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**Observations
on the Maturation Condition of Some
Pelagic Fishes
from Northern Australian Waters**

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OBSERVATIONS ON THE MATURATION CONDITION OF SOME PELAGIC FISHES FROM NORTHERN AUSTRALIAN WATERS.

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Abstract

Results of macroscopic staging of the maturation condition of three scombroid, one trichiurid, three sphyraenid and seven clupeoid species trawled during three fish exploratory surveys, one to the Timor Sea during June-July 1980, and two to the Arafura Sea - Gulf of Carpentaria during November-December 1980 and June-July 1981, are presented. Ripe and spent *Rastrelliger kanagurta* were taken from the Timor-Arafura Seas during June-July and November-December 1980; those from the Gulf of Carpentaria during November-December 1980 and June-July 1981 were in the early stages of maturity. *Scomberomorus queenslandicus* > 40cm FL and *Sphyraena jello* were a little more mature during November-December than in June-July. Ripe *Trichiurus lepturus* was taken in the Arafura Sea during both the cruises. Peculiar gonadal condition was seen in *Dussumieria acuta* during November-December cruise, the ovaries appearing spent but containing large loose whitish eggs. *Scomberomorus munroi*, *Sphyraena obtusata* and *Herklotsichthys koningsbergeri* were mostly in the early stages of maturity during both the cruises. Maturation condition of *Sphyraena forsteri*, *Sardinella jussieu*, *Sardinella sirm*, *Sardinella albella* and *Dorosoma chacunda* taken during one of the cruises only, and of *Pellona ditchela* insufficiently examined during June-July 1981, are also presented.

INTRODUCTION

Fishes inhabiting the tropical Australian waters are Indo-Pacific in distribution and although the maturation and spawning cycle of many of the commercially important and abundant species has been studied elsewhere in the Indo-Pacific, particularly extensively in India (see Qasim, 1973; Weber, 1976; Fursa, 1979, for references), similar investigations from northern Australian shelf waters have been few. Several studies are currently in progress at CSIRO and this paper describes the synoptic observations made on the maturation condition of the following 14 species from these

waters: *Rastrelliger kanagurta* (Cuvier); *Scomberomorus queenslandicus* Munro; *Scomberomorus munroi* Collette and Russo; *Sphyraena jello** Cuvier; *Sphyraena obtusata* Cuvier; *Sphyraena forsteri* Cuvier; *Herklotsichthys koningsbergeri* (Weber and de Beaufort); *Sardinella jussieu* (Lacepede); *Sardinella sirm* (Walbaum); *Sardinella albella* (Valenciennes); *Pellona ditchela* Valenciennes;

* It was difficult to distinguish fresh specimens of *Sphyraena bleekeri* Williams from *Sphyraena jello* Cuvier. Au (1979) encountered this problem with preserved specimens.

Dussumieria acuta Valenciennes and *Dorosoma chacunda* Weber and de Beaufort. All these species display pelagic and semi-pelagic habits, and they are thus caught by both pelagic and demersal gear.

There is no fishery for these species in Australian waters thereby making it difficult to obtain spatio-temporal data on their maturation and spawning cycles. Samples of the above species obtained during three exploratory trawl surveys, two in June-July (south-east monsoon) and one in November-December (beginning of north-west monsoon), were examined to find out if any major or obvious seasonal differences existed in their maturation condition. In the absence of information on the breeding biology of most of the above species in tropical Australian waters, observations made on species encountered during one of the cruises only, and on those taken in small numbers only have also been included here.

MATERIALS AND METHODS

CSIRO's chartered stern-trawler *FRV Soela* undertook three fish resource surveys in the Timor-Arafura Seas and Gulf of Carpentaria. Cruise S05-80 (21.6.80-26.7.80) worked in the Timor Sea; cruise S07-80 (1.11.80-20.12.80) in the Arafura Sea and Gulf of Carpentaria and cruise S02-81 (30.5.81-15.7.81) trawled most of the S07-80 stations again. Only those stations which are later referred to in the paper are shown in Fig. 1. Station 89 (20° 24'S 115° 44'E) of cruise S05-80 on the North West Shelf was far from the other stations and is not shown in Fig. 1. The stations from where each species was obtained are listed in Appendix 1.

Two kinds of trawl nets, with 10-20 mm cod-end liners, were mostly used: the New Zealand Frank and Bryce

during S05-80 and the Engel high opening net during S07-80 and S02-81. Several tows with the pelagic Engel net were also made during S07-80. The gonads of freshly caught fish (Table 1) were visually examined and classified into one of the following stages using the familiar field maturation key originally developed for temperate water species. Here, only a summary of the key is given and details can be found in numerous works, including that of Blackburn and Gartner (1954): Juvenile-sex indeterminate; stage 1 - immature male and female with small strap-like gonads; stage 2 - immature with gonads larger than in stage 1; stage 3 - immature-ripening; stage 4 - ripening; stage 5 - ripe; stage 6 - advanced ripe (and running ripe); stage 7 - spent; and stage 8 - recovering, where the gonads are medium-sized but bloodshot. The merits and limitations of the method of classifying the gonads visually in maturation studies have been discussed over the years by a number of workers and I do not intend to repeat them here. It would suffice to reiterate that systematic visual staging of gonads in the field provides the most rapid way of determining the breeding condition of fish populations.

RESULTS

Scombridae

Rastrelliger kanagurta (Indian or Chub mackerel) Figs 2 a and b.

