

**FINAL REPORT**  
**FIRTA PROJECT 83/12**

Identification of stocks and migration routes of Torres Strait and Gulf of  
Carpentaria narrow-barred Spanish mackerel, Scomberomorus commerson.

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## INTRODUCTION

Of the eighteen species of Scomberomorus recognised by Collette and Russo (1979), the migratory behaviour of only three species S. cavalla (king mackerel), S. maculatus (Spanish mackerel) and S. commerson (the narrow-barred Spanish mackerel) have been studied by tagging programmes. In these instances the programmes were preceded by studies of age, growth and reproduction which facilitated the analysis of tag return data.

Similarities exist between the distribution patterns of S. cavalla in southern USA waters and S. commerson in the northern Australian region. Both species are encountered in migratory schools within a large, equatorially-oriented, concave gulf with a long, equatorially-directed peninsula which tends to restrict adult movement (deep water between Florida and Cuba for S. cavalla, and the Torres Strait for S. commerson). To the east of each peninsula the movement of the species is to the north or south in shallow continental shelf waters. Similar growth rates, and maximum sizes have also been determined for S. cavalla and S. commerson (Johnson et al. 1983; McPherson, 1981a).

Sutherland and Fable (1980) reported the results of a five year tagging programme in which 2905 S. cavalla were released in Gulf of Mexico waters. The overall return was only 1.1%, however there were sufficient long range migrations to help answer the question of stock integrity between the Gulf and Atlantic populations of the species. Evidence from tagging showed conclusively that fish inhabiting the north-eastern and north-western Gulf of Mexico during the summer months could range into waters south-west and south of the Florida peninsula, and northwards along the peninsula. A north-south migration of S. cavalla along the east coast

of the United States was also identified. Overall, Sutherland and Fable (1980) concluded that there was evidence for an overlap in the range of Atlantic and Gulf of Mexico king mackerel. Although the tagging study contributed substantially to available knowledge on the behaviour of these species which assisted with the management of the various fished stocks, the tagging evidence in itself did not confirm or refute the concept of separate stocks.

A previous FIRTA-funded programme (1979/1981) (FIRTA 79/10) produced tag returns for S. commerson in Australian east-coast waters that confirmed the presence of a north-south migration component of the east coast stock (McPherson, 1981a). No returns were reported from fish tagged between Lizard Island and Weipa, however, this may be related to the small number of releases (n=101) over this large area.

The possibility of two stocks or populations of S. commerson occurring over the north to north-eastern Australian coastline was originally advanced by McPherson (1977). The movement and seasonality of catches made by Taiwanese gillnetters in the Gulf of Carpentaria prior to their exclusion in 1978, their current catches in northern waters (Millington, 1981) and the different approximate seasonal localities for S. commerson in Queensland waters (McPherson, 1981a) support this contention. The apparent easterly movement of concentrations of the species from the western parts of the Gulf of Carpentaria then north towards Cape York appears to be analagous to the S. cavalla situation in U.S. waters. Taking the analogy a little further, if an overlap exists between the range of S. cavalla in Atlantic and Gulf of Mexico waters, it would seem reasonable to predict some mixing of a hypothetical S. commerson Gulf of

Carpentaria/Torres Strait stock with a Torres Strait/east coast stock, approximately between latitudes 10°S and 14°30'S. The southern boundary of this hypothetical area of stock mixing is suggested to be approximately 14°30'S as no movement information is available for fish tagged north of this latitude, while all recaptures made of fish tagged in the vicinity of 14°30'S moved to the south.

To examine the possibility of separate stocks of S. commerson in north-east Australian waters, the 1983/84 FIRTA tagging programme reported here (FIRTA 83/12), was developed to specifically establish the extent of S. commerson migrations in Torres Strait and Gulf of Carpentaria waters.

The Northern Pelagic Fish Seminar (Darwin, January 1981) recommended a programme of study on the biology, population structure, stock identity and migration of S. commerson extending from the Great Barrier Reef region through Torres Strait, the Gulf of Carpentaria, and the Arafura and Timor Seas, to the North West Shelf. A research programme involving CSIRO, Northern Territory, Queensland and Western Australian Fisheries organisations, and referred to as the Northern Pelagic Fish Stock Research Programme (or Northern Pelagic Programme) was funded by FIRTA in 1984 to examine all aspects of larger pelagic fish (including S. commerson) in the northern Australian Fishing Zone (AFZ). Direct involvement of Fisheries Research Branch (Queensland Department of Primary Industries) ensured that the S. commerson tagging aspects of the Northern Pelagic Programme were complimentary to the 1983-84 FIRTA tagging programme.

## METHODS

Fisheries Research Branch (FRB) purchased a 5.72 m fibreglass mackerel dory 'Sagair' from FIRTA at the conclusion of the 1979/81 tagging studies. This vessel, a tagging cradle and equipment necessary for tagging S. commerson were maintained and utilised for this programme. In addition, a tagging cradle was constructed for use on the vessel chartered for the Northern Pelagic Programme.

The dory was transported from its home port of Cairns to fishing locations at Mornington Island and Torres Strait as deck cargo on coastal trading vessels. To minimise operational costs in remote locations, commercial fishing vessels were engaged as inexpensive motherships, including towage between distant fishing locations.

Experience from the 1979/80 Queensland east coast tagging programme indicated that S. commerson tagging effort should be spread geographically to maximise potential fish movement information. Every effort was made to distribute tagging effort between the commercial fishing grounds around the northern coastline of Mornington Island and the Great North East Channel in Torres Strait.

