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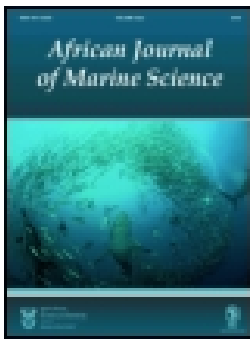


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ASPECTS OF THE SOUTH AFRICAN LONGLINE FISHERY FOR KINGKLIP *GENYPTERUS CAPENSIS* AND THE CAPE HAKES *MERLUCCIIUS CAPENSIS* AND *M. PARADOXUS*

A. BADENHORST*

Aspects of the demersal longline fishery in South Africa for kingklip and hake are described. Longline effort was distributed in five distinct regions in 1985 and a trend of increasing catch rate for kingklip was observed from the West Coast to the South and South-East Coasts. Most of the effort was expended between 350 and 449 m, the depth range where the kingklip catch rate was highest. Over three-quarters of the hake caught by longlines was also taken in the same depth range, but the best catch rates were between 150 and 199 m. The bulk of the hake catch probably consisted of *M. capensis*. Although the longlining method has substantially increased the rate of exploitation of the kingklip stocks, it is concluded that, at the time of writing, the stocks were not being adversely affected.

Aspekte van die Suid-Afrikaanse bodemlanglynvisserij vir koningklip en stokvis word beskryf. In 1985 is langlynpoging oor vyf duidelik afgebakende gebiede versprei en 'n tendens van toenemende koningklipvangkoers van die Weskus af na die Suid- en Suidooskus is waargeneem. Die meeste poging is tussen 350 en 449 m aangewend, die dieptesone waar die koningklipvangkoers die hoogste was. Meer as driekwart van die stokvis wat met langlyne gevang is, is ook in hierdie dieptesone gevang, maar die beste vangkoerse is tussen 150 en 199 m behaal. Die meerderheid van die stokvisvangs was waarskynlik *M. capensis*. Alhoewel die langlynmetode die tempo waarteen die koningklipbronne ontgin word aansienlik verhoog het, word daar afgelei dat die stapels, ten tyde van die skrywe, nie nadelig geraak is nie.

Demersal longline fishing is well established in the northern hemisphere as well as in South American, Australian and New Zealand waters (Gulland 1970). In South African waters, demersal longlining has only been practised since 1983, predominantly in ICSEAF (International Commission for the Southeast Atlantic Fisheries) Divisions 1.6, 2.1 and 2.2 (Fig. 1). The main target species are kingklip *Genypterus capensis* and the Cape hakes *Merluccius capensis* and *M. paradoxus*. By-catches of jacobever *Helicolenus dactylopterus*, monk *Lophius* sp., wreckfish *Polyprion americanus* and broadbill swordfish *Xiphias gladius* have also been recorded.

In 1983, experimental longline permits were granted to 10 South African vessels, of which only two or three were activated, primarily because of a lack of knowledge of this very specialized method of fishing. The following year the number of permits was reduced to seven but, largely because experienced foreign skippers and crew had been contracted, all boats were operative. As a result the catches, especially those of kingklip, increased markedly (Table I). In mid 1985 a further six permits were issued, all to smaller vessels (± 21 m in length as opposed to the ± 46 m of the larger vessels). Kingklip has remained the principal target species, probably because it is more profitable but, since 1984, the Cape hakes have contributed a progressively larger proportion of the

annual longline catch.

The 1985 longline catch of hake was only some 1 per cent of the national total allowable catch (TAC) for hake in South African waters and, as provision is made for longline hake catches within the TAC, the harvesting of hake by this method puts no extra burden upon the stocks.

On the other hand, the kingklip stocks have experienced a drastic increase in exploitation pressure. The longline catch in 1985 already exceeded the previous highest annual trawl catch of 5 800 t in 1973, the combined trawl and longline catch of 1985 being nearly double the 1973 catch. In 1986, both the total and longline catches were records yet again. In order to assess the effect of the increased directed

Table I: Catches of kingklip and hake by the longline and trawl fisheries

Year	Longline catch (metric tons)		Kingklip catch (metric tons)	
	Hake	Kingklip	Trawl	Total
1983	230 (18,1)	1 042 (81,9)	3 093	4 135
1984	381 (11,1)	3 040 (88,9)	3 352	6 392
1985	1 459 (17,3)	6 970 (82,7)	3 757	10 727
1986	1 680 (16,4)	8 539 (83,6)	2 633	11 172

