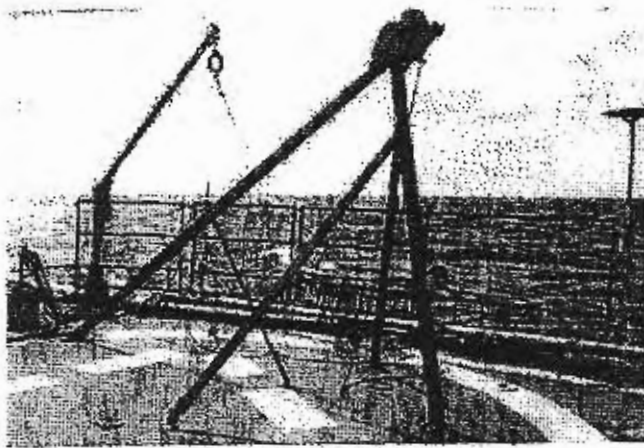
The chute, when fully retrieved, extended from about 1 m over the transom, up through the helideck, along the full length of the angle iron guide to where the trough rested on top of the A frame. It was secured in place by a pin through the lower end of the chute.

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



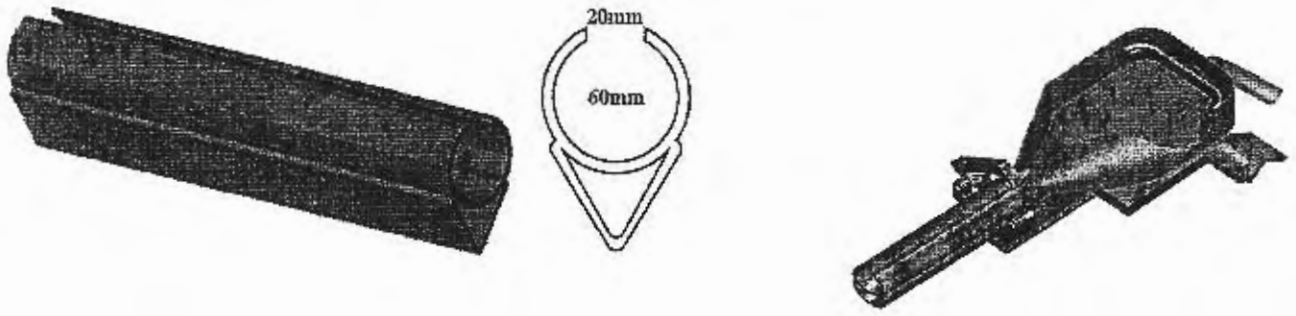


FIGURE 6. (ABOVE LEFT) CHUTE DESIGN AND (RIGHT) TROUGH USED ON F.V. *BRENDA KAY*.

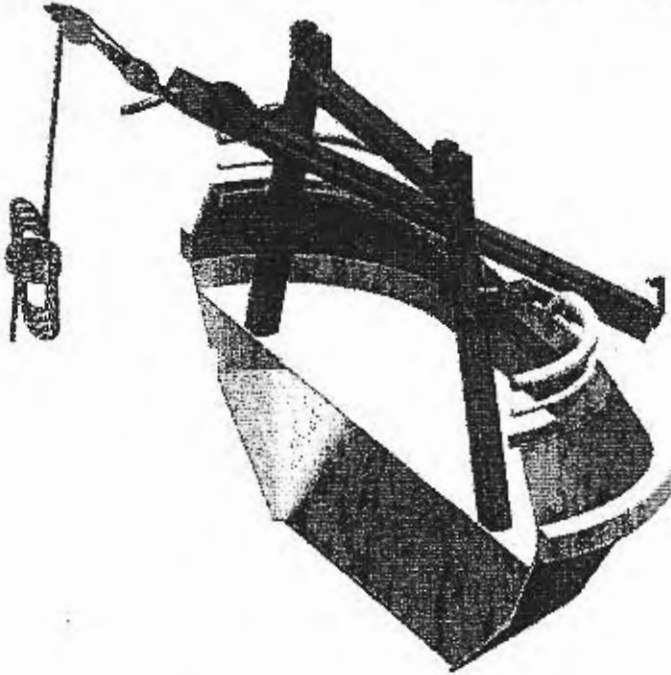


FIGURE 7. DEPLOYMENT AND RETRIEVAL SYSTEM USED ON F.V. *BRENDA KAY*. THE HOISTING GEAR WAS ATTACHED TO THE MAST ABOVE THE WHEELHOUSE. AN EXISTING GANTRY ON THE VESSEL CAUSED SOME OBSTRUCTION TO THE CHUTE.

