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NEW ZEALAND MARINE DEPARTMENT

FISHERIES TECHNICAL REPORT
No. 77

**BOTTOM TRAWLING IN COOK STRAIT
AND WESTERN TARANAKI BIGHT**

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WELLINGTON, NEW ZEALAND
1972

FISHERIES TECHNICAL REPORT

BOTTOM TRAWLING IN COOK STRAIT AND WESTERN
TARANAKI BIGHT

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SUMMARY

A series of three trawling projects are here presented and analysed. The area covered extended from Cloudy Bay (Cook Strait), the north of Tasman Bay and northwards to 60 miles west of New Plymouth. It was found that the weight of the fish caught decreased from the south to the north of the area, while the catch rates were lower in June than in April, increasing slightly in August.

MATERIAL AND METHODS

For all tows within the three projects the "W.J. Scott" used a Granton trawl with a headline of 79ft, groundline of 126ft, and wing mesh and codend of 4" (stretched). The otter boards were the normal rectangular type measuring 8ft x 4ft 9ins, while the sweeps were 40 fathoms long. Since these results were of possible use to the fisherman it was decided that four hour tows (except for "Constanta" 1969) were more realistic than the two hour tows preferred by Tunbridge (1966). Each tow was for 16 miles, the trawling speed was 4 knots, with a variable pitched propeller set at 16° pitch and 1,200 r.p.m. Experiments during the "Constanta" trawling of 1969 showed that the spread of the trawl boards varied with each tow, even if wire dip, wire length, and water depth remained constant: this spread varied from 226-260ft, with 17-18° dip, 150 fathoms of wire, and 36-40 fathoms of water. The ratio of water depth to wire length was generally 1:4, although this ratio could alter during a tow if the sea bottom contour varied.

For comparison purposes Mr Don York, who was on board the "Constanta", has supplied the following few dimensions of the Rumanian trawl net: headline = 574ft (175 m); wing mesh = 4 9/16" - 5 14/16" (11.5-15 cm); codend mesh = 3 9/16" (9 cm).

After each tow the fish were examined on deck, a number of fish being set aside for dissection. A record was made of the species composition of each tow plus the number of baskets per commercial species (each basket contained approximately 96lbs of fish), plus the presence of "rubbish" fish.

Names used are as in Sorensen (1970).

RESULTSA. "Tunbridge" Area

As four hour tows were used by the "W.J. Scott", most of Tunbridge's tows were combined for comparative purposes, as follows: 1 and 6, 2 and 3, 4 and 5, 7 and 8, 9 and 10, 11 and 12, 13 and 15. Owing to the shallower water, trawl 14 was treated separately, being a two hour tow comparable with Tunbridge: both tows were then corrected to four hour tows.

Table 1 illustrates the weights of the commercial fish caught in each tow, (Tunbridge catches in brackets). In these figures "shark" refers to both school shark and smoothhound, while "mackerel" includes both English and horse mackerel. From the table the following points emerge:

- (a) Of the 11 species common to both surveys, only 2 (jack mackerel and snapper) were found in spring 1968 which exceeded the 1966 summer total. In both surveys the snapper were found in greater numbers in the southern part of the zone, while the jack mackerel were fairly evenly distributed during 1968, but mainly in the southern area in 1966.
- (b) No southern kingfish and very little groper were found during the 1968 spring survey, as opposed to the 227lbs and 180lbs respectively during the summer 1966. Tunbridge (1966) found ripe gonads in the groper during summer, indicating probable migration during winter and spring into other areas for feeding purposes.
- (c) There occurred during spring 1968 big decreases throughout most of the surveyed area in the catch rates of john dory, tarakihi, shark, and barracouta compared to summer 1966.
- (d) Rough skate were found only off Cape Egmont during spring 1968, while in summer 1966 they were present in small but consistent numbers throughout the whole area.

(e) Squid and gurnard were found in small quantities in both surveys, with the summer 1966 catches being generally higher than in spring 1968.

(f) The total summer 1966 catch, though small in commercial terms, was twice that of spring 1968. A contingency test on the total weights per trawl zone gave a $\chi^2 = 648$ and $P = < .005$, while a comparative χ^2 between the 1966 and 1968 trawl totals, and using the formula $\chi^2 = \frac{\sum (o-e)^2}{e}$

gave the following results.

