Growth and stock differentiation of kingklip (*Genypterus capensis*) on the south-east coast of South Africa

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Much of the southern African kingklip *Genypterus capensis* catch is derived from the south-east coast, and the growth rate of the species from this area is presented. Females grew faster than males after attainment of maturity (± 60 cm L_t) and reached a greater age. The otoliths, on which this growth study was based, increase in length in relation to fish length in a diphasic, linear manner, growth of the otolith slowing down after maturity. From stock differentiation studies, on the basis of otolith morphology and growth rate, it is concluded that the south-east stock (that at the eastern side of the Agulhas Bank) is a third subpopulation of the species and that the stock on the western side of the Bank may well be too. There was no difference in the number of vertebrae between the south-east stock and the previously recorded Cape stock.
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'n Groot gedeelte van die vangs van suider-Afrikaanse koningklip *Genypterus capensis* is afkomstig van die Suidooskus. Die groeitempo van die spesie daar word gegee. Wyfies het vinniger as mannetjies gegroei na bereiking van geslagsrypheid (± 60 cm L_t) en het 'n hoër ouderdom bereik. Die otoliete, waarop hierdie studie oor groei gebaseer is, neem in lengte toe in verhouding tot die vislengte op 'n tweefasige lineêre wyse, maar na geslagsrypheid was otolietgroei stadiger. Die gevolgtrekking uit die ondersoek van otolietmorfologie en groeitempo, was dat die stapel van die Suidooskus (dié op die oostelike deel van die Agulhasbank) 'n derde subbevolking van die spesie is, en dat dieselfde moontlik geld vir die stapel op die westelike deel van die Bank. Wat die getal werwels betref, was daar geen verskil tussen die stapel van die Suidooskus en die Kaapse stapel wat vroeër geboekstaaf is nie.
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The South African trawling industry is based on the Cape hakes *Merluccius capensis* and *M. paradoxus*, which collectively constitute over 70% of the annual trawl catch (Botha 1970a). A by-catch of this fishery, usually in deep water and often close to rocky substrata, is the kingklip *Genypterus capensis*. However, certain areas exist, notably on the south-east coast of South Africa near Port Elizabeth, where kingklip seasonally congregate virtually in the absence of hake. At such times in this area, catches of over 20 t of the species per trawl have been reported, whereas under normal circumstances the kingklip by-catch in a hake-directed trawl rarely exceeds a few hundred kilograms.

Kingklip normally accounts for some 2% of the annual landings of South African trawl-caught fish, but it is nevertheless the most sought-after species of the deep-sea fleet (Botha 1970a). In terms of value, it ranks second only to the soles *Austroglossus pectoralis* and *A. microlepis*, and in terms of total wholesale value of the trawl landings, the so-called free-on-board (F.O.B.) value, it usually lies second only to hake. In 1983 the F.O.B. value of the South African kingklip landings was some R6 168 000 out of a total trawled F.O.B. value of R116 944 000 (i.e. 5,3%), exemplifying its importance to the deep-sea fishery.

During an earlier study on kingklip growth and stock differentiation Payne (1977) discovered the existence of at least two discrete stocks of the kingklip. The one caught north of Walvis Bay he named the Walvis stock. The Cape stock was found from the latitude of Lüderitz to south of Cape Town. The criteria on which the stock separation was based were otolith morphology, growth rate and the number of vertebrae. Isarev (1976a, b) also published data on otoliths and body morphology of kingklip supporting this division into two stocks. Payne (1977) also collected some information on what he called the south-east stock. He tentatively suggested, from the limited data, that a third geographically discrete stock may exist. Frost (1925) and Eziuzio (1963) regard otolith morphology as being species specific. Differences in the growth rate and in the number of vertebrae are influenced by the environment, the latter during the developmental and larval stages. However, they are useful tools in delimiting stocks.

With the purpose of clarifying the integrity of the south-east stock, data were collected along the whole coast over a period of a few years, and information was derived on the same parameters as during the earlier study. Figure 1 shows the fishing grounds surveyed. The south-east coast area (Divisions 2.1 and 2.2) of the International Commission for the Southeast Atlantic Fisheries (ICSEAF) accounted for 44,9% of the total kingklip landings made from South African

