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Game fishes of the east coast of southern Africa.  
2. Biology and systematics of the queen mackerel  
*Scomberomorus plurilineatus*

by

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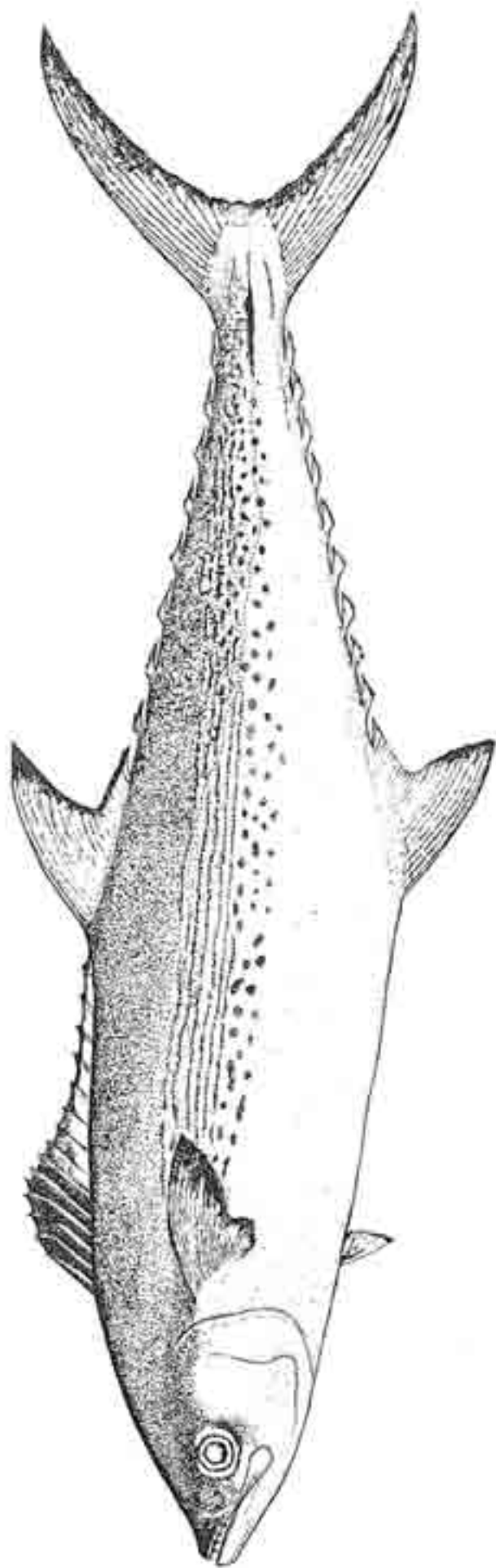


Fig. 1. *Scomberomorus plurilineatus*. Durban, South Africa. 598 mm FL., USNM 264809.

GAME FISHES OF THE EAST COAST OF SOUTHERN AFRICA.  
2. BIOLOGY AND SYSTEMATICS OF THE QUEEN MACKEREL  
*SCOMBEROMORUS PLURILINEATUS*

by  
RUDY VANDER ELST AND BRUCE B. COLLETTE\*

ABSTRACT

The systematic status of the queen mackerel, *Scomberomorus plurilineatus* Fourmanoir, 1966 is established as a western Indian Ocean endemic member of the *S. semifasciatus* species group. The queen mackerel ranks as a prime game fish to the sport fishermen of Natal and Zululand who make considerable catches during summer and winter respectively. No commercial fishing is currently exerted on this species. Female fish predominate in catches and the yearly average sex ratio of males to females is 1:1.44. Reproductive maturity is usually attained at 720-740 mm FL in males and 760-780 mm FL in females. Although most size classes are represented, as much as 75% of the catch is immature. Spawning does not occur in Natal but further to the north, probably in Mozambique waters. The queen mackerel is a voracious predator of small clupeiform fishes mostly taken during active surface feeding. Six types of parasites are recorded.

