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AN EVALUATION OF TAGGING EXPERIMENTS ON THE NEW ZEALAND SNAPPER, *CHRYSOPHRYS AURATUS* (FORSTER), DURING THE PERIOD 1952 TO 1963

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SUMMARY

Details of all known data on New Zealand snapper tagging operations to 1963 are presented and briefly analysed. Nearly 8,000 fish have been tagged, with 43 (0.5%) returned. Fishing methods have included beach-seining, trawling, and hand-lining; tags used have been "pig-rings", operculum strap tags, or Petersen discs attached by two different methods. The greatest number of returns were from line-caught fish with Petersen discs attached through the body by nylon thread. Of the 43 fish recaptured, 33 were taken less than six miles from their tagging site, and seven had moved between 10 and 260 miles (no recapture site was given for three fish. Days at liberty ranged from one to 1,127, with a mean of 164. There were insufficient growth data for analysis.

INTRODUCTION

During the period 1952-63 almost 8,000 snapper, *Chrysophrys auratus* (Forster), were tagged by various members of the New Zealand Marine Department staff to provide information on the movements of this fish, especially on the north-east coast of New Zealand where there is an important commercial fishery. In all, there were only 43 returns (0.5%).

McKenzie (1960) made brief mention of the Hauraki Gulf snapper tagging, and Allen (1963) gave an account of most of the New Zealand tagging experiments up to the end of 1962. Snapper tagging ceased in 1963; the last return was in March of that year, and no further returns have been made up to the time of writing. The present paper considers all the known data from the New Zealand snapper tagging programmes.

METHODS

TAGGING AREAS

The majority of snapper were tagged in the Hauraki Gulf area*, particularly around Great Barrier Island (Fig. 1). Most were line-

* The Hauraki Gulf is here considered to be that area of water between Bream Head in the north-west and the Mercury Islands in the south-east. It may be divided into the "Gulf" proper, south of a line from Cape Rodney to Cape Colville, and the "outer Gulf", seawards of this line (see Fig. 3).

caught and tagged either close inshore or in the vicinity of reefs. Some were taken by trawl or line in open-water areas (20–40 m) of the Gulf. Other main tagging grounds included North Cape, the Alderman Islands, Manukau Harbour, the shores and reefs of Mayor and Motiti Islands

