Recruitment and growth patterns of juvenile marine teleosts caught at King's Beach, Algoa Bay

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The recruitment patterns of six teleosts were studied at King's Beach, Algoa Bay. February to May marked the major recruitment period for *Diplodus sargus, Lithognathus mormyrus, Rhabdosargus globiceps* and *Trachurus capensis*. The major recruitment of *Sarpa salpa* fry took place between August and September. *Pomadasys olivaceum* fry of < 5 cm total length were caught throughout the year indicating an extended breeding period. The estimated growth rates of new recruits between February and May (autumn/winter) was 0,60 cm month^{-1} for *L. mormyrus*, 0,75 cm month^{-1} for *R. globiceps* and 0,40 cm month^{-1} for *T. capensis*. The empirical growth curve derived for *S. salpa* indicated a growth rate of 0,75 cm month^{-1}. No growth estimates could be made for *P. olivaceum* or *D. sargus*.

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Die werfpatroon van ses Teleostei-spesies is by King's Beach, Algoabaai bestudeer. Die hoof werwingsperiode vir *Diplodus sargus, Lithognathus mormyrus, Rhabdosargus globiceps* en *Trachurus capensis* was tussen Februarie en Mei. Die grootste werwing van klein *Sarpa salpa* het tussen Augustus en September plaasgevind. Klein *Pomadasys olivaceum* (< 5 cm totale lengte) is gedurende die jaar gevang wat 'n verlengde broeiperiode aantoon. Die beraamde groeitempo van nuwe werwelinge tussen Februarie en Mei (somer/herfs) was 0,60 cm maand^{-1} vir *L. mormyrus*, 0,75 cm maand^{-1} vir *R. globiceps* en 0,40 cm maand^{-1} vir *T. capensis*. Die empiriese groeikurwe wat vir *S. salpa* afgelei is, het 'n groeitempo van 0,75 cm maand^{-1} aangetoon. Dit was nie moontlik om beramings van groeitempo vir *P. olivaceum* of *D. sargus* te maak nie.

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Patterns of recruitment of marine teleosts cannot always be related to patterns of reproduction at that particular site (Sale 1980). This is particularly true of 'open' systems such as surf zones, where recruitment may result from reproductive activity elsewhere. Recruitment is, in general, brought about by the arrival of larvae/juveniles in the plankton, followed by the selection of suitable habitats (Luckhurst & Luckhurst 1977; Russell, Anderson & Talbot 1977; Sale 1980).

Few data are available on recruitment patterns of teleosts in South African waters. Wallace (1975) gives a brief account of recruitment patterns for the major 'estuarine-associated' teleosts in Natal. Marais (1976) gives similar data for four species of mullet in the Swartkops estuary and Winter (1980) discusses the recruitment patterns of several other species at the same site. Preliminary data on juvenile ichthyofauna of the surf zone at King's Beach were presented by Lasiak (1981). This paper gives more detailed information on the recruitment and growth of the more abundant species in the surf zone, namely the blacktail *Diplodus sargus,* the sand steenbras *Lithognathus mormyrus,* the gorrie *Pomadasys olivaceum,* the white stumpnose *Rhabdosargus globiceps,* the strepie *Sarpa salpa* and the marsbanker *Trachurus capensis.*

Methods

The surf-zone ichthyofauna at King's Beach was sampled monthly between September 1978 and October 1980 by seine netting. A coarse-meshed net, 60 m long and 2 m deep with a stretched-mesh size of 4 cm was used throughout. Each sampling session comprised three hauls; prior to, at twilight and after twilight. Additional hauls were made between October 1979 and October 1980 using a fine net, 30 m long and 2 m deep with a stretched mesh of 1,7 cm. The net had a 2 m deep purse bag attached at its midpoint.

Monthly length-frequency histograms were compiled for the most abundant species with each length class represented as a percentage of the total number of individuals of that species caught. Differences in the size selectivity of the coarse- and fine-meshed nets necessitated the compilation of separate frequency histograms. From these the months of onset and duration of recruitment were noted. The Petersen method of modal progression was used to estimate the growth rate of juvenile *L. mormyrus, R. globiceps* and *T. capensis.*

Results

Diplodus sargus

Fry < 5 cm were recorded throughout the year at King's Beach. The major periods of recruitment were discernible from the monthly length-frequency histograms (Figure 1) as February – April 1980 and July – August 1980. The monthly catches do not provide a clear modal series suitable for the estimation of juvenile growth rate. This is partly attributable to the prolonged recruitment period and also to size selectivity of the sampling gear. Examination of monthly length-frequency histograms for the coarse-meshed net does not alleviate this problem. Fish < 7 cm in length were rarely retained by this net. Furthermore, no modal progressions could be discerned.