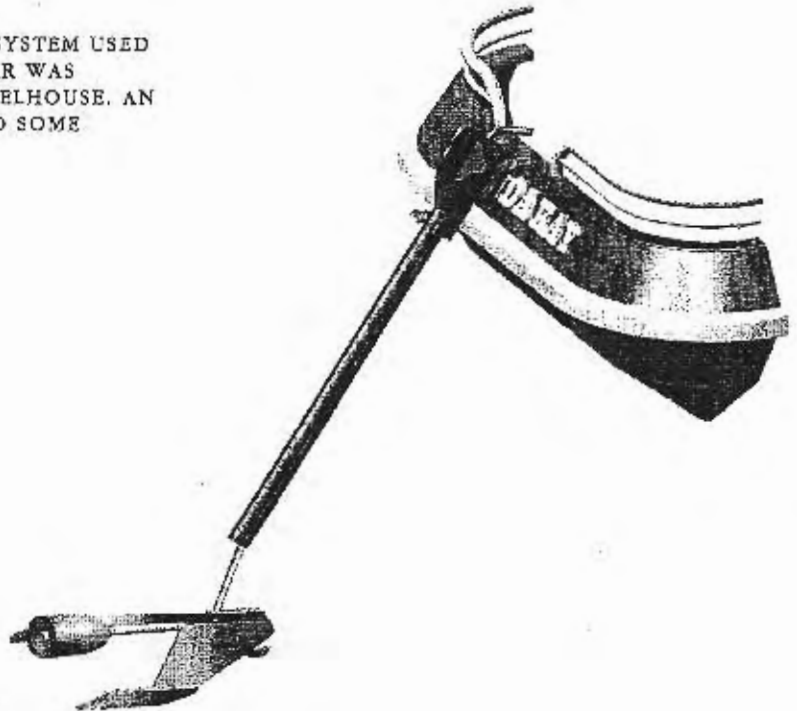


FIGURE 8. CHUTE IN USE ON F.V. *BRENDA KAY*. THE HANDRAIL HAD TO BE RECESSED TO ALLOW FOR IT.

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.