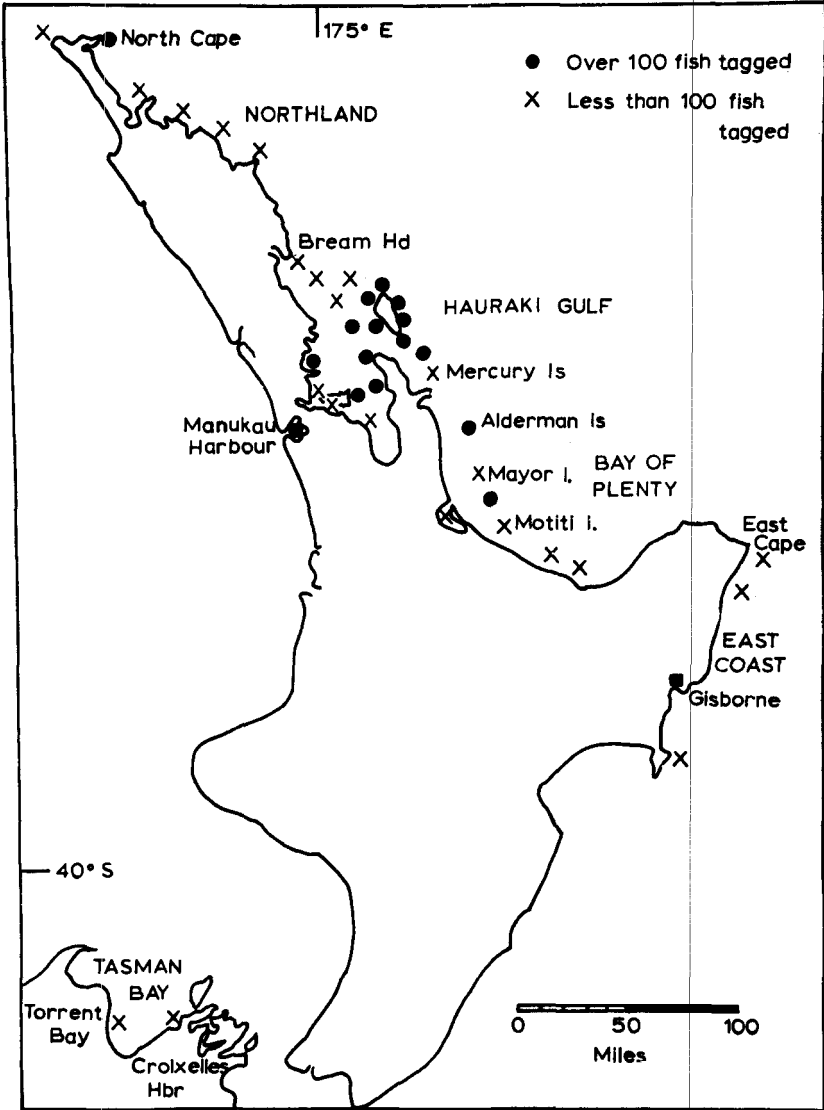


FIG. 1—New Zealand snapper tagging sites 1952 to 1963.

in the Bay of Plenty, and Tasman Bay. As far as can be determined from the existing records, all fish were tagged and released at the site where they were caught.

METHODS OF CAPTURE FOR TAGGING

Beach Seine: This method was used only in Tasman Bay in 1952 and 1955; 35 snapper were tagged, whenever possible under water.

Trawl: 1,365 fish were tagged; 1,167 in the Hauraki Gulf in 1954, 29 in Tasman Bay in 1955, and 169 in the Bay of Plenty and Hauraki Gulf in 1955-57. There is some doubt as to the care with which many of these fish were handled.

Hand-line: 6,535 snapper caught on hand-lines were tagged; 500 in the Manukau Harbour in 1953, five in Tasman Bay in 1955, and 6,030 on various Northland, Hauraki Gulf, and Bay of Plenty tagging sites between 1958 and 1963. Relatively large barbless hooks were used, and the fish hauled aboard rapidly rather than "played". The method caused little apparent harm to the fish, as they swam away rapidly on release. Fish with bleeding hook wounds were not tagged.

TYPES OF TAG USED (see Fig. 2)

Pig Ring Tags: These comprised metal split-rings clipped through the fish's back just below the dorsal fin. They were tried experimentally on 14 snapper in Tasman Bay in 1952.

Operculum Strap Tags: These were used on 500 Manukau Harbour fish in 1953, 1,167 Hauraki Gulf fish in 1954, and 55 Tasman Bay fish in 1955. They were made of light monel metal and clipped to the posterior edge of the left operculum. Their advantage over other tag types lay in their being easily and rapidly applied in the field.

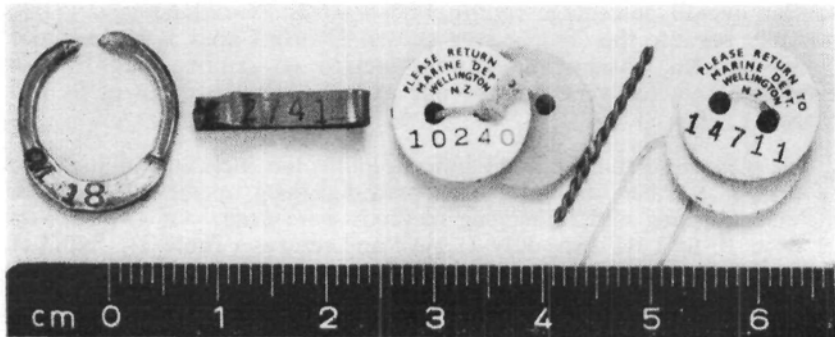


Photo: J. A. Bahler

FIG. 2—Types of tag used during snapper tagging experiments. From left: "pig ring", "operculum strap", "Petersen discs and elastic/toggle", "Petersen discs and nylon thread".

Petersen Discs and Elastic/Toggles: 2,337 fish were tagged by this method in 1959–61, mainly in Northland, Hauraki Gulf, and Bay of Plenty waters. Yellow and/or white plastic discs 13 mm in diameter were held by an elastic thread through the back of the fish just below the posterior edge of the spinous dorsal fin.