Mornington Island was selected as the site for tagging activities in the Gulf of Carpentaria as it appeared to be the region of highest S. commerson catches within the Gulf. Following tagging operations carried out during the June-August 1983 peak fishing season, sufficient time was available to transport the dory to Torres Strait in time for the

October–November 1983 peak fishing season in that region. Cruise six of the Northern Pelagic Programme was planned to co-incide with the presumed movements of S. commerson northwards from the southern Gulf in July and August 1984. The general location of all tagging operations in the Gulf of Carpentaria and Torres Strait are shown in Figure 1.

Techniques for the efficient tag and release of S. commerson were developed during the 1979/80 FIRTA-funded programme (McPherson, 1981b). Fish were landed and restrained in a padded cradle while the snout to caudal fin fork length (LCF) was recorded (to the nearest centimetre) and the hook removed. While each fish was immobilised, its mouth and gill region was carefully examined and a one to four condition rating (developed during the 1979/80 tagging programme) was assigned to each released fish. When the condition of fish taken during tagging operations was considered to be of an unacceptable condition for tag and release (eg torn or severed gill artery, damage to the eye) the LCF, sex and other biological parameters were recorded. In order to reduce some causes of immediate post-tagging mortality, tagging was avoided where sharks were common.

Publicity for the tagging programme was conducted through Australian Fisheries, personal and small ship radio contacts with the limited number of mackerel fishermen in the Gulf and Torres Strait waters and through Queensland and Northern Territory fisheries patrol officers. NT Fisheries Division arranged to have the tagging posters translated into Taiwanese for distribution to the foreign gillnet and pair trawl vessels operating in northern Australian waters. Dr John Lock, Chief Biologist, Papua New

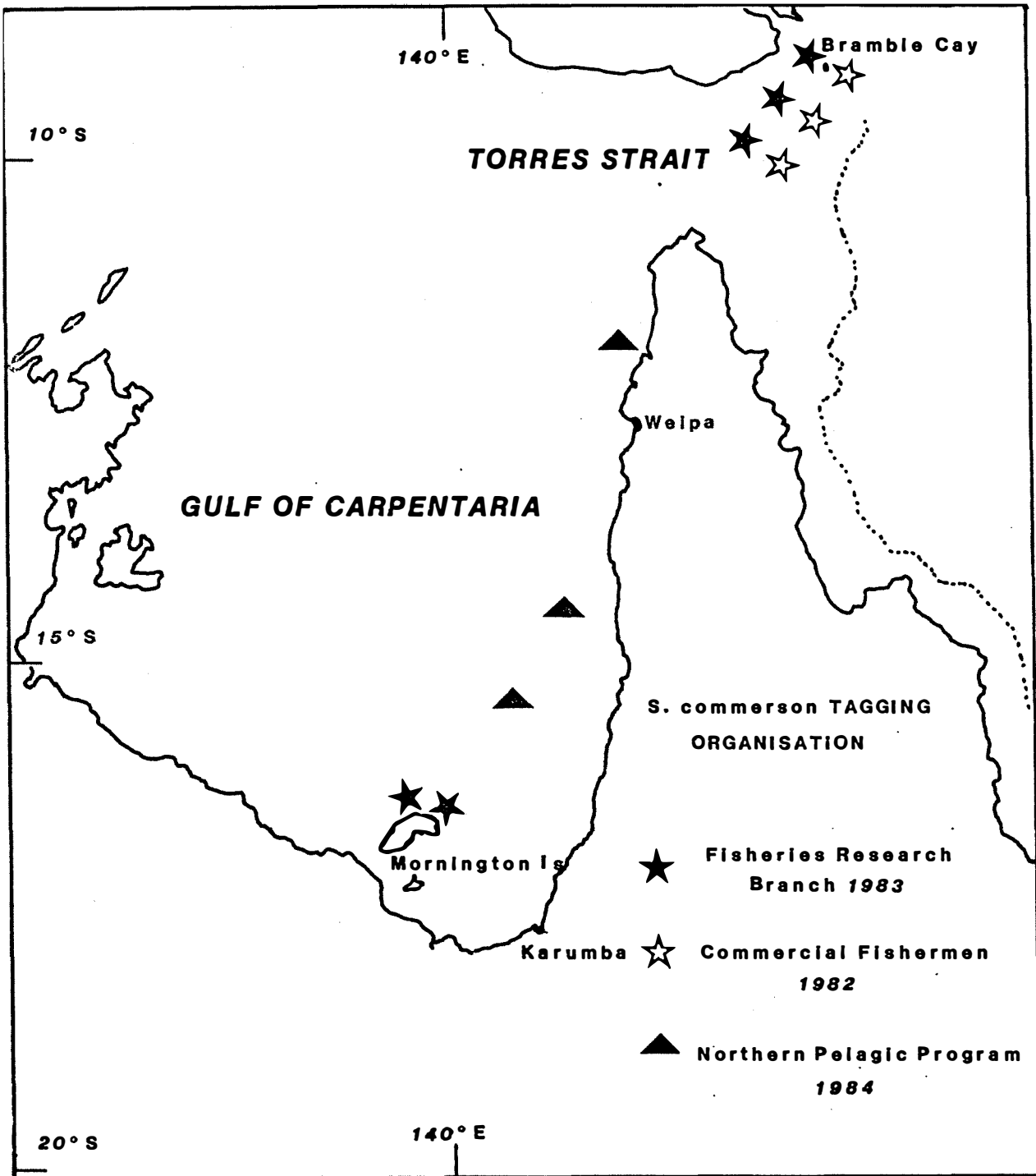


Figure 1 General locations of S. commerson tagging operations in Torres Strait and Gulf of Carpentaria 1982-1984.