N.B. Percentages of the total longline catch in parentheses

* Sea Fisheries Research Institute, Private Bag X2, Rogge Bay 8012, Cape Town

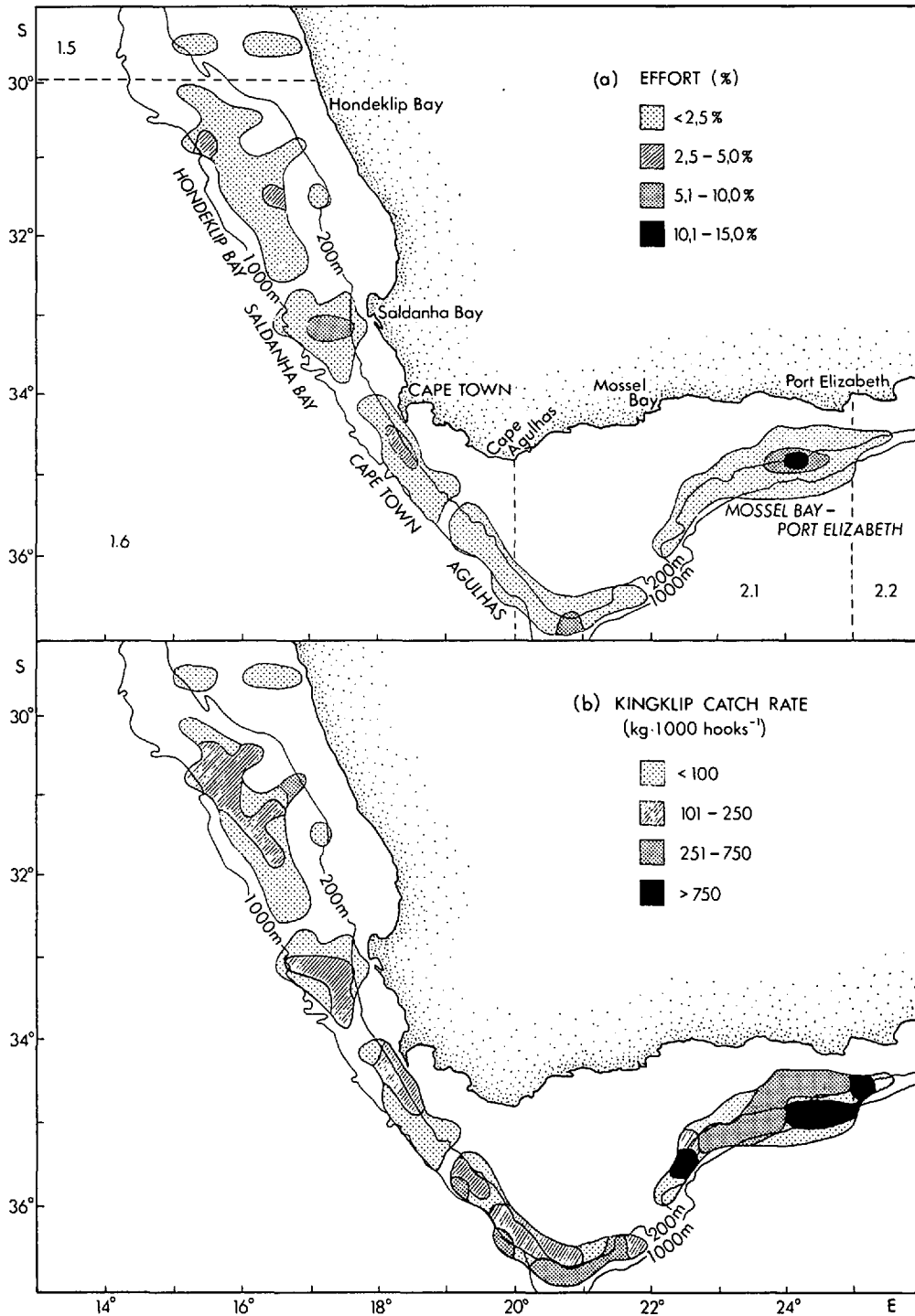


Fig. 1: Spatial distribution in 1985 of (a) longline effort and (b) catch rates of kingklip

effort on the kingklip stocks, the longline fishery is being carefully monitored. This report focuses on the extent and the general status of this fishery after three-and-a-half years of operation, the period for which catch-and-effort statistics are readily available.

METHODS

The lines used in the South African fishery are on average 15 km long. They are set in rocky areas adjacent to the main demersal trawling grounds. An average of 9 000 hooks (size 4/0–6/0) are attached to an 8-mm diameter nylon line by short lengths of nylon leader. Each hook is individually baited, usually with pilchard *Sardinops ocellatus*, before the line is shot. Lines are normally shot around midnight and hauled after first light, hauling and processing of the catch then taking most of the day. Because of the strong currents encountered locally, especially on the South-East Coast (Scott 1950), the lines are weighted down at regular intervals by bricks enclosed in netting. Information on position, depth, duration of set, number of hooks deployed and mass and species composition of the catch are supplied by the skipper of each vessel. Although the longline fishery started in 1983, usable data only became available from 1984 onwards. These data were analysed in order to establish the spatial and temporal distribution of effort and catch rates of kingklip and hake. In addition, the size composition of the catches has been regularly monitored at the landing points and at sea.