Petersen Discs and Nylon Thread: This tag type was used for the majority of the work (3,862 fish), mostly in Northland, Hauraki Gulf, and Bay of Plenty in 1957–63. Two plastic discs were attached to the back of the fish as described above, but with 0.5 mm nylon thread instead of elastic, looped and knotted outside the discs. One of the disadvantages of this method lay in its being slow to apply in the field.

RECOVERIES

Prior to 1962 no reward was offered for returns, and little publicity was given to the tagging scheme; from 1962 onwards four shillings (40 cents) per fish was offered. Tags were returned by amateur and commercial fishermen, and by the Marine Department's research vessel *Ikatere*.

EVALUATION OF TAGGING PROCEDURES

All the New Zealand snapper tagging operations, broken down by area, year, and tagging method, are shown in Table 1. Table 2 breaks down the same data by fishing method and tagging method. Both list the numbers of fish released and the numerical and percentage returns.

TAGGING AREAS

Three of the main areas (Gulf, outer Gulf, and Bay of Plenty) gave similar overall percentage returns of 0.4–0.6%; Northland gave 0.1%, possibly because the tagging area chosen (North Cape) is not a major fishing ground. Manukau Harbour yielded no returns, and Tasman Bay gave high recovery rates of one out of 14 and two out of 55 fish tagged (Table 1).

All these results have been influenced by the inclusion in the data of a large number of totally unsuccessful tagging operations in which inefficient fishing and/or tagging methods were used. Of 131 releases of from 10 to 1,167 fish, only 21 gave any returns (Table 3). Nine of these involved more than 50 fish, and gave percentage returns of 0.5 to 3.5%. (The 12 successful releases involving less than 50 fish gave percentage returns of 2.2 to 25%; this might suggest that more care was taken while tagging small samples, but the existence of so many other factors prevents any firm conclusion.) The higher percentage returns tended to come from areas which were more heavily worked by both amateur and commercial fishermen, e.g. Great Barrier Island

TABLE 1— Numbers of snapper tagged, by area, year, and tag type, showing numerical and percentage recaptures. Vertical order of entries for each year is: number of snapper tagged, number of snapper recaptured, and (in brackets) percentage recaptured. (Nil percentage figures are not listed for the sake of clarity.) Tag Types: PR = Pig Ring, OS = Operculum Strap, PN = Petersen Disc and Nylon Thread, PT = Petersen Disc and Elastic/Toggle.

Areas	Northland		Hauraki Gulf						Manukau		Bay of Plenty			East Coast			Tasman Bay			TOTALS					
	PN	Total	Gulf			Outer Gulf			OS	Total	PT	PN	Total	PT	PN	Total	PR	OS	Total	PR	OS	PT	PN	Total	
Year																									
1952																	14	14	14						14
																	1	1	1						1
																	(7.1)	(7.1)	(7.1)						(7.1)
1953									500	500									500					500	
									0	0									0					0	
1954			1167			1167													1167					1167	
			0			0													0					0	
1955												28	28				55	55	55			28	83		
												0	0				2	2	2			0	2		
																	(3.6)	(3.6)	(3.6)					(2.4)	
1956					52	52																52	52		
					0	0																0	0		
1957								76	76													76	76		
								2	2													2	2		
								(2.6)	(2.6)													(2.6)	(2.6)		
1958					209	209		333	333						13	13						555	555		
					6	6		4	4						0	0						10	10		
					(2.9)	(2.9)		(1.2)	(1.2)													(1.8)	(1.8)		
1959					1	36	37	487	1443	1930				1	1	17	17				488	1497	1985		
					0	0	0	0	20	20				0	0	0	0				0	20	20		
								(1.4)	(1.0)													(1.3)	(1.0)		
1960	2	2			391	391	1034	1034							8	8					1433	2	1435		
	0	0			2	2	0	0							0	0					2	0	2		
					(0.5)	(0.5)															(0.1)	(0.1)			
1961					9	88	260	348					319	116	435						416	376	792		
					0	0	0	1	1				1	1	2						1	2	3		
								(0.4)	(0.3)				(0.3)	(0.9)	(0.5)						(0.2)	(0.5)	(0.4)		
1962	364	364					353	353					50	50								767	767		
	1	1					0	0					0	0								1	1		
	(0.3)	(0.3)																				(0.1)	(0.1)		
1963	414	414					1	1					94	94								509	509		
	0	0					0	0					1	1								1	1		
													(1.0)	(1.0)								(0.2)	(0.2)		
Totals:	780	780	1167	401	297	1865	1609	2466	4075	500	500	319	289	608	8	30	38	14	55	69	14	1722	2337	3862	7935
	1	1	0	2	6	8	0	27	27	0	0	1	2	3	0	0	0	1	2	3	1	2	3	36	42
	(0.1)	(0.1)		(0.5)	(2.0)	(0.4)		(1.0)	(0.6)			(0.3)	(0.7)	(0.5)				(7.1)	(3.6)	(4.3)	(7.1)	(0.1)	(0.1)	(0.9)	(0.5)