In June-July 1980, mostly ripe and spent fish were taken from the Joseph Bonaparte Gulf (depth range 59-92 m) and from a single station on the North West Shelf (st.89; depth 52-56 m). In November-December 1980, off Coburg Peninsula (sts. 134 and 135; depth 36-44 m), 74.3% of the individuals were ripe and the remaining 25.7% spent. Further offshore in the Arafura Sea (sts. 88 and 92; depth 62-80m), 78.1% of the

Table 1. Numbers of juveniles, males and females in samples of 14 species examined for maturation condition

Species	Cruise	Juvenile	Male	Female	Total
<i>Rastrelliger kanagurta</i>	S05-80	-	139	94	233
	S07-80	35	91	80	206
	S02-81	-	182	149	331
<i>Scomberomorus queenslandicus</i>	S07-80	37	105	75	217
	S02-81	29	131	107	267
<i>Scomberomorus munroi</i>	S07-80	1	34	65	100
		2	42	58	102
<i>Trichiurus lepturus</i>	S07-80	36	58	46	140
	S02-81	-	109	141	250
<i>Sphyræna jello</i>	S05-80	-	40	35	75
	S07-80	-	29	22	51
	S02-81	-	62	40	102
<i>Sphyræna obtusata</i>	S05-80	-	13	12	25
	S07-80	-	25	15	40
	S02-81	-	90	50	140
<i>Sphyræna forsteri</i>	S05-80	10	28	27	65
<i>Herklotsichthys koningsbergi</i>	S07-80	-	24	51	75
	S02-81	-	33	27	60
<i>Sardinella jussieu</i>	S07-80	-	21	19	40
<i>Sardinella sirm</i>	S07-80	-	4	8	12
<i>Sardinella albella</i>	S02-81	4	12	4	20
<i>Pellona ditchela</i>	S07-80	-	48	32	80
	S02-81	-	16	4	20
<i>Dussumieria acuta</i>	S07-80	-	47	57	104
	S02-81	-	7	13	20
<i>Dorosoma chacunda</i>	S07-80	-	20	16	36

combined sample was spent and the remaining 21.9% in stage 2 or recovering. Also in the Arafura Sea at sts. 94 and 86 (depth 32-54 m), 73.4% of the combined sample was ripening (stages 3 and 4). Few *Rastrelliger* were taken from the Arafura Sea during June-July 1981 cruise.

The reproductive condition of the species was much more uniform throughout the Gulf of Carpentaria during both the November-December 1980 and June-July 1981 cruises, the species being mostly in the early stages of sexual maturity. Several juveniles <15 cm FL (Fork Length) were taken in a pelagic trawl at st.29 and shallow st. 19 (depth 17 m). According to Shubnikov (1975), length at first maturity of this species varies from 14-20 cm around the waters of the Indian subcontinent.

Scomberomorus queenslandicus
(School mackerel) Fig. 3.

Small numbers of this species were taken at a number of stations (depth range 15-72m but mostly in <50 m) during both the cruises (Appendix 1). The data of each cruise were therefore combined.

The maturation condition of this species during November-December 1980 was a little more advanced than during June-July 1981. Specimens >40 cm FL during November-December were mostly in stages 3-5 whereas those during June-July 1981 were in stages 2-3. Specimens <21 cm FL and most of the 22-28 cm FL fish were juveniles. Ripe fish were few and running specimens absent. In the November-December sample, 12 males which were staged 4/6 had medium sized testes producing milt when slightly pressed on the belly.

Scomberomorus munroi (Munro's
spotted spanish mackerel)
Fig. 4.

Again, due to small numbers of the species being taken at a large number of stations (depth range 18-64 m but mostly under 50 m), the data of each cruise were combined. The species was in the early stages of maturity during both the cruises, stages 1-3 being the commonest. Specimens <27 cm FL were juveniles, while ripening and spent fish were over 48 cm FL. No major difference in the reproductive condition of the species can be detected between the two cruises.

Trichiuridae

Trichiurus lepturus (Ribbon fish)
Fig. 5.

All the samples of this species examined during November-December 1980 and June-July 1981 were from the Arafura Sea (i.e. excluding the Gulf of Carpentaria) from depths of 44-169 m but generally over 70 m. The species showed a greater spread in its gonadial condition, with both maturing (stages 2-3) and ripe (stages 5-6) individuals occurring at both times of the year. This species therefore seems to have a prolonged spawning season. The higher numbers of ripe fish in November-December 1980 compared to June-July 1981 suggest greater spawning activity during summer. Varying findings have been reported by Indian workers on the spawning of this species. According to Prabhu (1955), spawning is restricted to a short definite period whereas Tampi *et al.* (1968) found the species to spawn more than once in a year along the Madras coast and the two spawning seasons are roughly around May-June and November-December.

Specimens <60 cm TL (Total Length) were generally juveniles and those >60 cm TL displayed gonads in all stages of maturity. On the other hand, Prabhu (1955) found the species begins to spawn at 45-49 cm. Males with medium sized testes exuding milt when slightly pressed on the belly were also encountered. These were staged 4/6.

Sphyraenidae

Sphyraena spp. Fig. 6.

The three species examined were mostly in the early stages of maturity. *Sphyraena jello* trawled at sts. 108 and 109 during November-December 1980 was only just a little more mature when compared with the June-July 1980 and 1981 samples. The reproductive condition of *Sphyraena obtusata* during the three cruises was basically similar. Blaber and Blaber (1980) found fry and juveniles of this species in Moreton Bay during summer, indicating that it may be spawning at this time. *Sphyraena forsteri* was caught in any numbers during June-July 1980 cruise only. Most were in the early stages of maturity. The staging of the smaller individuals (15-17 cm FL) of this species seems suspect as this size group is seen to contain both juveniles and spent individuals.

Clupeoidae Fig. 7.

Herklotsichthys koningsbergeri, the most abundant and widespread clupeid, was mostly in the early stages of maturity during both the cruises. Large specimens (15-17 cm FL) were taken in a pelagic trawl at st. 29. Most of these were spent. Not much is known about this species; it is not even listed by Whitehead (1967) and the species appears to be endemic to the inshore waters of the Timor-Arafura Seas.

