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A LINE - FISHING SURVEY OF THE FISHES OF THE SOUTH - EASTERN AUSTRALIAN CONTINENTAL SLOPE

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CONTENTS

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A LINE-FISHING SURVEY OF THE FISHES OF THE SOUTH-EASTERN AUSTRALIAN CONTINENTAL SLOPE

By

T.R. Cowper and R.J. Downie

Summary

An account is given of the results obtained from deep longlining and droplining with galvanized, flexible steel lines on the continental slope of south-eastern Australia.

Droplining with a vertical line of 25 hooks exceeded the catch rate obtained from longlining with a 200 hook groundline, by 45%. The dropline however operated almost exclusively on one species, *Hyperoglyphe porosa* (deep-sea trevally), hitherto considered rare in its occurrence.

The success of the droplining technique suggests that the stocks of deep-sea trevally, off the east coast of Tasmania at least, could be exploited commercially.

I. INTRODUCTION

The first account of systematic deep-water and continental slope exploratory fishing in Australian waters appeared in a pamphlet (Dannevig 1913) summarizing the trawling survey of the Fisheries Investigation Ship "Endeavour" during the period April 1909 - August 1913. Trawling operations were conducted in the eastern or Pacific area off the coasts of New South Wales, Victoria, and Tasmania, and in the Great Australian Bight area off the coasts of West and South Australia, in depths sometimes in excess of 200 fm. McCulloch (1914, 1915) published records of a number of species taken on the continental slope. Following this exploratory work of the F.I.S. "Endeavour" commercial trawling developed - initially in the eastern region and later in the Great Australian Bight, but confined almost exclusively to the waters of the continental shelf.

It was not until December 1949 that interest was revived in the possibilities of fishing on the continental slope. The Fisheries Research Vessel "Liawenee", under charter at that time to the CSIRO Division of Fisheries, was engaged in longlining for school shark (*Galeorhinus australis*) on the edge of the continental shelf east of Flinders I. in Bass Strait. A shot set over a depth range of 90-230 fm resulted in the capture of two deep-sea trevally (*Hyperoglyphe porosa*, Fig. 1), a species recorded from deep water in both areas surveyed by the "Endeavour". In April 1950, a longline shot in depths of 280-400 fm west of King I., Tasmania, captured not only deep-sea trevally but also ling (*Genypterus blacodes*) and deep-sea cod (*Mora mora*).

A chance discovery of deep-sea trevally off the east coast of Tasmania was reported by Challenger (1948), and a similar occurrence later (Anon 1951*a*) initiated the investigation of this resource by the Tasmanian Department of Agriculture and Fisheries. A subsequent report (Anon 1951*b*) stated that the Fisheries Division of the CSIRO had been deep-longlining in Tasmanian waters since April 1950 as an extension to the school shark longlining programme, and had taken deep-sea trevally, ling, and deep-sea cod together with a number of species of associated elasmobranchs.

In August 1952 this work was placed on a rather more systematic basis in an attempt to determine the bathymetric and seasonal distribution of these species as well as to collect data for a biological study. Fishing stations on the continental slope were selected within easy access of major fishing ports such as Eden (N.S.W.), Triabunna (Tas.), and Port Fairy (Vic.), and fishing carried out whenever the F.R.V. "Derwent Hunter" was working the particular area. Until June 1954 however, it was found that due to adverse weather conditions, shortages of bait, and other cruise requirements, periods devoted to fishing were not as regular or as frequent as desired. From that time onwards quarterly cruises were planned, devoted almost entirely to slope fishing. To minimize time spent in steaming, only Tasmanian east coast stations were worked since they were within easy steaming distances of ports and anchorages along an 80-mile section of that coast.

The continental shelf of south-eastern Australia does not extend very far from the coast and at the majority of stations worked, extends only from 10-15 miles seaward. The edge of the shelf occurs generally at depths ranging from 70-100 fm. It then falls away rapidly on a gradient of about 100 fm per nautical mile as the continental slope. However, in those areas found to be most productive of deep-sea trevally, ling, and deep-sea cod, the fall may be much greater than this for in some localities the slope consisted of a series of benches connected by falls so steep as to be almost precipitous. Throughout the survey fishing was carried out at various depths over the slope, the deepest shot being between 550 and 600 fm off the west coast of King I.

II. *GEAR, FISHING METHODS, AND LOCATION OF FISH*

(a) Conventional Longlining

The conventional longlining gear has been described (Downie 1953).

The ground and buoy lines were of Australian-made galvanized, flexible, 6/19 steel wire, the ground line being 3/8 in. and the buoy line ½ in. in circumference with breaking strains of 10 and 15 cwt respectively. As a preservative measure the lines were treated with wire rope lubricant as necessary.

The ground line (Fig. 2) was made up in 100 fm lengths which were clipped together as required. Hook spacing was achieved by moulding lead ball stops on the wire at intervals of 3 ft so that the hooks (sizes 10/0, 11/0, and 12/0) could be spaced at any desired distance apart (normally 2 fm) as the line was paid out. The ball stops were moulded directly on to the wire by a split, hinged mould and swaged tight where necessary.

Buoy lines were made up in 10, 20, 50 and 100 fm lengths and were clipped together in various combinations according to the depth of water worked. Lines were clipped together with the link clip (Fig. 3) which is commonly used on Danish seiners and on some crayfishing boats.

Snoods, made up from 96-thread cotton, were clipped on to the groundline with the safety-pin clip (Fig. 4) of the type formerly in common use with Australian longline fishermen. The use of this clip, for various reasons, has been discontinued by most fishermen, but on a wire line it has been found to be quite satisfactory.

The lines were hauled directly on to reels, each of which held 1,000 fm and weighed slightly more than 200 lb. Ground and buoy lines were hauled on to the same reel since hook snoods were unclipped from the groundline as it was hauled.

The reels (Fig. 5) were fabricated from mild steel and marine ply, the centre of the reel being 3 in. diameter pipe which formed the hollow central spindle. Mild steel flanges 6 in. in diameter were welded 1 in. from the ends of the pipe and to these flanges were bolted the sides of the reel which were made from 3/4 in. marine ply. Each reel engaged in lugs on the winch shaft and was secured by a flange-headed bolt screwed into the central axis of this shaft. The reels were therefore easily detachable from the winch.

The deck layout of the "Derwent Hunter" was such that the lines could be shot only over the quarter, though shooting directly over the stern is preferable. The winch, which was operated hydraulically, was used in shooting, the lines paying out directly from the reel over a fairlead on the quarter, and the hook snoods clipped on as the line paid out. The baited hooks were stowed in a 3 compartment galvanized iron trough (Fig. 6) along one side of which was a ½ in. mild steel rod to accommodate the hooks arranged in order for shooting.

Shooting the line over the quarter left room for only one man to clip on, whereas in a vessel suited for stern shooting two men could clip on alternately, thereby doubling the speed of shooting.

Normally, a groundline carrying 200 hooks spaced at 2 fm intervals was shot up the slope. Only the deeper end, i.e. the end shot first, was weighted, the sinker used being a bag of sand. The buoyed end of the line was therefore only a continuation of the groundline, albeit without hooks. This method of shooting allows for unexpected variations in the depth of water in that the entire line from sinker to buoy is, in effect, a buoy line; most necessary when it is considered that the line may be swept some distance by currents before finally settling on the bottom.

After 2 hours the line was hauled from amidships over a roller at the rail, the hook snoods being unclipped out-board of the roller so that the whole line could be wound compactly on to the reel. The gear was then ready for re-shooting.

(b) Droplining

This method of fishing aboard the "Derwent Hunter" (Fig. 7) was evolved and described by Downie (1955) and has proved most successful in the capture of the deep-sea trevally (*Hyperoglyphe porosa*).

A wire line carrying 25 hooks was lowered and hauled in the same manner as a handline without releasing it from the winch reel. The first 25 fm of the wire line was fitted with lead ball stops as for the conventional longline and to this portion only were the hooks attached. A 70 lb sinker was used and the line fished vertically with the sinker just clear of the bottom.

An unencased lead sinker was not very useful since it rapidly became deformed through contact with the bottom. It was most helpful when "feeling" the bottom that the sinker should stand upright since one that fell on its side when striking bottom gave the illusion of good bottom when in fact it may not have been there, or conveyed the impression that fish were biting. The sinker found to be most successful was a lead-filled 4 in. diameter steel pipe, the bottom end being closed by a steel plate and the top fitted with a handle; in effect, a narrow cylindrical bucket. By casting the lead filling in sections it was possible, by adding or removing sections, to adjust the weight of the sinker to suit prevailing conditions.

The wire line was 3/8 in. circumference, 6/19 galvanized, flexible wire and on the "Derwent Hunter" sufficient line was carried to fish to a depth of 1,000 fm.

In addition to the line, an echosounder recording to 720 fm and a revolution counter to measure the amount of line paid out were used. Without an echosounder it would be difficult and time consuming to locate suitable hard bottom and in the absence of a wire metering device difficulty would be experienced in lowering at speed the correct length of wire without fouling the bottom.

When fish were present their "bites" were easily detected by placing a hand on the wire line and, having allowed them to "bite" for 5-10 min. the line was hauled with its catch of fish.

(c) Location of Fish

Fishing demonstrated that the three main teleost species encountered throughout this survey were not uniformly distributed over the continental slope, though it was not until the technique of droplining was introduced that this condition was fully established. Droplining facilitated the working of gear over any desired range of depth, though normally, and this is its main operational advantage over conventional longlining, it was worked over a very limited depth range. By working up or down the slope at small intervals of about 10 fm it was possible to locate fish, and having done so, determine their distribution up and down the slope.

Considerable variations in catch resulted from relatively small changes in depth at any one locality, and as the slope was traversed isolated patches of fish were encountered. This patchy distribution of the fish was attributed to the nature of the slope floor over which they foraged, for it was noted that good catches of fish were taken only off a hard, rough, and broken bottom as indicated by echosounder traces, occasional samples of bottom brought up on hooks, bent or broken hooks, and sometimes fouled gear.

Echosounder traces of the areas fished not only provided continuous depth records but indicated the type of bottom from which fish were most likely to be taken, and eliminated considerable loss of time in shooting gear over relatively sterile and unproductive bottom. At no time while echosounding over depths from which these fish have been taken were any traces positively referable to fish; however some questionable traces appeared while fishing in 400 fm west of King I. in April 1950. Since that date numerous traces of the slope have been obtained between 100 fm and 400 fm and of these only two have shown traces which may have been caused by fish. However, since they were obtained from depths considerably less than those from which the deep-sea trevally, ling, and deep-sea cod have been taken consistently, it was concluded that they were attributable to some other species. On one occasion several specimens of king barracouta (*Rexea solandri*) were taken just prior to the appearance of such a trace.