INTRODUCTION

The queen mackerel, *Scomberomorus plurilineatus*, is among the dozen most important pelagic game fishes in Natal (van der Elst, 1976). The taxonomic status of the queen mackerel has been confused; it has been considered as conspecific with *S. guttatus* (Bloch & Schnieder, 1801) or with *S. lineolatus* (Cuvier, 1831), neither of which extends into the western Indian Ocean. The species was not even formally described until Fourmanoir (1966) distinguished it from *Scomberomorus lineolatus*. The primary source of published biological information is Williams (1960), as *S. lineolatus*, based largely on observations in Zanzibar. The purpose of this paper is to summarize published information on the systematics and biology of *S. plurilineatus* and to present new data on its biology, particularly in Zululand and Natal from research by the first author. This paper is the second in a series on the game fishes of southern Africa (see van der Elst, 1976 on *Pomatomus saltatrix*).

*Scomberomorus plurilineatus* Fourmanoir, 1966  
(Fig. 1)

*Cybium lineolatum* (not of Cuvier, 1831); Gilchrist & Thompson, 1911: 41 (description, Durban).

*Scomberomorus lineolatum* (not of Cuvier, 1831); Gilchrist & Thompson, 1917: 395 (Natal).

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- Scomberomorus lineolatus* (not of Cuvier, 1831); Barnard, 1927: 803 (description, Natal); Fowler, 1934: 441 (Durban); Smith, 1935: 210–211 (description, Port Alfred, South Africa); Williams, 1960: 183–192 (description, synonymy, range), pl. 2; Williams, 1964: 151–154 (distribution, fishery biology); Merrett & Thorp, 1966: 371–372 (references, range, size, biology); van der Elst, 1976: 5 (one of dozen most important game fishes in Natal).
- Scomberomorus leopardus* (not of Shaw, 1803); Fowler, 1929: 254 (description Natal); Smith, 1949, 1953, 1961: 301 (description, range), fig. 841, pl. 64; Morrow, 1954: 815 (near Shimoni and Pemba I., East Africa); Talbot, 1965: 469 (Mafia area, Tanganyika); Mauge, 1967: 234 (Anakao, Tulear region, Madagascar); Shiino, 1976: 231 (common name).
- Scomberomorus* sp. Williams, 1956: 44 (Kenya).
- Scomberomorus guttatus* (not of Bloch & Schneider, 1801); Smith, 1956: 722 (Aldabra); Smith & Smith, 1963: 43 (Seychelles), pl. 30B, Smith, 1964: 176–177 (description, Durban and Delagoa Bay), pl. 8, figs. 3–5; Silas, 1964: 314–328 (western Indian Ocean population only); Smith & Smith, 1966: 72 (Natal), colour pl. 841.
- Cybium leopardus* (not of Shaw, 1803); Fourmanoir, 1957: 227 (description, Mozambique Channel).
- Cybium lineolatus* (not of Cuvier, 1831); Fourmanoir & Crosnier, 1964: 387–388 (Madagascar).
- Scomberomorus plurilineatus* Fourmanoir, 1966: 223–226 (original description, Madagascar), Fig. 1; Klawe, 1977: 2 (range, common name); Collette, 1979: 29 (characters); Collette & Russo, 1979: 13 (diagnostic characters, range); Cressey & Cressey, 1980: 47 (infested with *Pseudocycnoides armatus*); Van der Elst, 1981: 275 (description, natural history, range, photograph); Joubert, 1981: 5 (minor component of shore anglers' catches, Natal, South Africa); Cressey, Collette & Russo, 1983: 264 (parasitic copepods); Collette & Nauen, 1983: 73 (FAO Catalogue); Collette & Russo, in press, (systematics, anatomy); Collette & Russo in press, (relationships).

### Types

*Scomberomorus plurilineatus* Fourmanoir, 1966 was based on a 740 mm specimen collected near Nossi-Be, Madagascar, in 1965. The type was supposed to be transferred from the ORSTOM collections to the Muséum National d'Histoire Naturelle collection in Paris but apparently was inadvertently discarded (pers. comm., M.-L. Bauchot and P. Fourmanoir, Dec. 1974.)

### Common names

The official common name in South Africa is queen mackerel (Smith, 1975) though the misleading name of snoek is still widely used in Natal. In Mozambique this species, together with *S. commerson*, is commonly known as "peixe serra", while the vernacular name in East Africa is kanadi.

### Diagnosis

The only species of *Scomberomorus* that has a pattern of short, wavy horizontal lines and spots on its sides (Fig. 1). Other species have straight lines, spots, blotches or bars on the side or are plain.