Dussumieria acuta showed peculiar gonadal condition during November-

December 1980. Most ovaries were with transparent walls containing large loose and scattered whitish eggs. Because of the uncertainty in staging this ovarian condition, some were classified as partially spent whilst others as recovering. This peculiar condition might perhaps be explained by the fact that this species has a prolonged spawning period with individuals spawning twice during the season (Dharmamba, 1959). The one sample examined during June-July 1981 had immature-ripening gonads.

Sardinella jussieu (= *gibbosa*), *Sardinella albella* and *Dorosoma chacunda* were obtained during one of the cruises only and in the case of *Sardinella sirm*, in very small numbers too. Observations made in East African and Indian coastal waters (see Okera, 1974 for references) indicate that the first two species have a single spawning season of 3-4 months duration. With *D. chacunda*, Annigeri (1963) concluded that this species also has a single spawning season with individual fish spawning twice during the same season.

Pellona ditchela, although abundant, was difficult to stage in the field and only a few samples were examined. The results are shown in the figure.

DISCUSSION

Only tentative inferences on the maturation condition of the species obtained and examined during both the cruises to the Arafura Sea and Gulf of Carpentaria can be drawn from the present synoptic and opportunistic observations. Furthermore, the present observations are on fishes taken mostly by demersal tows and from deeper waters. The reproductive condition of such samples, especially those of scombrid species, is likely to be different from the catches of pelagic gear, or of those taken close to shore, reefs and estuaries.

A single general pattern in the maturation condition of the species examined in some detail, which could be related to the times of the year, is not apparent from the present data. Ripe *Rastrelliger kanagurta* and *Trichiurus lepturus* were found at both times of the year, suggesting that these species may be breeding in the offshore shelf waters (>50 m) throughout the year, the latter species perhaps with an increased spawning activity during summer. Whether the absence of ripe *R. kanagurta* from the Gulf during both the cruises means that this species does not breed there will only become apparent with future intensive sampling. *Scomberomorus queenslandicus* and *Sphyraena jello* were a little more mature during November-December than in June-July. Thus, at least three species were more mature during November-December than in June-July, probably indicating an increased spawning activity during the warmer north-west monsoon season. According to McPherson (1981), *Scomberomorus commerson* in eastern Queensland waters also breeds in early summer (October-December), although in Torres Strait the species shows protracted spawning. *Scomberomorus munroi*, *Sphyraena obtusata* and *Herklotsichthys koningsbergeri* showed no difference in their maturation condition between the two cruises. Males of *R. kanagurta*, *S. queenslandicus* and *T. lepturus* with small to medium-sized testes exuded milt when the belly was pressed or when the testes were cut in halves. Blackburn and Serventy (1980) also noted this male gonadal condition in the skipjack. The significance of this observation in the maturation and spawning cycle of the males of these species is difficult to determine without detailed histo-physiological reproductive studies.

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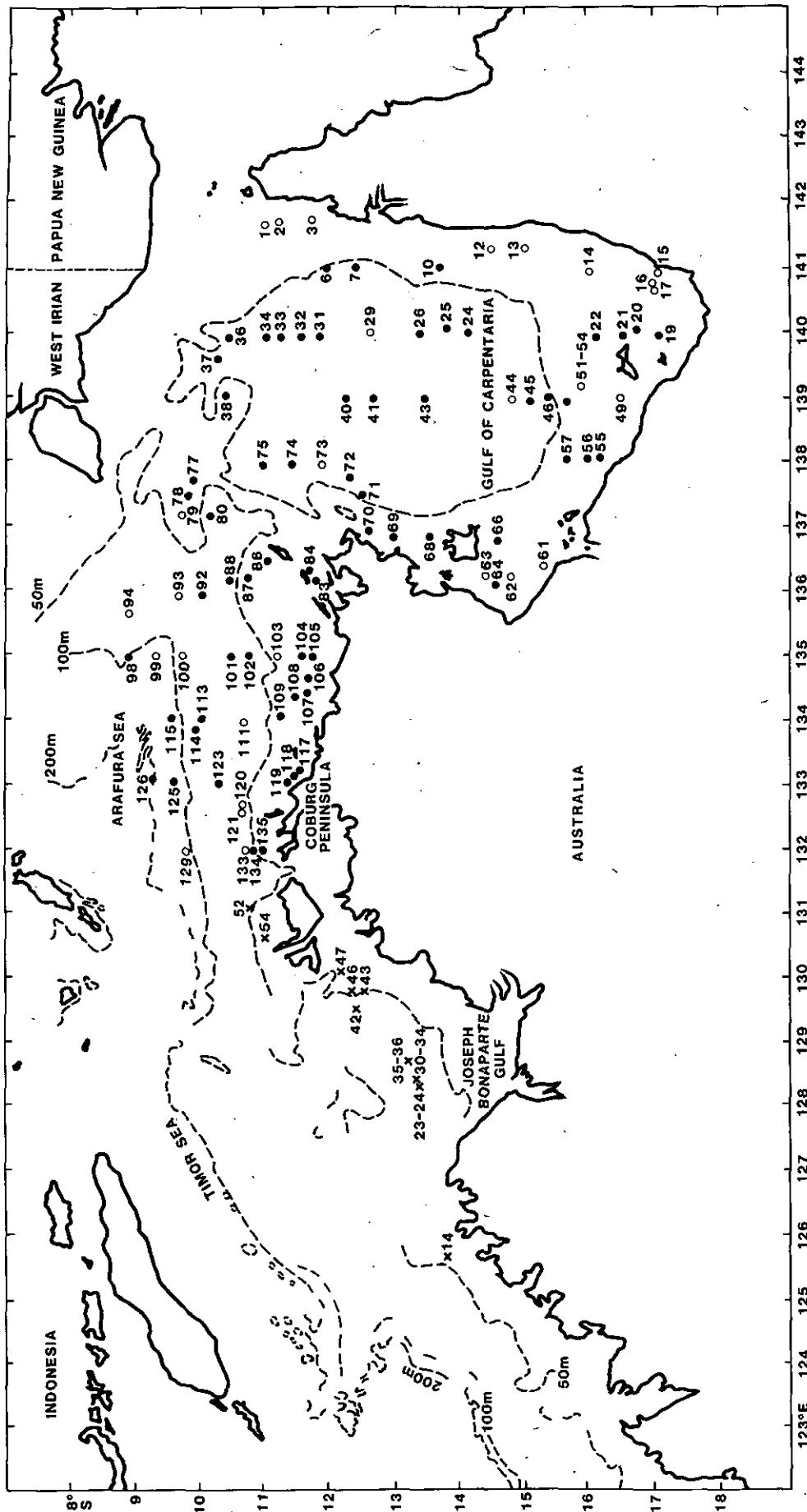