Typical echographs of the type of bottom from which fish were normally taken in fair quantities are shown (Fig. 8, 9 and 10). These traces were obtained from a Kelvin Hughes MS.24E instrument having a range of 0-720 fm by phases of 160 fm and were recorded while the vessel was drifting with a drop-line of 25 hooks fishing off the bottom.

Echographs of the slope floor were normally of two distinct types; one indicating an even, comparatively smooth bottom denoted by a single line trace progressively fading as the stylus passed over the paper; the other similar to those illustrated, i.e. multiple non-parallel traces having varying degrees of cross-over and confusion. The latter type of trace, similar to those obtained by the R.R.S. "Discovery II" from the continental slope off Otago Harbour, New Zealand, and from the mid-Atlantic Ridge (Herdman 1948, 1955), was assumed to indicate a hard, rough, and confused bottom giving off a number of side echos which produced multiple traces on the record paper. It was on such bottom that the 70 lb sinker sometimes fouled if allowed too much line and from which longlines were either lost completely after having fouled the bottom, or recovered whole or in part having many hooks lost, broken, or bent after engaging such bottom. Occasionally samples of this bottom were brought up on hooks, among these being rock fragments, hydroid corals, and shell, confirming in part any assumptions as to the nature of the bottom.

III. AREA SURVEYED AND SPECIES ENCOUNTERED

(a) Fishing Stations

All stations worked throughout the survey are plotted in Figure 11 though those closely grouped off the east coast of Tasmania were sampled most frequently and regularly thus supplying the bulk of the data. The area surveyed extended from Port Stephens off the coast of New South Wales, southwards to

TABLE 1

NUMBER OF SPECIES ENCOUNTERED AT EACH FISHING STATION

*Specimen Encountered	Fishing Stations																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
1								1			1													2
2		2			7	3		33	1	28		1	1	2				6	4	4				92
3			4	20		1		24				7			3		26	124	96	70	12	31	3	421
4				1		3		4									7	5	7	4	1	1		33
5	21		8	14	38	6		47	1	26	5	29	4	4	15	2	4	51	105	55	6	12	7	460
6					1	1		2																4
7					7	3	2						2			2			1					17
8						1												4						5
9		33		6	1	1												1		54		4		100
10																1								1
11		1			6	8		22					3			3		8	2	4				57
12						20	2																	22
13						6		4				1												11
14					2									1										3
15																		6						6
16							1																	1
17		5		13	34	59	1	59	16	10			27	6	3	29		17	40	11				330
18						2									1	2								5
19										1														1
20		1	2	64	275	119	9	17	157	291	232	113	24	5	8	63		3	56	5		2		1446
21												2							1			2		5
22		1		12	66	51		54	12	21	6	5	13	88	10	7		1	2	5		3		357
23	1			1	4			4	1	4		1							7			1		24
24				1	11	5		3	4	2		3	2		3	2		1		3			1	41
25																		1	1	1	1		1	5
26																			5			3		8
27																						1	1	2

* see Table 2

TABLE 2

SCIENTIFIC AND COMMON NAMES OF THE SPECIES ENCOUNTERED

1.	*Heptranchias dakini* Whitley	One-finned shark
2.	*Cephaloscyllium isabella laticeps* (Dumeril)	Swell shark
3.	*Galeorhinus australis* (Macleay)	School shark
4.	*Mustelus antarcticus* Gunther	Gummy shark
5.	*Squalus megalops* (Macleay)	Spur dogfish
6.	*Squalus kirki* Phillipps	White-spotted dogfish
7.	*Scymnodon plunketi* (Waite)	Lord Plunket's shark
8.	*Centroscymnus waitei* (Thompson)	Waite's deep-sea dogfish
9.	*Centrophorus scalpratus* McCulloch	Endeavour dogfish
10.	*Centrophorus nilsoni* Thompson	Nilson's dogfish
11.	*Deania kaikourae* (Whitley)	Dorian Gray
12.	*Deania quadrispinosa* (McCulloch)	Long-snouted dogfish
13.	*Raja nasuta* Muller and Henle	Long-nosed skate
14.	*Hydrolagus ogilbyi* (Waite)	Ghost shark
15.	*Diastobranchus danae* (Brunn)	Basket-work eel
16.	*Lepidion microcephalus* Cowper	Small headed cod
17.	*Mora mora* (Risso)	Deep-sea cod
18.	*Macruronus novaezelandiae* (Hector)	New Zealand rattail
19.	*Coelorhynchus australis* (Richardson)	Hollow-nosed rattail
20.	*Hyperoglyphe porosa* (Richardson	Deep-sea trevally
21.	*Nemadactylus macropterus* (Bloch and Schneider	Morwong
22.	*Genypterus blacodes* (Bloch and Schneider	Ling
23.	*Helicolenus papillosus* (Bloch and Schneider)	Red gurnet perch
24.	*Rexea solandri* (Cuvier and Valenciennes)	King barracouta
25.	*Polyprion oxygeneios* (Bloch and Schneider)	Hapuku
26.	*Oplegnathus woodwardi* Waite	Knife-jaw
27.	*Neoplatycephalus speculator* (Kluzinger)	Deep-water flathead

The depth ranges of the various species encountered are plotted in Figure 12.

southern Tasmania waters, thence north-west to the eastern portion of the Great Australian Bight. At all these stations various species of fish were taken, the number of species at each station depending mainly on the frequency of sampling. One or more of the three species, deep-sea trevally, ling, and deep-sea cod, were taken at almost every station worked and their occurrence from Eden (N.S.W.) to Port Fairy (Vic.) along the continental slope has been established. Both the deep-sea trevally and ling were taken by the "Derwent Hunter" as far west as Kangaroo I. in South Australia, and McCulloch (1914) recorded the former species from the western section of the Great Australian Bight, thus indicating its probable continuous distribution along the continental slope in that region. The deep-sea cod, though not taken west of Port Fairy (Vic.) by the "Derwent Hunter", has been recorded from the Great Australian Bight (Whitley 1948) and therefore might well extend along the whole southern portion of the Australian continental slope.

(b) Species Encountered

From a total of 23 fishing stations 27 species of fish were encountered (Table 1). A list of the complete results from March 1949 - July 1955 appears as Appendices 1 and 2, which give all fishing operations conducted in depths greater than 100 fm. The scientific and corresponding common names of the various species are listed in Table 2.

IV. THE COMPARATIVE EFFICIENCIES OF CONVENTIONAL LONGLINING AND DROPLINING GEARS

Over a period of five years (1950 - 1955) conventional longlining gear used from the F.R.V. "Derwent Hunter" captured the species, deep-sea trevally, ling, and deep-sea cod in almost equal proportions, while similar gear used from the F.R.V. "Liawenee" during the period June 1951 - October 1953 captured them in the ratio 10:3:5 respectively.

Following the introduction of droplining in June 1954 the catches from this gear were almost exclusively of deep-sea trevally. The first days fishing off the east coast of Tasmania resulted in a catch of 51 deep-sea trevally (cleaned weight 589 lb), 2 ling, and 1 king barracouta from 11 shots, each of 25 hooks. The second days catch comprised 56 deep-sea trevally (722 lb cleaned weight), and 1 king barracouta from 12 shots, while the final day of that particular cruise produced 39 deep-sea trevally (497 lb cleaned weight) and 1 one-finned shark from a total of 8 shots.

In subsequent cruises even better hauls were made off this coast between Cape Lodi and Cape Pillar. In September 1954, 13 shots in one day produced a total of 80 deep-sea trevally (1019 lb cleaned weight), 2 deep-sea cod, 1 king barracouta, and 2 dogfish, while 14 shots the following day produced a total of 78 deep-sea trevally (927 lb cleaned weight), and 1 king barracouta. In January 1955, 14 shots in one day produced 55 deep-sea trevally (744 lb cleaned weight) and 3 ling; 15 shots the following day produced a record catch of 145 deep-sea trevally (1790 lb cleaned weight), 1 ling, and 1 king barracouta, and subsequent days' catches comprised 47 (436 lb cleaned weight), 43 (379 lb cleaned weight), and 89 (1197 lb cleaned weight) deep-sea trevally. On one occasion (that of the catch of 145 deep-sea trevally) there were catches of 15, 18, 22, 0, 22, 19, 0, 19, 5 and 17 fish in successive shots of 25 hooks, showing that the technique has much to commend it.

(a) Comparison of Catch Rates

Catch records from droplining for the period June 1954 - July 1955 have been compared with those obtained from conventional longlining over almost the same period as well as over the period April 1950 - April 1955, and the figures obtained from droplining show to considerable advantage. Table 3 shows the longlining catch rate of each of the three major teleost species for the "Derwent Hunter" and "Liawenee", separately and combined, and the droplining catch rate of the "Derwent Hunter".

Although for each vessel the longlining catch rates of individual species vary somewhat, there is a close agreement in the figures for total catch rate, these being 9.1 and 10.3 fish per 100 hooks, respectively.

The right hand column of this table shows the "Derwent Hunter" dropline catch rates and the superiority of the total catch rate is immediatly apparent, being 15.6 fish per 100 hooks as against 10.8 per 100 hooks obtained from longlining over a comparable period. This represents an increase of almost 45% in the rate of catch. The dropline catch by species however was completely unbalanced, for whereas the longline catch approximated the ratio 2:1:1, that of the dropline approximated 1:0:0, being almost exclusively of deep-sea trevally. This feature, though rendering the dropline virtually ineffective as a sampler of the ling and deep-sea cod populations, and therefore of limited use in a survey of the fish populations as a whole, in no way detracts from its commercial potentiality.

As a further comparison, Table 4 was drawn up in order to determine any seasonal variation in the efficiencies of the gears. The periods shown are the only ones in which both types of gear have been used, and the figures for longlining have been drawn from results over more than one year.

It will be seen that the catch rate from droplining, for deep-sea trevally alone, exceeded the total catch rate from longlining for each of the periods except March (autumn) when the rates were equal. The superiority of the drop-line over the longline was particularly apparent for the periods June-July (winter) and December-January (summer) when the droplining catch rate exceeded that obtained from longlining by 91% and 39% respectively.

The fall off in the droplining catch rate for the period September-October (spring) was probably the result of the use of inferior bait. Barracouta and tuna, as used for the other cruises, were not available so that apart from a few king barracouta which made excellent bait, the use of some stale mackerel (*Trachurus novaezelandiae*) and freshly caught deep-sea cod was resorted to with only fair results.

The low rate of catch for both gears during March would seem to reflect a diminution in the deep-sea trevally stocks at that time of year. This species was densely schooled in summer (Jan.-Feb.), presumably for spawning, as is shown by the catch records for that period. Spawning was virtually completed by March and almost immediately the catch rate fell to a minimum. There is no evidence available to suggest why this should be, thought it could be that these fish disperse following the spawning season and therefore are caught only in small numbers during the ensuing autumn months.