Because the lines are only shot and hauled once per day the "most convenient measure of effort" (Gulland 1983) should have been boat-days. However, this is a biased estimate of effort because there is a tremendous variation in the number of hooks per line. The variation is apparent not only between different vessels but also between individual sets during the same fishing trip. For instance, during the period 1984–1986, the number of hooks per line ranged from 1 000 to 19 000 with an average of 9 226. Because of this bias, the standard measure of effort was taken as 1 000 hooks and catch rates are therefore expressed as kilogrammes per thousand hooks.

RESULTS AND DISCUSSION

Spatial distribution of effort and catch rates

The spatial distribution of longline effort and kingklip catch rates are presented for the 1985 data

(Figs 1a, b). These data reflect more accurately the overall distribution of kingklip than do those of 1984 when the fishery was still in the development phase. During 1985, effort was distributed in five distinct regions, which for convenience are named Hondeklip Bay, Saldanha Bay, Cape Town, Agulhas and Mossel Bay/Port Elizabeth (Fig. 1a). Most of the analyses were carried out on the basis of this division. The trend of increasing kingklip availability (as expressed by catch rates) from the West to the South and South-East Coasts is shown in Fig. 1b. The same trend was evident in all three years (Fig. 2a), while the opposite trend was noted in the case of hake, especially during 1985 and 1986 (Fig. 2b). Catch rates of kingklip on these grounds were substantially higher than those of hake (Fig. 2), though commercial trawling activities reveal that kingklip catches tend only to be some 2–3 per cent of the hake catch (Botha 1970). The reason for this higher catch rate of kingklip is given later. The highest kingklip catch rate of 2 420 kg·1 000 hooks⁻¹ for a single set was recorded in the Mossel Bay/Port Elizabeth region in November 1985. This set yielded 29 tons compared to the mean for that year of 3.5 tons per set. Such exceptionally high individual catch rates obviously inflate the mean catch rate for the area. Nonetheless, the South-East Coast area, as Scott (1950) and Payne (1985a) point out, has traditionally been important for the catching of kingklip. During the period 1976–1983, the region accounted for 45 per cent of the total kingklip landed by trawlers in South African waters (Payne op. cit.).

Kingklip catch rates in 1985 were lower than in 1984 (Fig. 2a), except in the Mossel Bay/Port Elizabeth region. Very little effort was deployed there in 1984 (Fig. 2c) and then only very late in the year. A slight recovery in catch rates seemed to have taken place in the first four regions in the first six months of 1986 (Fig. 2a), but this may not be a true reflection of kingklip availability. As will be seen later, catch rates of kingklip in these four regions peak in summer and in one case autumn. The 1986 data cover only the first six months, which are traditionally (1983–1985) the best months for kingklip catches in these regions. In the Mossel Bay/Port Elizabeth region, catch rates peak in spring (see next section), so the catch rate then will probably have increased in that area and concomitantly decreased in the other areas.

Seasonal trends in catch rates

The seasonal trends in catch rates for 1984–1986 are presented in Figure 3. For this purpose, the definition of each season is that of Payne (1986), namely December–February (summer), March–May