Fig. 1. Northern Australian shelf showing the stations from where the species were examined for maturation condition.

- Crosses - cruise S05-80 stations
- Filled circles - stations sampled during both S07-80 and S02-81 cruises
- Open circles - stations sampled once only, either during S07-80 or S02-81.

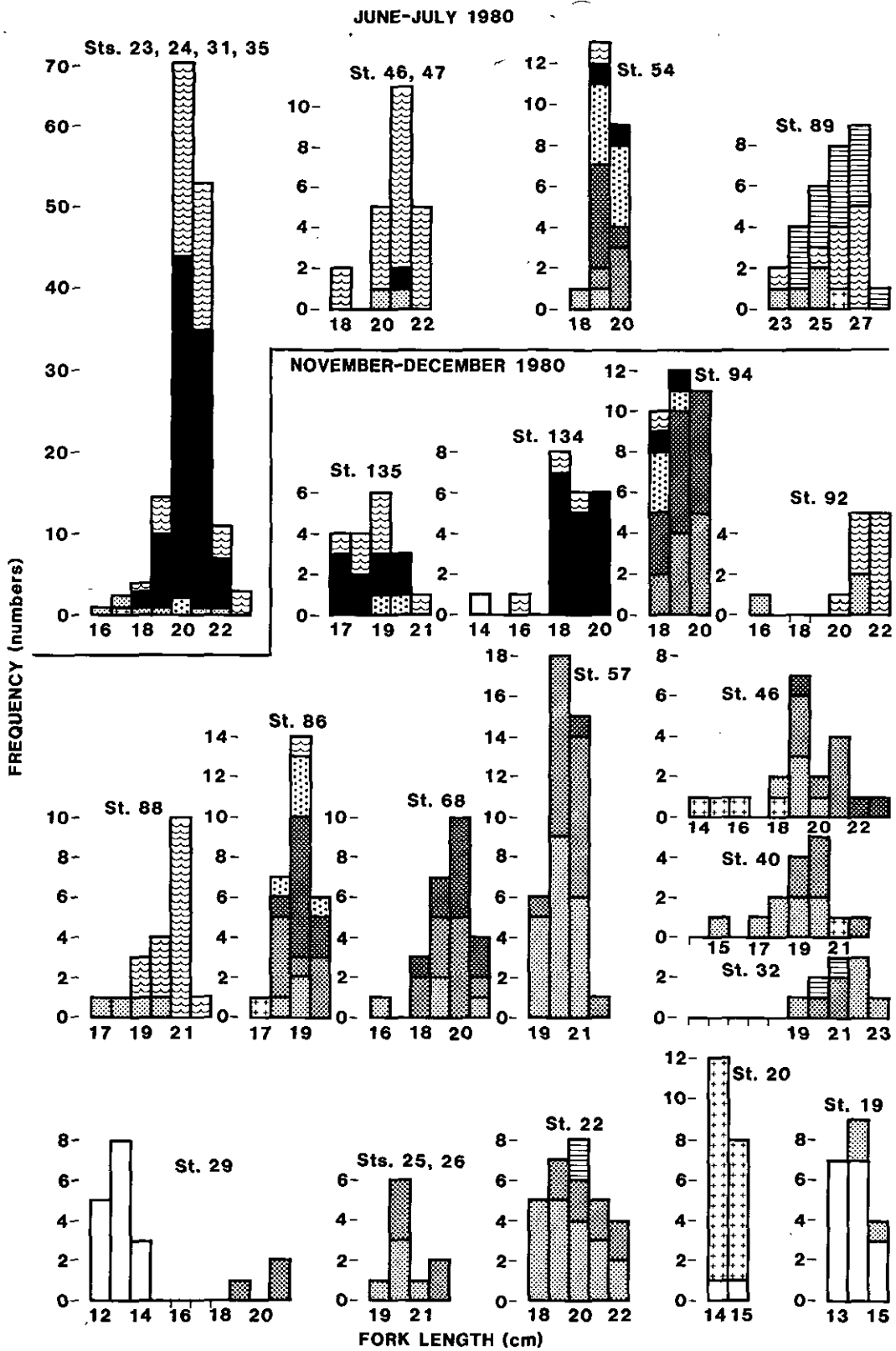


Fig. 2a. Maturation condition of *Rastrelliger kanagurta* in June-July 1980, November-December 1980.