Guinea Fisheries, distributed the translated posters to the Taiwanese gillnet vessels operating in the Gulf of Papua.

a) Mornington Island Operations

The dory 'Sagair' was at sea (travelling and fishing) in the vicinity of Mornington Island over a 25 day period from 9 July to 2 August 1983. Two commercial vessels were utilised as motherships.

Due to poor weather conditions (seven days with strong wind warnings in effect, that is, winds greater than 20-25 knots) and at times 'impossible' fishing conditions, tagging activities were restricted to 19 days. Tagging locations were distributed along a 25 nautical mile stretch of coastline around the northern and eastern shores of Mornington Island.

The mackerel fishery at this location is comprised of a day troll fishery for S. commerson around sand banks and rocky shoals up to 10 nm away from the island, and a night gillnet fishery for S. semifasciatus (the grey or broad-barred mackerel) in shallow water adjacent to the sandy beaches of the island. The LCF and sex of up to 20 S. commerson or S. semifasciatus were recorded from each commercial troll or gillnet catch examined. Otoliths from these sampled fish were retained for subsequent age and growth analysis as part of an S. commerson and S. semifasciatus age and growth study being conducted by the author. Tissue samples from Scomberomorus species (eye lens, liver and white muscle) were taken for electrophoretic analysis by CSIRO.



b) Torres Strait Operations

After launching the 'Sagair' at Bamaga on the northern tip of Cape York, it was steamed over to Thursday Island from where it departed for fishing grounds in eastern Torres Strait on 28 September 1983. It returned 21 days later on 18 October 1983. Two commercial vessels were used as motherships and for towage.

When this programme was being developed in 1982, discussions with commercial fishermen operating in the area resulted in an extension into the northern Torres Strait of a tag and release programme by commercial fishermen directed at S. commerson. The programme involved two fishermen tagging, estimating LCF and releasing small S. commerson (that is, fish below legal or economic size) in Torres Strait during late 1982.

FRB conducted tagging operations in 1983 at four locations along the Great North East Channel in Torres Strait (that is Bramble Cay, Stephens Island, Marsden Island and Roberts Island). The sites of all tag releases in Torres Strait during 1982 and 1983 are shown in Figure 2.

At the conclusion of morning and afternoon tagging operations, up to 20 S. commerson were subsampled from the commercial catch of the mothership. LCF, sex and other biological parameters were recorded while otoliths were retained and tissue samples were obtained for CSIRO.

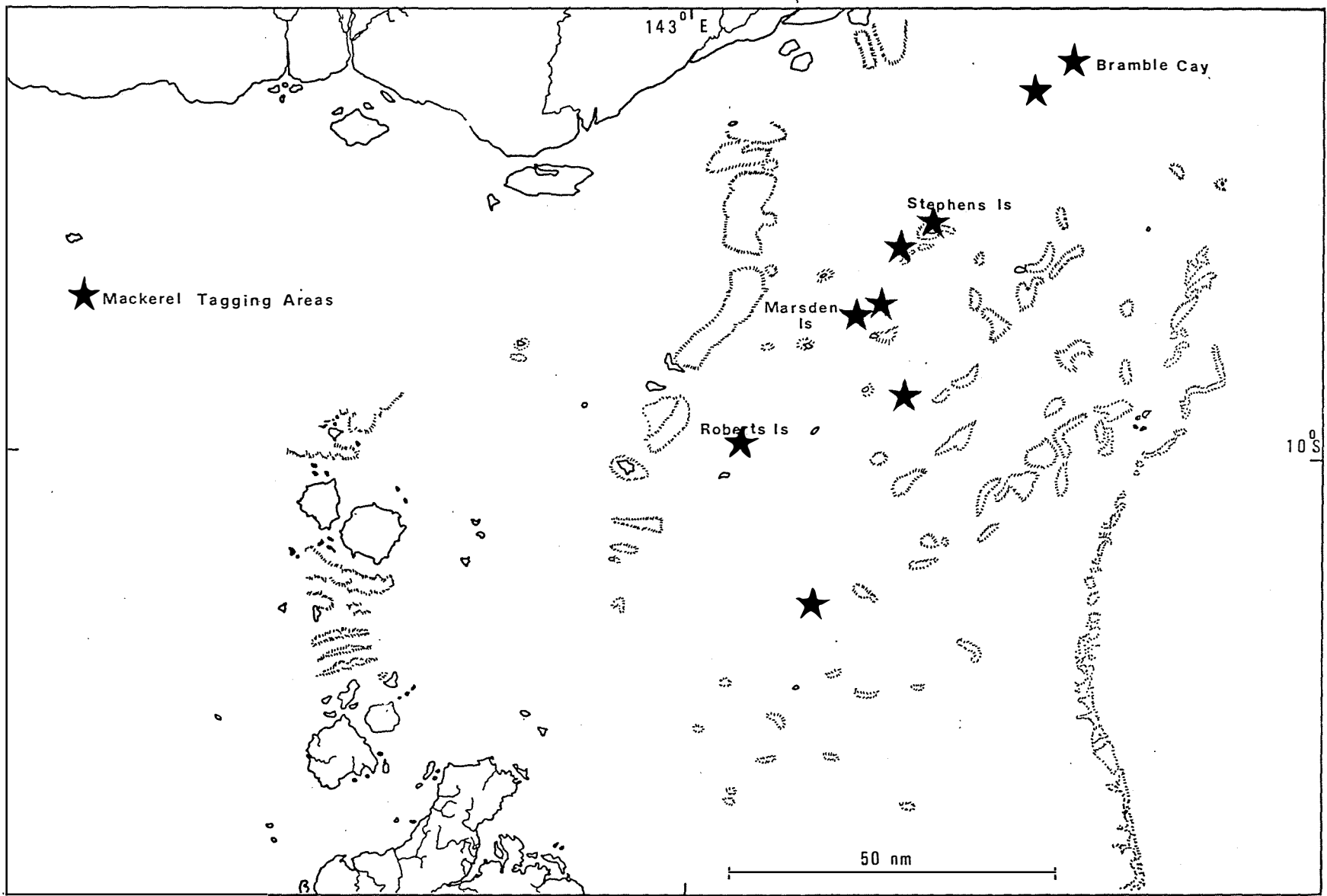


Figure 2 Locality of S. commerson tag releases within Torres Strait, 1983-83.