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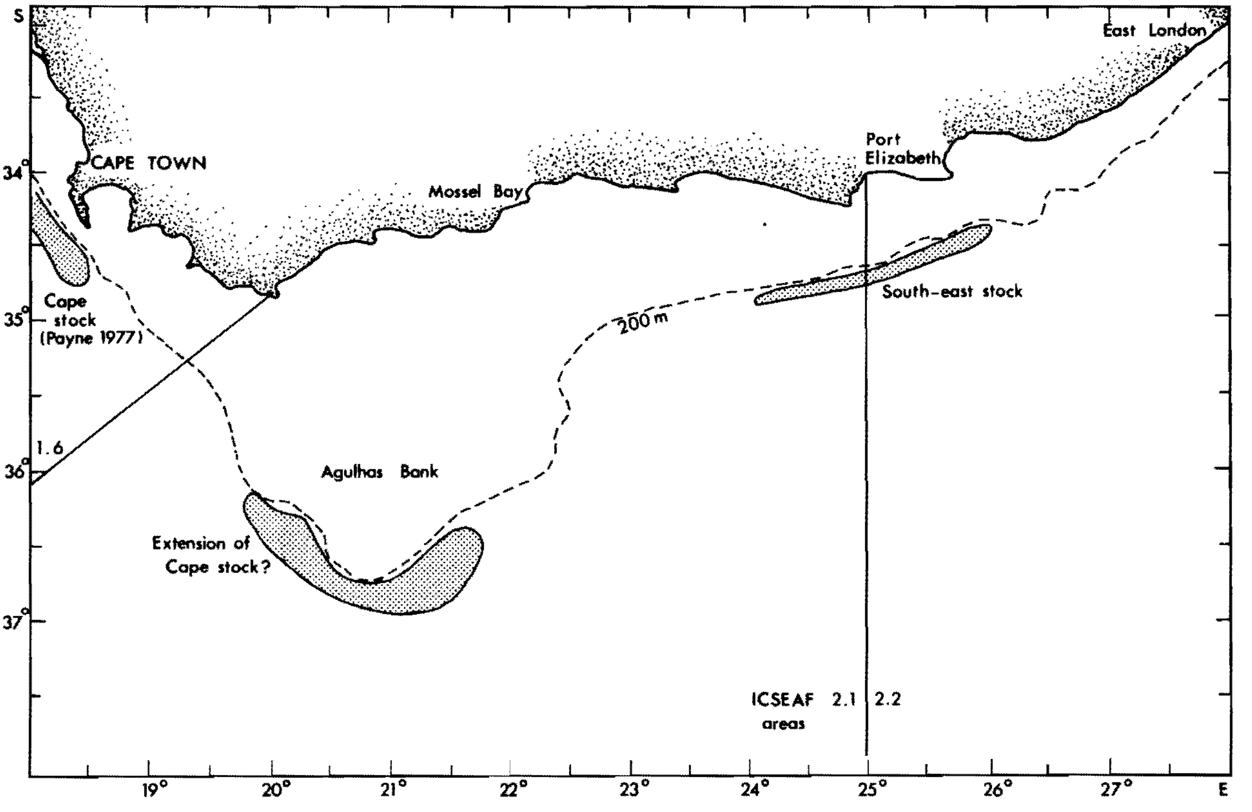

Figure 1 The south-east coast of South Africa, showing the known kingklip grounds and the ICSEAF areas referred to in text.

waters by South African trawlers during the period 1976–1983 (Figure 2). However, the proportion of hakes landed in the area to the total in South African waters for 1976–1982, the last year for which full figures are available, was only some 31,3% (Payne, Leslie & Augustyn 1984). From these proportions, it is concluded that the south-east coast area is important for catching kingklip. Information on the growth rate of the species there is therefore an essential prerequisite for reliable stock assessment.

Material and Methods

Kingklip were collected during the South-East Coast Routine Trawl between April 1975 and October 1978. The grid is given in Director of Sea Fisheries (1981). All cruises were conducted on R.S. *Africana II*, a side-trawler of 805 t. Trawling gear was a standard 27,5 m (90 foot) Granton otter trawl with a codend of mesh size 75 mm, lined on the inside with pilchard netting of 27,5 mm mesh to retain all small fish. Trawling was usually for 60 min to ensure capture of a small sample of fish only, though as much as 5 t of kingklip was taken on occasion.

Where possible, all kingklip were sampled. If catches were large, however, a predetermined number of fish from each 10 cm fish length group was subsampled. A total of 1 090 pairs of otoliths was collected in this manner.

Removal of otoliths was according to the method of Botha (1970b) for hake, but it was found to be better to store them dry and only immerse them in 0,75% salt solution for about one week prior to counting the rings. Following Payne (1977), a birthdate of 1 September was applied in interpretation. Wherever doubt existed as to the completeness of the last opaque ring, it was accepted as an annual one only if it had been collected between March and August. Otoliths were read twice, with at least one week between readings, and a third reading was only made if the first two differed. Reading was done with the naked eye with the occasional aid of a 3,5 × eyepiece. The age was then taken as that of two similar readings. For some 10% of the otoliths, the age was