TABLE 3

TOTAL CATCH AND RATE OF CATCH OF LONGLINE AND DROPLINE

	Derwent Hunter Longline			*Liawenee* Longline			*Derwent Hunter* and *Liawenee* Longline			*Derwent Hunter* Longline			*Derwent Hunter* Dropline		
	Apr 50 - Apr 55			June 51 - Oct 53			Apr 50 - Apr 55			June 54 - Apr 55			June 54 - July 55		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
No. of fish	302	344	315	1005	314	551	1307	658	866	110	181	120	1141	13	15
No. of hooks (100's)		106			182			288			38			75	
Catch per 100 hooks	2.8	3.2	3.0	5.5	1.7	3.0	4.5	2.3	3.0	2.9	4.8	3.1	15.2	0.2	0.2
Total catch		961			1870			2831			411			1169	
Total catch per 100 hooks		9.1			10.3			9.8			10.8			15.6	

(1) Trevally (2) Ling (3) Cod

TABLE 4

SEASONAL TOTAL CATCH AND RATE OF CATCH
FOR LONGLINE AND DROPLINE

		June-July	Sept-Oct.	Dec-Jan.	Mar.
Derwent Hunter	Deep-sea trevally catch No. of fish	428	228	404	47
	No. of hooks (100's)	21.7	21.5	20.0	7.5
dropline	Catch per 100 hooks	19.7	10.6	20.2	6.3
Derwent Hunter and *Liawenee*	Total catch No. of fish	1049	386	492	114
	No. of hooks (100's)	102	40	34	18
longline	Catch per 100 hooks	10.3	9.6	14.5	6.3

(b) Economic and Technical Advantages of Droplining

Results obtained from June 1954 - July 1955 indicate that, provided there is no objection to the absence of ling and deep-sea cod from the catches, and from the prevailing market price of each species there should be none, droplining is to be preferred from a commercial standpoint. Apart from its greater efficiency in catching fish it has a number of economic and technical advantages over its longline counterpart.

1. It requires a much smaller and therefore less costly unit of gear, in that the amount of wire line required depends only upon the maximum depth of water worked. A longline requires this length of wire (buoy line) plus the extra length of the groundline which, in the work reported, was of the order of about 400 fm. Assuming a maximum working depth of 400 fm for droplining, then the outlay for wire is at least halved. Further, there is the reduction in cost obtained by working only 25 hooks instead of 200; this reduction includes the cost of snoods and safety clips.

2. Associated with the cost of gear is the fact that losses of gear from fouling the bottom are virtually non-existent using the droplining technique so that the costly and laborious replacement of gear, as is so frequently necessary when longlining on the continental slope, is also reduced to a minimum. In fact, the only replacements necessitated during the period of droplining were those of hooks and snoods which were torn off from time to time by fish. With a 200 hook longline it was not unknown to lose the entire groundline with its complement of hooks, or more commonly, to lose part, and almost invariably to lose a large number of hooks on the very rough bottom over which this gear has of necessity to be worked.

3. Droplining is exceedingly economical in its consumption of bait, for apart from the fact that each shot requires only 25 baits, those recovered can be used repeatedly with good effect until they become too soft for further use. This is especially important when bait is scarce.

4. One major operational advantage of droplining lies in its extreme mobility. Droplining results have shown that the deep-sea trevally at least, and this almost certainly applies also to the ling and deep-sea cod, are confined to relatively small patches of rough bottom in the areas fished. The dropline can be dropped repeatedly over these spots taking fish from each shot, or can be used to reconnoitre an area either by drifting or steaming with the line down, at the same time keeping the sinker in close proximity to the bottom.

5. It is possible to dropline in weather conditions that may be unfavourable for conventional longlining since at no time is the gear in actual contact with the bottom; therefore the motion of the vessel in a heavy swell will have little effect on the working of the gear. With a fouled longline there is always the possibility of breaking the line as the vessel surges on a heavy swell. Moreover, should there be a sudden deterioration in the weather while droplining, one has only to haul in the line and get under way for shelter. There is no delay or risk to gear as there might be with a longline to be hauled in rapidly worsening weather conditions.

6. The dropline is simple to operate and, given a well-planned, compact arrangement of winch and roller, could be operated single-handed.

The foregoing has assumed that vessels engaged in such a fishery, of necessity, would be equipped with echosounding gear operating over the appropriate depth range (at least to 300 fm). Droplining, in addition, requires some mechanism by which the amount of line paid out is measured accurately, this being used in conjunction with the echosounder. This was effected in the "Derwent Hunter" by connecting an electrical revolution counter to the deck fair-lead (1 m circumference). The count was relayed to a dial indicator at winch control.

The hydraulic winch aboard the "Derwent Hunter" was not provided with a free-wheeling device which would allow the line to run out freely under its own weight. Such a mechanism would have speeded up the operation of shooting the line thus allowing more shots to be made in a given time. It is possible too that more than one line could be operated though this was not possible aboard the "Derwent Hunter".

For the continental slope fishery then it seems that the technique of droplining might have far greater commercial potentialities than that of conventional longlining. The nature of the fishery and the bottom topography are such that the use of commercial longlines bearing a number of thousands of hooks is not possible as on the continental shelf, so that development in that direction is hardly likely. The 200-hook longline, which for this fishery is considered the longest practicable, has been found to be less efficient than the 25-hook dropline.

V. COMMERCIAL POTENTIALITY

(a) Edible Flesh

The only figures available from which can be calculated the expected gross return to fishermen contemplating engaging in a fishery on the Australian continental slope are those obtained from experimental fishing conducted from the "Derwent Hunter" and "Liawenee" off the east coast of Tasmania. Since neither of these vessels was operating full-time on a line-fishing programme it is reasonable to assume that the figures given below (Table 5) represent a conservative determination of the actual returns to be obtained by full-time commercial exploitation of the three major fish species involved.

During the period June 1951 - October 1953 the "Liawenee" devoted 63 working days to longlining on the Tasmanian continental slope shooting an average of 288 hooks per day. The minimum number of hooks shot in one day was 200 while the maximum was 600.

From April 1950 - April 1955 the "Derwent Hunter" devoted 46 working days to longlining on the continental slope off south eastern Australia, such work forming only part of the vessel's programme during that period. An average of 230 hooks was shot per day, the minimum number being 150 and the maximum 600 hooks on one day. Following the introduction of droplining in June 1954 only 14 working days were devoted to longlining during the remainder of the survey. In these 14 days an average of 270 hooks was shot per day, the minimum being 200 and the maximum 600 hooks per day.

From June 1954 - July 1955 the "Derwent Hunter" devoted 39 working days to droplining on the continental slope off eastern Tasmania shooting an average of 192 hooks per day, the minimum number being 25 and the maximum 500 hooks in one day. This included 16 days in which less than 150 hooks were shot per day, mainly due to the fact that the vessel was engaged in other duties during those days, e.g. hydrological and planktological station sampling and conventional longlining. For the purposes of calculation therefore it can be assumed that the "Derwent Hunter" devoted 23 working days exclusively to droplining, shooting an average of 263 hooks per day, the minimum being 150 and the maximum 500 hooks in one day. However, in Table 5 below, both working periods were used as a basis for calculation in order to give a fair presentation of the facts.

Table 5 sets out the gross returns obtained by longlining operations from the "Liawenee" and "Derwent Hunter" and those obtained by droplining operations from the "Derwent Hunter". The superiority of droplining is immediately apparent, both in market value of average daily catch and market value of catch per 100 hooks. Droplining returns calculated from a working period of 39 days are superior to the best return obtained by longlining and it is most unlikely that a commercial enterprise would fail to do considerably better than this. When droplining returns are calculated from a working period of 23 days devoted entirely to droplining then they are far superior to any other calculated return.

(b) Liver Oil

Liver samples were collected from certain of the fishes of the continental slope in the hope that they might be of commercial value as sources of liver oil and vitamin A. The analyses are given in Table 6.

Liver oil analyses made earlier (Jowett and Davies 1938) on a number of species of Australian fish revealed that the liver of the school shark (*Galeorhinus australis*) yielded about 50% oil, and this was later exploited commercially. With the exception of the deep-sea trevally, all the species listed in Table 6 yield liver oil equal to or in excess of that obtained from school shark livers. However, the livers of the deep-sea trevally, ling, and deep-sea cod are comparatively small and therefore not likely to be taken in bulk sufficient for commercial exploitation. The livers of the elasmobranchs on the other hand are all comparatively large, but again are not likely to be taken in sufficient bulk to warrant their utilisation commercially.

The vitamin A content of all livers sampled was too low to warrant commercial utilisation.

VI. CONCLUSIONS

Any conclusions to be drawn from the results of this survey must, of necessity, be based mainly on data obtained from fishing operations conducted off the east coast of Tasmania, where the bulk of the data was obtained.

TABLE 5

GROSS RETURNS OBTAINED FROM EXPERIMENTAL LONGLINING AND DROPLINING

	Longlining			Droplining	
	Liawenee	*Derwent Hunter*	*Derwent Hunter*	*Derwent Hunter*	*Derwent Hunter*
	June 51- Oct. 53	Apr. 50- Apr. 55	June 54- Apr. 55	June 54- July 55	June 54- July 55
No. of working days	63	46	14	39	23
No. of hooks shot	18,200	10,600	3,800	7,500	6,050
Average no. of hooks shot per day	288	230	270	192	263
Total catch (cleaned wt.) of fish (lb)	*18,311	8,850	3,639	13,338	12,828
Average catch (cleaned wt.) per day (lb)	*291	192	260	342	558
Market value of catch	£1,178	£663	£277	£1,000	£962
Market value of average daily catch	£18.14.0	£14.8.0	£19.16.0	£25.13.0	£41.17.0
Market value of catch per 100 hooks	£6.10.0	£6.5.0	£7. 6.0	£14. 2.0	£15.18.0

* Total weight (cleaned weight not available)

TABLE 6

LIVER OIL ANALYSES OF SOME FISHES OF THE CONTINENTAL SLOPE

Species	*Oil - g/100g fresh liver	Unsaponifiable matter g/100g fresh liver	Vit. A I.U./g fresh liver	No. of livers
Hyperoglyphe porosa	2.7-3.8	-	-	1
Genypterus blacodes	40.7-42.6	1.9	8,500	7
Mora mora	68.5	2.1	3,700	1
Squalus megalops	70.4-70.9	14.2-14.3	11,900	4
Cephaloscyllium isabella laticeps	53.6-59.8	2.9	670	1
Hydrolagus ogilbyi	90.0	30.8	-	1
Scymnodon plunketi	93.4	26.9-27.5	500	1
Squalus kirki	70.0-76.0	9.2	3,400	7
Centrophorus scalpratus	86.9-90.7	68.7-73.5	-	2

* For the oil analyses 5g of fresh liver were mixed with $CaSO_4$ and the mixture extracted with ether. The higher values obtained may carry some sampling error.