### Description

Lateral line gradually descending to midline on caudal peduncle, without the deep dip under the second dorsal fin present in *Scomberomorus commerson* (Lacepède, 1800). Intestine with two folds and three limbs. Spines in first dorsal fin 15–17, usually 15–16; second dorsal fin rays 19–21, usually 20; dorsal finlets 8–10, usually 9; anal fin rays 19–22, usually 20–21; anal finlets 7–10, usually 8–9; pectoral fin rays 21–26, usually 22–23.

Precaudal vertebrae 19 – 20, usually 20, caudal vertebrae 25 – 27, usually 26; total vertebrae 45 – 46, usually 46. Gill rakers on first arch (2 – 3) + (9 – 13) = 11 – 16, usually 2 + (10 – 11) = 12 – 13. Morphometric characters given in Table 1.

Table 1. Summary of morphometric data on *Scomberomorus plurilineatus* expressed as thousandths of fork length or head length.

CHARACTER	NO.	MIN	MAX	MEAN	SD
Expressed as % of fork length	37	144	910	547	211
Snout to anal	36	478	614	502	22
Snout to 2nd dorsal	36	446	622	473	28
Snout to 1st dorsal	36	202	247	221	12
Snout to pelvic	36	207	261	232	12
Snout to pectoral	37	176	228	192	11
Pectoral to pelvic	26	96	117	103	5
Head length	37	175	222	193	11
Maximum depth	32	184	225	205	11
Maximum width	20	76	123	97	13
Pectoral length	31	98	140	123	10
Pelvic length	35	44	66	51	6
Pelvic insertion to vent	24	223	257	244	9
Pelvic tip to vent	23	158	207	187	15
Base of 1st dorsal	23	219	256	240	11
Height of 2nd dorsal	29	122	166	148	11
Base of 2nd dorsal	27	101	156	128	11
Height of anal	27	91	155	135	14
Base of anal	27	111	143	126	9
Fleshy snout	35	61	75	67	3
Bony snout	25	48	67	58	4
Maxillary length	36	83	113	96	7
Postorbital sinus	36	81	107	94	6
Fleshy orbit	37	22	139	34	19
Bony orbit	27	33	60	45	8
Interorbital	36	46	67	56	4
Second dorsal to caudal	25	318	375	349	15
Expressed as % of head length	37	31	159	104	37
Fleshy snout	35	309	371	348	13
Bony snout	25	256	327	305	15
Maxillary length	36	469	529	496	14
Postorbital sinus	36	413	527	485	23
Fleshy orbit	37	121	769	179	104
Bony orbit	27	178	276	231	27
Interorbital	36	253	352	290	21

### Size

Maximum size 120 cm Lcf, South African angling record 10.0 kg.

### Colour pattern

Williams (1960) published a good description of fresh specimens from Zanzibar. Head blue-grey above silvery white below, except for lower jaw tip, preorbital area and maxillary groove dusky to black. Pupil of eye black, rest silvery. Body iridescent blue-grey above lateral line, silver below becoming whitish ventrally. Body with a series of about 6 – 8 interrupted horizontal black lines on sides, much narrower than interspaces. Usually only one of these lines above lateral line anteriorly; replaced posteriorly by a number of short oblique black lines becoming somewhat confused, and only 2 – 3 continue to caudal peduncle. Horizontal black lines on body interrupted to varying degrees, almost intact in places, but broken up into a series of small rectangular "spots" in others. Juveniles spotted but developing adult pattern of interrupted lines at a length of 400 mm (Smith, 1964: 177).

Upper areas of caudal peduncle and median keel black, lower areas dusky. First dorsal fin black, except lower areas of membrane may be pale posteriorly. Second dorsal fin with leading edge and tips of rays dusky, rest silver to pale; finlets dusky with silver area at

centre. Anal fin, leading edges and tips of rays dusky, rest silvery; finlets white with dusky central area. Pectoral fins and axilla black inside, dusky outside with edges black; pelvic fins whitish with outside of mid-rays dusky, groove on body a little dusky. Caudal fin basally pale, rest of fin dusky to black.