TABLE 2—Numbers of snapper tagged, by fishing method and tag type, showing numerical and percentage recoveries. One toggle-tagged fish (No. 43) could have been either trawl or line caught, and is included only in totals column (asterisk).

Tag Type	Fishing Method			Total
	Beach Seine	Trawl	Line	
Pig Ring Tag	14 1 (7.1)	—	—	14 1 (7.1)
Operculum Strap Tag	21 2 (9.5)	1196 0 (0.0)	505 0 (0.0)	1722 2 (0.1)
Petersen Disc and Elastic/ Toggle	—	8 0 (0.0)	2329 3 (0.1)	2337 3 (4)* (0.1) (0.2)
Petersen Disc and Nylon Thread	—	161 2 (1.2)	3701 34 (0.9)	3862 36 (0.9)
Total	35 3 (8.6)	1365 2 (0.1)	6535 37 (0.6)	7935 42 (43) (0.5) (0.5)

and the Coromandel coast. The low return of snapper from the Gulf—a heavily fished area—may be partly explained by the unsatisfactory methods used for catching and tagging these fish (see following).

METHODS OF CAPTURE FOR TAGGING

Beach Seine: Three fish were returned from the 1952 and 1955 Tasman Bay tagging work. Only small numbers of fish were involved, but the method seemed promising for inshore snapper, particularly as it was possible to tag fish without removing them from the water.

Trawl: Only two fish of the 1,365 fish caught by this method were returned. Over 1,100 were tagged with operculum strap tags during one week in the Gulf in 1954. However, to judge from the data sheets—up to 333 fish were tagged from a single trawl haul—it is almost certain that many fish were out of water for an appreciable time and were therefore in poor condition by the time they were released.

The two returns of trawl-caught fish (Table 3, Nos 29 and 35) were from a group of small samples of snapper totalling 161 fish tagged more carefully in later years with Petersen discs and nylon thread, and this 1.2% return (Table 2) compares favourably with the total return of 0.9% for line-caught snapper tagged in the same way.

Hand-line: Because of the early unsatisfactory results from trawling it was decided to restrict tagging to line-caught snapper, and from 1958

onwards all 6,043 snapper were caught for tagging by this method. The 1958 releases gave an encouraging 1.8% return, but this declined in subsequent years and the total return for the years from 1958 onwards was only 0.6%.

TYPES OF TAG USED

Pig Ring Tags: One fish of 14 tagged in Tasman Bay in 1952 was caught on its original tagging site three years later.

Operculum Strap Tags: These were used with moderate success on a small number of snapper in Tasman Bay in 1955, two out of 55 fish (3.6%) being returned. The tags were not successful on larger numbers of snapper in Manukau Harbour in 1953 and in the Gulf in 1954 as no fish from these two operations were returned. These failures may have been due to the tags being too inconspicuous for recognition by commercial fishermen and, in addition, the finding of fish with healed scars suggested that the tags could eventually work loose from the operculum. The Gulf results are probably unreliable for other reasons already mentioned.

Petersen Discs and Elastic/Toggles: Four out of 2,337 fish (0.2%) were returned. The three documented returns (Nos. 8, 9, 38) had been at liberty for only short periods. One fish (No. 43) had lost the numbered tag, but had retained sufficient of the elastic toggle to identify the tag type. Several snapper showing tag wounds were caught by the tagging crew on the main tagging sites during the work with this tag type. It appeared from these results that the tags were retained by the fish for only short periods, and therefore the method was abandoned after 1961.