An analysis of the catches obtained from deep-lining over the south-eastern Australian continental slope from April 1950 - July 1955 reveals that, of the 27 species encountered, only five are worthy of consideration for possible commercial exploitation. These are the school shark, gummy shark, deep-sea trevally, ling and deep-sea cod.

The school and gummy shark support an established fishery in continental shelf waters of New South Wales, Victoria, Tasmania, South Australia, and Western Australia and it is probable therefore that this fishery will now be extended to the upper waters of the continental slope.

With the exception of the above sharks it is doubtful if any of the elasmobranchs encountered will ever be of sufficient size or taken in sufficient quantity to warrant their commercial exploitation. The only other elasmobranch taken in any quantity was the small spur dogfish (*Squalus megalops*) which is too small normally to be acceptable to the trade.

A number of teleostean species was captured upon which commercial fisheries are already established in waters of the continental shelf. Their abundance in the slope waters appears to be so limited that they are unworthy of commercial consideration. The deep-sea trevally, ling, and deep-sea cod remain therefore as the only teleosts having some commercial potentiality.

The deep-sea trevally was taken at every station sampled between Eden (N.S.W.) and Kangaroo I. (S.A.) with the exception of station No. 17 west of Strahan (Tas.). Since only one longline shot was made at this station its apparent absence was due presumably only to insuffecent sampling. This also applied to stations No. 1 (Port Stephens, N.S.W.) and No. 23 (S.W. Lacey I., S.A.) where none of this species was taken (only two shots at each station). This species had been recorded previously from the western section of the Great Australian Bight (McCulloch 1914) so in all probability it is to be found along the entire extent of the continental slope off southern Australia.

Off the east coast of Tasmania, where fishing for this species was largely concentrated, it was taken at all seasons of the year, mainly in depths of 200-300 fm. While it was available in quantity during the summer and winter months, catches fell to a minimum during the autumn. Data for other stations are insufficient for conclusions to be drawn concerning its seasonal abundance elsewhere.

The average total weight of the deep-sea trevally was 15 lb. After cleaning, i.e. with gills and intestines removed, the average cleaned weight was 12½ lb. If the fish were made up into cutlets after removal of head, gills, and intestines then the average weight of the processed carcase was 10 lb. The loss in weight from cleaning was therefore 17% while that from processing as cutlets was 33%. By processing the carcase in the form of cutlets there is a considerable saving in freezer space required, the product requires no further processing for the retail trade, and further, the backbone is included in the retailed product.

It is reasonable to conclude that of all the species encountered the deep-sea trevally is the one most promising of commercial exploitation, and it is probable that a dropline fishery for this species will develop off the east coast of Tasmania in the near future.

The ling was taken at almost every station sampled, being absent only from Stations Nos. 1, 3, 7, 17, 21, and 23. No records are available of this species westwards from South Australian slope waters into those of the Great Australian Bight so it is not possible to postulate a distribution exactly similar to that of the deep-sea trevally. However, it is reasonable to suppose that the ling is distributed over the same range as the deep-sea trevally, at least as far west as Kangaroo I. (S.A.).

Catch records from eastern Tasmanian waters indicated that this species was available to the longline in small numbers throughout the year, mainly in depths of 250-400 fm. Since it did not usually appear in large schools (one catch of 88 off southern Tasmania being the only exception observed) it is not likely to be taken profitably by conventional longlining.

Unfortunately too, apart from an odd specimen or two, it was not taken by the dropline so that this type of gear is unlikely to lend itself to a fishery for ling as it probably will do for the deep-sea trevally. Therefore, unless some new technique and/or gear can be evolved it is doubtful if a commercial fishery for ling on the continental slope will eventuate.

The deep-sea cod closely parallels the deep-sea trevally in its observed distribution in Australian waters. Though it was not taken west of Station 20 (Port Fairy, Vic.) it has been recorded from the Great Australian Bight (Whitley 1948) and therefore might well extend along the whole southern portion of the Australian continental slope.

Off the east coast of Tasmania it was located mainly in depths of 300-500 fm, its seasonal occurrence being comparable with that of the ling. It was taken in quantity on only one occasion by conventional longlining and a few individuals were occasionally taken by droplining. This, together with the fact that to date it has not been received with much favour by the trade, leads to the conclusion that it is unlikely to receive consideration as a potential commercial species.

Thus it would seem that should a commercial fishery develop from the results of this survey it will be a dropline fishery operating solely upon the stocks of deep-sea trevally, since this species is readily available to the dropline which takes almost 45% more fish for a given number of hooks than does the conventional longline operating on the three major teleostean species simultaneously.

VII. ACKNOWLEDGMENTS

Data obtained by the F.R.V. "Liawenee" were very generously made available to us by the officers of the Tasmanian Department of Agriculture and Fisheries to whom we express our appreciation. The liver analyses were kindly carried out by Mr K. Anderson and Mr O. Miezitis of the CSIRO Division of Food Preservation and Transport at the Tasmanian Regional Laboratory, Hobart. Mr I.G. MacInnes, Editor of Fisheries Newsletter, assisted by lending the photographs which appear as Figures 2 and 5.

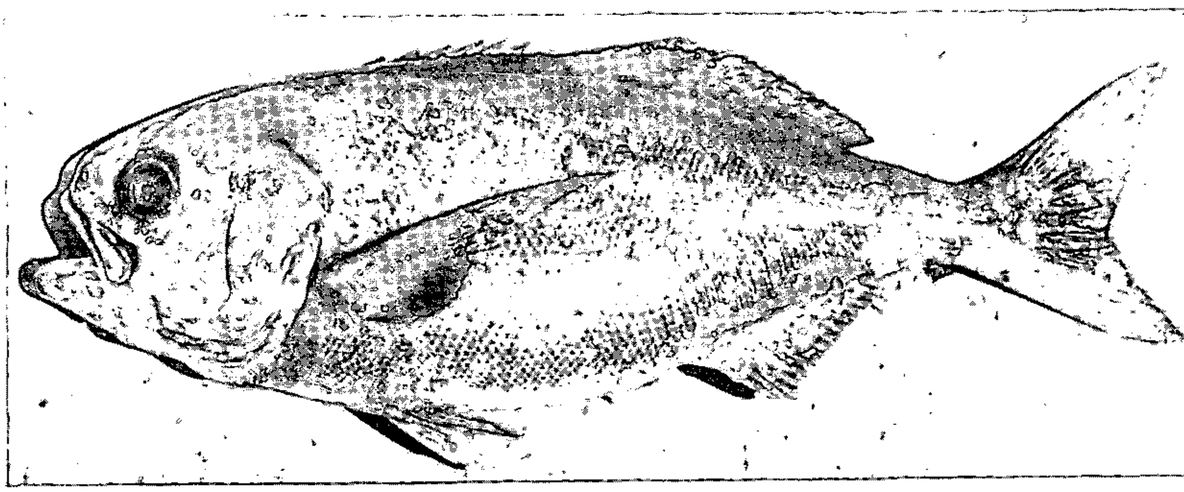


Fig. 1.- Hyperoglyphe porosa (Richardson). Deep-sea Trevally.

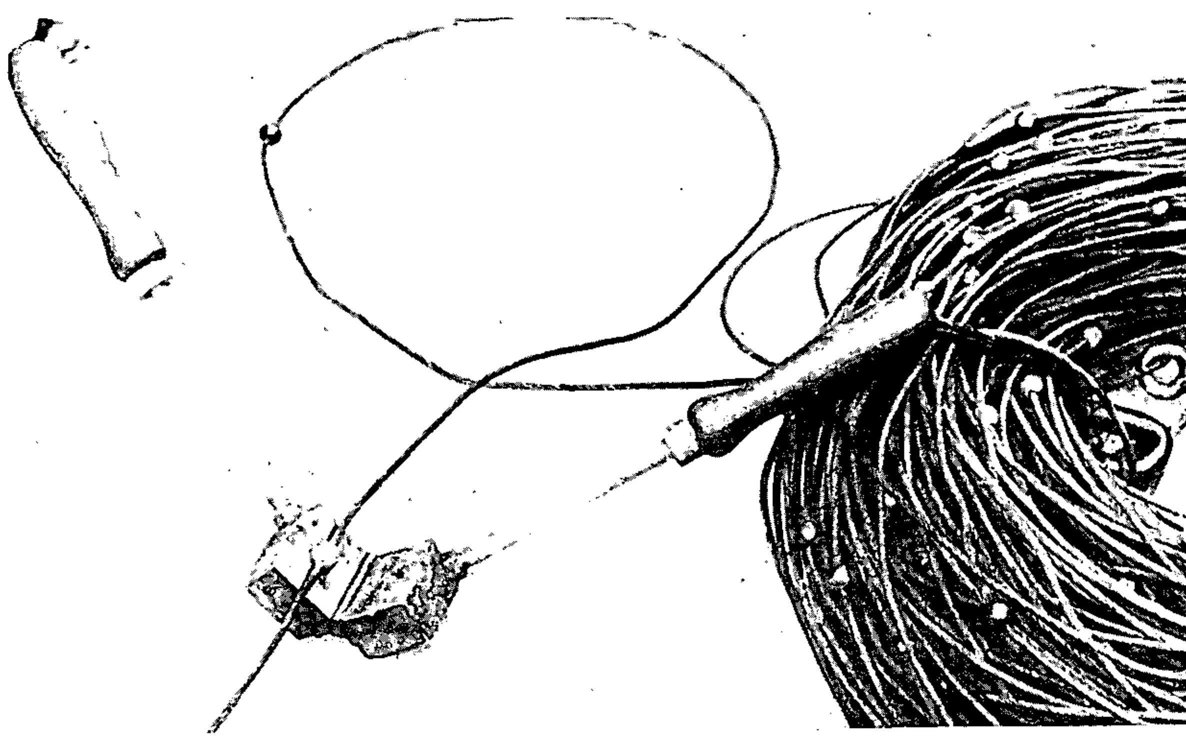


Fig. 2.- Galvanised, flexible steel wire groundline with split hinged mould for casting lead stops.