<u>Trawl Zone</u>	<u>χ^2</u>	<u>P</u>	
1 & 6	.6	.5 -	.25 (no significant difference)
2 & 3	456	>.005	(significant difference)
7 & 8	180	>.005	(" ")
11 & 12	970	>.005	(" ")
13 & 15	104	>.005	(" ")
14	662	>.005	(" ")

Thus the total catch rates in all the areas except for 1 & 6 are significantly different. In 1 & 6 although the total weights of the catches showed no significant difference, species composition did differ significantly between the 2 periods.

(g) In summer 1966 the predominant fish species were tarakihi, shark, and barracouta whereas in spring 1968 these species had decreased in importance in favour of snapper and jack mackerel. Nevertheless, the spring catches were still too low for profitable exploitation.

Associated with the above species were a number of other fish species: Table 2 shows the weights of the main "rubbish" fish per trawl area.

TABLE 1 **WEIGHT (LBS) OF COMMERCIAL AND "RUBBISH" FISH SPECIES PER 4 HR TRAWL**
 (Tunbridge figures in brackets)

FISH	Trawl Area								Total	% Composition of totals
	1 & 6	2 & 3	4 & 5	7 & 8	9 & 10	11 & 12	13 & 15	14		
Tarakihi	50(263)	190(1040)	-	48(180)	-	95(216)	190(153)	0(10)	573(1862)	10.9(17.6)
Snapper	50(56)	47(156)	-	98(66)	-	190(150)	96(208)	570(24)	1051(660)	20.0(6.2)
Shark	46(215)	48(887)	-	31(315)	-	142(690)	0(570)	30(840)	297(3517)	5.4(33.3)
Southern Kingfish	0(59)	0(168)	-	0(0)	-	0(0)	0(0)	0(0)	0(227)	0(2.1)
Groper	0(0)	0(108)	-	0(36)	-	0(12)	15(24)	0(0)	15(180)	.2(1.7)
John Dory	15(20)	48(194)	-	0(20)	-	0(12)	0(100)	0(120)	63(466)	1.1(4.4)
Gurnard	34(6)	4(111)	-	2(33)	-	9(7)	12(94)	48(276)	109(527)	2.0(4.9)
Barracouta	26(86)	47(44)	-	0(144)	-	24(420)	292(528)	0(640)	389(1862)	7.4(17.6)
Jack Mackerel	600(2)	1045(3)	-	237(87)	-	47(411)	695(16)	48(66)	2672(585)	50.8(5.5)
Squid	0(71)	6(50)	-	5(11)	-	6(28)	9(192)	32(0)	58(352)	1.1(3.5)
Skate	3(14)	24(100)	-	0(20)	-	0(66)	0(0)	0(120)	27(320)	.5(3.0)
Total	824(792)	1459(2861)	-	421(912)	-	513(2012)	1309(1885)	728(2096)	5254(10,558)	

5.

TABLE 2 WEIGHTS (LBS) OF THE MAIN "RUBBISH" FISH SPECIES -
SPRING 1968

Trawl Zone	Porcupine Fish	Rockfish	Eagle Rays	Bream (Warehou)	Ling
1 & 6	26	8	56	0	0
2 & 3	0	0	0	0	0
7 & 8	0	12	0	0	46
11 & 12	190	0	0	0	12
13 & 15	332	0	0	9	0
14	95	3	0	14	0

While only a few specimens were caught three points were evident:

- (a) The porcupine fish occurred off Cape Egmont and north of Cape Farewell to a maximum distance from the shoreline of 40 miles.
- (b) Eagle rays were caught only off Cape Egmont.
- (c) Bream (warehou) were caught only off Cape Farewell.

Other fish species caught included broad-snouted seven-gilled shark (1), frostfish, pilchards, carpet sharks, silver dory, leather jackets, snipe fish, blue warehou, sand eels and sprats.

Surface temperatures taken in this area ranged from 12.6°C 45 miles W.N.W. off Farewell Spit lighthouse to 13.0°C 48 miles west of Cape Egmont, as compared to 16.5°C found by Tunbridge in summer.

B. The "Constanta" Area

During 14-15.8.68 2, 4 hour tows were made in each of the "Constanta" zones (Figure 1), while between 11-15.6.69 4, 2 hour tows were made in each zone. To compare the 2 surveys, the catches were added for each zone to give the total caught in 8 hours trawling in each period. Table 3 gives the total fish weight of each species caught in each zone.