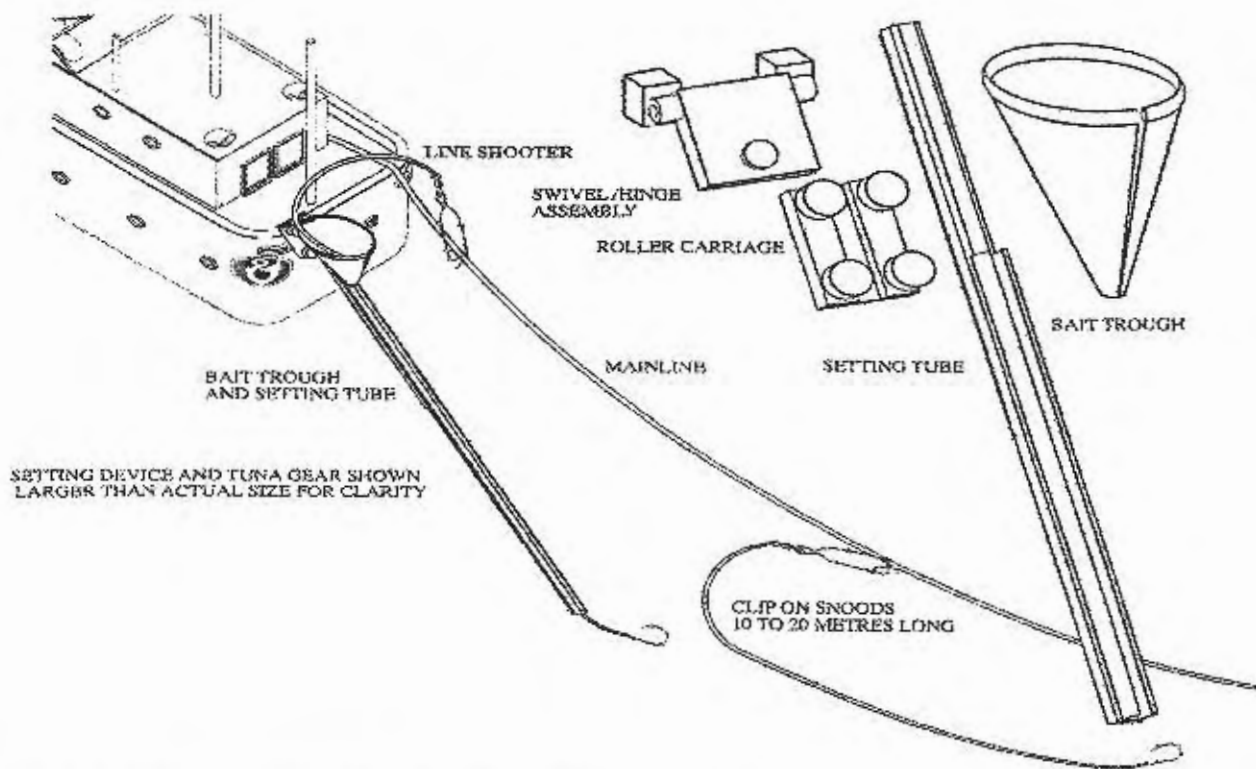


FIGURE 9. UNDERWATER SETTING CHUTE IN USE ON F.V. ATU S.

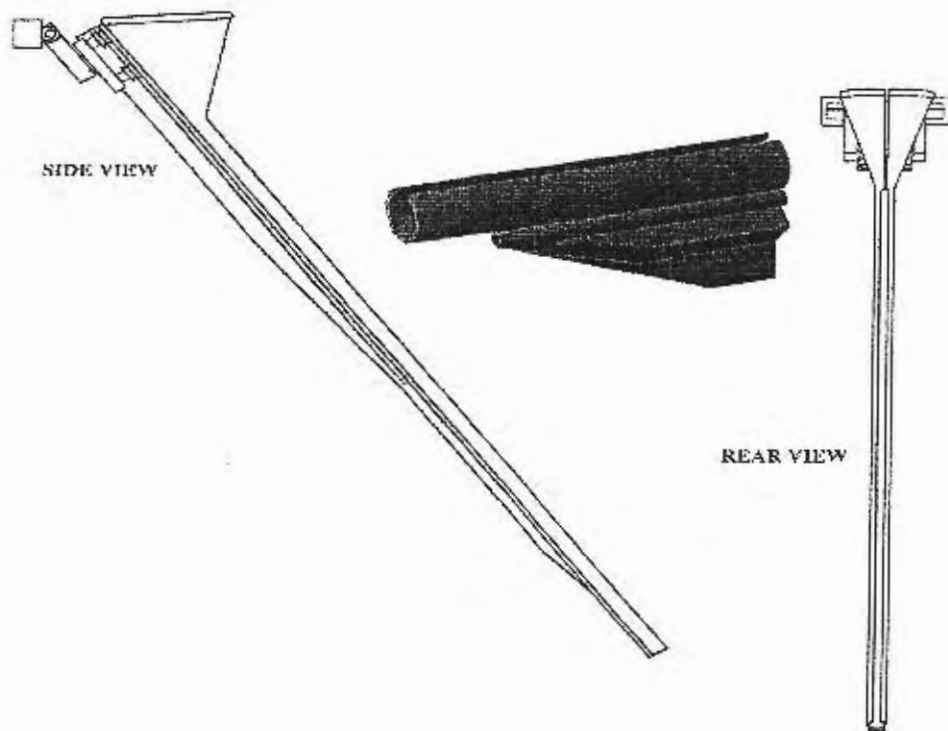


FIGURE 10. VIEWS OF THE CHUTE.