c) Northern Pelagic Programme Operations

Some FIRTA funds from FIRTA 83/12 enabled FRB officers to participate in Cruises one and three of the Northern Pelagic Programme in order to tag S. commerson in offshore Northern Territory waters. As part of the Queensland contribution to the Northern Pelagic Programme, two officers participated in Cruise six which was conducted between waters to the north of Mornington Island and to the north of Weipa. The locations of S. commerson tagging operations during Cruise six are shown in Figure 1.

## RESULTS

a) Mornington Island

## . Tag Releases

Over the 25 days spent in the Mornington Island area tagging operations were conducted for a total of 98 hours. A total of 226 fish were taken, predominantly S. commerson with small numbers of S. semifasciatus and S. queenslandicus (Queensland school mackerel). The 5% of fish rejected for tagging was relatively high compared to previous findings from the Queensland east coast programme. The numbers of fish tagged or rejected for tagging is broken down by species in Table 1.

Table 1. Numbers of Scomberomorus tagged or rejected for tagging at Mornington Island, July to August 1983.

Species	Fish tagged	Fish rejected
<u>S. commerson</u>	204	11
<u>S. queenslandicus</u>	9	0
<u>S. semifasciatus</u>	1	1
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	214	12
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The length frequency distribution of 201 measured S. commerson, tagged at Mornington Island is shown in Figure 3. From an age-length key (McPherson, unpublished) derived from Queensland east coast S. commerson, it was estimated that the most common age classes tagged at Mornington Island during July-August 1983 were three- and four-year-old fish, ranging from one-year-olds to fish of about nine years of age.

#### . Tag Returns

Based on the results of the previous 1979-80 tagging on the Queensland east coast, a tag return rate of 2% (that is, four fish) was expected from the 204 S. commerson releases made throughout the southern Gulf. There have been no tag returns to date.

#### . Biological Samples

The numbers of fish sampled from the commercial gillnet and troll catches, as well as those rejected for tagging and subsequently sampled, are shown in Table 2. While otoliths were taken from all S. commerson and S. semifasciatus sampled, tissue samples for electrophoretic analysis by CSIRO were taken primarily from S. commerson.

## MORNINGTON IS 1983

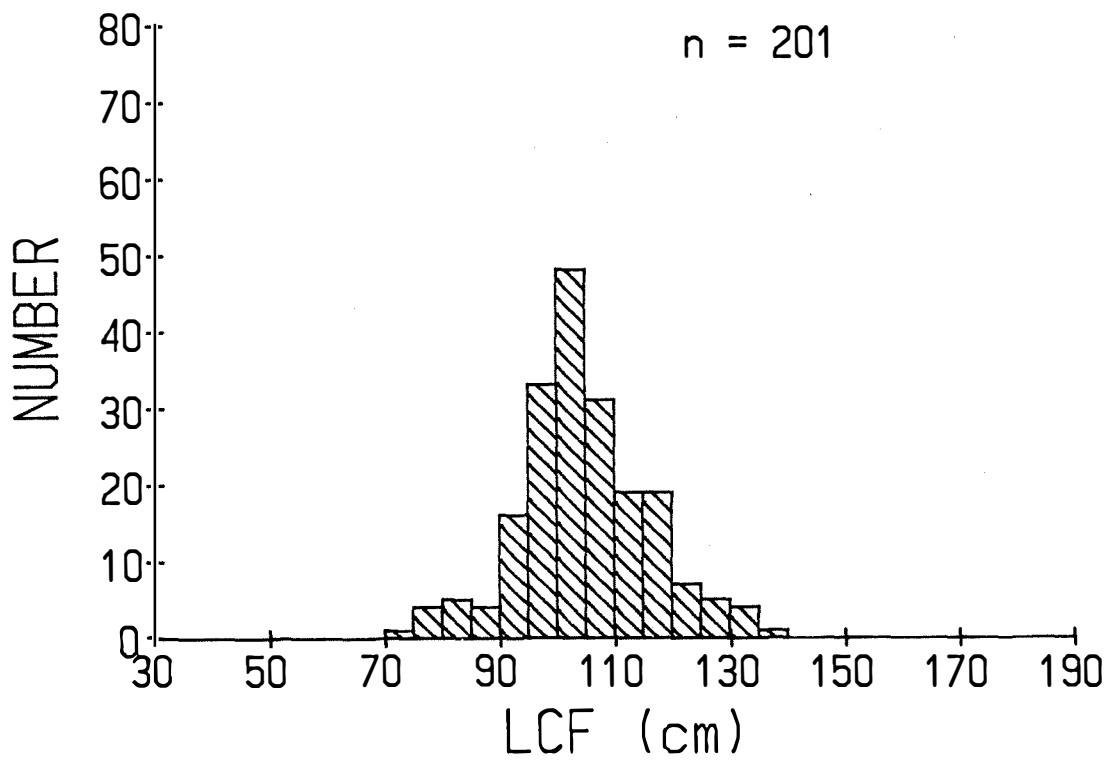


Figure 3 Length frequency distribution of 201 measured S. commerson tagged at Mornington Island, July-August 1983.