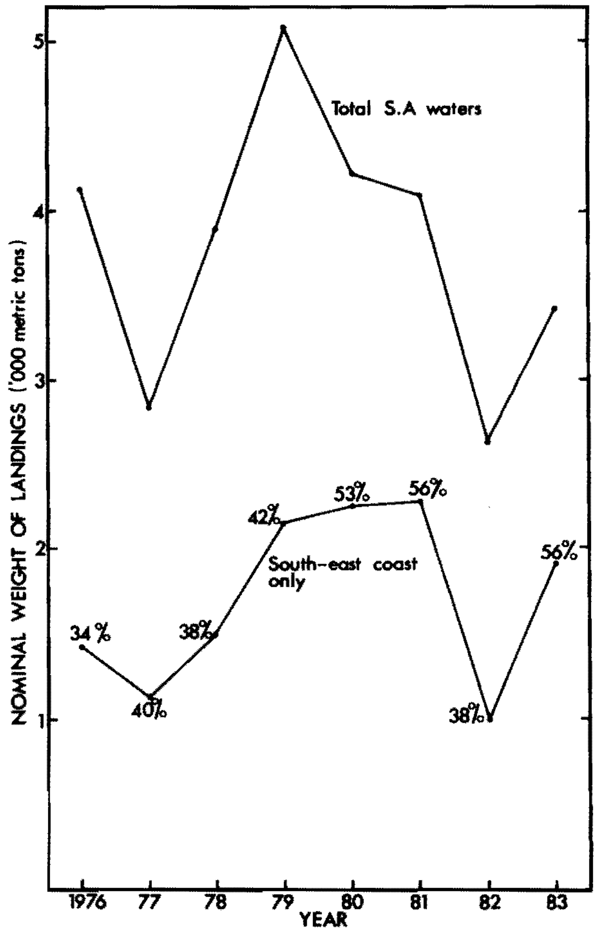

Figure 2 Kingklip landings in South African waters and the proportion taken on the south-east coast.

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indeterminate either because the otolith was crystalline or the rings confused, but for 991 fish the age was accepted.

The maximum height and length of dry otoliths were measured by means of a Vernier caliper to an accuracy of 0,02 mm. Both otoliths from each fish were measured unless one of the pair was damaged, and the mean was used in subsequent calculations.

Because large numbers of fish were involved, it was decided to count the number of vertebrae of commercial-sized fish *in situ*. To do this, the fish were first filleted on one side and then the vertebrae were counted twice, usually by different personnel. Care was taken to start with the first vertebra, and if the urostyle was missing, the count was disregarded. Small fish were X-rayed and the number of vertebrae determined by viewing the X-ray plate over a bright light source in a darkened room. In most cases, the same fish from which the otoliths were removed had their vertebrae counted. Vertebrae were counted from 966 kingklip, all from the eastern area shown in Figure 1.

Stages of sexual maturity were distinguished visually for all kingklip examined for biological parameters.

Growth

In order to establish that a relationship existed between the length of the fish and the dimensions of the otolith, fish length was plotted against otolith length. For reasons given later, the data collected from the trawls made in the west of the survey area (Figure 1) were not used in the regression. Most of the data came from the area reflected in Figure 1 as containing the south-east stock. It was immediately evident from the individually plotted points that the relationship could not be described by a single linear regression. A curvilinear regression was also attempted, but again that could not adequately describe the relationship. The best fit was from two linear regressions, the first up to a total fish length (L_t) of just over 60 cm, and the second for older fish. These regressions are illustrated in Figure 3. The equations describing the relationships are given in Table 1.

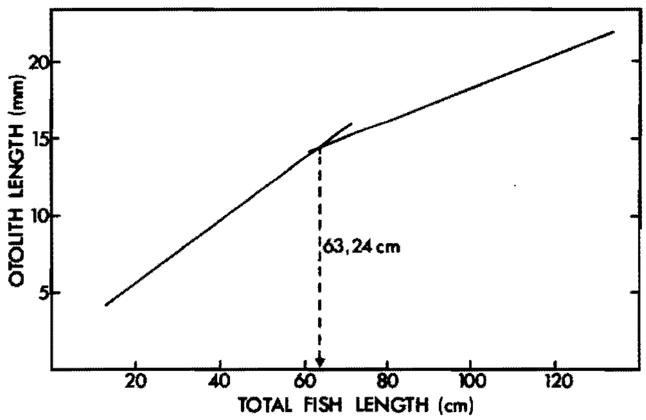

Figure 3 Relationship between otolith length and fish length for the south-east coast kingklip.