### ***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.

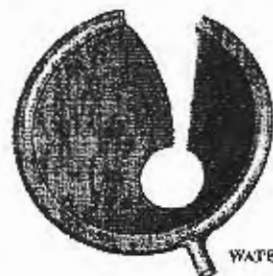
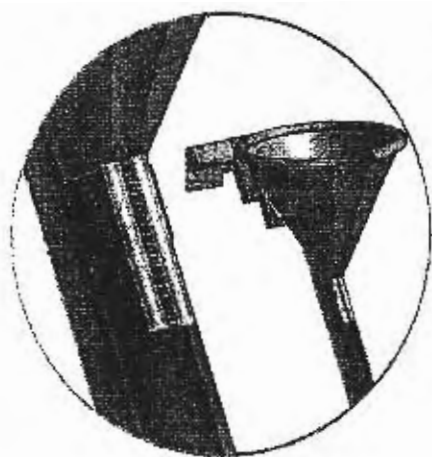
The chute was then deployed and used during a normal setting procedure. After 13 minutes of setting, the mainline carried across the transom to the chute and become tangled around the shackles connecting them. The skipper removed the chute and continued shooting in the normal manner. Details of the trial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

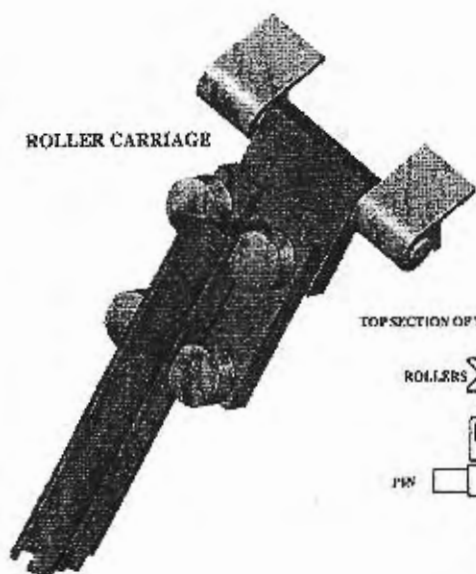
Date	Start time	Finish time	Start position	Finish position	Wind speed	Wind direction	Swell height	No. of hooks	Vessel speed	Line speed
17/2/98	1950	2320	35° 17' S 172° 14' E	35° 24' S 172° 26' E	15 kt	N	2.5 m	840	8.5 kt	12.5 kt