Black and white photographs of *S. plurilineatus* have been published by Williams (1960: pl.2, 640 mm Zanzibar specimen as *S. lineolatus*) and Fourmanoir (1966: Fig. 1, 740 mm holotype from Madagascar). Illustrations of a spotted 300 mm juvenile and two adults over 1 m long were presented by Smith, 1964 (pl. 8). A coloured figure of a juvenile is included in Smith and Smith (1966: Fig. 841). Figure 1 that accompanies this account was also used in the FAO Catalogue (Collette & Nauen, 1983).

#### Relationships

*Scomberomorus plurilineatus* is a member of the *S. semifasciatus* species group; (Collette & Russo, 1984), defined by the presence of a greatly expanded posterior end of the maxilla. The other members of the group are *S. lineolatus* (Cuvier), found along the coast of India east to Indonesia, and *S. semifasciatus* (Macleay), found in northern Australia and southern New Guinea.

#### Distribution

Common in coastal waters, especially near rocky and coral reefs. Its range is confined to the western Indian Ocean along the coast of East Africa from Kenya (1°30'S) and Zanzibar (Williams, 1964) to Natal, South Africa. The southernmost records are from rare catches at Tsitsikama (34°1'S, 23°55'E) (Smith & Smith, 1966). *S. plurilineatus* is also found in the Seychelles (Smith & Smith, 1963) and along the west coast of Madagascar.

## BIOLOGY

#### Seasonal abundance

It is well known by Natal fishermen that *Scomberomorus plurilineatus* is a distinctly seasonal fish and that catches vary for different parts of the coast at any one time. Records from the sport fishing community reveal that best catches are made in Zululand (about 28°30'S) from April to July (Fig. 2). This corresponds with the period of increased abundance in the Zanzibar Channel where large shoals are present from March – April until August – September (Williams, 1960) Further south at Durban (30°S), however, *S. plurilineatus* attains its greatest abundance during November – April. As this region approximates its southwestern limit of distribution, it follows that these fish are summer migrants from warmer waters of Zululand southwards to the high latitudes and more temperate waters off Natal. Coastal water temperatures in Zululand range from 23°C to 27°C during the April to July period, rather similar to the 23 – 25.5°C range found off Durban during the summer (S.A. Dept. of Transport). As bait fish are known to be common off Durban during winter (van der Elst et al., 1978) it may well be that a minimum temperature of 23°C serves as a limiting factor in the distribution of *S. plurilineatus*.

#### Length composition

The mean length of *S. plurilineatus* landed by line fishermen in Natal during 1975 – 1977 is 692 mm FL with a range of 336 to 1090 mm. This is similar to the 600 to 800 mm length range reported from Zanzibar (Williams, 1960). There is no significant difference between the size distributions of male and female fish, though the latter tend to be marginally larger (0.8%) in most catches. Their combined length frequency distribution (Fig. 3) reveals a distinct mode at 600 mm with less obvious modes at higher length classes. As growth data are not yet available it is impossible to separate the length composition into age classes.