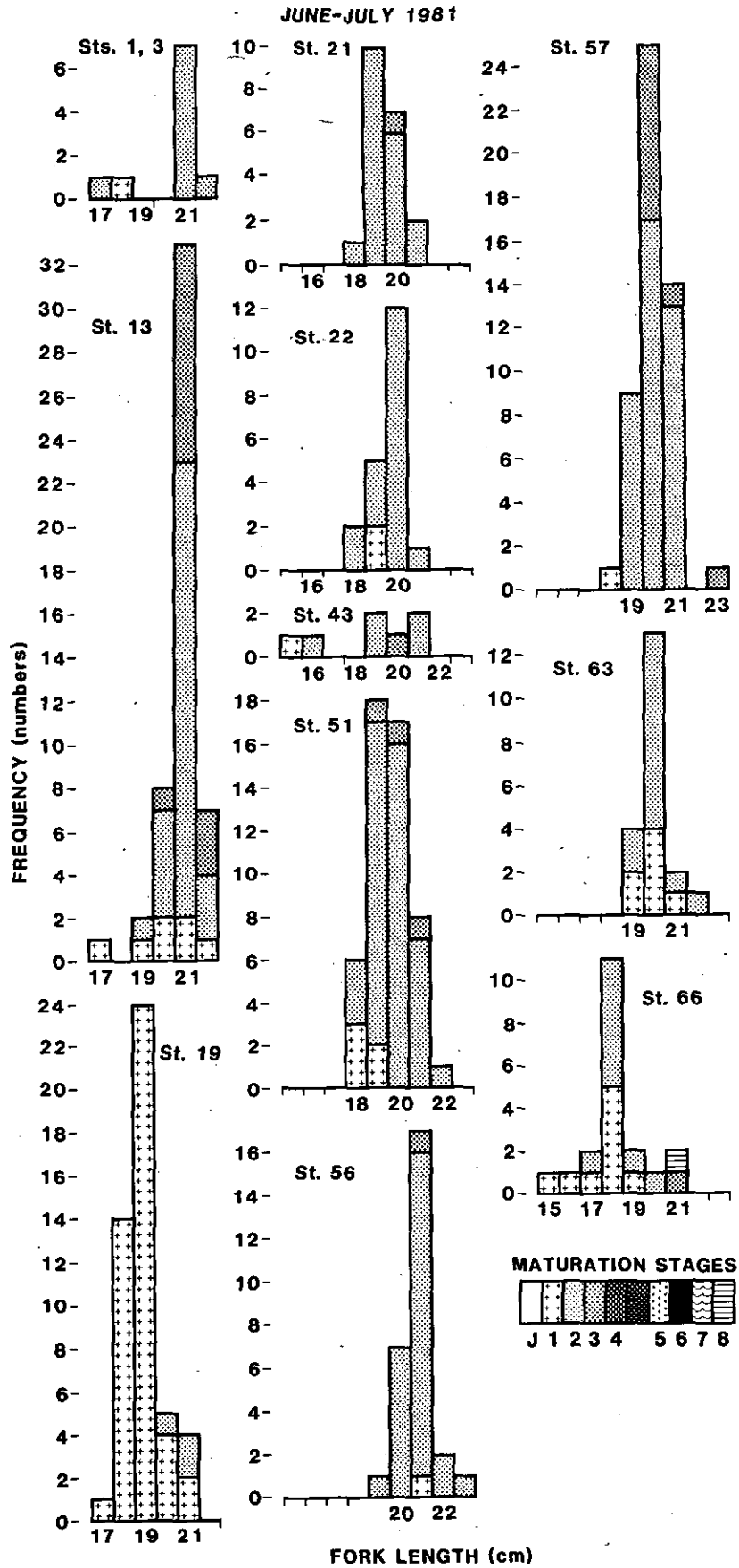


Fig. 2b. Maturation condition of *Rastrelliger kanagurta* in June-July 1981.