Petersen Discs and Nylon Thread: Thirty-six of the 43 returned snapper were tagged by this method, the majority being line-caught for tagging. From results available at the time the tagging was carried out it appeared that this was the most satisfactory method, and more snapper (3,701) were tagged using this fishing and tagging combination than any other. The final results (Table 2) only faintly confirm this and suggest that the use of Petersen discs and nylon thread on carefully handled trawl-caught fish may also have been worth continuing.

MOVEMENTS OF SNAPPER

HAURAKI GULF

Snapper tagged during summer within the Hauraki Gulf and returned in summer (January–April) were not more than four miles from the release point; 16 of 18 were right at the release point. Of 15 fish returned during autumn and spring (May–December) seven were within two miles of the release point, while seven were between five and 50 miles away, and one was 260 miles away at Gisborne (their movements are shown in Fig. 3).

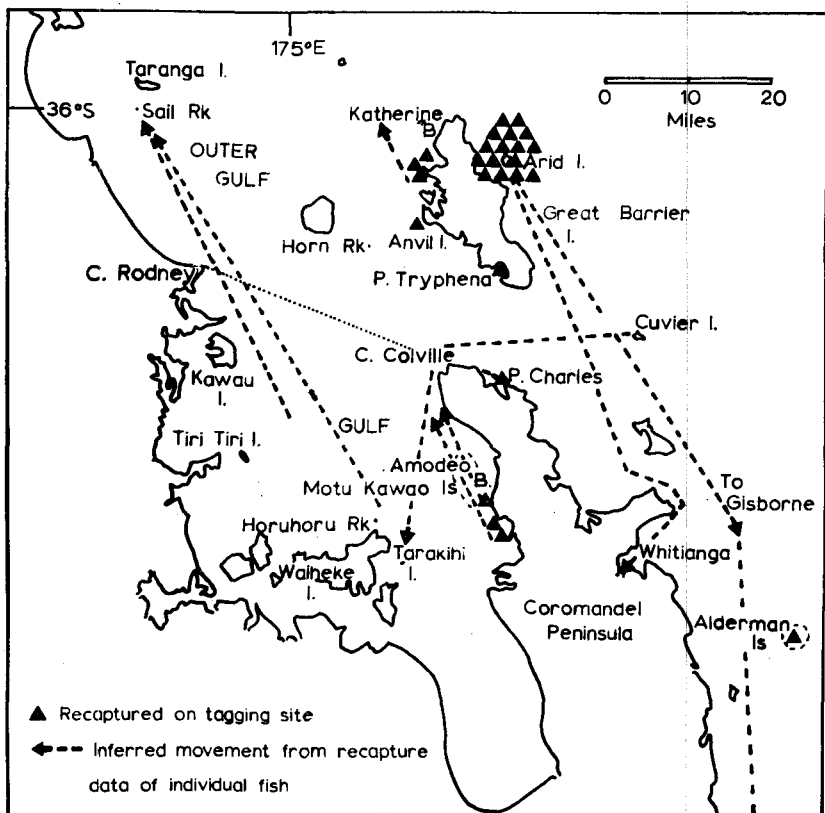


FIG. 3.—Inferred movements of tagged snapper in the Hauraki Gulf, New Zealand.

Thus the majority (25 of 33 fish) were retaken within four miles of their release point. This suggests that a significant part of the Gulf snapper population (or that part available for tagging) is "resident". McKenzie (1960) pointed out that many of the summer recaptures of "residents" were made almost exactly one year after tagging and suggested that these snapper may have moved elsewhere during winter and then come back to their summer grounds. However, the final figures do not support this. Of the 25 apparently resident fish, 15 were caught again in the summer they were tagged, five in the following winter, and six in the following summer. These figures seem more consistent with a higher summer fishing intensity, probably coupled with a high early tag loss, than with a large seasonal movement of fish. After a winter recovery of five fish a second summer influx of "migrants" might have been expected to provide more than six returns.