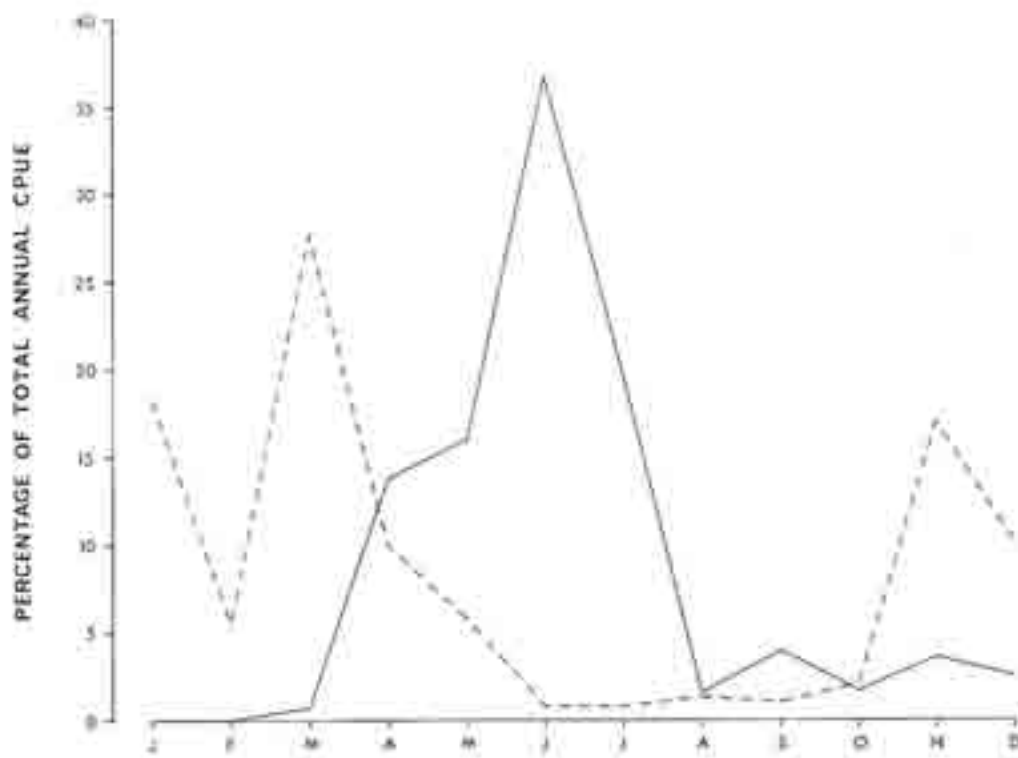


Fig. 2. Catch per unit effort as a percentage of the total skiboat catch of *Scomberomorus plurilineatus* (1975 - 1977) in Zululand (solid line, n=2558) and Durban (dashed line, n=1253).

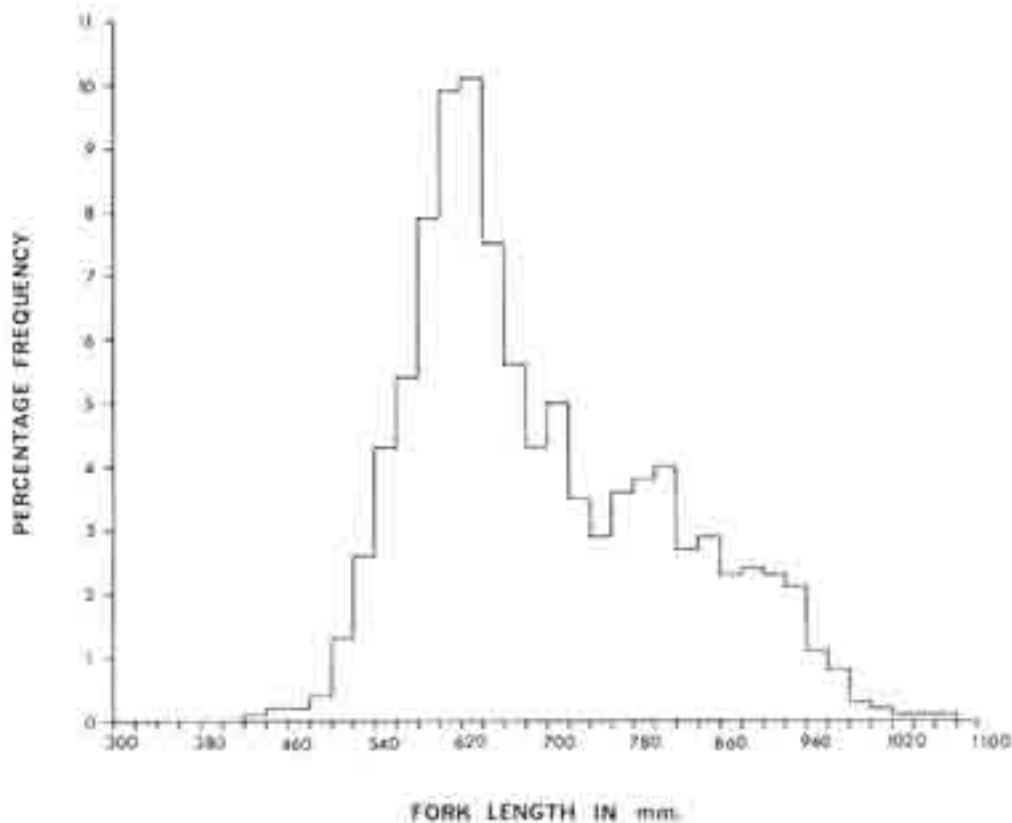


Fig. 3. Length frequency distribution of the total sample of *Scomberomorus plurilineatus* (1975 - 1977) (n=4998).