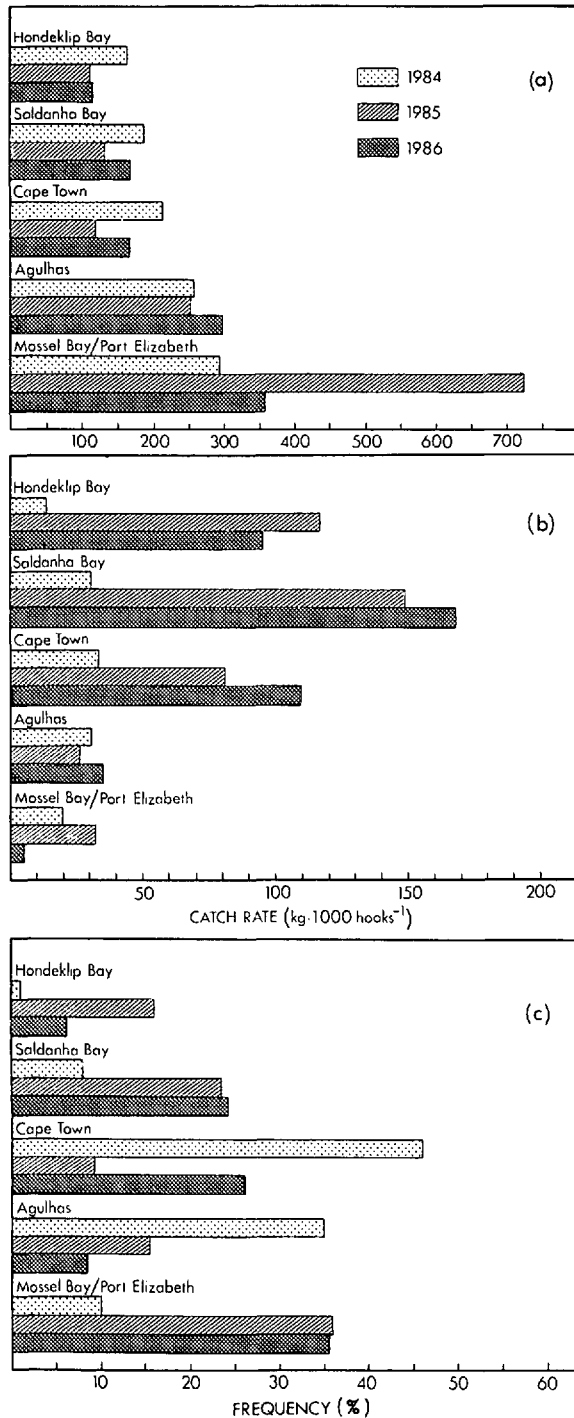


Fig. 2: Distribution by region and year of (a) kingklip catch rate (b) hake catch rate, (c) longline effort

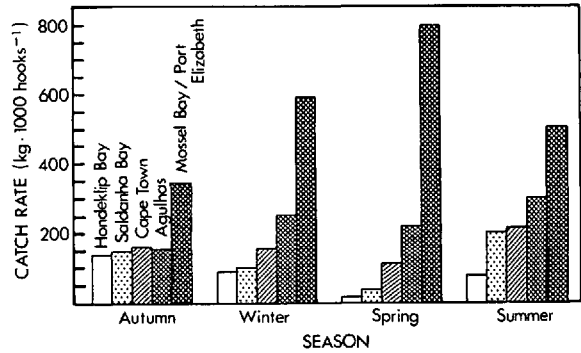


Fig. 3: Seasonal trends in kingklip catch rates by region, 1984-1986 (first six months)

(autumn), June–August (winter) and September–November (spring). The trend of higher catch rates in the east than in the west, even on a seasonal basis, is also highlighted in Figure 3.

In the Hondeklip Bay region, catch rates are lowest in spring and highest in autumn. Farther south on the South African west coast, in the Saldanha Bay and Cape Town regions, the trend is similar, though the low catch rate in spring is followed by a peak in summer, slightly earlier than in the north. In the Agulhas region there is no clear seasonal trend in catch rate, one (major) peak being recorded in summer and a lesser peak in winter. Farther east, in the Mossel Bay/Port Elizabeth region, catch rates are lowest in autumn and peak in spring, rather later than the lesser peak in the Agulhas region.

The trend in catch rates for the Mossel Bay/Port Elizabeth region exactly mirrors those in research and commercial trawl catch rates described for the South-East Coast by Payne (1986). Both Payne (op. cit.) and Hecht (1976) consider that kingklip on the South-East Coast aggregate for spawning purposes and note that peak trawl catches in spring are made when spawning of the species is at its maximum.

Payne (1977, 1985a) describes three separate kingklip stocks in southern African waters: the "Walvis stock" distributed north of Walvis Bay, the "Cape stock" from Lüderitz to south of Cape Town, and a "south-east stock" on the eastern side of the Agulhas Bank. A stock on the southernmost part of the Agulhas Bank he considers to be an extension of the Cape stock.

If high catch rates by longlines on the South-East Coast reflect aggregations and enhanced availability during the spawning season, and if kingklip behave similarly wherever they spawn, it must be concluded that the peak spawning season for the northern part

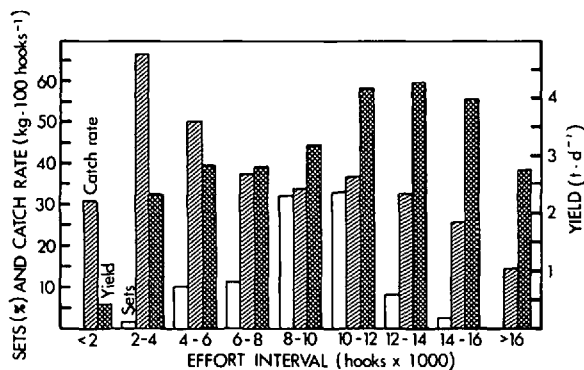


Fig. 4: Effort and kingklip catch rate and yield per effort interval, 1984-1986 (first six months)

of the Cape stock would be autumn. Farther south, on the western side of the Agulhas Bank, kingklip apparently spawn during the summer season of upwelling (Andrews and Hutchings 1980). Isarev (1981) reports peak trawl catch rates for kingklip between 25 and 27°S in January and February, also during a period of strong upwelling (Parrish *et al.* 1983).