- (a) In both surveys bream (warehou), trevally, and red cod were not common. Bream (warehou) was caught in only 1 tow during spring 1968, while not at all in winter 1969; red cod was located in 2 tows during 1968 and absent in 1969; while trevally occurred rarely during both surveys.
- (b) Other commercial species caught in small quantities were john dory, shark, squid, and gurnard. In all cases the total winter 1969 catches were smaller than the 1968 spring catches, indicating that in August various fish species began to migrate into the trawled area.
- (c) The main species caught were jack mackerel, snapper, barracouta, and tarakihi. χ^2 analysis for each species except barracouta gave a P value $< .005$ indicating that catches were significantly higher in August 1968 than in June 1969. This was also reflected in the respective % compositions of the species. Barracouta was the only one in which the 1969 winter % and fish weight, was higher than in spring 1969. Winter tows in the "Constanta" area therefore contained a narrower range of fish species than for spring.
- (d) In the 1964 "Constanta" tows zone 1 was the most productive followed by 2 and 3. This sequence was also found by the "Scott" in winter 1969, while in spring 1968 the sequence was 1, 3, 2.

Throughout the area a number of other fish were trawled. These included rockfish (spotted spiny dogfish), porcupine fish, carpet shark, ling, blue hake, leatherjackets, anchovies and pilchards. A large number of juvenile squid, gurnard, and tarakihi were rejected, as were a few small horse mackerel, barracouta, and undersize snapper. One basking shark measuring about 24 feet was caught on 14.8.68.

TABLE 3 WEIGHT (LBS) OF COMMERCIAL SPECIES CAUGHT IN
"CONSTANTA" AREA BY "W.J. SCOTT" (AUGUST 1968
AND JUNE 1969)

(Eight hours trawling in each survey - figures
in brackets are for 1969)

ZONE (See map)

Species	1	2	3	Total	% of Total
Jack Mackerel	1789(336)	288(104)	168(28)	2245(468)	35.0(14.6)
Snapper	118(44)	144(144)	576(130)	838(318)	13.0(9.9)
Bream (Warehou)	288(0)	0(0)	0(0)	288(0)	4.4(0)
Barracouta	501(576)	96(332)	192(466)	789(1374)	12.3(42.9)
Tarakihi	262(184)	644(212)	530(168)	1436(564)	22.4(17.6)
John Dory	75(28)	23(44)	120(18)	218(90)	3.4(2.8)
Trevally	5(2)	0(6)	5(6)	10(14)	.1(.4)
Shark	22(192)	140(108)	228(0)	390(300)	6.0(9.7)
Red Cod	10(0)	0(0)	5(0)	15(0)	.2(0)
Squid	22(13)	25(24)	53(19)	100(56)	1.5(1.7)
Gurnard	0(0)	20(2)	53(8)	73(10)	1.1(.3)
Total	3092(1376)	1380(976)	1930(843)	6402(3194)	

Temperatures varied slightly according to location, from 11.4°(C) (14 miles west of Stephens Island) to 12.7°(C) (10½ miles north of Farewell Spit). Generally, temperatures were higher closer to the shoreline than further out to sea.

C. Marlborough Sounds - Cook Strait

Table 4 illustrates the weights of the commercial fish species caught per tow. "Shark" refers to school shark and smooth-hound, while "mackerel" refers to jack mackerel only as no blue mackerel were caught. The following points are evident from the table:

- (a) Three species, kahawai, blue hake and squid were caught in only one or two tows. Kahawai were trawled close inshore in Cloudy Bay; when dissected they were found to have immature gonads. The blue hake occurred in tow 6 only, while the squid were in the area northeast to northwest of Stephens Island.
- (b) Other species of localised distribution were gurnard, elephant fish, John Dory, and groper. The gurnard occurred only in inshore areas of the Marlborough Sounds and in Cloudy Bay, in depths from 15-35 fathoms. John Dory were confined to the area north of the Marlborough Sounds and Stephens Island. The elephant fish occurred only in waters of tows 1, 2, 4, and 8. It was noted in Cloudy Bay that the larger female elephant fish had mature gonads, plus fully developed egg capsule producing organs. Groper were mainly found in Cloudy Bay in depths 15-25 fathoms, while a few were trawled in 65 fathoms north of Pelorus Sounds. The groper caught in Cloudy Bay were immature forms of 51-63 cms long.
- (c) Two species, red cod and bream (warehou), were caught over a wide area, but in small numbers. Concentrations of each species occurred inshore both in Cloudy Bay and north of the Sounds. Both males and females of the species had ripe gonads, indicating that spawning was taking place.