Such a diphasic pattern of otolith growth has been demonstrated for other fish species, e.g. hake (Botha 1971), as well as for the Walvis and Cape stocks of kingklip (Payne 1977). Eziuzio (1963) was the first to propose that the onset of the second stage of maturity corresponds with the start of this second stage of otolith growth. The length at 50% maturity for the south-east stock of kingklip is 52 cm L_t (Table 2), slightly smaller than the length corresponding with the commencement of the second stage of otolith growth. It is, however, considered to be close enough to substantiate the evidence that there is some relation between the two. The second stage of otolith growth commences, according to the data presented in Figure 3, at a fish length of just over 63 cm. This is slightly longer than the length of commencement of the second growth stage of the stock given by Payne (1977). However, it must be conceded that the earlier relationship was based on only 74 fish compared with the 863 fish of this study.

Table 1 Parameters of the equations describing the relationships between otolith length and fish length for the south-east stock of kingklip

Fish length (cm)	Regression*	Standard deviation of y	Correlation coefficient (r^2)
< 63,24	$y = 0{,}184x + 2{,}393$	2,76	0,874
> 63,24	$y = 0{,}100x + 8{,}192$	2,35	0,771

*x = fish length, y = otolith length

Table 2 Number of immature and mature male and female kingklip per length group on the south-east coast

Length group (cm)	Number of specimens found					
	Males		Females		Both sexes	
	Immature	Mature	Immature	Mature	Immature	Mature
<38	All fish immature					
38–39	6	2	7		13	2
40–41	6	1	4		10	1
42–43	6		2		8	
44–45	3		4		7	
46–47	2	1			2	1
48–49	3	3	2		5	3
50–51	1	3	1	1	2	4
52–53		4	1		1	4
54–55	3	6	1	1	4	7
56–57	3	7	1	2	4	9
58–59	5	12	3	4	8	16
60–61	2	7	5	2	7	9
62–63	3	20	3	10	6	30
64–65	2	34	10	3	12	37
66–67	5	44		9	5	53
68–69	2	41	6	14	8	55
70–71	1	47	7	13	8	60
72–73	1	49	10	19	11	68
74–75	1	33	3	18	4	51
76–77	1	46	3	16	4	62
78–79		47	5	27	5	74
80–81		44	1	18	1	62
82–83		38	2	25	2	63
84–85		35	2	14	2	49
86–87		27	2	14	2	41
88–89		20	1	8	1	28
90–91		27	1	9	1	36
92–93		14		11		25
94–95		30		8		38
96–97		28	1	8	1	36
98–99		17	1	7	1	24
100–101		13		10		23
102–103		13	3	12	3	25
104–105		21	1	7	1	28
>105	All fish mature					
50% maturity	49 cm		62 cm		52 cm	

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Payne (1977) gave a figure of 64 cm for the onset of the second growth phase of the otolith of Cape stock kingklip, so the present figure is very much in line with that.

Tables 3 and 4 reflect the frequency distribution of age readings at 2 cm fish length intervals for the south-east stock and those kingklip caught in the extreme west of the survey area, hereafter referred to as the Cape(?) stock, respectively.

Table 3 Frequency distribution of age readings at 2-cm fish length intervals for the south-east stock

Length	Age (years)														
(cm)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
16– 17		1													
18– 19	1	2													
20– 21		12	2												
22– 23		10													
24– 25		12													
26– 27		2	8												
28– 29		2	10	2											
30– 31		1	14	1											
32– 33			4	2											
34– 35			6	1											
36– 37			4	1											
38– 39			5	8											
40– 41			1	4	4										
42– 43			2	3	1										
44– 45				1	1										
46– 47															
48– 49				2	2										
50– 51						1									
52– 53					1										
54– 55					1	3									
56– 57					4	2	1								
58– 59						5	1								
60– 61					6	4	1								
62– 63					5	6	3	1							
64– 65					7	13	5	2							
66– 67					3	17	4	2							
68– 69					2	12	11								
70– 71						6	12	4	1						
72– 73						5	12	3	1						
74– 75						2	13	5	2						
76– 77						3	8	6	5						
78– 79						2	8	15	4	2					
80– 81							5	21	6	1					
82– 83							4	15	8	3					
84– 85								6	8		1				
86– 87							2	3	8	3	1				
88– 89							1	2	5	3	1				
90– 91								2	6	3	3				
92– 93								1	6	6					
94– 95								3	8	8	3				
96– 97									6	10	4	1			
98– 99									4	8	4	1			
100–101										9	3	2			
102–103									2	6	7	1			
104–105										4	7	3	1		
106–107									1	4	8				
108–109											5	2	2		
110–111										3	4	6	1		1
112–113										1	7	3	1	1	
114–115										1	3	6	3	3	
116–117											4	2	5	1	
118–119											2	6	7		
120–121											2	5	7	2	
122–123												3	4		
124–125											2	2	5		1
126–127											1	1		2	2
128–129												2	6		
130–131												1	3	5	2
132–133												1	3	1	2
134–135														1	1
136–137														2	1
138–139														1	3
140–141															
142–143														1	
144–145															1
Total	1	42	56	25	37	81	91	91	81	75	72	48	48	20	14

Data from kingklip caught in the west (Figure 1) are again given separately because it was found, on comparing age readings, that their growth rate was somewhat slower. For both stocks, there is a noticeable scattering of length classes within the limits of the separate age groups, a finding typical of long-lived species such as kingklip. Botha (1970b) identified the same trend for the Cape hake, which is another long-lived species.