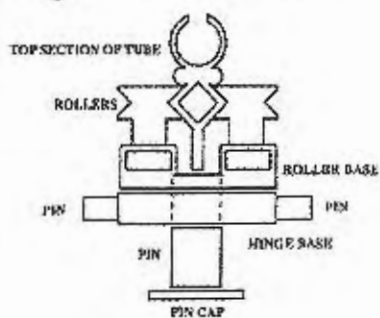
WATER INLET

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

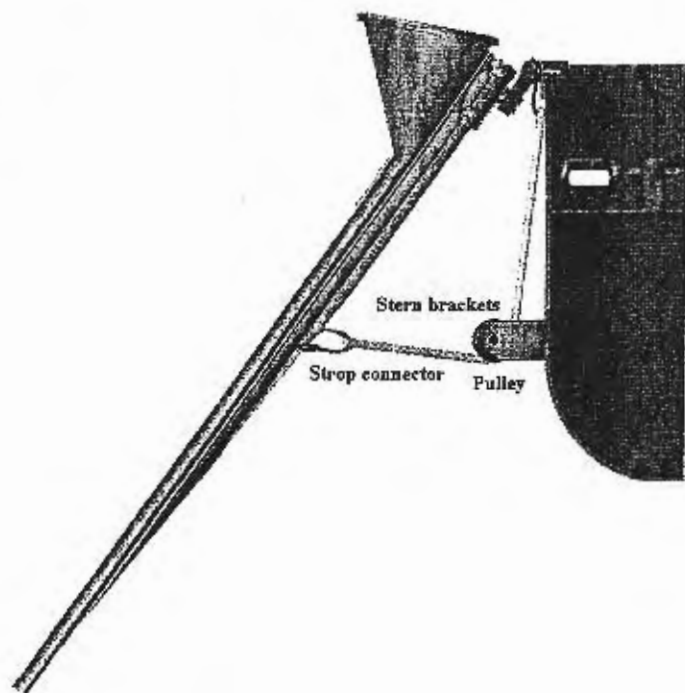
PIN

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.

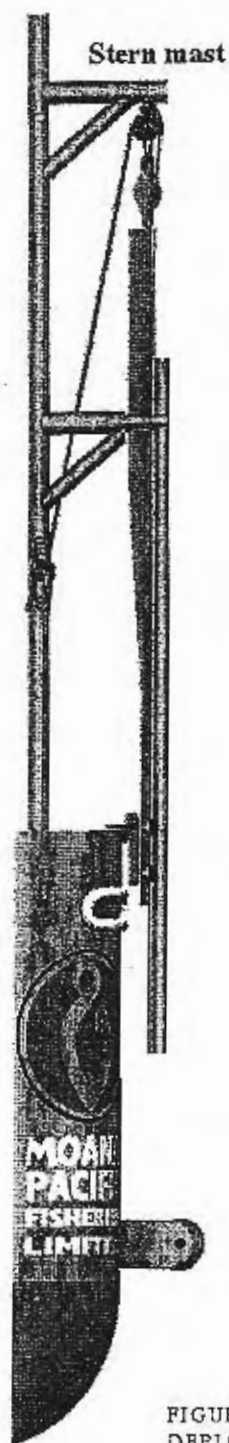


FIGURE 14. FIRST DEPLOYMENT AND RETRIEVAL SYSTEM USED ON F.V. ATU S.

## 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.

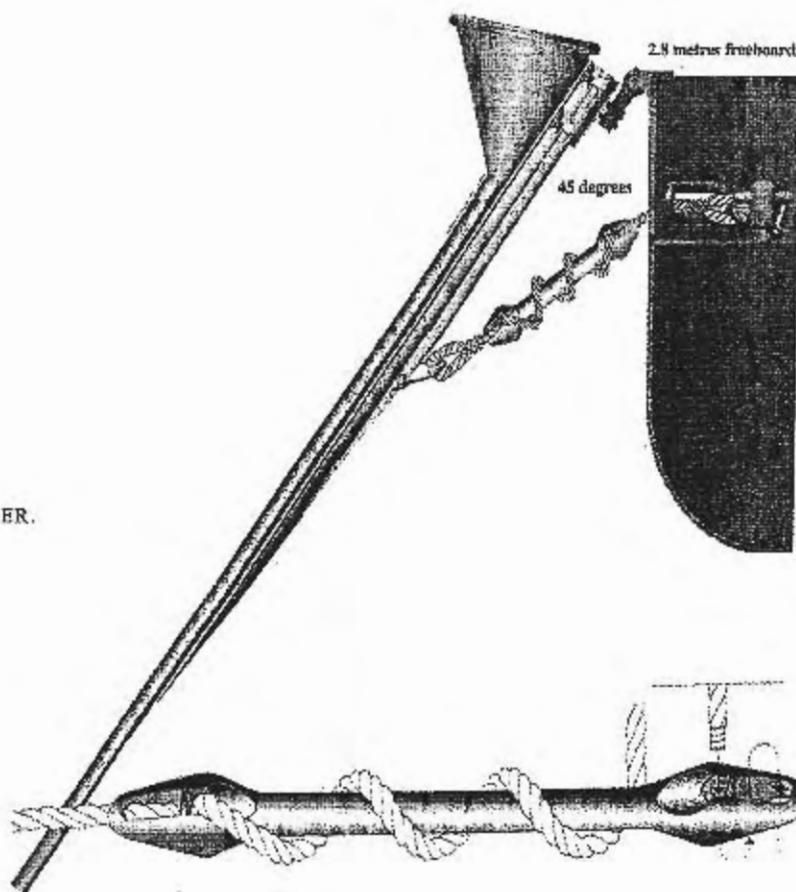


FIGURE 15. VIEW OF THE SHOCK ABSORBER.