TABLE 4: Weights of Commercial Fish Species (lbs) per Trawl Zone

Trawl No.	Barracouta	Tarakihi	Snapper	Gurnard	Elephant Fish	Mackerel spp.	Shark	John Dory	Groper	Red Cod	Bream (Warehou)	Kahawai	Blue Hake	Squid	Total
1	840	216	96	240	120	792	24	75	5	0	0	0	0	0	2,408
2	288	0	0	48	48	2,784	528	192	192	240	240	0	0	0	4,560
3	0	0	72	0	0	192	36	0	0	16	0	0	0	0	316
4	252	72	24	240	384	48	140	0	336	115	5	168	0	0	1,784
5	1,960	48	48	96	0	48	96	0	192	0	112	0	0	0	2,600
6	0	24	24	0	0	0	140	0	24	0	0	0	72	0	284
7	0	240	144	0	0	816	264	5	0	28	12	0	0	20	1,529
8	120	360	86	0	192	480	168	86	0	0	0	0	0	20	1,512
Total	3,460	960	494	624	744	5,160	1,396	358	749	399	369	168	72	40	14,993

(lbs)

- (d) Tarakihi and snapper were not present in large quantities.
- (e) The main species were mackerel, barracouta, and shark, representing 66.7% of the total catch. The mackerel were mainly found north of the Sounds in depths of 60-80 fathoms, while the shark were evenly distributed within the area. Most of the female school sharks contained pre-hatching young suggesting the existence of a spawning and/or nursery ground in this region. Concentrations of barracouta occurred in Cloudy Bay and around Stephens Island and north of Pelorus Sound. Fish larger than 70 cms had ripe to ripe-running gonads. Large numbers of small barracouta (20-30 cms long) were also located.

Other species caught included leatherjackets, porcupine fish, rockfish (spotted spiny dogfish), rough skate, carpet shark, witch, ling, sea perch, blue warehou, silver dory, rat-tail, blue cod, and frostfish. The numbers of the more common species in each haul are as follows:

<u>Species</u>	Numbers of specimens per tow							
	1	2	3	4	5	6	7	8
Porcupine fish	32	0	3	0	0	0	2	5
Rockfish	30	0	0	0	0	0	0	5
Rough Skate	3	0	0	13	0	4	3	0
Carpet Shark	2	0	0	0	0	0	0	0
Leatherjackets	10	0	0	0	0	0	0	0

Small rat-tails and frostfish were numerous in depths from 60-80 fathoms north of the Sounds, but absent elsewhere. In Cloudy Bay and north of Pelorus Sounds small barracouta, gurnard, and tarakihi were plentiful, while juvenile elephant fish were abundant in Cloudy Bay.

DISCUSSION

A. Comparison of the 3 areas are as follows.

In general catch rates (lbs/hr) in winter were lower than in spring (see below).

<u>"Tunbridge" area</u>		<u>"Constanta" area</u>		<u>Cloudy Bay</u>
Summer (1966)	Spring (1968)	Winter (1969)	Spring (1968)	Spring (1968)
43.9	218	133	266	468

A comparison between the areas indicated that in spring the catch rate increased from north to south. This was evident in the catch per hour and per trawled mile for each area shown in Table 5.

TABLE 5 FISH WEIGHT CAUGHT PER HOUR AND PER TRAWLED MILE

"Tunbridge" area (Figures in brackets from 1966)

<u>Trawl No.</u>	<u>Fish weight per hour</u> (lbs)	<u>Fish weight per mile</u> (lbs)
1 & 6	206(198)	51.5(49.5)
2 & 3	365(715)	91.1(178.8)
7 & 8	105(228)	26.3(57.0)
11 & 12	128(503)	32.0(125.7)
13 & 15	327(471)	81.8(117.0)
14	182(524)	45.5(131.0)

"Constanta" area (Figures in brackets from 1969)

<u>Zone No.</u>	<u>Fish weight per hour</u> (lbs)	<u>Fish weight per mile</u> (lbs)
1	386(172)	96(43)
2	172(122)	43(30)
3	241(105)	60(26)

TABLE 5 Contd.

<u>Trawl No.</u>	<u>Cloudy Bay Area</u>	
	<u>Fish weight per hour</u> (lbs)	<u>Fish weight per mile</u> (lbs)
1	601	163
2	1140	285
3	79	19
4	386	96
5	650	162
6	71	18
7	382	95
8	378	93

It was assumed that the fish population had not altered significantly during the period 1966-1969.

B. Of the fish species landed mackerel species, barracouta, and shark were the main species common to all 3 areas, although they make up varying percentages of the catch. Snapper and tarakihi were important species in the "Tunbridge" and "Constanta" areas, but were relatively unimportant north of the Sounds and in Cloudy Bay. Species occurring on all 3 areas in small quantities were squid, John Dory, and gurnard.