Mean lengths-at-age were calculated from the frequency

Table 4 Frequency distribution of age readings at 2-cm fish length intervals for the Cape (?) stock

Length	Age (years)													
(cm)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
22– 23		1												
24– 25														
26– 27														
28– 29														
30– 31														
32– 33														
34– 35														
36– 37														
38– 39			1											
40– 41			1	1										
42– 43				1										
44– 45				2	2	1								
46– 47				2	1									
48– 49				3	1									
50– 51				2	2									
52– 53				3	1									
54– 55				1	5									
56– 57					3	1								
58– 59				1	8	4								
60– 61						2								
62– 63					6	5								
64– 65					3	3								
66– 67					3	6	5							
68– 69					3	3	2							
70– 71						5	6							
72– 73						6	4	1						
74– 75							7	2						
76– 77							1	4		1				
78– 79						1	5	5	1					
80– 81						1	2	5	1					
82– 83							4	5	1	1				
84– 85						1	4	1	4					
86– 87							1	4	3		1			
88– 89								2	1	1				
90– 91								1	3					
92– 93								2	1					
94– 95														
96– 97									1					
98– 99														
100–101										1				
102–103										2	1			
104–105									1	1	3			
106–107														
108–109												2		
110–111										1	1			
112–113												1		
114–115										1		1	1	
116–117												3		1
Total		1	2	16	38	39	41	32	17	9	6	7	1	1

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distributions and used as a basis for growth estimates. Those calculated for ages 0 to 2 were not used, because it was anticipated that mesh selection would have affected the length of the fish caught, larger fish of these ages being over-represented in the data.

The von Bertalanffy growth equation (Ricker 1975)

$$L_t = L_\infty (1 - e^{-k(t - t_0)}),$$

was calculated for the south-east stock, the Cape(?) stock and for males and females of the south-east stock. It was not possible to derive adequate parameters for the sexes of the Cape(?) stock as data were too few.

The parameters of the equation for the various stocks are given in Table 5.

Table 5 Von Bertalanffy parameters for the various stocks determined during this study and by Isarev (1976c) and Wrzesiński (1975)

Stock/sex	Values of von Bertalanffy parameters: k	t_0	L_∞
Cape (?)	0,0726	−1,2287	185,67
South-east	0,0539	−0,6034	244,54
South-east ♂♂	0,0697	−0,5677	198,58
South-east ♀♀	0,0617	−0,1480	235,95
Isarev (ICSEAF Divs 1.5+1.6)	0,0656	−0,6189	184,861
Wrzesiński (all ICSEAF Divisions)	0,05	−1,203	170

The largest kingklip caught during the surveys was just over 150 cm long. The L_∞ values given in Table 5 appear at first glance to be somewhat high, but kingklip 'almost 2 m long' have been caught by South African fishermen, so the figures are not beyond the realms of possibility. Wrzesiński (1975) and Isarev (1976c) are the only other workers to have investigated the growth of kingklip in the Commission area, and only Wrzesiński collected material from the south-east coast. Nevertheless, the von Bertalanffy parameters found by both of them are similar to those determined here (Table 5), though L_∞ was in each case less than 200 cm. The results of Isarev (1976c) for kingklip caught off the Cape are not dissimilar to those given here for the Cape(?) stock. Furthermore, Isarev's methods and indeed results of interpretation resemble those of Payne (1977) and those presented here. The results of Wrzesiński (1975), however, are somewhat different in that the ages-at-length are about double those given here and by Isarev. It is concluded that his interpretation is somewhat doubtful.

The observed and predicted lengths at age on which these four von Bertalanffy relationships were based are given in Table 6. It is evident from this Table that there is a fairly good agreement between observed and predicted lengths at age.