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.

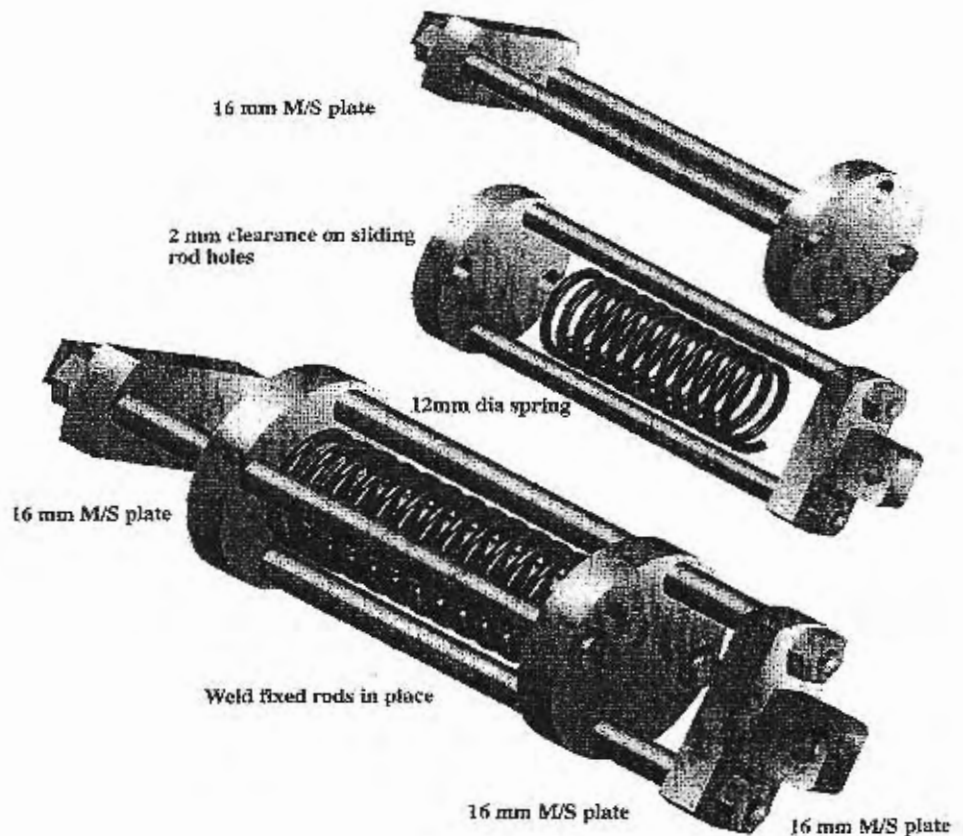


FIGURE 17. IMPROVED SHOCK ABSORBER USING A STEEL SPRING.