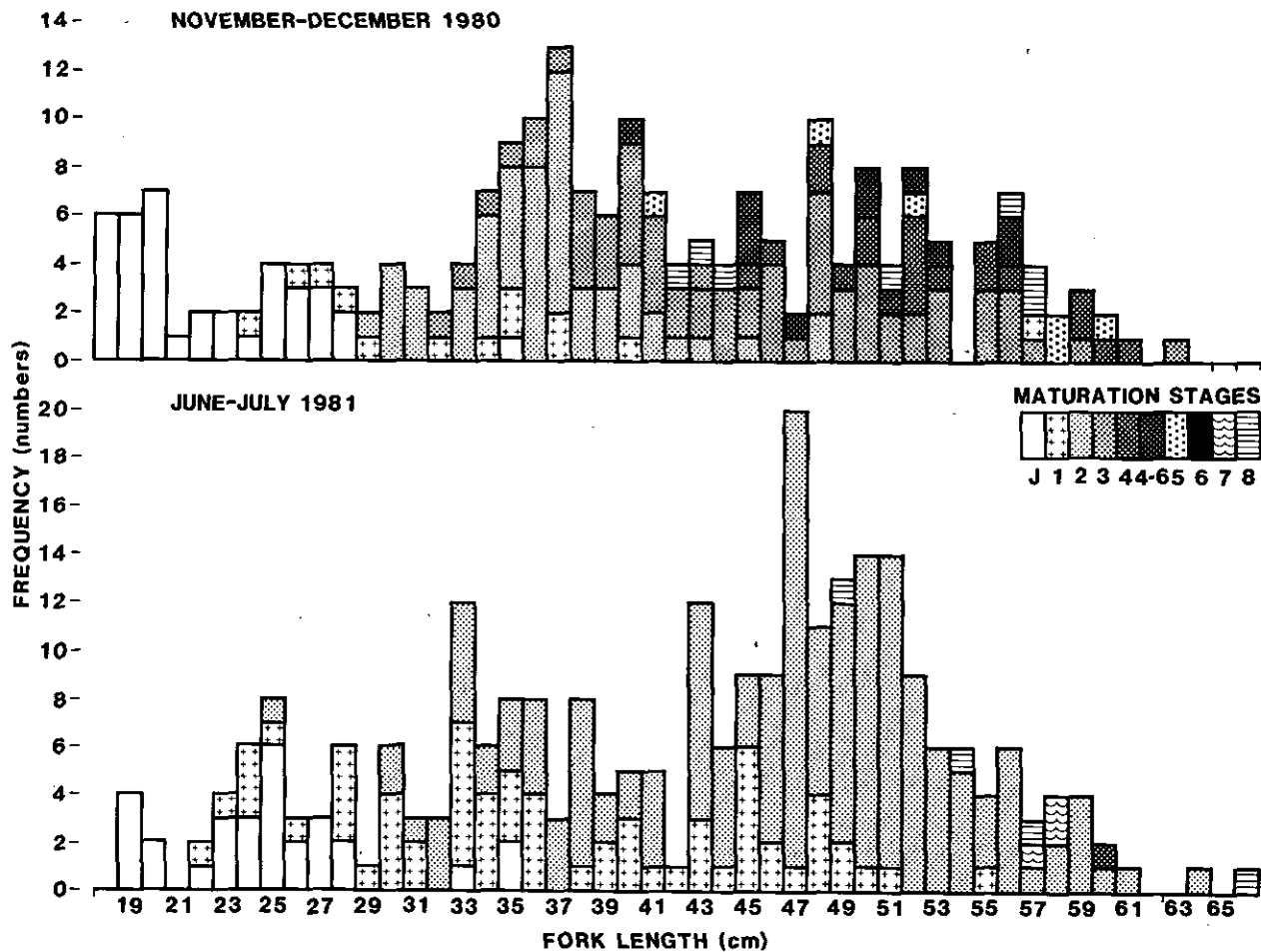


Fig. 3. Maturation condition of *Scomberomorus queenslandicus* in November-December 1980 and June-July 1981. Stations from where the samples were obtained are given in Appendix 1.

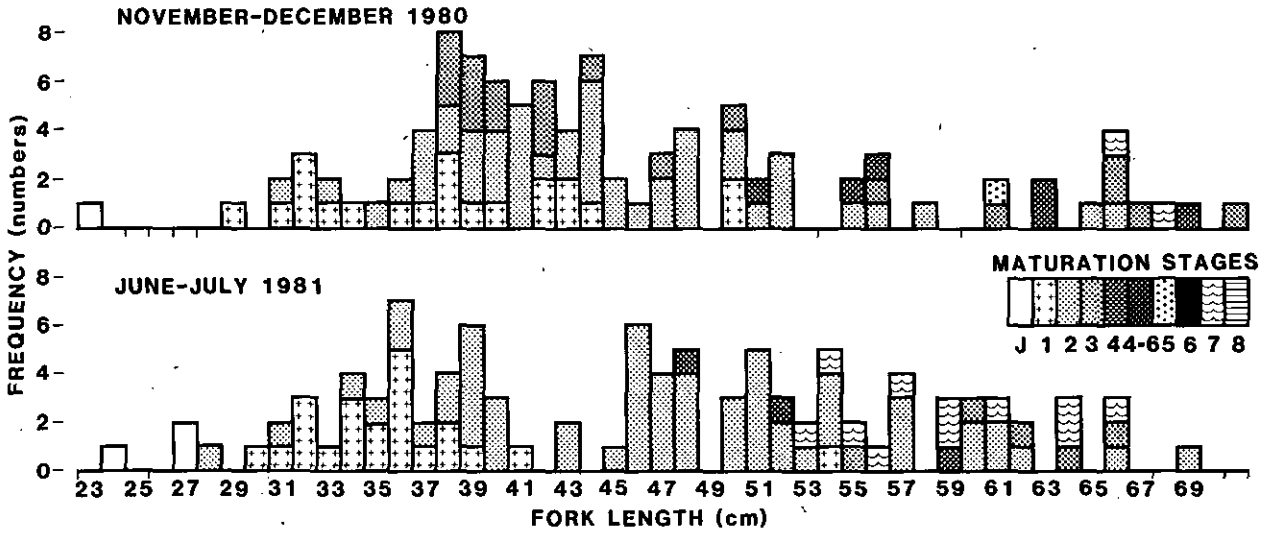


Fig. 4. Maturation condition of *Scomberomorus munroi* in November-December 1980 and June-July 1981. Stations from where the samples were obtained are given in Appendix 1.