The other fish species had localised distributions: red cod and bream (warehou) were absent from the "Tunbridge" area, while southern kingfish occurred only in the 1966 "Tunbridge" area; trevally was found only in the "Constanta" area, and groper was absent from the "Constanta" area, but present in the other two. Kahawai were found only in Cloudy Bay in contrast to the large concentrations of shoals usually present in the whole area in summer.

C. Catches in the area off New Plymouth were low in both bottom feeding commercial fish and non-commercial fish reflecting the barren nature of this western area (this was also noted by Tunbridge 1966). This was in contrast to the tows further south where up to a quarter of the fish catch was of no commercial value.

D. The localised distribution of a number of commercial species including kahawai, blue hake, squid, gurnard, elephant fish, John Dory and groper in the Cloudy Bay/Marlborough Sound area was noticed. These species were concentrated in either Cloudy Bay or in the area between Stephens Island and Cape Jackson. This may indicate the existence of two different communities with associated fish species in the trawled area. Temperature recordings showed a 3°C difference between Cloudy Bay and north of the Marlborough Sounds. Trawled barracouta, red cod, bream (warehou), school shark, and elephant fish had mature gonads. The presence of considerable numbers of small barracouta, gurnard, groper, and tarakihi indicated that this area may be a nursery ground for these species.

E. No details concerning the catch of the "Constanta" tows exist, although Mr York (pers comm.) has stated that the Rumanians were landing some 50 tons, predominantly jack mackerel, each day. Although the difference in swept areas and head rope heights between the "Constanta" and the "W.J. Scott's" nets was not known, it did appear as if the majority of the fish moved out of the area between April and June. Further evidence for this occurred when a series of bottom trawls, using mid-water trawl doors and the Cranton net, were made in the "Constanta" area between 27.5.69 and 1.6.69. Despite the spread of the doors being only 104ft-144ft (half the spread of the normal doors) the catch rate averaged 280lbs of fish per hour. This was substantially higher than the 133lbs per hour caught from 11.6.69-15.6.69 when using the normal trawl doors. Another explanation of this difference in catch rate is that with the smaller doors and narrower spread the headrope would be higher.

Two questions arise from the results: firstly, what constitutes a good catch? Secondly, would fishing in the area be commercially profitable? Allowing approximately 5c per lb of fish landed, a ship the size of the "W.J. Scott" would have to average 1-1½ short tons of commercial fish per 4 hour tow, or 8-12,000lbs per day. During the surveys only 6 tows landed this amount of fish: three described by Tunbridge (1966) and in the present survey three in the area north of the Sounds and in Cloudy Bay.

It appears, therefore, that in the areas sampled it would not be profitable to operate a vessel of 90ft during the seasons sampled. Whether this would remain so in the September-April period will have to remain uncertain until further exploratory trawling is carried out.

ACKNOWLEDGEMENTS

I wish to thank the following people: Captains D. Munro, J. Brew and M. Baker, and the crew of the "W.J. Scott" for helpful assistance throughout the sampling period; Mr G. Freeman, Administration Officer, Nelson, for his work in keeping the "Scott" operational; Captain T. Rowlings for help in a relieving capacity throughout the projects; Messrs C. Alves, S. Robertson, T. Ure, and B. Ransby (Technicians) for assistance in data collecting; and Mr D. York for supplying information on the original 1964 "Constanta" survey.

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GLOSSARY

Appendix: Scientific Names of fish mentioned in this report.
All names are from Sorenson (1970).

<u>Common Name</u>	<u>Scientific Name</u>
Anchovy	<i>Engraulis australis</i>
Barracouta	<i>Thyrsites atun</i>
Basking Shark	<i>Halsydrus maximus</i>
Blue Cod	<i>Parapercis colias</i>
Blue Hake	<i>Macuronus novaezelandiae</i>
Blue Mackerel	<i>Scomber australasicus</i>
Blue Warehou	<i>Seriolella punctata</i>
Broad snouted seven-gilled shark	<i>Notorynchus cepedianus</i>
Bream (Warehou)	<i>Seriolella brama</i>
Carpet Sharks	<i>Cephaloscyllium isabella</i>
Eagle Ray	<i>Myliobatus tenuicaudatus</i>
Elephant fish	<i>Callorhynchus milii</i>
Frost fish	<i>Lepidopus caudatus</i>
Groper	<i>Polyprion oxgeneios</i>
Gurnard	<i>Cheilodonichthys kumu</i>
Jack mackerel	<i>Trachurus declivis</i>
John Dory	<i>Zeus japonicus</i>
Kahawai	<i>Arripis trutta</i>
Ling	<i>Genypterus blacodes</i>
Leatherjackets	<i>Navodon scaber</i>
Porcupine Fish	<i>Allomycterus jaculiferus</i>
Pilchard	<i>Sardinops neopilchardus</i>
Rat-tail	<i>Paramacrurus australis</i>
Red Cod	<i>Physiculus bachus</i>
Rough Skate	<i>Raja australis</i>
Rockfish (spotted spiny dogfish)	<i>Squalus acanthias</i>
Smoothhound	<i>Mustelus antarcticus</i>