The growth curves are plotted on Figures 4 and 5. The curves in Figure 4 of the males and females of the south-east stock, show that up to a length of approximately 60 cm,

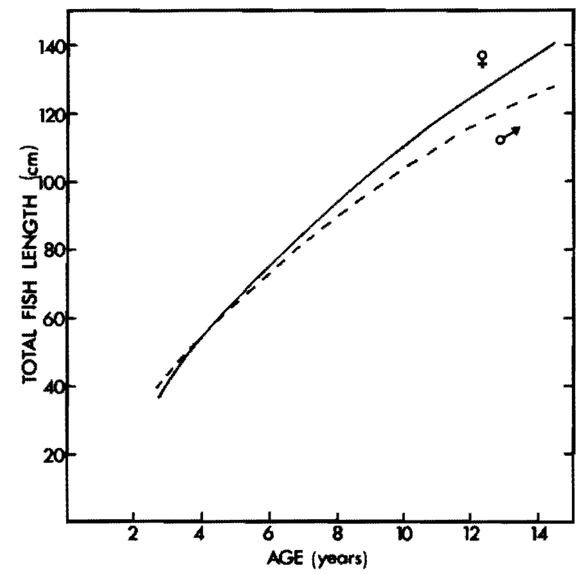

Figure 4 Growth curves of males and females of the south-east stock of kingklip.

Table 6 Observed and predicted lengths-at-age for the different stocks and sexes

Age (years)	Cape (?) O*	Cape (?) P*	South-east ♂♂ O	South-east ♂♂ P	South-east ♀♀ O	South-east ♀♀ P	South-east ♂♂ + ♀♀ O	South-east ♂♂ + ♀♀ P
3	49,4(4,7)	49,1	39,7(5,0)	43,7	38,4(5,6)	41,7	39,0(5,2)	43,1
4	59,0(6,6)	58,7	59,4(8,6)	54,2	56,5(9,1)	53,3	58,4(8,7)	53,7
5	67,1(7,2)	67,6	65,8(5,5)	63,9	68,1(5,6)	64,3	66,5(5,6)	63,7
6	75,8(6,0)	75,8	72,5(6,1)	72,9	74,8(6,1)	74,5	73,2(6,1)	73,2
7	82,3(5,3)	83,5	79,1(6,4)	81,4	82,2(5,3)	84,2	80,3(6,1)	82,2
8	88,3(6,2)	90,7	87,4(7,8)	89,3	88,7(7,5)	93,3	87,9(7,7)	90,7
9	98,6(12,8)	97,3	95,9(7,4)	96,7	100,4(7,9)	101,8	97,4(7,7)	98,8
10	102,7(8,1)	103,5	103,7(8,3)	103,5	111,2(8,7)	109,9	106,5(9,2)	106,4
11	113,9(3,6)	109,3	111,4(7,3)	109,9	119,8(7,5)	117,4	115,6(8,5)	113,6
12	115,5(−)	114,6	118,2(5,6)	115,9	125,7(5,9)	124,5	121,7(6,7)	120,5
13	116,5(−)	119,6	120,0(6,3)	121,5	132,5(7,0)	131,2	127,5(9,1)	127,0
14	−	−	126,6(9,4)	126,7	135,4(6,0)	137,5	132,3(8,3)	133,2

*O = observed; P = predicted; standard deviations in parenthesis.

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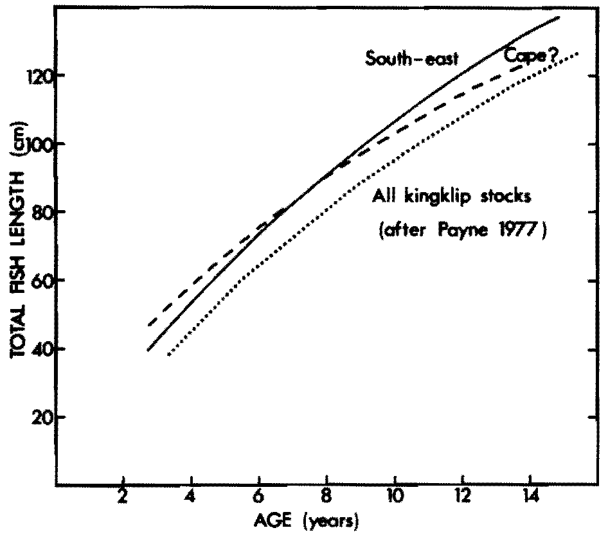

Figure 5 Growth curves of south-east and Cape (?) stock kingklip during the present study, and of all southern African kingklip (last after Payne 1977).

growth is similar. Thereafter, males are slightly shorter at corresponding ages than females. As shown in Table 2, the length at 50% maturity for kingklip is 52 cm. There is therefore justification for pointing to the maturity cycle as the reason for the slowing down of male growth. Males do, in fact, mature earlier, their 50% maturity length being 48 cm; also all males were found to be mature at 78 cm. The 50% maturity length for females is 62 cm (Table 2), but many of the females were still immature at much greater lengths. The longest immature female found was 104 cm. Payne (1977) noted the same growth pattern of the sexes for both the other stocks of kingklip, and Hickling (1933) and Botha (1971) did so for the European and South African hakes respectively. Such disparity in growth pattern between the sexes seems, therefore, to be common in long-lived demersal species. The relative abundance of males and females was virtually the same up to the age of 11, but then females became progressively more abundant than males. It would appear therefore that females grow slightly faster and probably reach a greater age than males.