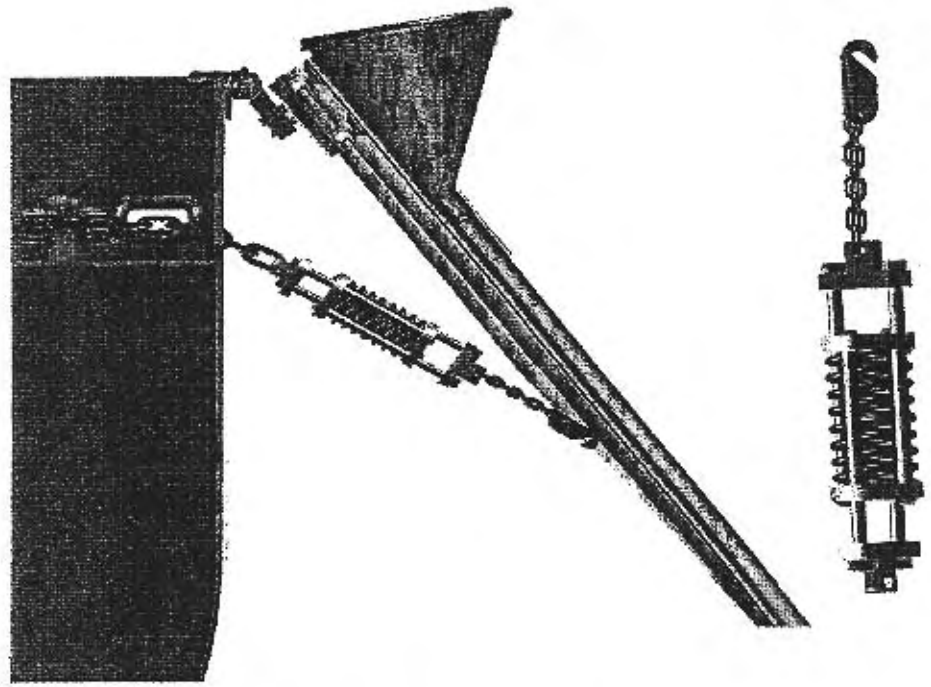


FIGURE 18. SPRING SHOCK ABSORBER CONNECTED TO THE CHUTE.

### 3.5 BAIT SETTING TIMES

*by K. Walsbe*

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.