Table 2. Total numbers of S. commerson biological samples and electrophoretic samples taken at Mornington Island.

Species	Total fish sampled	Tissue samples taken
<u>S. commerson</u>	237	165
<u>S. queenslandicus</u>	7	2
<u>S. semifasciatus</u>	137	2

The S. commerson sampled at Mornington Island were taken from one or more dories that operated in the vicinity of the 'Sagair' during tagging operations. A comparison of the size range of S. commerson taken by commercial fishermen and by the 'Sagair' indicates that the fish tagged were representative of the fish susceptible to commercial gear in the area (Table 3).

Table 3. LCF's and total weights of sampled (n=234) and tagged (n=201) S. commerson at Mornington Island (LCF to nearest cm, total weight to nearest 0.1kg)

	Tagged fish	Sampled fish	
	LCF (cm)	LCF (cm)	total weight (kg)
mean	104	104	9.6
standard deviation	11	12	3.4
minimum	72	73	3.1
maximum	140	133	20.5

b) Torres Strait

. Tag Releases

A total of 411 S. commerson was tagged by FRB during 80 hours of trolling in the north-eastern Torres Strait. Less than 2% of this number were rejected for tagging. A summary of the numbers of S. commerson tagged and rejected for tagging by FRB and commercial fishermen is shown in Table 4.



Table 4. Summary of S. commerson tag releases in Torres Strait.

Year/tagger	Fish tagged	Fish rejected
1982/commercial fishermen	141	-
1984/Fisheries Research Branch	404	7

Length frequency histograms of the S. commerson released and measured by FRB and commercial fishermen are shown in Figures 4 and 5 respectively. From an age-length key (McPherson, unpublished) derived from Queensland east coast S. commerson (including Torres Strait), it appears that the commercial fishermen released one-year old fish. The most common year classes released by FRB in September/October 1983 were two-year to four-year-old fish, ranging from one-year-olds to fish in excess of 14 years of age.

#### . Tag Returns

Only four tag returns have been reported from Torres Strait to date. Two fish were recaptured short distances from their release locations after

## TORRES STRAIT 1983

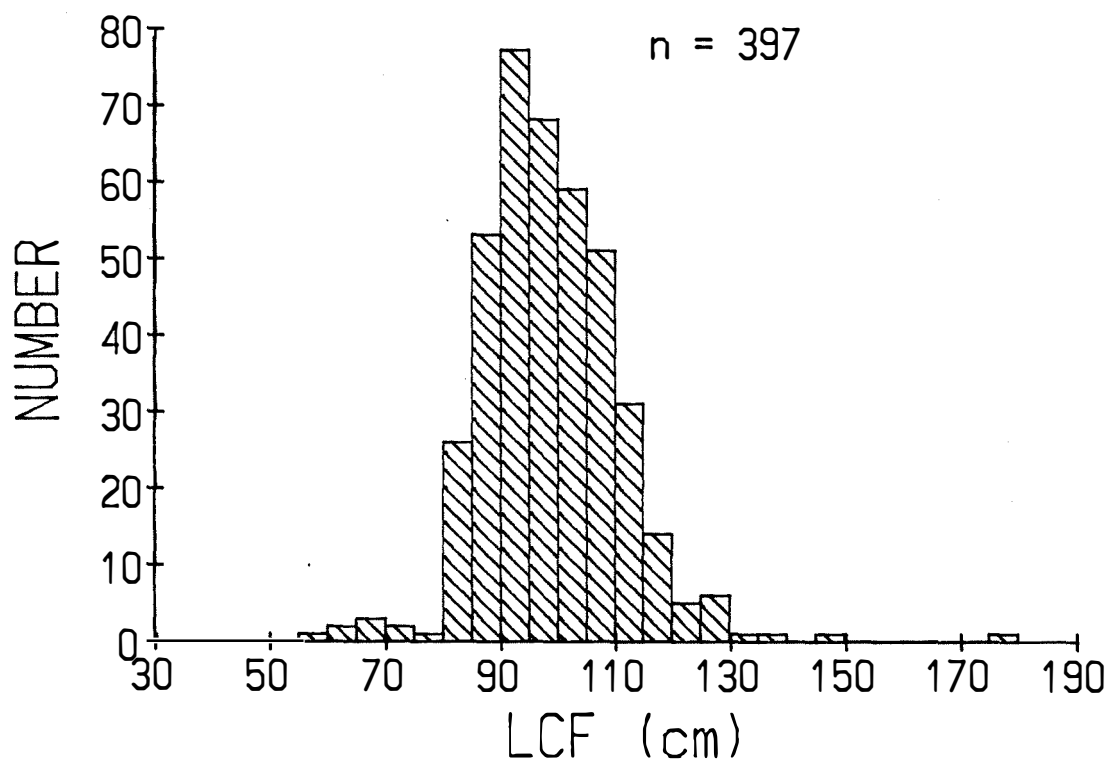


Figure 4 Length frequency distribution of 397 measured S. commerson tagged in Torres Strait, September-October 1983.