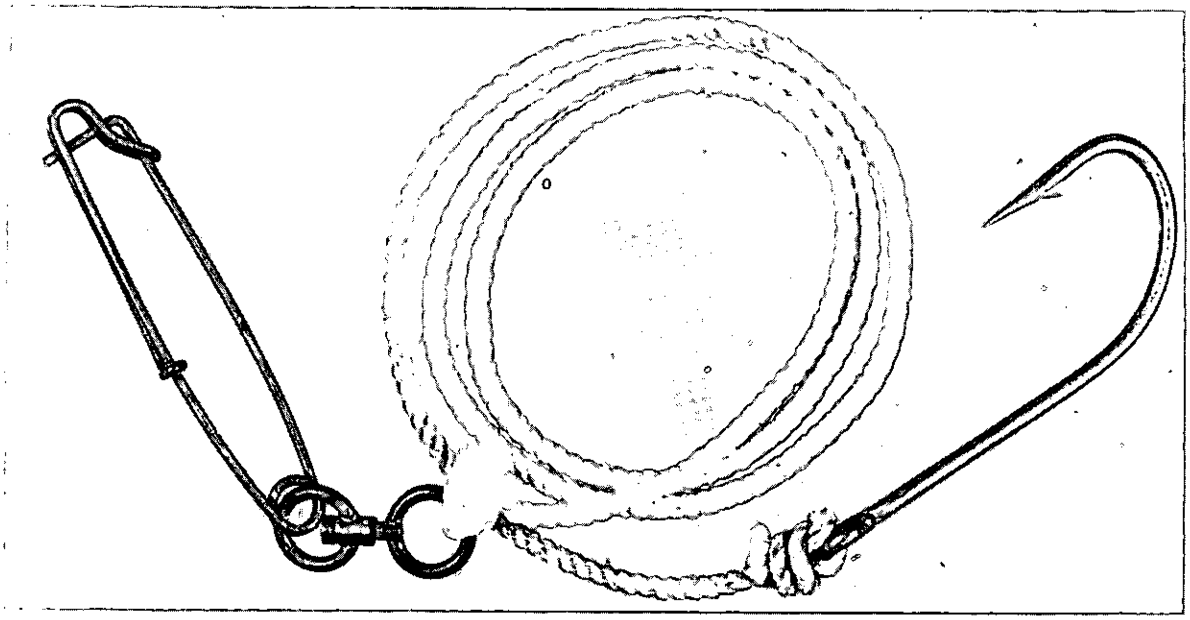


Fig. 3.- Link clip used to join lines.

Fig. 4.- Snood with safety-pin clip.

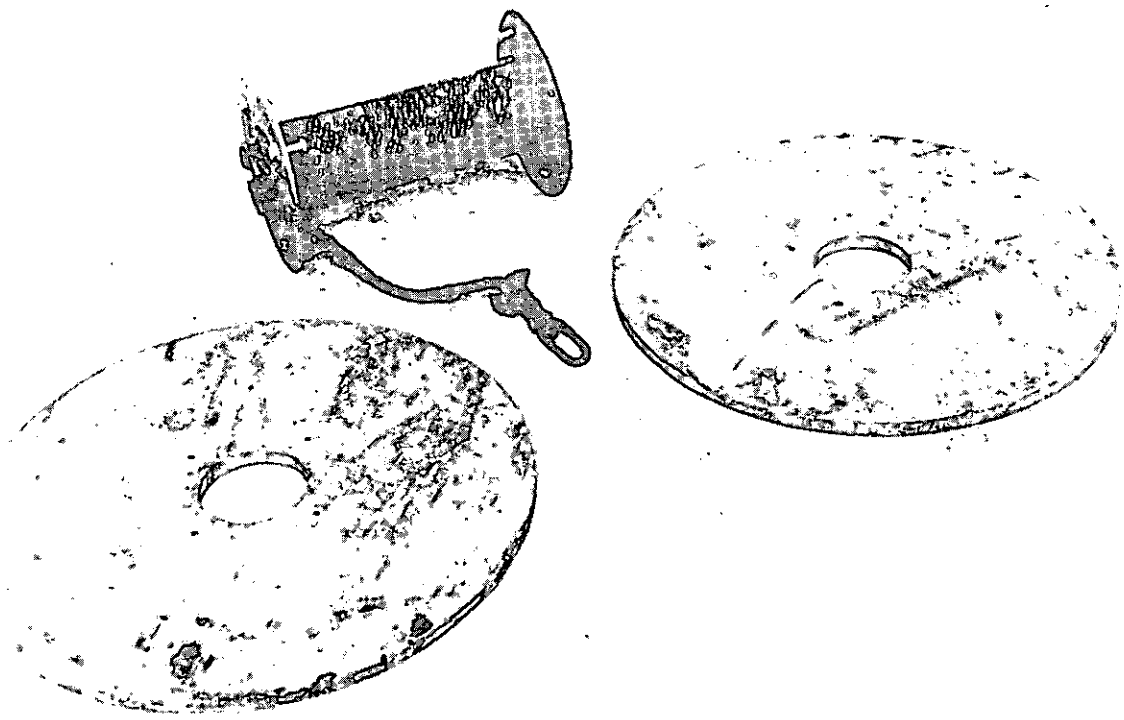


Fig. 5.- Detail of longline reel.

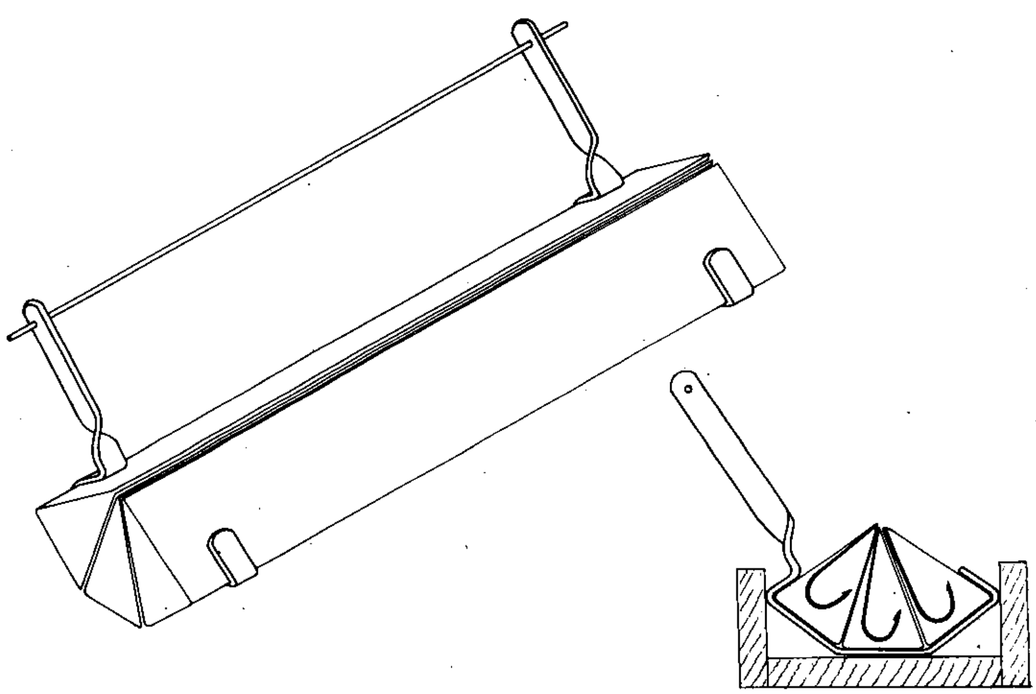


Fig. 6.- 3 - compartment, galvanised iron bait trough.

Fig. 7.- Droplining for deep-sea trevally aboard F.R.V. "Derwent Hunter".

Fig. 8.

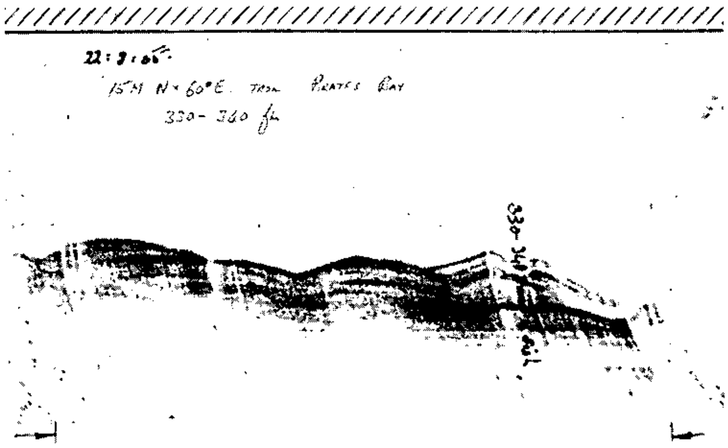


Fig. 9.

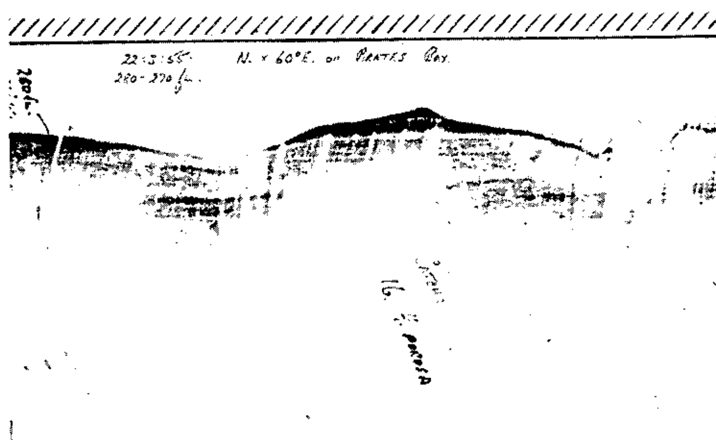
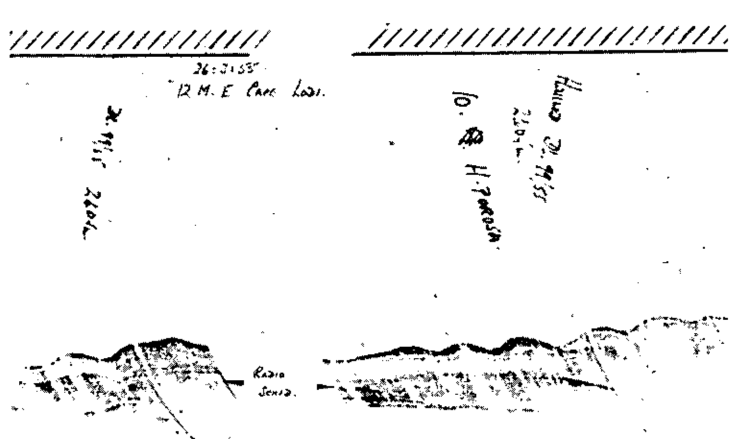


Fig. 10.



Echographs of the type of bottom from which fish were normally taken.