The growth curves given in Figure 5 show that individuals of the south-east stock of kingklip grow faster than the overall (for combined stocks) rate of the species in southern Africa (Payne 1977). Data from only a few south-east specimens were incorporated in the combined equation for kingklip of Payne (1977). The growth rates of the other stocks were, however, slower and the combined growth curve was consequently substantially different from that of the south-east stock alone. The curve derived from those fish caught at the west of the survey area is clearly different from that of those caught in the east, providing further justification for considering them separately.

Few small fish were caught in this western part of the area, so the rather high lengths at age should be viewed with some caution. However, this stock of kingklip in the west does lie in an area of exceptionally heavy exploitation of hake and there is little doubt that kingklip there have been subjected to fishing pressure as heavy as that of hake, over just as long a period. (Deep-sea exploitation of the hake and kingklip stocks off Port Elizabeth is a recent — since the early seventies — innovation, whereas exploitation in the west has been at a high level since the war.) Exploitation was particularly heavy on the west side of the Agulhas Bank during the late sixties and early seventies when fishing effort by foreign trawlers exceeded that of the local vessels. The growth rate of the Cape(?) stock given here is slightly higher than that of Payne's (1977) Cape stock and also slightly higher than that of Wrzesiński (1975) and Isarev (1976c) for the stocks of kingklip they distinguished. This statement applies particularly to the younger groups. However, the heavy exploitation in the 1970s, which continued unabated through the years between collection of data by the earlier three workers and for this report, may be a possible reason for this apparent accelerated growth rate in the kingklip. Such an observation has been made on other species subjected to heavy exploitation, e.g. the South African hake (Sea Fisheries Research Institute, unpublished data).

In summary, therefore, kingklip growth is slow, but reasonably uniform to quite an advanced age and to a great length.

Stock differentiation

There was no obvious visible difference between the kingklip caught in any part of the survey area nor between these fish and those previously identified by Payne (1977) as the Cape stock. Furthermore, the outward appearance of the otoliths of all these kingklip was similar. The basic shape of the otolith described by Payne (1977) as belonging to the Cape stock applies equally well to the south-east stock investigated here.

Growth rate differences between stocks have been adequately described in the last section, and it is evident from the data presented that the stock may be distinguished from the others on that basis at least. The other means of separating stocks used for this study, that of number of vertebrae, is also a critical parameter that is usually determined by non-biological factors. Just as growth rate is influenced by environmental conditions which in turn directly influence the availability of food, so the number of vertebrae may be influenced by the environmentnal conditions, particularly temperature, at the developmental stage. Nevertheless, each (growth rate and number of vertebrae) may alone be regarded as proof of stock integrity.

Morphometric differences between otoliths

Many authors have used otolith form to distinguish between stocks of a species (e.g. Messieh 1972) or even between species in combination with other factors (e.g. Botha 1971). Figure 6 reflects the relationship between otolith length/height ratio and

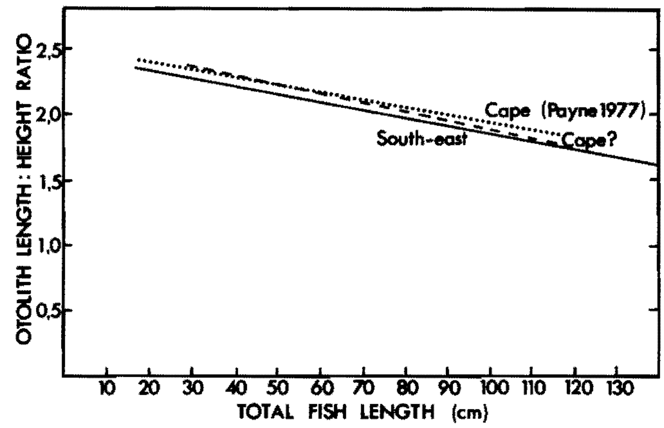

Figure 6 Relationship between otolith length/height ratio and fish length for the south-east stock, the Cape (?) stock and for the Cape stock of kingklip (last after Payne 1977).

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fish length for the south-east and Cape(?) stocks, with the same regression for the Cape stock given by Payne (1977) as a comparison. The parameters for all three regressions are given in Table 7. The diphasic pattern observed in the relationship between fish length and otolith length (Figure 3) is suppressed, evidently by a similar relationship between fish length and otolith height.