### Sex ratio

Analysis of the catch reveals an overall ratio of males to females of 1:1.44 (probability < 0.05, n = 2558). Females predominate in monthly catches from January to October, and only in much lowered catches during November and December do male fish occasionally outnumber females. As fish are mostly of similar size, the skewed sex ratio does not appear to be a product of differential catchability. A breakdown of sex ratios for each 2 mm size class clearly indicates that the predominance of females persists throughout the length range of this species. Similarly, individual shoals of *S. plurilineatus* are composed of both sexes, precluding the possibility of sexually segregated shoals influencing the data.

It would appear, therefore, that the unequal sex ratio is not just a feature of the catch but that it reflects the true situation within the stock itself.

### Length-weight relationship

There is no significant size difference between samples of males and females, as both exponential curves fall within the 95% confidence limits of each other. Hence the overall length-weight relationship for this species in Natal waters can be given as:

$$w = 1.26 \times 10^{-7} Lcf^{2.911}$$

where w = weight in grams and Lcf = fork length in mm.

### Reproduction

During the two year period (1975 – 1976) the gonads of 2558 *S. plurilineatus* from Natal and Zululand were macroscopically examined and assessed according to the definitions provided by Laevastu (1965). There is no evidence to suggest that this species actively spawns in Natal's coastal waters because only 0.3% of the sample was found to be in a ripe reproductive phase. However, there is considerable evidence to indicate that fish migrating southward into Zululand waters had recently spawned. This can be seen from the increased number of partially spawned and spent fish that appear in Zululand catches from August onwards. This confirms reports from Zanzibar that an increase in spent fish occurs from September to November (Williams, 1964). It is useful to consider the relationship between pre-spawning fish and post spawning or spent fish (Fig. 4). Clearly there is a marked change in this ratio from July onwards and it may thus be deduced that spawning of *S. plurilineatus* occurs during late winter and spring in waters to the north of Natal. There do not appear to be any published references to eggs or larvae of *S. plurilineatus*.

### Size at sexual maturity

Considering only those reproductive phases that indicated recent or imminent spawning, it was found that only 25% of the sample demonstrated clear signs of sexual maturity. This, when related to the length frequency distributions of males and females separately, indicates that *S. plurilineatus* attains a 50% level of sexual maturity at 720 – 740 mm FL for male and 760 – 780 mm for female fish. Overall this gives a mean value of 750 mm at which 50% of the population is sexually mature. Males would appear to mature at a smaller size than females. In fact the smallest mature male and female fish were found to be 546 mm and 585 mm respectively.

### Food and feeding

*Scomberonorus plurilineatus* is a voracious feeder and it is during times of frenzied surface feeding that most catches are made with rod and line. Overall, however, only 26% of stomachs were found to contain remnants of food. A low incidence of stomach contents