The secondary peak in winter in the Agulhas region is probably the forerunner of the main spawning season in the Mossel Bay/Port Elizabeth region, which reaches its peak in spring. This spawning peak thus follows the period of strong vertical mixing on the Agulhas Bank in winter (Schumann and Beekman 1984). However, it must be stressed that the strong west-flowing Agulhas Current combined with prevailing westerly winds, often at gale force strength, affect winter trawl catches and catch rates markedly, as Scott (1950) and Payne (1986) have pointed out. Therefore the apparent spring spawning in the Mossel Bay/Port Elizabeth region may well be a sampling artefact.

The distribution of kingklip is more or less continuous around southern Africa (Figs 1a, b), a feature which Payne (1985a) could not record because of the limitations of his sampling grid (Payne 1986) and the limitations dictated by the availability of trawlable ground. The edge of the continental shelf (200–500 m) on the South-East Coast, i.e. between the kingklip stock on the western Agulhas Bank and the South-East stock described by Payne (1985a), is largely untrawlable (Sea Fisheries Research Institute, unpublished statistics). Although it is acknowledged that real differences in growth rates and otolith morphology between the Cape and South-East stocks, as recorded by Payne (1985a), probably exist, the results of the present study indicate that there is

greater continuity, though not necessarily interchange, between the Cape kingklip stock, that on the western Agulhas Bank and the South-East stock, than had previously been assumed.

Relationship between catch rate and number of hooks deployed

In 1985 the best catch rates of kingklip were achieved when between 2 000 and 4 000 hooks were deployed per line. Catch rate also decreased substantially as the number of hooks per line was increased (Fig. 4). The best daily kingklip yields were made when 12 000–14 000 hooks were deployed per set. This conclusion was expected because the lines are only shot and hauled once per day, irrespective of the length of the line and the number of hooks. Therefore, more hooks per day yield a larger catch, albeit at a lower catch rate. Few of the vessels can manage to set more than 12 000 hooks per line and two thirds of the sets were of 8 000–12 000 hooks per line. The size of the vessel and the number of crew are obviously the two major limiting factors in respect of the number of hooks per line. The original seven larger vessels carry more crew than the later six entrants. The latter group deploy an average of 5 000 hooks and the original seven, 10 000 hooks per line. From Figure 4 it is also evident that there is not much to be gained in terms of yield per day above a level of 12 000 hooks per line, and it is therefore not surprising that the percentage of sets above this level dropped sharply. It is rather more difficult to account for the inverse relationship between catch rate and the number of hooks per line. Lines with fewer hooks are possibly better prepared and baited, whereas longer lines are possibly more prone to losses to seals or other predators because of the longer hauling time, especially at high hook-occupancy.

Skud (1972) observed that, in the longline fishery for Pacific halibut, the catch rate increased with increased hook-spacing. Ricker (1958) states that a suitable measure of effort requires that each additional unit of gear should increase the instantaneous rate of fishing by the same quantity. This condition is obviously not met in the local longline fishery, where the tendency would be to overestimate effort and hence underestimate catch rate as the number of hooks per line increases. In future, therefore, effort in the local fishery should be standardized according to hook spacing, and the influence of other factors which may affect the fishing power of the longline gear, such as soak time, hook size, type of bait and competition by other species (Skud 1978), should be investigated.

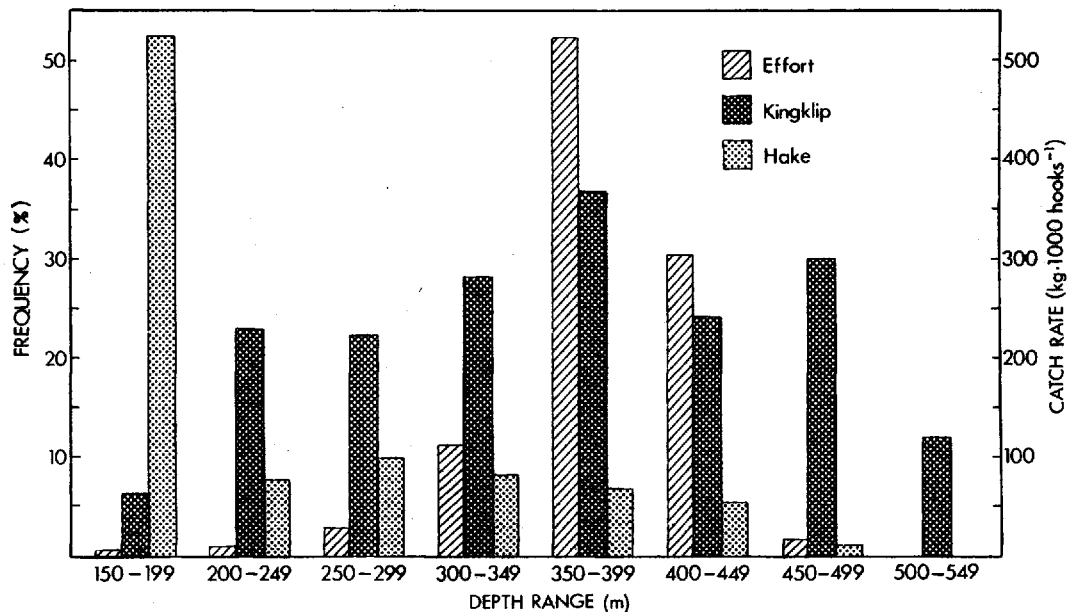


Fig. 5: Effort and kingklip and hake catch rates per depth range, 1984-1986 (first six months)