School shark	<i>Galeorhinus australis</i>
Sea perch	<i>Helicolenus percoides</i>
Silver dory	<i>Zenopsis nebulosus</i>
Snapper	<i>Chrysophrys auratus</i>
Snipe fish	<i>Macroramphosus elevatus</i>
Southern kingfish	<i>Rexea solandri</i>
Squid	<i>Notodarus sloani</i>
Sprat	<i>Macegeclupea antipodum</i>
Sand eel	<i>Leptoquathus novaezealandiae</i>
Tarakihi	<i>Cheilodactylus macropterus</i>
Trevally	<i>Caranx lutescens</i>
Witch	<i>Arnoglossus scapha</i>

FIG. 1 TRAWL POSITIONS FOR TUNBRIDGE (1966) AND 'W.J. SCOTT' (1968)

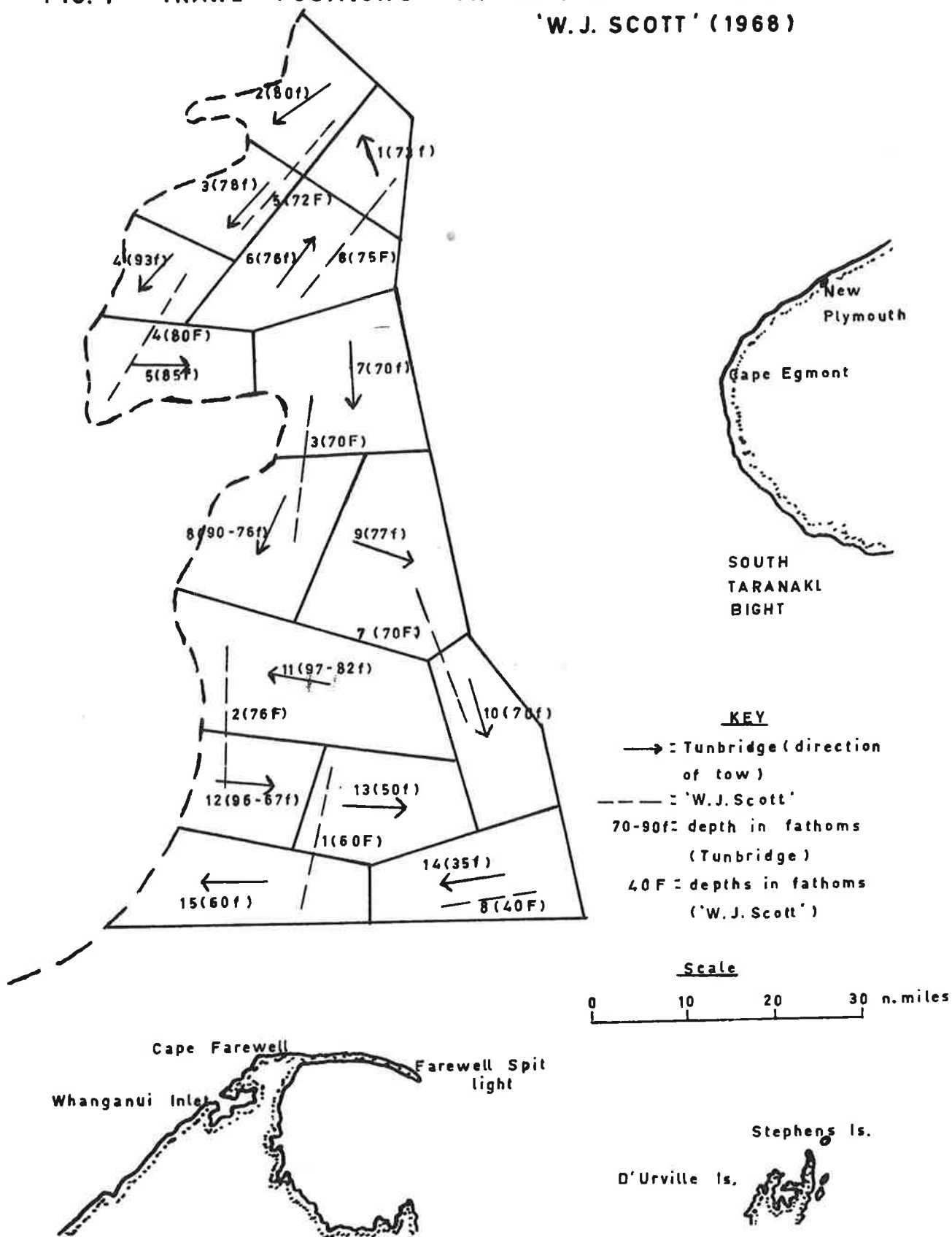


FIG. 2 TRAWL AREA FOR 'CONSTANTA' AND
'W. J. SCOTT'