## TORRES STRAIT 1982

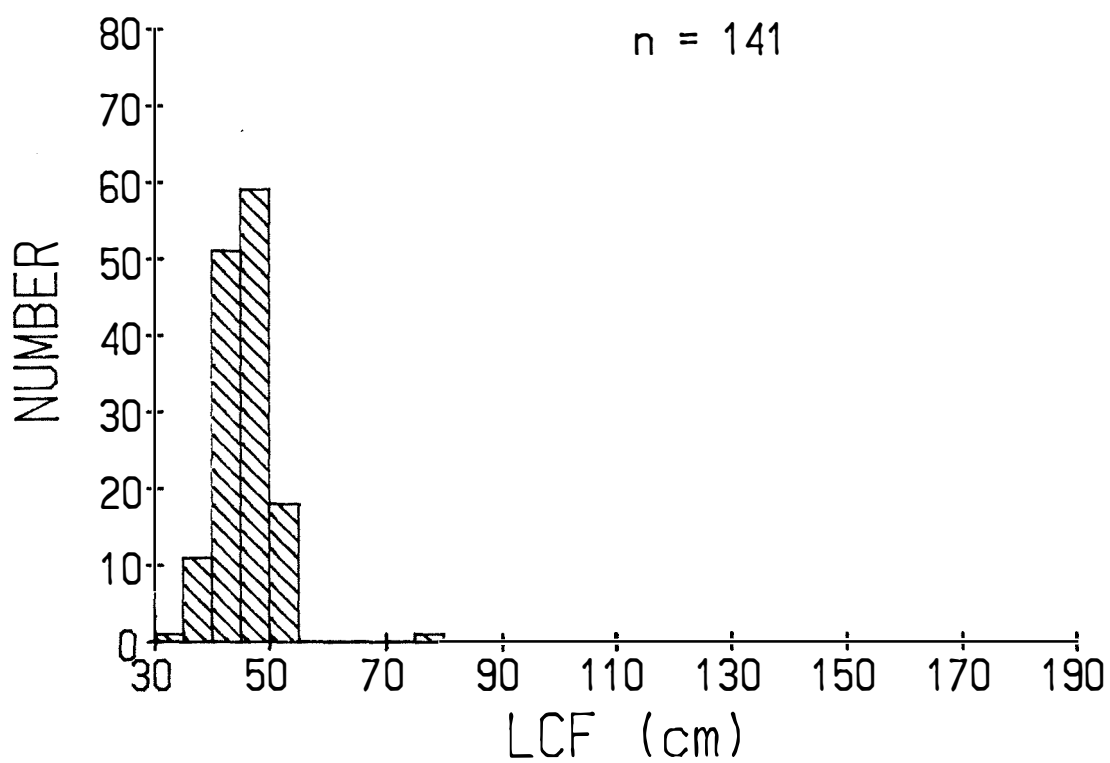


Figure 5 Length frequency distribution of 141 *S. commerson* tagged in Torres Strait, 1982.

less than three months at liberty. Two other fish were recaptured after a year at liberty; one failed to show any net movement while the other moved north-east across Torres Strait (Figure 6). Little can be deduced from this limited number of returns.

In September 1984, a novice assistant commercial fisherman operating in Torres Strait removed a 'piece of plastic' from the dorsal surface of an S. commerson caught at Bramble Cay. As the fish was being filleted some time later by a master fisherman familiar with the tagging programme, the assistant fisherman was questioned about the wound on the dorsal surface of the fish. The master fisherman ascertained that the piece of plastic was in fact a yellow dart tag similar to those used in this project.

#### . Biological Samples

The commercial troll catch in northern Torres Strait is almost entirely composed of S. commerson. Table 5 shows the total number of biological samples (including otoliths) and electrophoretic tissue samples taken by Fisheries Research Branch in 1983 and an additional sample taken by a commercial fisherman in 1984 (CSIRO funded).