Table 7 Parameters of the equations describing the relationship between otolith length/height ratio and fish length for the south-east, Cape(?) and Cape stocks of kingklip (the last recalculated from the data of Payne 1977)

Stock	Regression*	Standard deviation of y	Correlation coefficient (r^2)
South-east	$y = 2{,}3903 - 0{,}0056x$	0,22	0,5516
Cape(?)	$y = 2{,}4929 - 0{,}0063x$	0,17	0,4165
Cape	$y = 2{,}5053 - 0{,}0058x$	0,19	0,5034

*x = fish length; y = otolith length/height ratio.

Student's t distribution was applied to test the statistical significance between all three stocks on the basis of both slopes and intercepts of these regressions. The results are given in Table 8.

Table 8 Statistical comparison of the south-east, Cape(?) and Cape stocks of kingklip on the basis of the regressions of otolith length/height ratio on fish length

	Slope difference		Intercept difference	
Stocks compared	t	Degrees of freedom	t	Degrees of freedom
South-east:Cape	11,3903	1 196	9,3578	1 197
South-east: Cape(?)	6,9010	1 074	4,3664	1 075
Cape:Cape(?)	3,5160	552	4,4053	553

Where $t_{\alpha(2),\infty}$ = 1,96, $P < 0{,}001$ and thus the differences between all stocks are significant on the basis of the pattern of otolith growth. The decision to treat the westernmost kingklip caught during this survey as a separate entity is therefore fully justified.

Differences in number of vertebrae

The percentage distribution of the number of vertebrae in kingklip drawn from the south-east stock and from the Cape stock (Payne 1977) are shown in Figure 7. There is very little evident difference between them, except that there are apparently more outliers in the south-east stock than in the Cape stock, probably because the sample was much larger in the former (966 *v.* 68).

Student's t distribution was applied to test the statistical significance of the difference between the means, but the differences were insignificant ($t_{0,05(2),\infty}$ = 1,96; $P > 0{,}05$). Therefore, on the basis of number of vertebrae, the Cape stock and the south-east stock studied here are the same.

Discussion

The growth of the kingklip on the south-east coast is somewhat faster than it is elsewhere in southern Africa. The value of k obtained in this study (0,054) is of the same order as those given by Wrzesiński (1975), for the whole Commission area, and by Isarev (1976c), for ICSEAF Divisions 1.5 and 1.6, namely 0,050 and 0,066 respectively (Table 5). As stated previously, however, the growth rate found by Wrzesiński (1975) was much lower than that of Isarev (1976c), of Payne (1977) or of that found in this study and his interpretation seems to be somewhat suspect. Nevertheless, all studies agree that the growth rate is slow and that the kingklip is a species that tends to display longevity.

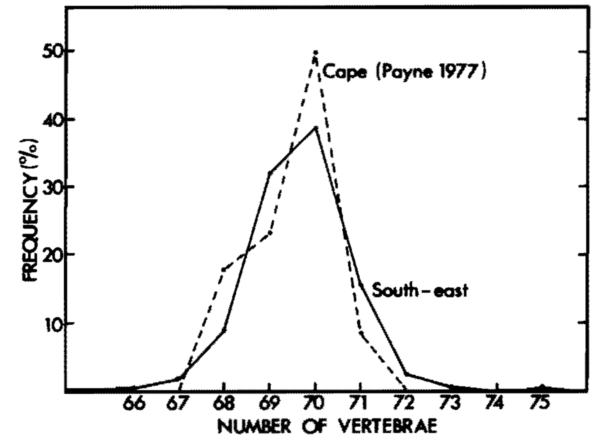

Figure 7 Frequency of number of vertebrae in kingklip of the south-east and Cape stocks (latter after Payne 1977).

On the subject of stock differentiation, it is concluded that, on the basis of the information presented here, the stock of kingklip on the south-east coast in the vicinity of Port Elizabeth maintains its own integrity. Although the number of vertebrae are similar, the growth rate and also the otolith growth pattern are sufficiently distinct to elevate its status to that of the third stock off southern Africa. On the basis of otolith growth pattern and growth rate, the kingklip found on the westernmost side of the Agulhas Bank, i.e. the Cape(?) stock, could also be defined as a separate stock. However, the time lapse between collection of data by Payne (1977) and during this survey is long and growth rates over the years tend to change under large-scale exploitation. Also, data from the area are very few, and therefore it is not feasible to reach a definite conclusion on integrity. Further work on the kingklip in this area is therefore necessitated.

The difference between the Walvis stock and the Cape stock as proved by Payne (1977) and by Isarev (1976a, b) remains fully substantiated, though the difference is probably at a higher level than that between the stocks off the Republic. The Walvis stock may, in fact, be different on a subspecific rather than on a stock level, such is the visible difference between kingklip from north of Walvis Bay and off the Cape. Isarev (1976a, b) concluded that the two stocks were subpopulations of a single species and, until further definitive evidence is forthcoming therefore, the kingklip of southern Africa will be regarded as a single species with at least three discrete subpopulations.

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