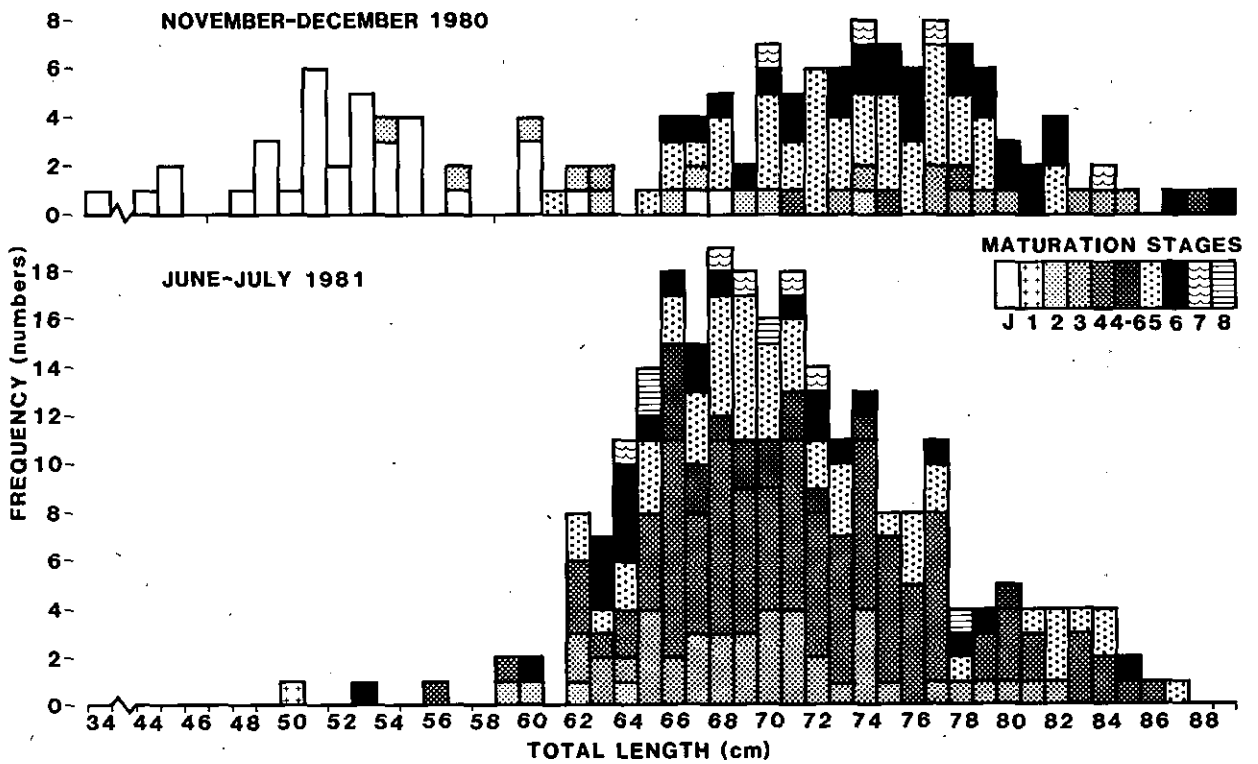


Fig. 5. Maturation condition of *Trichiurus lepturus* in November-December 1980 and June-July 1981. Stations from where the samples were obtained are given in Appendix 1.

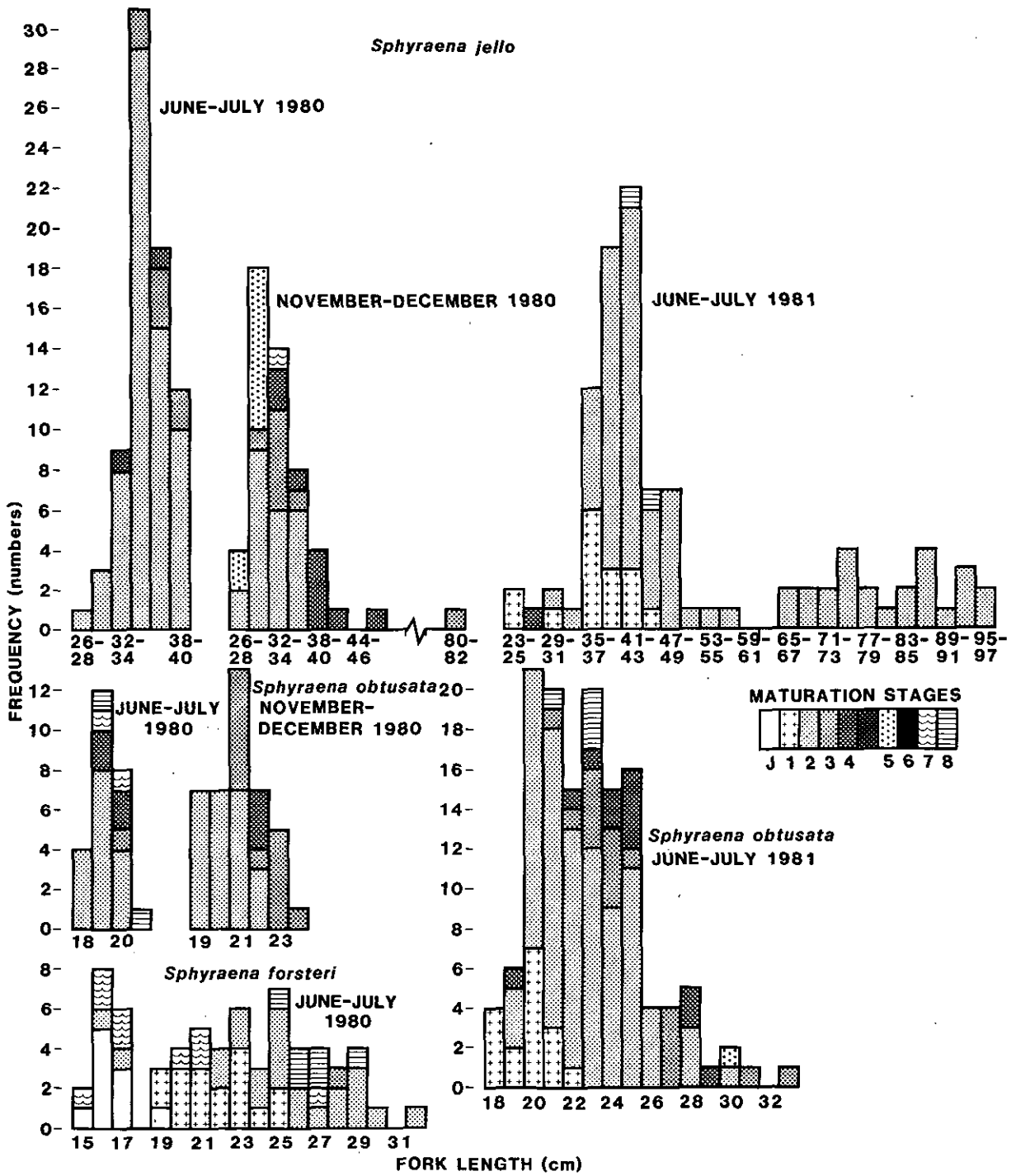


Fig. 6. Maturation condition of *Sphyraena jello* and *Sphyraena obtusata* in June-July 1980, November-December 1980 and June-July 1981. *Sphyraena forsteri* was obtained during June-July 1980 only. Stations from where the samples were obtained are given in Appendix 1.