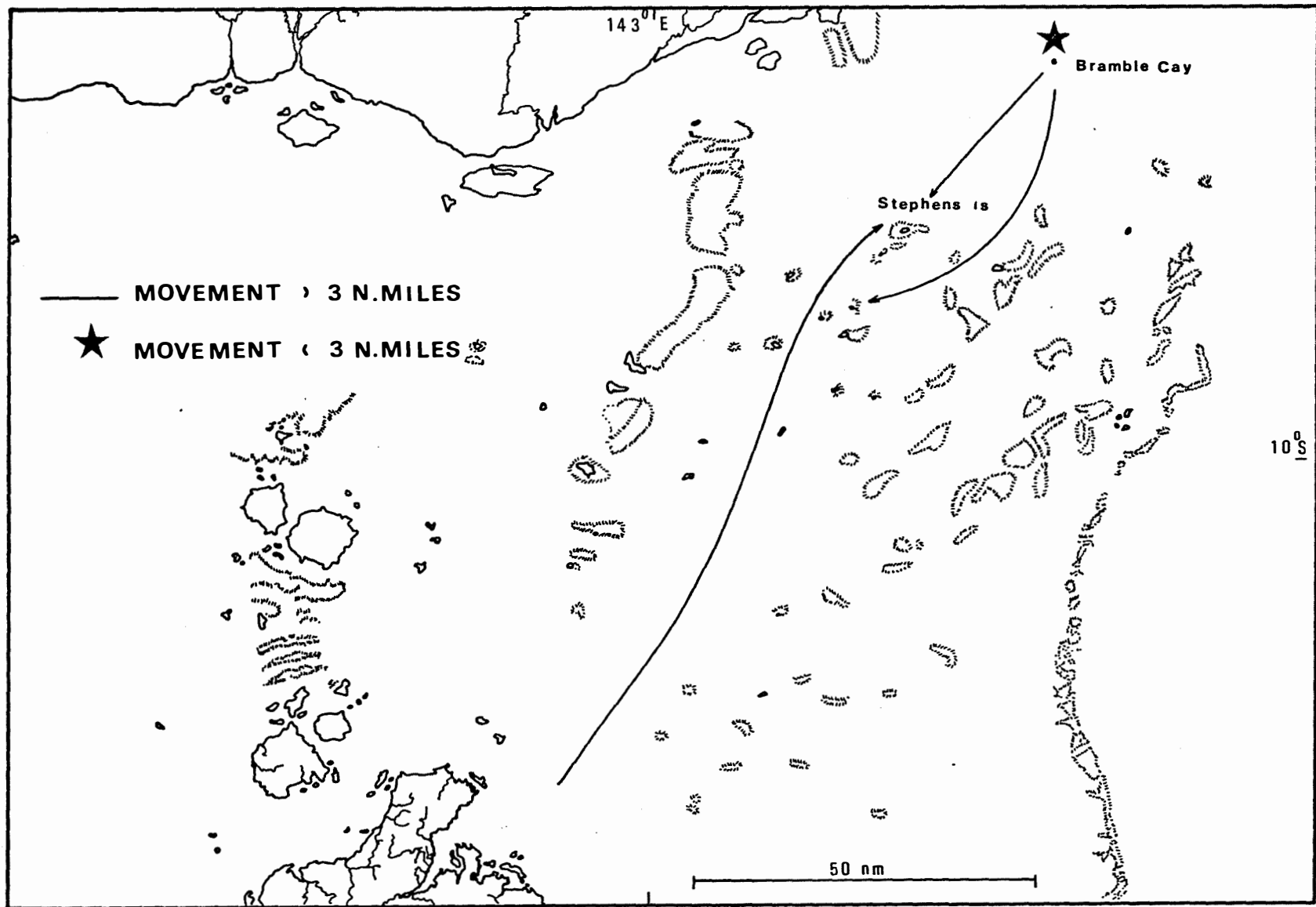


Figure 6. Tagged *S. commerson* movements in Torres Strait (data from four recaptures up to December 1985).

Table 5. Total numbers of S. commerson biological samples and electrophoresis samples taken in Torres Strait.

Date	Total biological samples	Electrophoresis samples
Sept/Oct 1983	377	162
Aug 1984	110	110

The 1983 north Queensland (including Torres Strait) mackerel season was considered by commercial fishermen to have been characterised by a generally higher-than-average upper size range of fish than in previous years. Reports from fishermen of S. commerson in the range 35 to 50 kg were common. Table 6 summarises the LCF's and total weights (where available) of fish sampled and tagged in September/October 1983. To indicate the variability in catches between years a Bramble Cay, the lengths and total weights of a sample of fish taken by FRB at Bramble Cay in October 1978 are included.

Table 6. LCF's and total weights of S. commerson sampled and tagged at Bramble Cay in 1978 and 1983 (LCF to nearest cm, total weight to nearest 0.1 kg, sample numbers in parenthesis).

	Sampled (Oct 1978)		Sampled (Sept/Oct 1983)		Tagged (Sept/Oct 1983)
	LCF (cm)	Total Wt (kg)	LCF (cm)	Total Wt (kg)	LCF (cm)
	(245)	(242)	(336)	(336)	(397)
mean	95.0	7.1	101.0	8.7	98.3
standard deviation	10.7	2.8	11.5	3.3	12.0
minimum	60.0	1.8	50.0	2.8	56.0
maximum	143.0	27.0	145.0	29.5	178.0

While large fish of up to 178 cm LCF (approximately 50 kg in total weight) were taken during tagging operations, the tagged and released fish were of a slightly lower mean LCF than fish from the commercial catch. This was due in part to an active preference (by the tagger) for shoal areas around Bramble Cay where smaller fish were more prevalent during any one fishing period. Smaller fish can usually be landed into the cradle, tagged, and released back into the water in a shorter time (usually one to

five seconds), thus minimising time out of the water and maximising condition on release.

c) North-east Gulf of Carpentaria (Northern Pelagic Programme.)

. Tag Releases

The vessel chartered for Cruise six of the Northern Pelagic Programme released 128 S. commerson between 8 and 14 July 1984. The fish were located around isolated offshore shoals and in open water between Karumba and north of Weipa (Figure 1.).

A length-frequency distribution of the S. commerson tagged during Cruise six is shown in Figure 7. The mean LCF of tagged fish was  $94 \pm 8$  cm (mean  $\pm$  1 standard deviation), with individual fish lengths ranging between 60 and 128 cm.