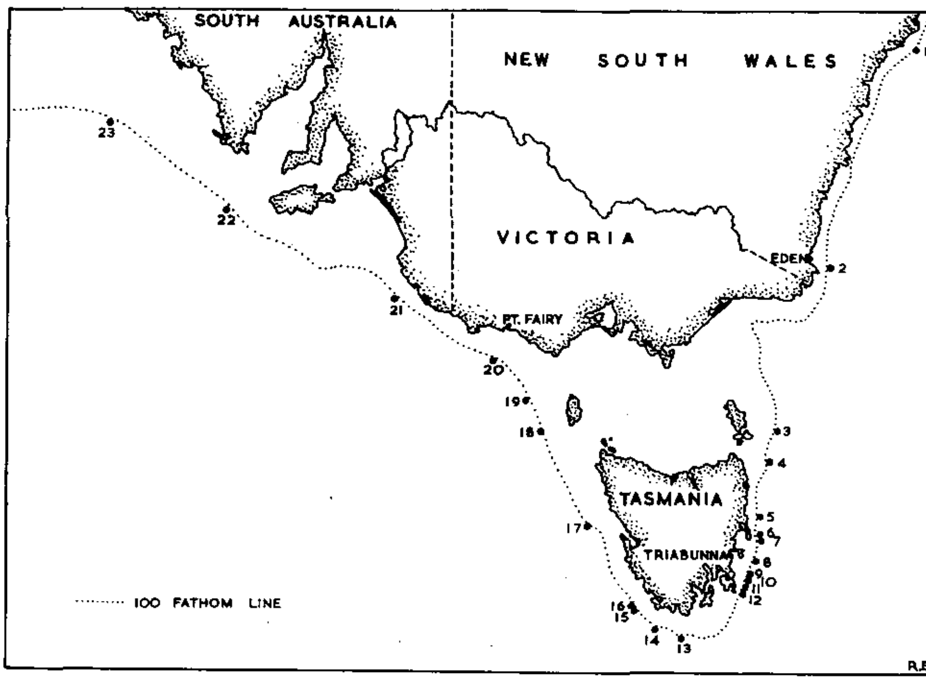


Fig. 11.- Area surveyed and positions of stations worked.

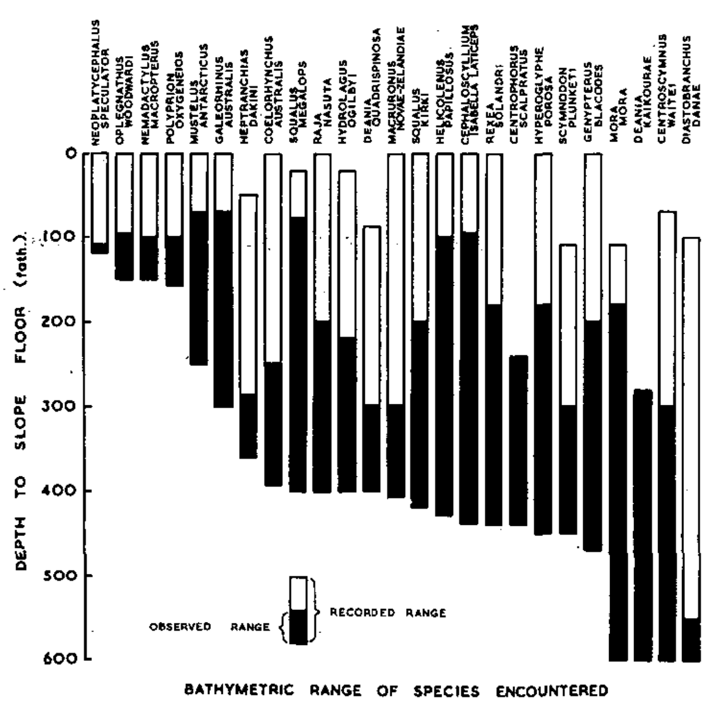


Fig. 12.

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APPENDIX I

RESULTS OF LONGLINING OPERATIONS - FROM MARCH 1949 - APRIL 1955

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
2. 3.49	S. of Port Fairy 20	110-140	School shark	1	
			Gummy shark	1	
			Spur dogfish	8	
3. 3.49	S. of Port Fairy 20	130-158	School shark	2	
			Hapuku	1	
6. 4.49	E. of Northern Maria I. 8	70-130	School shark	16	
			Gummy shark	4	
4. 6.49	W. by N. of Strahan 17	90-135	School shark	26	
			Gummy shark	7	
			Spur dogfish	4	
10. 6.49	W. of Currie, King I. 18	110	School shark	105	
			Gummy shark	5	
			Swell shark	1	
			Spur dogfish	23	
14. 9.49	Port Fairy wide 20	150-250	School shark	9	
			Gummy shark	3	
			Swell shark	1	
			Spur dogfish	6	
22. 9.49	S.W. by W. of *Phoques B.*, King I. 19	110	School shark	9	
			Hapuku	1	
			Morwong	1	
			Knife jaw	1	
			Spur dogfish	53	
15.12.49	E. of Vansittart I. 3	90-230	Deep-sea trevally	2	
			School shark	4	
			Spur dogfish	8	
19.12.49	S.S.E. of Cape Pillar 12	100	School shark	5	
			Morwong	2	
			Red gurnet perch	1	
			Spur dogfish	22	
15. 4.50	W. of King I. 19	100-110	School shark	18	
			Swell shark	3	
			Spur dogfish	33	
			Knife jaw	2	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
15. 4.50	W. of King I. 19	280-400	Deep-sea trevally	35	769
			Ling	2	16
			Deep-sea cod	16	
			Red gurnet perch	4	
			Spur dogfish	2	
			Long-snouted dogfish	4	
10. 7.50	W. of Port Davey 16	110-230	Deep-sea trevally	3	17
21.10.50	W. of King I. 19	95	School shark	50	
			Gummy shark	4	
			Swell shark	1	
			Spur dogfish	15	
			Knife jaw	2	
21.11.50	W. of King I. 19	400	Deep-sea cod	15	99
			Red gurnet perch	3	
			Long-snouted dogfish	9	
			Spur dogfish	3	
21.11.50	W. of King I. 19	110	School shark	6	
			Gummy shark	2	
			Spur dogfish	9	
3. 3.51	Banks Strait wide 4	100	School shark	20	
			Gummy shark	1	
			Spur dogfish	3	
12. 3.51	W. of King I. 19	232	Deep-sea trevally	20	341
			Deep-sea cod	2	12
2. 6.51	W. of Stokes Pt King I. 18	273	Spur dogfish	15	
			Swell shark	5	
3. 6.51	S. by E. of Port Fairy 20	280	Ling	1	
			Endeavour dogfish	19	
			Spur dogfish	15	
			Swell shark	3	
7. 7.51	W.S.W. of Phoques Bay 19	113	School shark	6	
			Spur dogfish	1	
			Gummy shark	1	
8. 8.52	Eden wide 2	280	Deep-sea trevally	1	12
			Ling	1	16
			Deep-sea cod	5	15
			Endeavour dogfish	33	
			Dorian Gray	1	
			Swell shark	1	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
28. 8.52	S. of Port Fairy 20	290-440	Ling	1	3
			Deep-sea cod	1	
			King barracouta	1	
			School shark	1	
			Endeavour dogfish	21	
			Spur dogfish	3	
28. 8.52	S. of Port Fairy 20	200	King barracouta	1	
			School shark	10	
			Spur dogfish	4	
12. 9.52	King I. wide 19	375-450	Deep-sea trevally	1	
			Deep-sea cod	3	17
			Lord Plunket's shark	1	
			Dorian Gray	2	
			Spur dogfish	3	
12. 9.52	King I. wide 19	180-200	School shark	4	
12. 9.52	King I. wide 19	110	School shark	3	
			Spur dogfish	4	
13. 2.53	E. of Schouten I. 7	400-420	Deep-sea trevally	1	22
			Lepidion microcephalus	1	
			Lord Plunket's shark	2	
			Long-snouted dogfish	2	
14. 2.53	E. of Cape Forestier 6	84-220	Deep-sea trevally	15	135
			School shark	1	
			Gummy shark	3	
			Spur dogfish	2	
2. 3.53	Port Fairy wide 20	356	Ling	2	14
			Deep-sea cod	3	21
			King barracouta	1	
			Spur dogfish	1	
3. 3.53	Port Fairy wide 20	90	School shark	5	
			Spur dogfish	8	
13. 3.53	W. of Kangaroo I. 22	110	Deep-water flathead	1	
			School shark	11	
			Gummy shark	1	
			Spur dogfish	2	
13. 3.53	W. of Kangaroo I. 22	100-110	Knife jaw	2	
			School shark	15	
			Spur dogfish	4	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
17. 3.53	W. of Kangaroo I. 22	280-315	Deep-sea trevally	2	22
			Ling	3	12
			Spur dogfish	6	
			Endeavour dogfish	4	
17. 3.53	W. of Kangaroo I. 22	110-150	Morwong	2	
			Knife jaw	1	
			School shark	5	
8. 4.53	S.W. of Lacy I. 23	120	Hapuku	1	
			Deep-water flathead	1	
			School shark	3	
9. 4.53	S.W. of Lacy I. 23	400	King barracouta	1	
			Spur dogfish	7	
2. 5.53	Port Fairy Wide 20	290-320	Ling	1	17
			Red gurnet perch	1	
			Endeavour dogfish	14	
			Spur dogfish	10	
2. 5.53	Port Fairy wide 20	420	Deep-sea trevally	5	111
			Deep-sea cod	6	38
			Dorian Gray	4	
3. 5.53	Port Fairy wide 20	430	Deep-sea cod	1	8
3. 5.53	Port Fairy wide 20	104-161	School shark	42	
8. 5.53	W. of Stokes Pt 18	405-410	Deep-sea trevally	2	44
			Ling	1	6
			Deep-sea cod	11	57
			Dorian Gray	6	
			Spur dogfish	2	
8. 5.53	W. of Stokes Pt 18	550-600	Deep-sea cod	2	10
			Basket work eel	6	
			Dorian Gray	2	
			Waite's deep-sea dogfish	4	
9. 5.53	W. of Stokes Pt 18	130-240	Hapuku	1	
			School shark	17	
16. 6.53	Maria I. wide 8	370-460	Ling	4	33
			Deep-sea cod	17	126
			Dorian Gray	20	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
13. 8.53	S. by 15°E. of Margaret Brock Reef 21	110-112	Hapuku	1	
			School shark	12	
			Gummy shark	1	
			Spur dogfish	6	
24. 9.53	E.N.E. of Stokes Pt 18	240-300	Deep-sea trevally	1	12
			King barracouta	1	
			School shark	2	
			Endeavour dogfish	1	
			Spur dogfish	11	
2.10.53	Maria I. wide 8	300-370	Deep-sea trevally	12	212
			Ling	10	96
			Deep-sea cod	6	35
			Swell shark	1	
2.10.53	Maria I. wide 8	240-295	Deep-sea trevally	2	14
			King barracouta	2	
			Spur dogfish	3	
			Swell shark	5	
4.12.53	S. by W. of Maatsuyker I. 14	220-360	Deep-sea trevally	5	97
			Ling	88	769
			Deep-sea cod	6	44
			Ghost shark	1	
			Spur dogfish	4	
			Swell shark	2	
30.12.53	Maria I. wide 8	330-400	Ling	10	95
			Deep-sea cod	16	106
			Dorian Gray	2	
			Spur dogfish	2	
			Long-nosed skate	1	
31.12.53	Maria I. wide 8	240-304	Ling	5	39
			Red gurnet perch	1	
			Spur dogfish	8	
			Swell shark	4	
			Long-nosed skate	1	
1. 1.54	Banks Strait wide 4	350-360	Deep-sea trevally	2	36
			Ling	12	125
			Deep-sea cod	12	75
			Red gurnet perch	1	
			Endeavour dogfish	6	
1. 1.54	Banks Strait wide 4	200-250	Deep-sea trevally	10	104
			Spur dogfish	11	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
19. 1.54	E. of Port	388-405	Red gurnet perch	1	
	Stephens 1		Spur dogfish	14	
19. 1.54	E. of Port	170-200	Spur dogfish	7	
	Stephens 1				
27. 5.54	W. of S.W. Cape	248-330	Deep-sea trevally	2	30
	15		Ling	8	56
			School shark	3	
			Spur dogfish	4	
27. 5.54	W. of S.W. Cape	318-364	Deep-sea trevally	6	84
	15		Ling	2	13
			Deep-sea cod	3	19
			Macruronus novae-zelandiae	1	
			Spur dogfish	11	
29. 5.54	S.W. of Port Davey	394-400	Deep-sea trevally	43	970
	16		Ling	4	35
			Deep-sea cod	12	73
			Dorian Gray	2	
			Lord Plunket's shark	2	
29. 5.54	S.W. of Port Davey	426-430	Deep-sea trevally	12	265
	16		Ling	3	22
			Deep-sea cod	12	57
			Nilson's dogfish	1	
30. 5.54	W. of S.W. Cape	402-408	Deep-sea trevally	5	110
	16		Deep-sea cod	5	24
			Macruronus novae-zelandiae	2	
			Spur dogfish	2	
			Dorian Gray	1	
31. 5.54	S. of Pedra Blanca	396-440	Deep-sea trevally	5	130
	13		Ling	5	62
			Deep-sea cod	22	141
			King barracouta	1	
			Swell shark	1	
			Dorian Gray	1	
			Spur dogfish	1	
1. 6.54	S. of Pedra Blanca	390-430	Deep-sea trevally	4	106
	13		Ling	2	18
			Deep-sea cod	5	20
			Lord Plunket's shark	2	
			Dorian Gray	2	
			Spur dogfish	2	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
1. 6.54	S. of Pedra Blanca 13	280-380	Deep-sea trevally	14	304
			Ling	6	73
			King barracouta	1	
			Spur dogfish	1	
16. 6.54	E. of Cape Forestier 6	345-370	Deep-sea trevally	1	15
			Ling	14	151
			Deep-sea cod	7	38
			Macruronus novae-zelandiae	1	
17. 6.54	E. of Cape Forestier 6	320-400	Deep-sea trevally	4	73
			Ling	8	88
			Deep-sea cod	22	143
			Dorian Gray	8	
			Lord Plunket's shark	2	
			Spur dogfish	1	
			Endeavour dogfish	1	
			Long-nosed skate	1	
17. 6.54	E. of Cape Forestier 6	260-420	Deep-sea trevally	4	51
			Ling	11	92
			Deep-sea cod	3	23
			White-spotted dogfish	1	
			Lord Plunket's shark	1	
18. 6.54	E. of Cape Lodi 5	360-400	Ling	25	218
			Deep-sea cod	22	146
			Lord Plunket's shark	7	
			Dorian Gray	6	
			Ghost shark	1	
			Spur dogfish	3	
18. 6.54	E. of Cape Lodi 5	260-410	Deep-sea trevally	30	397
			Ling	26	260
			Deep-sea cod	4	28
			Red gurnet perch	1	
			Swell shark	6	
			Ghost shark	1	
			Spur dogfish	9	
22. 6.54	E. of Ragged Head 8	260-350	Deep-sea trevally	1	8
			Ling	2	13
			Red gurnet perch	1	
			School shark	1	
			Swell shark	10	
			Spur dogfish	7	
22. 6.54	E. of Ragged Head 8	200-360	Deep-sea trevally	1	6
			Ling	5	43
			School shark	6	
			White-spotted dogfish	2	
			Swell shark	3	
			Long-nosed skate	2	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
22. 6.54	E. of Ragged Head 8	250-360	Ling	5	49
			King barracouta	1	
			Red gurnet perch	1	
			School shark	1	
			Swell shark	6	
			Spur dogfish	6	
12. 1.55	E. of Cape Forestier 6	300-380	Deep-sea trevally	3	54
			Ling	16	176
			Deep-sea cod	26	176
			Macruronus novae-zelandiae	1	
			Swell shark	3	
			Long-nosed skate	1	
			Spur dogfish	3	
14. 1.55	E. of Yellow Bluff 9	280-430	Deep-sea trevally	29	563
			Ling	11	90
			Deep-sea cod	13	88
			Red gurnet perch	1	
			Swell shark	1	
			Spur dogfish	1	
16. 1.55	E.S.E. of Ragged Head 8	300-430	Ling	7	73
			Deep-sea cod	5	35
			Spur dogfish	1	
25. 3.55	E. of Cape Lodi 5.	320-380	Deep-sea trevally	12	141
			Ling	12	121
			Deep-sea cod	7	42
			Red gurnet perch	1	
			Spur dogfish	3	
26. 3.55	E. of Cape Lodi 5	200-320	Deep-sea trevally	7	77
			Ling	1	
			King barracouta	2	
			Red gurnet perch	1	
			Swell shark	1	
			Spur dogfish	23	
28. 3.55	E. of Ragged Head 8	285-360	Ling	6	76
			Deep-sea cod	8	46
			Red gurnet perch	1	
			Swell shark	4	
			One-finned shark	1	
			Spur dogfish	19	