Depth distribution of catch rate and effort

The depth distributions of both effort and catch rates were similar for the three years and the data for the period 1984-1986 are therefore grouped (Fig. 5). During this period the depths of the sets ranged from 54 to 586 m. However, most of the effort was deployed between 350 and 449 m (Fig. 5), where the kingklip catch rate was at its highest. Payne (1986) found that kingklip was reasonably abundant in research trawls on the South-East Coast only in offshore waters (deeper than 183 m) and that the species only occurred sporadically in shallower waters. On the west coast of the Cape Peninsula, kingklip are not normally caught shallower than 220 m (Botha 1980). Farther north, off the mouth of the Orange River, kingklip are, however, occasionally taken in shallow (< 100 m) water in substantial numbers by research trawlers (Payne 1985b). During 1985, 51 per cent of the kingklip taken by South African trawlers was caught between 350 and 449 m (Sea Fisheries Research Institute, unpublished statistics). The highest longline catch rates for kingklip were encountered between 350 and 399 m, the depth range coinciding with that in which more than 50 per cent of the longline effort was expended, confirming the observation that kingklip is the main target species.

In the case of hake, 77 per cent of the catches were made in 350-449 m of water where, because kingklip was the main target species, most of the effort was concentrated. However, the best catch rate of hake was in the 150-199 m depth range. The hake ranged from 46 to 98 cm long, with a modal peak at 74 cm. These may be classified as medium to large fish (Botha 1985). According to Botha (op. cit.), most medium and large *M. capensis* are found in the depth range 230-330 m off the Cape Peninsula and the same size categories of *M. paradoxus* are most abundant deeper than 440 m. The depth distribution of the sizes of the two Cape hake species is probably similar around South Africa and, as less than 0.4 per cent of the longline-caught hake were taken deeper than 450 m, it is concluded that the bulk of the catch consisted of large *M. capensis*.

The recent entrants into the fishery are small operators who possibly lack the ability and expertise to venture to the deeper kingklip areas and who find it less of a risk to target on hake on the more extensive, shallower grounds. In 1986, 62 per cent of the catch of these new entrants consisted of hake, compared with only 18 per cent of the catch of the original seven permit holders.

The longlines are set differently when catching hake than when catching kingklip (A. du Plessis, Sea Harvest Corporation, pers. comm.). The latter is a

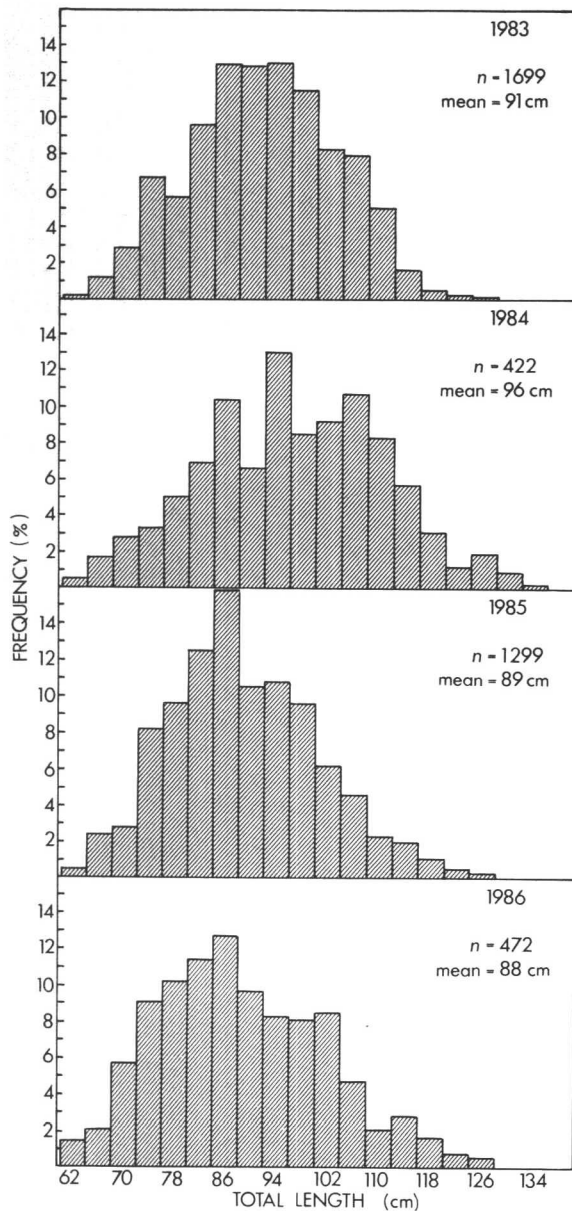


Fig. 6: Annual size composition, by 4-cm groups, of longline-caught kingklip

nocturnal benthic feeder (Macpherson 1983), and Mitchell (1984) describes a similar benthic feeding mode in the congeneric species *Genypterus blacodes* off New Zealand. There is therefore little evidence to support Davies' (1949) statement that kingklip feed