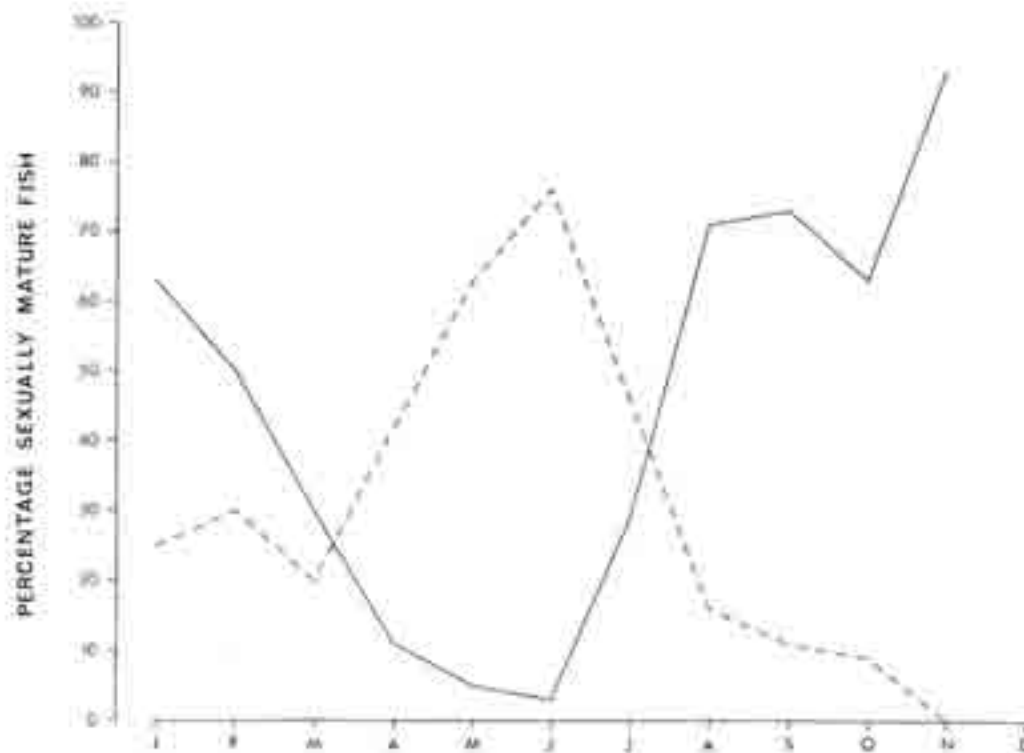


Fig. 4. Percentage composition of sexually active (solid line) and inactive (dotted line) *Scomberomorus plurilineatus*.

has also been reported in *S. cavalla* caught off the USA east coast (Beaumariage, 1973; de Vane, 1978). Undoubtedly regurgitation contributes to these low percentages, but the possible effects of nocturnal feeding cannot be excluded. Whereas all catches of *S. plurilineatus* were made during daylight, it is known however that the related *S. cavalla* from eastern USA coastal waters feeds predominantly at night (de Sylva, pers comm.). Food items were classified into broad categories and then dried to constant weight at 60°C. This permitted a measure of quantification by weight (w). Likewise percentage frequency of occurrence was calculated (f). Both values are expressed in annual terms and are given in parenthesis. Dominant food items were anchovies (w = 88.8%; f = 73.9%), primarily *Stolephorus holodon* with lesser amounts of *Thryssa vitirostris*. Clupeid fishes (w = 2.6%; f = 0.1%) were most commonly found during winter, mainly *Sardinops ocellata* and *Etrumeus teres*. Small squid (*Loligo* sp. w = 3.6%; f = 5.2%), juvenile mantis shrimps (*Squilla* sp. w = 1.6%), mysids (w = 1.3%; f = 2.2%) and penaeid prawns (w = 0.1%; f = 0.3%) were also noted. In addition to these a number of smaller or juvenile teleosts (w = 1.11%; f = 9.2%) were also identified; *Sphyraena* sp., *Diplodus sargus*, *Secutor insidiator*, *Carangoides* sp., *Mugil cephalus*, *Hilsa kelee*, *Chirocentrus dorab* and *Silago sihama*.

Food in East Africa is similar, largely engraulids such as *Anchoviella* sp. and clupeids such as *Amblygaster* and *Sardinella* (Williams, 1964; Merrett & Thorp, 1965).

#### Parasites

Most specimens examined were hosts to parasites. Of the six parasite species recorded by Bray (in prep.), three were noticeably abundant: the larval cestodes of *Callotetrarhynchus gracilis* (52% infested) and *Pterobothrium* sp. (11%) both from the coelomic cavity and the copepod *Pseudocycnoides armatus* (50%) found attached to the gill filaments. Some parasites displayed distinct seasonality, such as *C. gracilis*, which infested 1.5 times as many fish during autumn/winter as during summer.

Five species of copepods were reported from 14 specimens of *S. plurilineatus* by Cressey *et al.* (1983: 264): *Pseudocycnoides armatus* (12 of 14 fish infested), *Unicolax ciliatus* (4, in the nasal cavity), *Brachiella thynni* (1), *Caligus asymmetricus* (1), and *Shiinoa occlusa* (1, attached to the nasal rosette). The following parasites were recorded from Zululand and Natal:

<u>Parasite</u>	<u>Type</u>	<u>Organ Infested</u>
Pseudophylliden larvae	cestode	gonad membrane, body cavity and stomach wall
<i>Callotetrarhynchus gracilis</i>	cestode	body cavity, mesenteries
<i>Pterobothrium</i> sp. larvae	cestode	body cavity
Anisakine larvae and cysts	nematode	mesenteries, gonad membrane
<i>Pseudocycnoides armatus</i>	copepod	gills
<i>Caligus cybii</i>	copepod	buccal