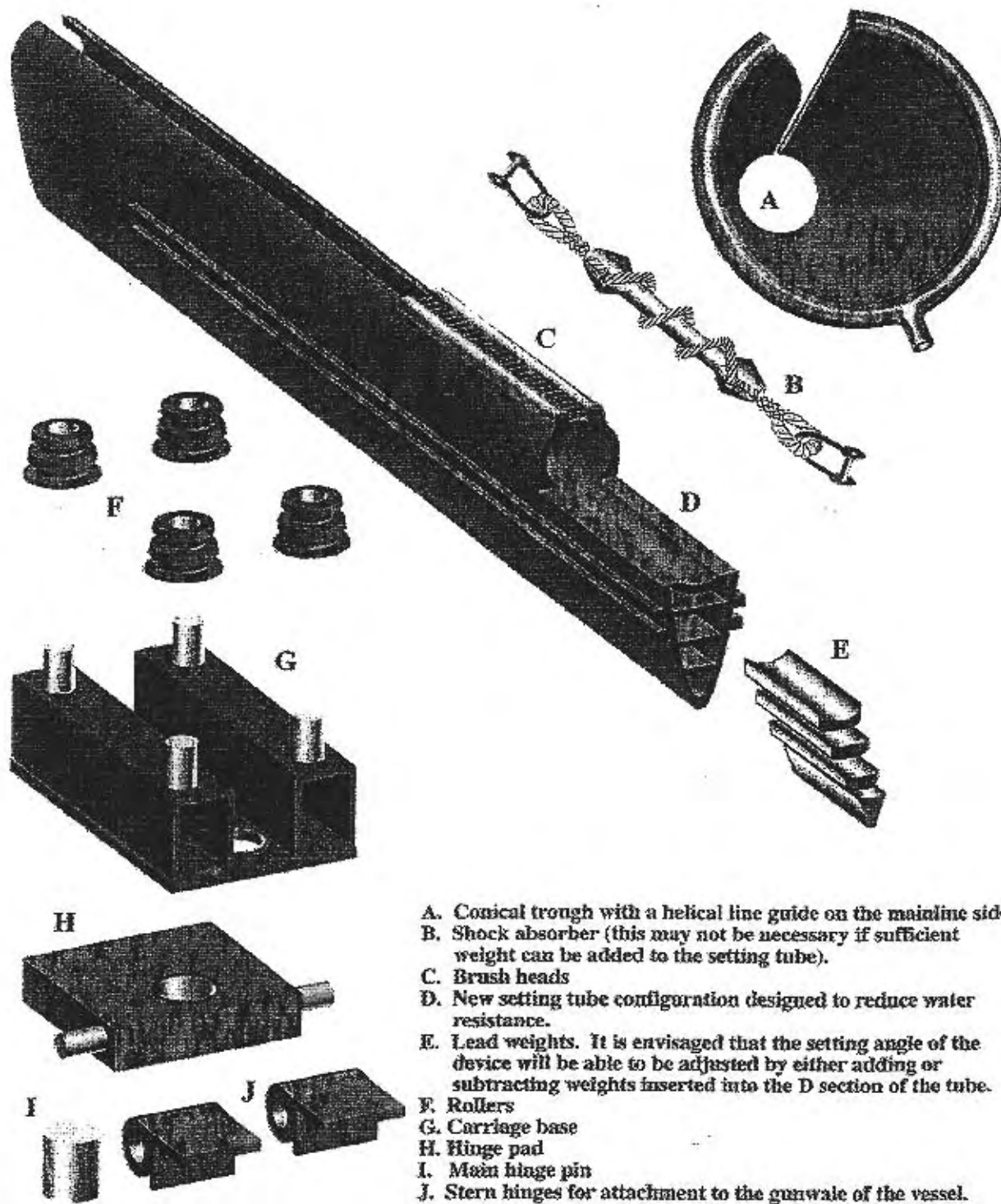


FIGURE 19. PROPOSED DESIGN OF A CHUTE, USING EXPERIENCE GAINED FROM SEA-GOING TRIALS.

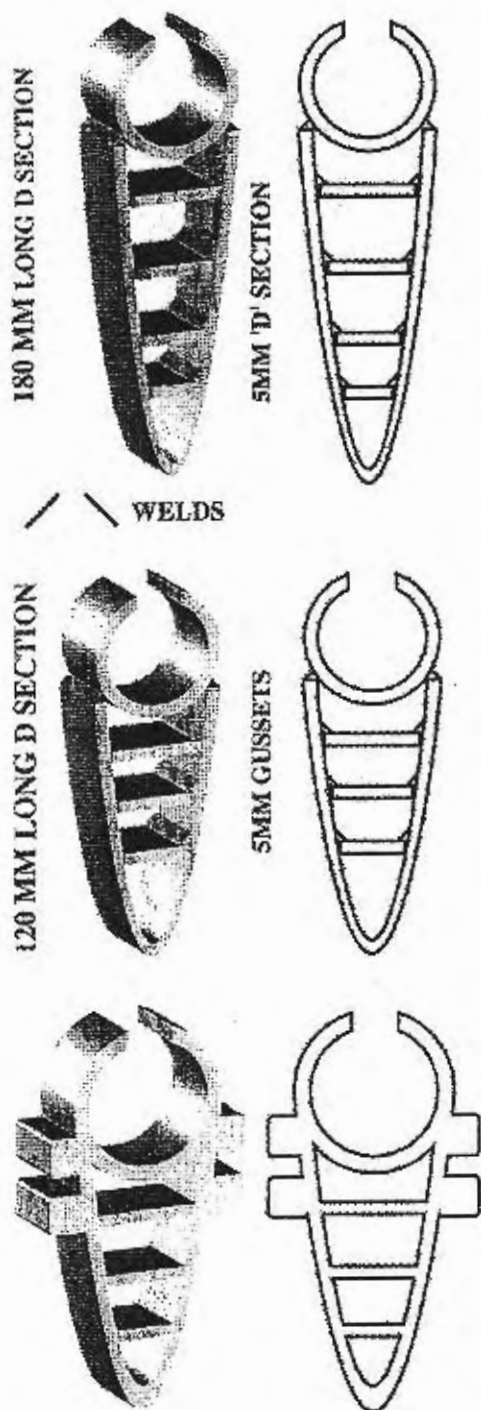


FIGURE 20. PROPOSED IMPROVED CROSS-SECTIONS TO THE CHUTE.

### 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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