pelagically, the prey species he listed from kingklip stomachs being predominantly bottom dwellers. Hake also tend to feed at night, but they rise from the bottom to feed at mid-depths (Botha 1980). Although some feeding does take place by day, hake rarely feed on benthic organisms or scavenge dead material on the bottom (Payne *et al.* 1987). They are therefore active, off-bottom predators (Payne *et al.* op. cit.). Fishermen know this, and therefore, when targeting on hake, the lines are buoyed with the hooks suspended above the substrate. For kingklip the hooks rest on the bottom. If the same technique was to be employed for hake in deeper water, the catch rates of hake there may well increase markedly.

IMPACT OF LONGLINING ON KINGKLIP STOCKS

Size and stage of maturity of captured kingklip

The frequency distribution of longline kingklip catches, by 4-cm group, is presented in Figure 6. Although the numbers of fish sampled in each year are small, it is confidently predicted that they accurately reflect the total distribution of lengths in the catches. On the West Coast, kingklip males mature at lengths of 50–60 cm, corresponding to an age of approximately five years (Payne 1977). The corresponding values for females are 60–75 cm and 6–7 years (Payne op. cit.). On the South-East Coast the length at 50-per-cent maturity for all kingklip is 52 cm, at an average age of 3,8 years (Payne 1985a).

All fish measured from longline catches were longer than 62 cm during each year of study, which fact indicates that very few immature fish are being caught. There is not much difference between the distributions in the various years and, although the mean lengths in 1985 and 1986 are somewhat lower than in 1984, there has been no drastic decline in mean length and the concomitant positively skewed distribution that would be expected to accompany a large-scale reduction of the older year-classes.

Historical catches and catch rates

Kingklip catches by South African trawlers and longliners (Chalmers 1976 and Sea Fisheries Institute, unpublished statistics) since 1955 are reflected in Figure 7. Peak catches of 5 800 t and 5 300 t were made in 1973 and 1980 respectively. In 1985 the total catch of 10 727 t was more than double the 1973 peak trawl catch, and even the longline component

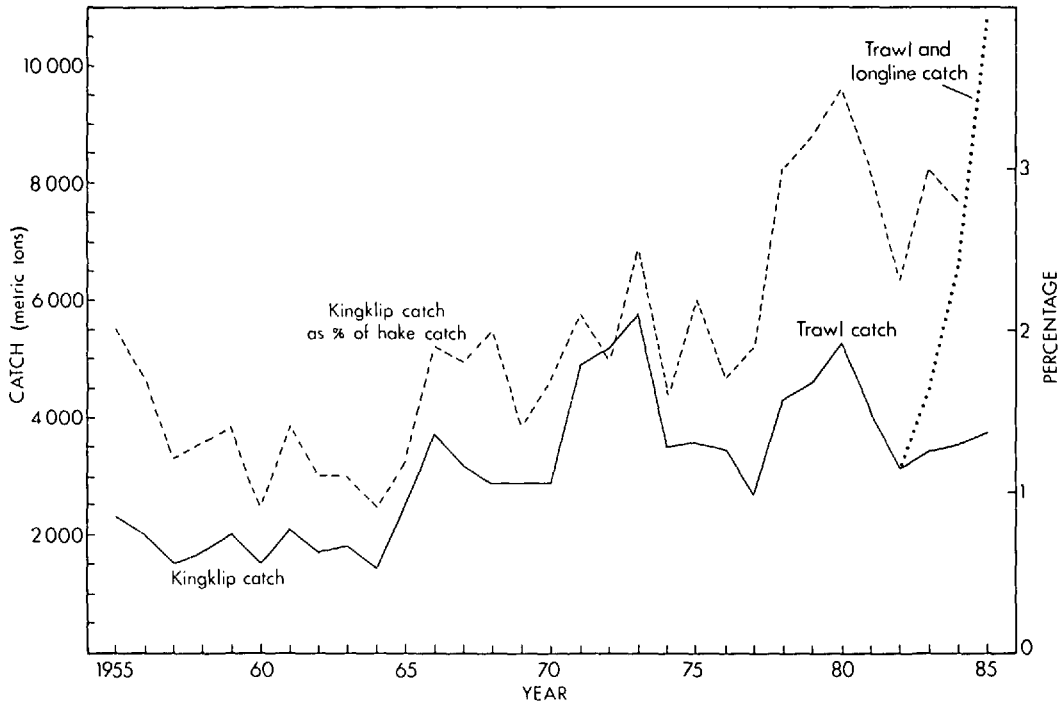


Fig. 7: Annual kingklip catches and kingklip catch expressed as a percentage of the hake catch, in the South African trawl fishery.

exceeded the maximum historic trawl catch. It is therefore evident that the kingklip stocks have experienced a large increase in the rate of exploitation and it is important to assess the impact of this increased pressure on the stocks.