The fact that three groups of snapper which had been tagged together were caught together on their original tagging site after intervals of

TABLE 3—Details of the 21 successful snapper tagging operations, and of tagged snapper returns. Fishing method abbreviations: L = Line; T = Trawl; BS = Beach Seine; S = Danish Seine. Tag abbreviations: PR = Pig Ring; OS = Operculum Strap; PN = Petersen Disc and Nylon Thread; PT = Petersen Disc and Elastic/Toggle.

RELEASE DATA					DATA FROM RETURNS					ANALYSIS								
Date	Locality	Fishing method	Tag type	No. released	Return No.	Date	Locality	Fishing method	No. caught	% caught	Distance travelled	Days at liberty	Size (in.)		Growth (in.)	Notes*		
													Released	Caught				
NORTHLAND																		
26.5.62	½m. SE N.Cape Light	L	PN	226	1	27.10.62	On tagging site	L	1	0.4	0	154	15.2	15.5	+0.3	4		
HAURAKI GULF																		
12.3.58	Frenchmans Cap, Motu Kawao Is., Coromandel	L	PN	142	2	7.4.58	Papaaroa, Coromandel	L	5	3.5	2	26	10.4	—	—	1, 5, 9		
13.3.58	"	"	"	"	3	17.5.58	On tagging site	L			0	67	10.3	10.6	+0.3			
"	"	"	"	"	4	25.11.58	"	S			10	257	12.1	12	—			
12.3.58	"	"	"	"	5	2.12.58	C. Colville area	S			10	264	11.0	11.5	+0.5			
10.12.58	Amodeo B., Coromandel	L	PN	14	7	1.1.59	Near tagging site	L	1	7.1	0	22	11.9	—	—	7		
22.11.60	7m. NE Tiritiri I.	L	PT	158	8	10.12.60	Sail Rk., Taranga I.	T	1	0.6	36	18	13.0	12.7	-0.3	—		
23.11.60	7m. N Horuhoru Rk.	L	PT	220	9		"	"	T	1	0.5	44	17	12.9	12.6		-0.3	
OUTER GULF																		
Gt. Barrier I.																		
14.1.58	Arid I.	L	PN	30	10	19.3.58	Arid I.	L	3	1.6	0	64	10.2	10.0	-0.2	2		
20.3.58	"	L	PN	193	11	16.1.59	"	L			0	302	19.3	—	—	—	2	
19.3.58	"	"	"	"	12	27.1.59	"	L			0	314	10.2	11.9	+1.7	4		
"	"	"	"	"	13		"	L			0	314	11.9	12.0	+0.1	4		
27-29.1.59	"	L	PN	937	14	28.1.59	"	L			0	1	12.1	—	—	—	1, 4	
"	"	"	"	"	15	4.2.59	"	L			0	7	11.3	11.3	0			
"	"	"	"	"	16	20.3.59	"	L			0	51	12.0	—	—	—		
"	"	"	"	"	17		"	L			0	51	12.5	—	—	—		
5.2.59	"	"	"	"	18	25.3.59	"	L			0	43	13.5	—	—	—		
4.2.59	"	"	"	"	19		"	L			0	49	9.1	8	—	—		
12.2.59	"	"	"	"	20	28.3.59	Whangapoua Bch., Gt. Barrier I.	L			15	1.6	2	—	13.0	12	—	6. 9
27-29.1.59	"	"	"	"	21	6.6.59	Arid I.	L					0	129	14.9	—	—	—
"	"	"	"	"	22		"	L					0	129	17.9	—	—	—
3.2.59	"	"	"	"	23		"	L	0	123			12.3	—	—	—		
11.2.59	"	"	"	"	24	15.6.59	Between Tuaheni Pt. & Tatapouri Hd., Gisborne	T	—	260			124	12.6	13.2	+0.6	2	
27-29.1.59	"	"	"	"	25	3.11.59	Arid I.	L	—	2	278	11.0	10.9	-0.1	3			
"	"	"	"	"	26	15.11.59	"	L	0	291	10.9	—	—					
3.2.59	"	"	"	"	27	2.1.60	"	L	0	333	16.5	—	—					
18.2.59	"	"	"	"	28	4.5.60	½m. upstream Whiti-anga Wharf	L	—	50	441	15.6	16.2	+0.6				
24.1.57	Anvil I.	T	PN	15	29	12.3.57	Near Anvil I.	L	1	6.7	0	47	12.3	—		—	1	
6.1.59	Green I., Katherine B.	L	PN	36	30	20.3.59	Green I.	L	1	2.8	0	73	11.8	11.5	-0.3	2, 4		
20.1.59	"	L	PN	188	31	13.9.59	Mid Simpsons Rk.-Katherine B.	T	2	1.1	5	236	9.4	9.5	+0.1			
19.12.61	"	L	PN	35	32	19.2.59	Katherine B.	L			0	30	10.9	—	—	—		
14.1.59	Shoal B., Port Tryphaena	L	PN	11	33	Apr-May 1962	Green I.	L	1	2.9	0	130	—	14	—	1, 9		
8.1.57	Cuvier I.	T	PN	39	34	end.1.59	Shoal B.	L	1	9.1	0	14	6.6	7	—	1, 9		
13.1.59	Sugarloaf Rks., Port Charles	L	PN	46	35	17.10.57	Tarakahi I., Waiheke I.	S	1	2.6	40	282	10.6	10.4	-0.2	1, 2		
					36	24.3.59	S. of Port Charles	S	1	2.2	4	70	10.1	10.5	+0.4	1		
BAY OF PLENTY																		
18.4.61	Alderman Is.	L	PN	23	37	12.5.61	On tagging site	L	1	4.3	0	24	10.4	10.4	0	1, 5		
23.2.61	Penguin Shoal, Mayor I.	L	PT	229	38	6.5.61	"	—	1	0.4	—	72	27.7	—	—			
28.1.63	Schooner Rk., Motiti I.	L	PN	55	39	11.3.63	Near tagging site	L	1	1.8	0	42	12.5	—	—			
TASMAN BAY																		
26-27.2.52	Whangarae Inlet, Croixelles Hbr.	BS	PR	14	40	end.3.55	Near tagging site	—	1	7.1	0	1127	16.8	21	+4.2	1, 9		
28.3.55	McLarens B., Croixelles Hbr.	BS	OS	22	41	19.2.56	Near tagging site	—	1	4.5	0	328	13.0	15	+2	9		
19.3.55	Torrent B.	BS	OS	4	42	11.5.55	Near tagging site	BS	1	25.0	0	53	11.8	—	—	1		
—	UNKNOWN	—	PT	—	43	14.12.60	Horn Rk.	—	—	—	—	—	—	—	—	8		