## GULF OF CARPENTARIA 1984

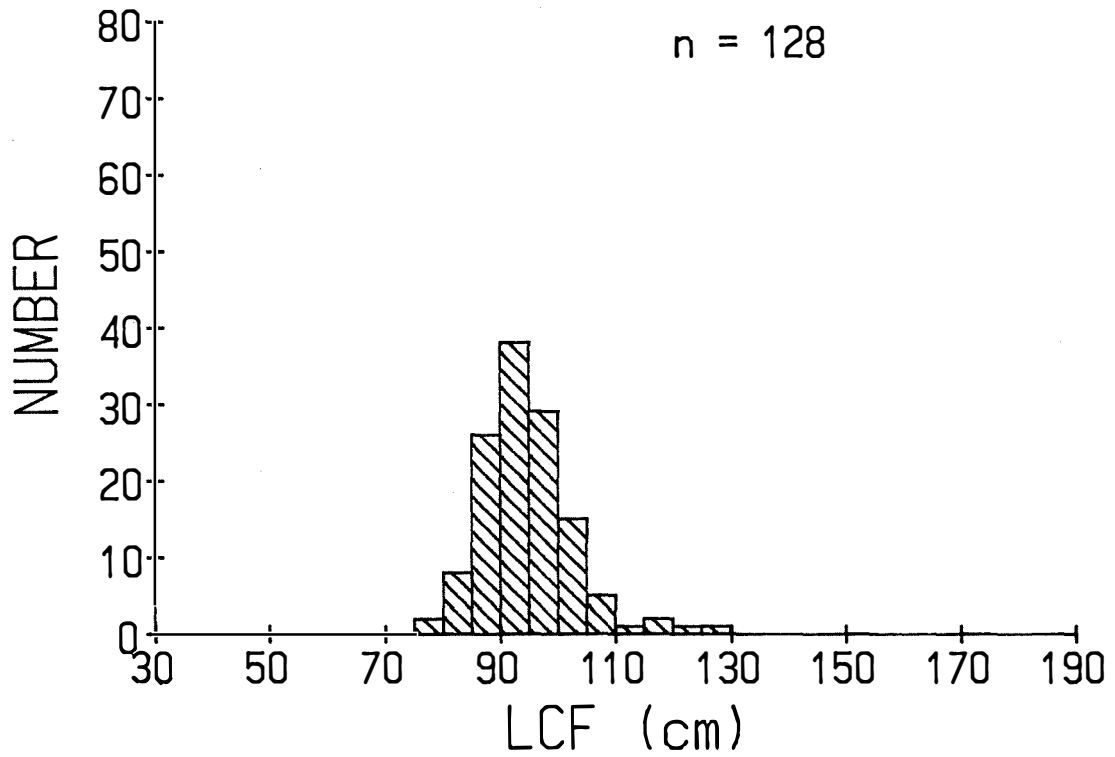


Figure 7 Length frequency distribution of 128 measured S. commerson tagged in the southern and eastern Gulf of Carpentaria, July 1984.

## DISCUSSION

A more complete understanding of the identities of, and relationships between the fished stocks of S. commerson throughout northern Australian waters awaits the additional results from the population genetics study by CSIRO and the age and growth study by Queensland FRB.

Little can be determined from the tagging work in the Gulf of Carpentaria and Torres Strait. Eighteen months after tagging ceased in the Torres Strait, only four confirmed tag recaptures had been reported. It is unlikely that more than one or two additional recaptures will be reported during 1985. Localised short term movements of less than 50 nm were expected (McPherson, 1981b) and were represented by two of the confirmed tag recaptures. No movement strategies can be inferred for this migratory species from localised returns recaptured after periods of almost 12 months.

It is perhaps a little surprising that tags were not reported from the Taiwanese gillnet vessels in the Gulf of Papua. The loom of their deck lights was always obvious during tagging operations at Bramble Cay, and they were known to fish south of Bramble Cay during the hours of darkness (McPherson, 1985). However it is quite likely that if the Taiwanese had recaptured any tagged fish, they may consider reporting the event as an affirmation of their impact on the resource or an indication of their fishing within restricted waters.

Return rates on an annual basis, that is tag recaptures made within 12 months of release, have been low (less than 1%) compared to the 2.5% annual return rate from the Queensland east coast tagging study. The low return rate may reflect either the relatively small number of tagged fish released into an exceptionally large exploitable stock in north-eastern, Australian waters, or that the release areas may be very small relative to the dispersal region of the tagged fish.

There is circumstantial evidence to suggest a movement of S. commerson from north-western Gulf of Carpentaria waters to Torres Strait. The unconfirmed reporting of a yellow dart tag removed from an S. commerson at Bramble Cay in September 1984 was significant in that no algal growth was apparently obvious on the tag when the fish was removed from the water. Of the 91 S. commerson tag recaptures reported from the Australian east coast since tagging of the species commenced in 1976, it has been obvious that algal growth is common on the exposed part of the dart tags. No specific information is available on the rate of growth of algae on the tags, however, from the returns reported throughout Queensland east coast waters algal growth usually commenced one to two months after release.

Furthermore the only tagging operations that had been conducted in northern Australian waters within two or three months of September 1984 were the activities of the Northern Pelagic Programme in the eastern Gulf of Carpentaria during July 1984. It is likely that the unconfirmed tag recapture made at Bramble Cay was released in the eastern Gulf six to eight weeks prior to its recapture.

Little evidence exists for any migration of S. commerson within the area studied. Nevertheless it is my contention that the single unconfirmed tag recapture in Torres Strait does represent a movement from the Gulf of Carpentaria to Torres Strait. Further, there may be some mixing of a hypothetical Gulf of Carpentaria/Torres Strait stock with an Australian east coast stock within Barrier Reef waters from approximately 10°S to 14°30'S.

The relationship between Torres Strait Protected Zone and Gulf of Papua fished stocks of S. commerson is uncertain. There is circumstantial evidence to suggest that the decline in Torres Strait Protected Zone area landings during the early 1980's may have been influenced by the Taiwanese gillnet fishery in the Gulf of Papua (McPherson, 1985). While the identification of the number of Torres Strait S. commerson stocks remains as the most important question to be addressed for the region, the interaction between the Protected Zone troll fishery and the Gulf of Papua gillnet fishery should be addressed.

**RECOMMENDATIONS**

- 1) That no continuation of tagging, other than by commercial fishermen, be considered until after consideration of results from the north-east Australian genetic stock identification study by CSIRO.
  
- 2) That the interaction between the Torres Strait Protected Zone troll fishery and the Gulf of Papua gillnet fishery be examined.

**ACKNOWLEDGEMENTS**

The author wishes to thank the Fishing Industry Research Committee which funded this research.

The masters of the fishing vessels 'Pomaz' and 'Daydream' (at Mornington Island) and 'Winston' and 'Acacia' (in Torres Strait) provided invaluable advice and assistance which enabled the author to maintain catch rates comparable to those of commercial vessels.

The Project Manager of the Northern Pelagic Programme made available the S. commerson tagging data from Cruise six of that Programme. Mr Peter Cooper (FRB) assisted with the tagging on this Cruise.

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