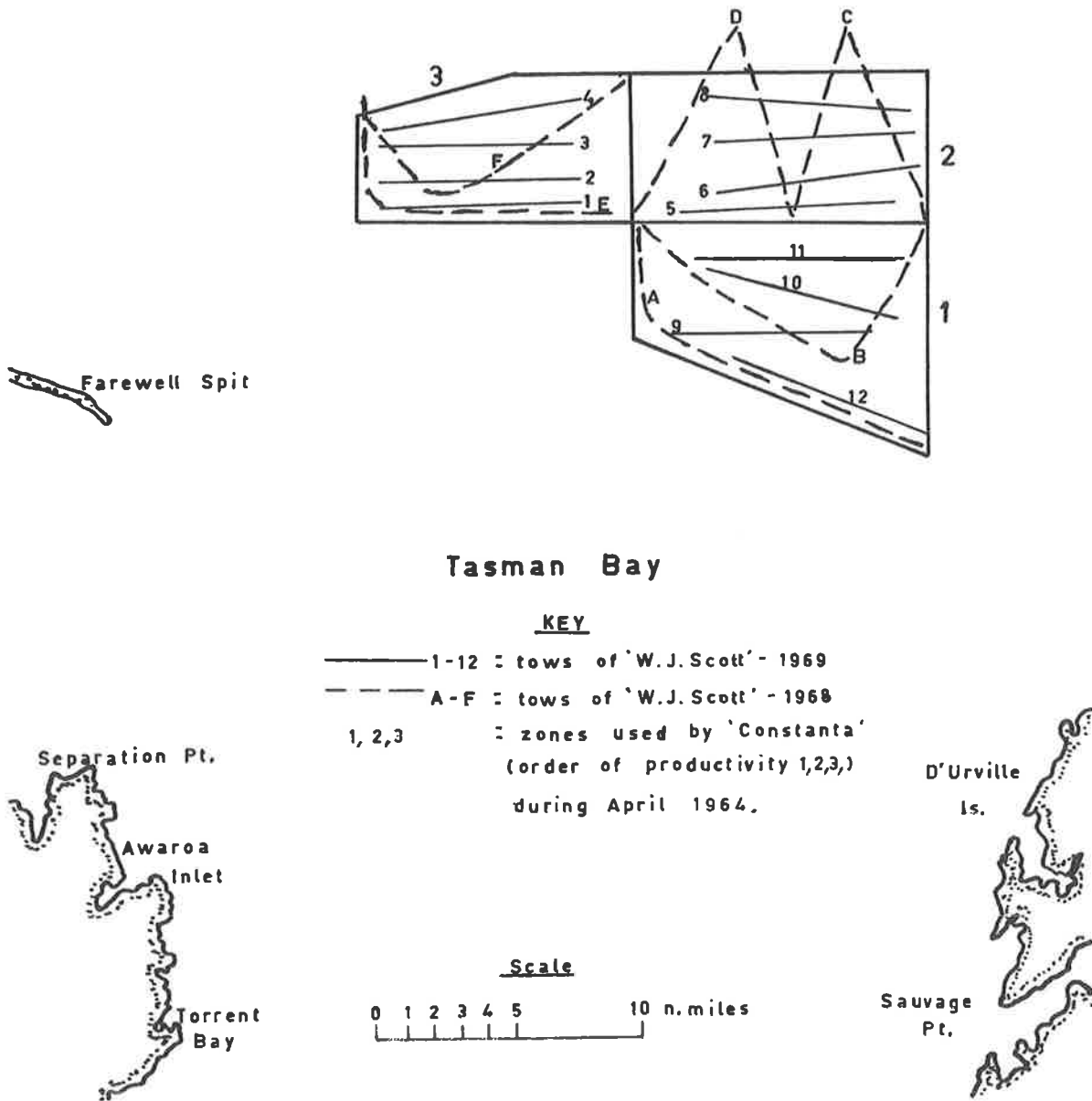
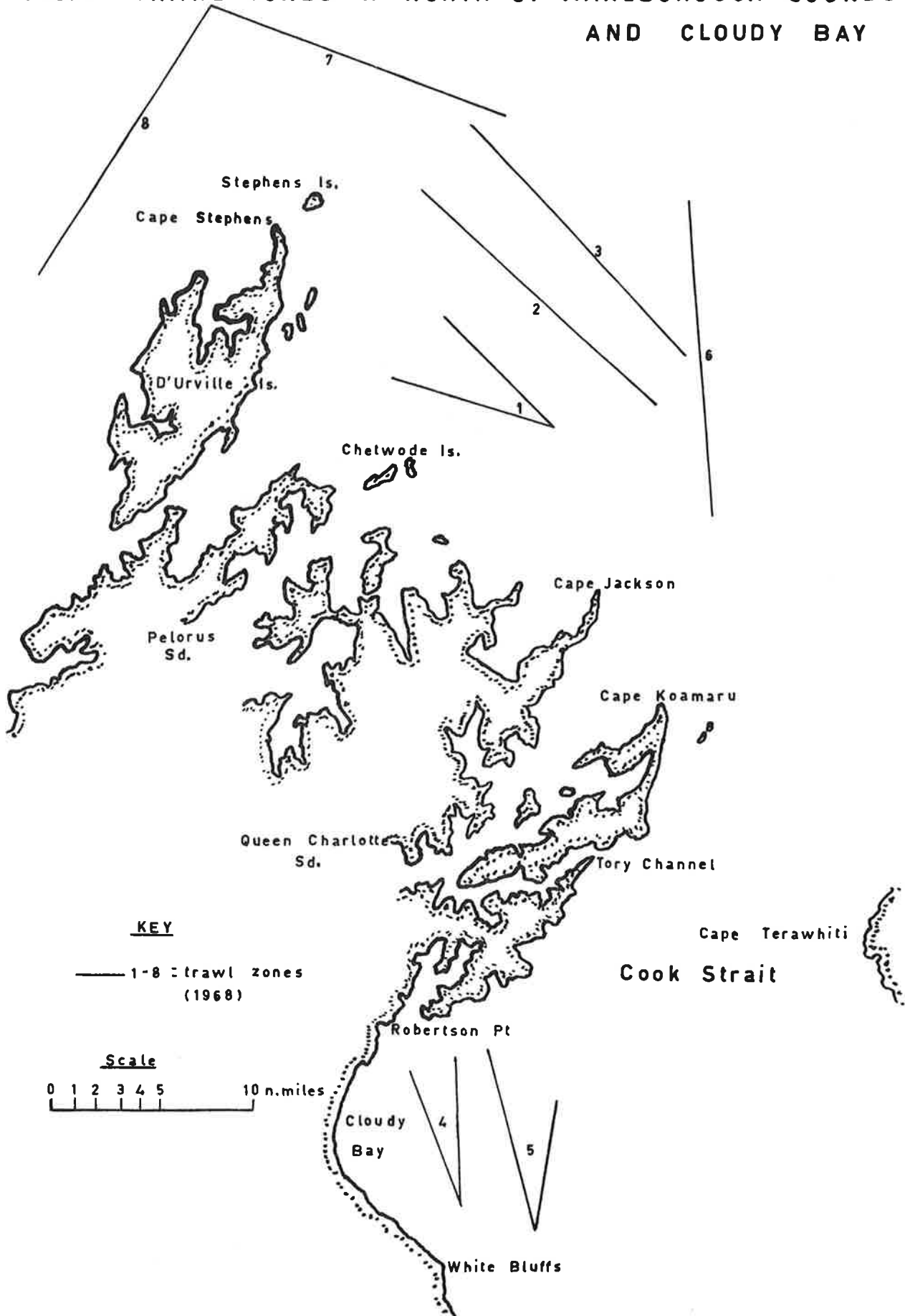


FIG. 3 TRAWL ZONES IN NORTH OF MARLBOROUGH SOUNDS AND CLOUDY BAY



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