* 1: Recapture date and number of days at liberty known only approximately. 2: Tag firm, fish in good condition. 3: Fish in poor condition. 4: Tags covered with algal growth. 5: Tagged fish found in commercial fish market. 6: Tagged fish found dead on beach. 7: Tag found on deck of seiner while fishing. 8: Blank tag and elastic/toggle only, found on recaptured fish. 9: Recapture length only approximate, no growth estimate possible.

two, four, and 10 months also strongly suggests that a large part of this inshore population is resident (Recapture Nos. 16 + 17 + 18, 21 + 22 + 23, and 12 + 13 in Table 3).

Nevertheless, five fish did show considerable movements, both into and out of the Gulf (Fig. 3). No hypothesis can at present be advanced for these movements.

OTHER AREAS

All of the six adequately documented returns from snapper tagged outside the Hauraki Gulf were made on or close to the original tagging site.

GROWTH RATES

Of the 43 returns only 21 included measurements (see Table 3) and most of these were only approximate, being given by amateur or commercial fishermen. No reliance could be placed on any growth results for, as can be seen from Table 3, some fish appeared to shrink whilst others grew at rates of up to 2 in. per year, a rate twice as fast as that previously reported for snapper (Longhurst 1958).

CONCLUSIONS

Both catching and tagging methods need further study before the most suitable combination can be recommended. Until this has been done no worthwhile studies of snapper movements or populations can be undertaken. Methods as well as the locality of the tagging sites used have strongly influenced the results reported here.

The present analysis shows that for the portion of the snapper population sampled (predominantly in shallow and rocky areas of Hauraki Gulf) there is generally little *nett* movement of fish away from the area where they were originally caught.

ACKNOWLEDGMENTS

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