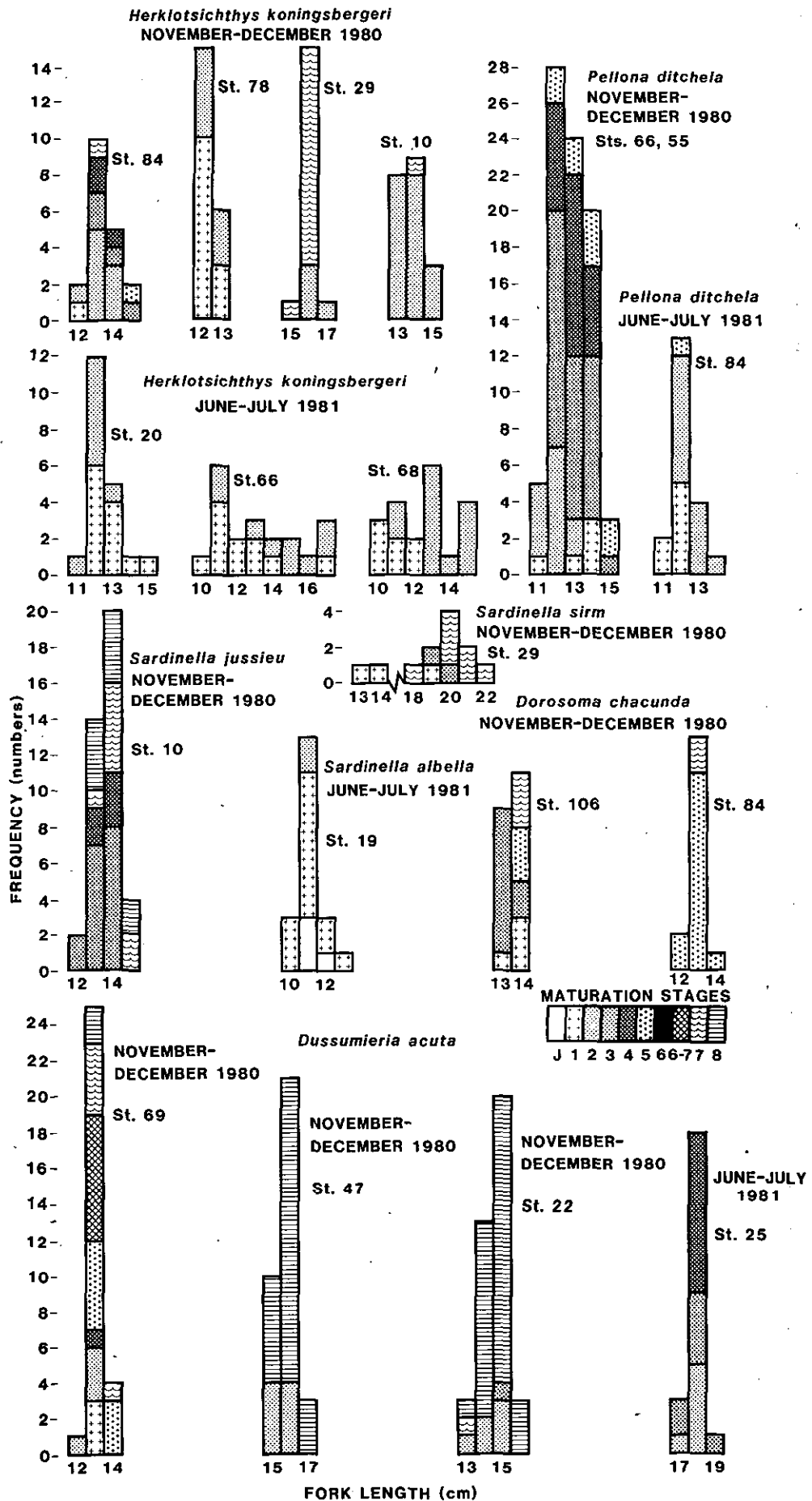


Fig. 7. Maturation condition of some clupeoid species.

Appendix 1. Stations from where the species listed below were obtained

Species	Cruise	Combined sample from stations
<i>Scomberomorus queenslandicus</i>	S07-80	10, 14, 15, 20, 21, 22, 25, 31, 36, 46, 55, 56, 57, 64, 66, 68, 69, 70, 72, 73, 75, 79, 83, 84, 85, 102, 104, 105.
	S02-81	1, 2, 3, 7, 12, 13, 20, 21, 24, 32, 33, 34, 36, 37, 38, 45, 55, 56, 57, 58, 61, 62, 63, 65, 66, 68, 69, 74, 77, 78, 79, 83, 87, 88, 101, 102, 103, 105, 106, 107, 108, 117, 118.
<i>Scomberomorus munroi</i>	S07-80	14, 20, 22, 69, 70, 71, 78, 79, 84, 85, 88, 104, 105.
	S02-81	1, 2, 6, 10, 21, 31, 32, 33, 37, 44, 49, 51, 55, 56, 57, 66, 68, 69, 71, 77, 78, 86, 106, 107, 108, 117, 118, 119, 133.
<i>Trichiurus lepturus</i>	S07-80	93, 112, 114, 125, 126.
	S02-81	77, 80, 88, 98, 99, 100, 109, 111, 113, 123, 129.
<i>Sphyræna jello</i>	S05-80	35, 36.
	S07-80	68, 109.
	S02-81	12, 47, 61, 62, 79, 101, 122.
<i>Sphyræna obtusata</i>	S05-80	31, 36.
	S07-80	41.
	S02-81	43, 56, 61, 62, 113.
<i>Sphyræna forsteri</i>	S05-80	14, 42, 43, 52, 61.

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