Date	Location and Station No.	Depth (fm)	Catch	No.	Wt. (lb)
30. 3.55	N. by 60°E. of Pirates Bay 10	250-392	Ling	10	82
			Coelorhynchus australis	1	
			Red gurnet perch	2	
			Swell shark	25	
			Spur dogfish	8	
31. 3.55	E. of Pirates Bay 10	270-320	Ling	11	83
			Deep-sea cod	5	35
			Red gurnet perch	1	
			Swell shark	3	
			Spur dogfish	18	
1. 4.55	S.E. of Cape Pillar 12	230-280	Ling	3	28
			School shark	2	
			Swell shark	1	
			Spur dogfish	7	
			Long-nosed skate	1	

APPENDIX II

RESULTS OF DROPLINGING OPERATIONS FROM JUNE 1954 TO JULY 1955

Date	Location and Station No.	Depth (fm)	Catch	No.
26. 6.54	E. of Tasman I.	315	Deep-sea trevally	1
	12	350	Deep-sea trevally	1
			Ling	2
		380	Nil	
		390	Nil	
		300	Deep-sea trevally	6
Total Deep-sea trevally = 51		300	Nil	
Total Weight = 696 lb		294	Deep-sea trevally	2
		280-300	Deep-sea trevally	15
		300	Deep-sea trevally	21
		300	Deep-sea trevally	4
		290	Deep-sea trevally	1
			King barracouta	1
27. 6.54	E. of Tasman I.	284	Deep-sea trevally	5
	12	300	Deep-sea trevally	1
		300	Deep-sea trevally	2
		290	Deep-sea trevally	14
		273	Deep-sea trevally	4
		292	Deep-sea trevally	9
Total Deep-sea trevally = 56		286	Deep-sea trevally	2
Total Weight = 839 lb		300	King barracouta	1
		292	Deep-sea trevally	5
		276	Nil	
		300	Nil	
		280	Deep-sea trevally	14
28. 6.54	E. of Fortescue	293-303	One-finned shark	1
	Bay 11	270	Deep-sea trevally	7
		260-270	Deep-sea trevally	17
Total Deep-sea trevally = 39		268	Deep-sea trevally	5
Total Weight = 588 lb		260	Nil	
		260	Deep-sea trevally	5
		260	Deep-sea trevally	5
		260	Nil	
9. 7.54	N.E. of Eddystone	280	Nil	
	Point 4	312	Deep-sea trevally	2
		312	Deep-sea trevally	9
		322	Deep-sea trevally	2
		306	Deep-sea trevally	6
Total Deep-sea trevally = 28		304	Nil	
Total Weight = 411 lb		306	Nil	
		306	Nil	
		290	King barracouta	1
		300-330	Deep-sea trevally	9
		280	Nil	
		314	Nil	
		120	Nil	

Date	Location and Station No.	Depth (fm)	Catch	No.
18. 7.54	N.E. of Eddystone Point 4	300	Deep-sea trevally	5
19. 7.54	N.E. of Eddystone Point 4	320	Nil	
		310	Nil	
		318	Deep-sea trevally	5
		310	Deep-sea trevally	2
		300	Deep-sea trevally	12
27. 9.54	E. of Cape Lodi 5	312	Deep-sea trevally	2
			Deep-sea cod	1
		294	Deep-sea trevally	2
		264	Deep-sea trevally	13
			Endeavour dogfish	1
		280	Deep-sea trevally	14
Total Deep-sea trevally = 80		315	White-spotted dogfish	
Total Weight = 1105 lb		410-450	Nil	
		500	Nil	
		240-260	Deep-sea trevally	10
		240-260	Deep-sea trevally	14
		240-300	Deep-sea trevally	12
			King barracouta	1
		200-280	Deep-sea trevally	8
		270-300	Deep-sea trevally	4
			Deep-sea cod	1
		260	Deep-sea trevally	1
28. 9.54	E.N.E. of Cape Lodi 5	300	Deep-sea trevally	1
		260	Deep-sea trevally	11
			King barracouta	1
		260	Deep-sea trevally	10
		260	Deep-sea trevally	5
		260	Deep-sea trevally	10
Total Deep-sea trevally = 78		220-230	Deep-sea trevally	4
Total Weight = 1105 lb		190	Nil	
		255	Deep-sea trevally	11
		240-250	Deep-sea trevally	3
		240-250	Deep-sea trevally	4
		260-270	Deep-sea trevally	8
		270	Deep-sea trevally	4
		254-270	Deep-sea trevally	2
		270-290	Deep-sea trevally	5