With the present short time-series of longline catch-and-effort data available, it is impossible to undertake an assessment of the impact of the longline fishery on kingklip stocks based upon the trend in catch rates. However, other indicators, such as kingklip catch rates in the hake-directed demersal trawl fishery, may be consulted. Although kingklip is not strictly a target species in the trawl fishery, the trend in kingklip catch rates (Fig. 8), which reflect essentially the same kingklip stocks as those fished by the longline fishery, should yield some indirect evidence as to the state of the stocks. Stable kingklip catch rates (tons per day of South African effort directed at hake) over the period 1960–1977 were followed by distinctly higher catch rates in subsequent years, while hake catch rates (Leslie 1985) declined drastically between 1960 and 1977. Alone, this index should be viewed with some caution, because kingklip normally constitutes only a 2-per-cent by-catch in the hake fishery (Botha 1970, Payne 1985a) and is seldom

a target species, even though it is commercially a much sought-after species. Trawl-caught kingklip catches as a percentage of hake catches in the hake-directed fishery are also shown on Figure 7. The trend since 1964 is clear, there being a gradually increasing proportion of kingklip in the catches over the period notable for the tremendous increase in total hake-directed effort (foreign and South African) — the late 1960s and early 1970s (Botha 1985). Although it must be conceded that there could have been an under-reporting of kingklip catches in the statistics of earlier years, the data suggest that kingklip stocks have been better able to withstand exploitation pressure than the hake stocks.

In summary, therefore, all direct and indirect evidence indicates that the kingklip stocks are not as yet deteriorating, despite the marked increase in fishing effort directed at them.

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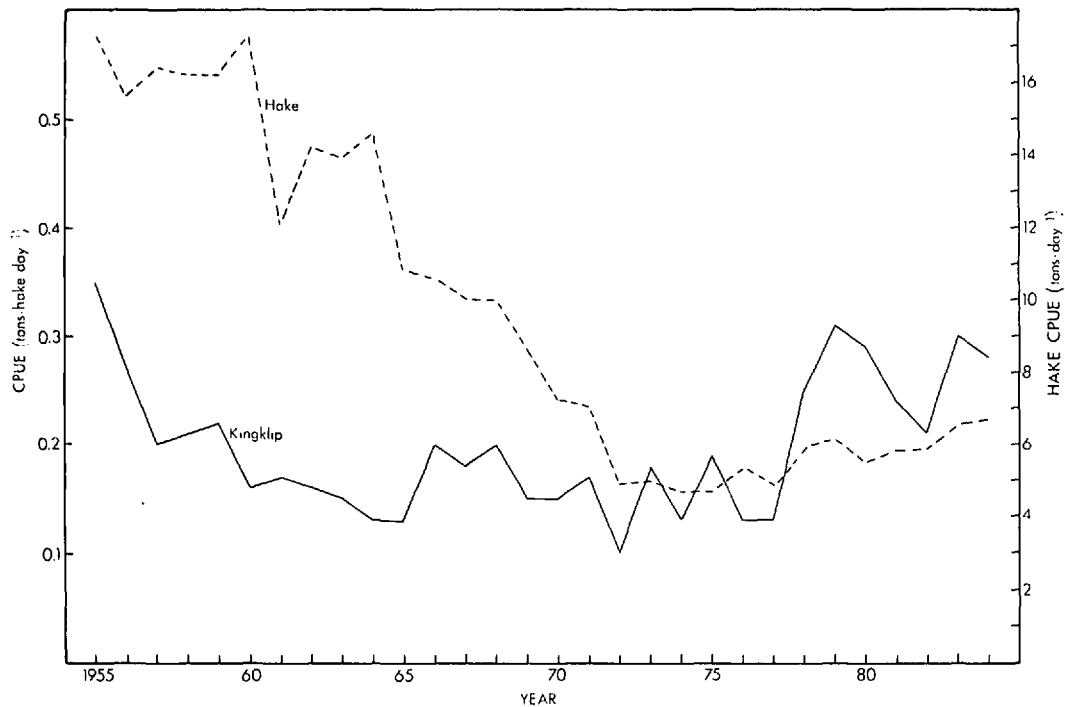


Fig. 8: Kingklip and hake catch rates in the South African trawl fishery

for their constructive criticism of the manuscript.

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