### Habits

Unlike most other South African scombrid fishes, *S. plurilineatus* is primarily confined to the immediate coastal zone, with catches seldom being made more than one kilometre offshore. Although distributed along the entire coast, *S. plurilineatus* shows preference for areas close to river mouths, providing the water is not excessively turbid. It is a strongly gregarious species, often forming dense shoals of up to 250 m across. Occasionally these fish will 'bask' at the surface for days at one particular spot, refusing any bait but being very easily approached. Such 'resting' shoals, which are readily netted, indicate a complete lack of feeding and reproductive activity. It is not clear what induces such passive behaviour, but the sudden appearance of food fish often triggers active surface feeding. Small fishes, especially anchovies, are then often 'balled' into tight shoals before being eaten, usually in close association with actively feeding common terns, *Sterna hirundo*.

### Fishery

*Scomberomorus plurilineatus* is an important component of the recreational line fishery in Natal. It is regularly caught by anglers fishing from their more than 1000 outboard powered dinghies (locally known as skiboats) that launch from the 569 km long Natal coastline. Some 2500 tons of linefish are landed from these small craft yearly. Historic catch trends indicate that up to 75% of this catch normally consisted of demersal species, especially endemic sparids. However, as these bottom fishes become depleted, so the proportion of pelagic gamefish in the catch has increased. This is especially true in heavily exploited areas such as off Durban, where the pelagic gamefish fraction of the catch now comprises 62% (both by weight and number). The queen mackerel ranks only second to the king mackerel or tangigue (*Scomberomorus commerson*) in importance as a game fish and comprises some 17% of the pelagic catch by number. There is, therefore, a noticeable shift in target species brought about by a change in angling habits. Anchoring a skiboat with the intention of bottom fishing is now becoming less productive than trolling with lures and feathers for queen mackerel, despite much higher fuel consumption.

In terms of peak catchability, this species far exceeds that of all other game fish caught in the region. In Zululand catch rates in excess of 160 fish per 100 angling hours (a.h.) have been recorded when frenzied fish are caught on virtually any type of lure offered. During such catches the question of gear saturation comes into play as an increasing proportion of angler's effort is spent fighting the fish, hence limiting the actual fishing time. Such catches are not persistent, however, and the average high monthly values recorded are 30 fish/100 a.h. in Zululand (van der Elst, 1980) and 13 fish/100 a.h. off Durban.

Spearfishermen also take queen mackerel and the approximately 1500 licence holders in Natal rate this species as fifth most important in their annual catch returns. With spearfishermen there has also been a shift in target species from demersal to pelagic game fishes.

Though pelagic gamefish stocks may well be less vulnerable to exploitation than endemic demersal fishes, it is evident that species such as *S. plurilineatus* will be subjected to considerably greater fishing pressure in future. For this reason beach-seine netting of this species was prohibited by the management authorities a decade ago. Netted shoals comprised only sexually immature fish and it was considered that this added vulnerability would thus adversely affect the viability of the growing linefishery.

There is no doubt, however, that *S. plurilineatus* is a marketable species which could represent a considerable protein resource to the people of Natal, as indeed it is in East Africa.

In the Malindi area of Kenya, catches of *S. plurilineatus* are mainly made by trolling and hand lines while in the Zanzibar Channel many methods are used but gill nets prevail (Williams, 1964). On the west coast of Zanzibar a trap net called the mensab is used to intercept fish on their projected paths of movement (Williams, 1964). More recently, tuna purse-seiners have been used in Zanzibar, with catches of several tons reported off the northwest coast (Merrett & Thorp, 1966).

The ability of *S. plurilineatus* stocks to sustain commercial exploitation has yet to be ascertained, and studies on growth rates, migration and stock assessment are underway. Already there are clashing interests between recreational and commercial fishermen over the right to exploit this species and renewed commercial exploitation is likely to aggravate this. A similar situation exists in Florida over *S. mitchilli* and *S. cavalla*, where conflict between sport and commercial fishermen is very intense (Lorio, Heaton & Dakin, 1980). If Natal's fishery administrators are to succeed in minimising such socio-economic conflicts, then a sound overall fisheries policy needs to be promptly introduced.

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