Date	Location and Station No.	Depth (fm)	Catch	No.
29. 9.54	E. of Schouten	270-303	Deep-sea trevally	1
	Passage 7	293	Deep-sea trevally	3
		287	Deep-sea cod	1
		270-275	Nil	
		260-270	Deep-sea trevally	3
Total Deep-sea trevally = 8		270-300	Deep-sea trevally	1
Total Weight = 117 lb		380-420	Nil	
		260	Nil	
30. 9.54	E. of Ragged Head 8	280-380	Nil	
3.10.54	E. of Pirates Bay	285-293	Nil	
	10	270-280	Nil	
		260-290	Nil	
		284	Nil	
3.10.54	E. of Fortescue	265-315	Ling	2
	Bay 11		Spur dogfish	4
		270-280	Nil	
		280-320	Nil	
4.10.54	S.E. of Cape	290	Deep-sea trevally	2
	Pillar 12	330-340	Nil	
		400-440	Nil	
Total Deep-sea trevally = 5		535-540	Nil	
Total Weight = 97 lb		296	Deep-sea trevally	1
		272-284	Deep-sea trevally	1
		254-260	Deep-sea trevally	1
5.10.54	E. of Tasman I.	265	Deep-sea trevally	1
	12	220-265	Nil	
		230	Nil	
		236-245	Nil	
		310-315	Nil	
6.10.54	E. of Cape Lodi	*320-340	Nil	
	5	*230-310	Nil	
		*240-260	Nil	
		* 70-90	Nil	
		*270	Deep-sea trevally	3
		*275	Nil	
	*Night shots	*260-280	Nil	
		*290	Deep-sea trevally	1
		*280	Nil	
Total Deep-sea trevally = 43		310-320	Nil	
Total Weight = 484 lb		260-280	Deep-sea trevally	1
		270	Deep-sea trevally	8
		260	Deep-sea trevally	2
			Ling	1

Date	Location and Station No.	Depth (fm)	Catch	No.
6.10.54	E. of Cape Lodi	260-265	Deep-sea trevally	1
	(cont'd) 5	265	Deep-sea trevally	3
		265-275	Nil	
		260-280	Deep-sea trevally	1
			King barracouta	1
		260	Deep-sea trevally	1
		220-260	Deep-sea trevally	3
		240-295	Deep-sea trevally	19
14.10.54	E. of Cape Lodi	253	Nil	
	5	284	Nil	
		284	Deep-sea trevally	1
		295	King barracouta	1
Total Deep-sea trevally = 13		437	Nil	
Total Weight = 199 lb		240-284	Nil	
		262	Deep-sea trevally	2
		284	Deep-sea trevally	10
		284	Nil	
		262	Nil	
5. 1.55	E. of Cape Pillar	284	Nil	
	12	250-260	Nil	
		290-300	Nil	
6. 1.55	E. of Fortescue	320	Nil	
	Bay 11	284	Nil	
		240-260	Deep-sea trevally	6
		270	Nil	
		240-260	Deep-sea trevally	5
		260	Ling	2
		260	Nil	
Total Deep-sea trevally = 55		240-260	Deep-sea trevally	11
Total Weight = 936 lb		240-260	Deep-sea trevally	7
		240-260	Deep-sea trevally	9
		248	Deep-sea trevally	3
		240	Deep-sea trevally	8
		240	Deep-sea trevally	6
		240	Ling	1
7. 1.55	N.E. of Fortescue	240-280	Deep-sea trevally	1
	Bay 11		Ling	1
		240-274	Nil	
		240	Deep-sea trevally	15
Total Deep-sea trevally = 138		230	Deep-sea trevally	18
Total Weight = 2139 lb		230-240	Deep-sea trevally	22
		240	Nil	
		230	Deep-sea trevally	22
		220	Deep-sea trevally	19
		230	Nil	
		240	Deep-sea trevally	19
		240	Deep-sea trevally	5
		230	Deep-sea trevally	17
		240	Nil	

Date	Location and Station No.	Depth (fm)	Catch	No.
7. 1.55	E.N.E. of Yellow	220	Deep-sea trevally	4
	Bluff 9	220	Deep-sea trevally	3
Total Weight	= 83 lb		King barracouta	1
10. 1.55	E. of Schouten	260	Nil	
	Passage 7			
10. 1.55	E. of Cape	222	Deep-sea trevally	6
	Forestier 6		King barracouta	1
		180-215	Deep-sea trevally	2
			King barracouta	1
		212	Deep-sea trevally	7
		200-220	Deep-sea trevally	5
		238	King barracouta	3
Total Deep-sea trevally	= 47	206-212	Deep-sea trevally	1
Total Weight	= 539 lb	208-246	Deep-sea trevally	12
		220-240	Nil	
		230-240	Deep-sea trevally	6
		220-230	Deep-sea trevally	8
12. 1.55	E. of Cape	220-240	Deep-sea trevally	4
	Forestier 6	240-260	Deep-sea trevally	3
		230-252	Deep-sea trevally	5
		260-280	Deep-sea trevally	9
		230-250	Deep-sea trevally	4
Total Deep-sea trevally	= 43	224-240	Deep-sea trevally	2
Total Weight	= 448 lb	230-240	Deep-sea trevally	9
		220-226	Nil	
		240-260	Deep-sea trevally	7
			Ling	2
		256-260	Nil	
14. 1.55	E. of Yellow Bluff	230-240	Deep-sea trevally	19
	9	230-235	Deep-sea trevally	18
		220	Nil	
		255	Nil	
		230	Deep-sea trevally	7
Total Deep-sea trevally	= 89	320-324	Deep-sea trevally	8
Total Weight	= 1485 lb	350-380	Deep-sea cod	2
		440-450	Nil	
		232-240	Deep-sea trevally	10
		243-250	Deep-sea trevally	8
		238-240	Deep-sea trevally	14
		240-300	Deep-sea trevally	5
			Deep-sea cod	1
16. 1.55	E.S.E. of Ragged	280	Deep-sea cod	2
	Head 8		Spur dogfish	1
		240-246	Nil	
		250	Nil	

Date	Location and Station No.	Depth (fm)	Catch	No.
16. 1.55	E. of Pirates Bay	230-234	Nil	
	10	225	Deep-sea trevally	15
		222	Nil	
Total Weight	= 233 lb	252	Nil	
17. 1.55	E. of Pirates Bay	238-255	Deep-sea trevally	7
	10	250-255	Nil	
		260	Deep-sea trevally	3
		240	Nil	
18. 1.55	E. of Fortescue	254	Nil	
	Bay 11	260	Nil	
		280	Spur dogfish	1
		244-250	Nil	
22. 3.55	N. by 60° E. of	240-246	Deep-sea trevally	8
	Pirates Bay 10	220	Nil	
		260-304	Nil	
Total Deep-sea trevally	= 36	240	Nil	
Total Weight	= 376 lb	290	Deep-sea trevally	12
		270-280	Deep-sea trevally	16
		280	Nil	
		290-300	Nil	
		330-340	Nil	
		400-410	Nil	
24. 3.55	E. of Cape	260	Nil	
	Forestier 6	255-288	Deep-sea cod	1
		177-188	Nil	
		220-240	Nil	
		270-276	Nil	
25. 3.55	E. of Cape Lodi	280-300	Nil	
	5	270-278	Nil	
		268-272	King barracouta	
26. 3.55	E. of Cape Lodi	240	Deep-sea trevally	10
	5	225	King barracouta	4
		176	Nil	
		200-292	Red Gurnet Perch	1
28. 3.55	E. of Ragged Head	330-340	Deep-sea trevally	1
	8	300	Deep-sea cod	1
		335	Nil	
Total Weight	= 23 lb	200-210	Nil	
		248-270	Nil	

Date	Location and Station No.	Depth (fm)	Catch	No.
30. 3.55	N. by 60° E. of	276	Nil	
	Pirates Bay 10	230-270	Nil	
		230-247	Nil	
		212-240	Nil	
		390	Deep-sea cod	4
31. 3.55	E. of Pirates Bay	240	Nil	
	10	250-254	Deep-sea trevally	2
		250-254	Deep-sea trevally	1
Total Deep-sea trevally = 3		260-270	Nil	
Total Weight = 50 lb		246-260	Red gurnet perch	1
		260-280	Nil	
1. 4.55	S.E. of Cape	275	Nil	
	Pillar 12	240-246	Nil	
30. 5.55	E. of Yellow	284	King barracouta	1
	Bluff 9	284	Nil	
		273	Deep-sea trevally	1
		273	Deep-sea trevally	8
		279	Deep-sea trevally	7
		273	Deep-sea trevally	3
			King barracouta	2
		279-290	Deep-sea trevally	11
			Ling	1
12. 7.55	E. of Cape	296-312	King barracouta	1
	Pillar 12			
17. 7.55	N. by 70° of	275-284	Deep-sea cod	1
	Pirates Bay 10	216-220	Deep-sea trevally	11
		214-220	Deep-sea trevally	7
		242-256	Deep-sea trevally	9
			King barracouta	1
		240-260	Deep-sea trevally	17
Total Deep-sea trevally = 122		250-270	Deep-sea trevally	17
Total Weight = 1561 lb		236-270	Deep-sea trevally	15
		250	Deep-sea trevally	12
			King barracouta	1
		238-250	Deep-sea trevally	18
		250-268	Deep-sea trevally	6
		224-232	Deep-sea trevally	10
		270	Nil	
		220-260	Nil	

Date	Location and Station No.	Depth (fm)	Catch	No.
18. 7.55	N. by 60° E. of	248-300	Nil	
	Pirates Bay 10	220-234	Deep-sea trevally	14
		230-248	Deep-sea trevally	13
		226-230	Deep-sea trevally	12
Total Deep-sea trevally = 61		226-234	Deep-sea trevally	14
Total Weight = 875 lb		246-260	Nil	
		234-240	Deep-sea trevally	1
		218-232	Deep-sea trevally	7
20. 7.55	E. of Cape Lodi	252-260	Nil	
	5	220-236	Deep-sea trevally	1
		253-270	Ling	1
Total Deep-sea trevally = 2		240-245	Nil	
Total Weight = 25 lb		260-282	Deep-sea trevally	1
21. 7.55	E. of Cape	238	Deep-sea trevally	1
	Forestier 6	318-324	Nil	
Total Weight = 5 lb		374	Nil	
21. 7.55	E. of Schouten	206-236	Nil	
	Passage 7			
23. 7.55	N. by 60°E. of	220-232	Nil	
	Pirates Bay 10	220-250	Deep-sea trevally	7
		210-222	Deep-sea trevally	6
Total Deep-sea trevally =44		240-400	Nil	
Total Weight = 492 lb		218-222	Deep-sea trevally	20
		209-212	Deep-sea trevally	11

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