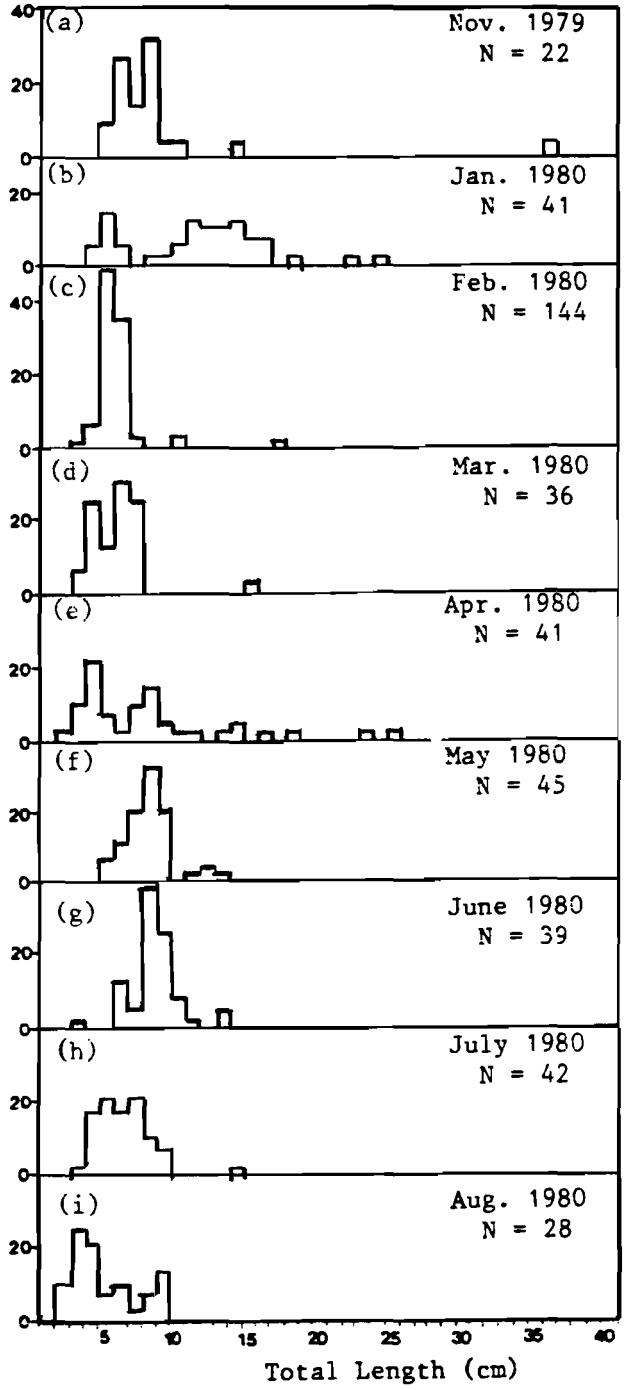

Figure 1 Monthly length-frequency histograms (a – i) for *Diplodus sargus* from fine-meshed seine hauls.

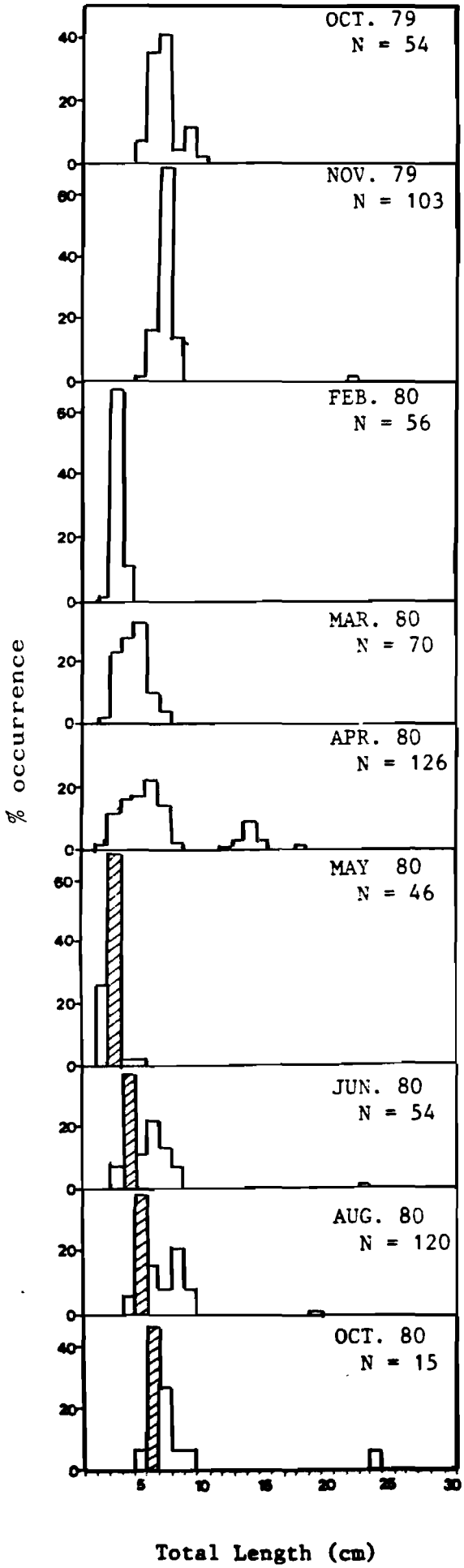

Figure 2 Monthly length-frequency histograms for *Lithognathus mormyrus* for the fine-meshed seine net.

Lithoghathus mormyrus

The monthly length-frequency histograms for the fine seine net (Figure 2) indicated that the majority of new recruits were 3 – 5 cm in length. Fry of 3 cm were particularly abundant from February to May 1980, which marks the major recruitment phase. Between May and October 1980 the monthly modal length class increased from 3 cm to 6 cm, indicating a growth rate of 0,6 cm per month for this period. *L. mormyrus* was caught less frequently in the coarse-meshed net. The monthly histograms for this net did not reveal clear class modal progressions.

Pomadasys olivaceum

Fish within the 3 – 5 cm total length range were abundant throughout the year, indicating a very extended recruitment period (Figure 3). The monthly catches did not show a modal progression for more than two or three consecutive months; consequently no attempts were made to estimate the growth rate of juvenile fish. Fish < 5 cm were virtually absent from the fine-net hauls while fish of the 5 – 15 cm size range predominated in the coarse-net hauls. No modal progressions could be followed from the coarse net data.

Rhabdosargus globiceps

More than 10 specimens of this species were caught on five occasions. Fry < 5 cm were represented in catches from January to July 1980, which indicates a prolonged recruitment period. Between January and April 1980 the monthly

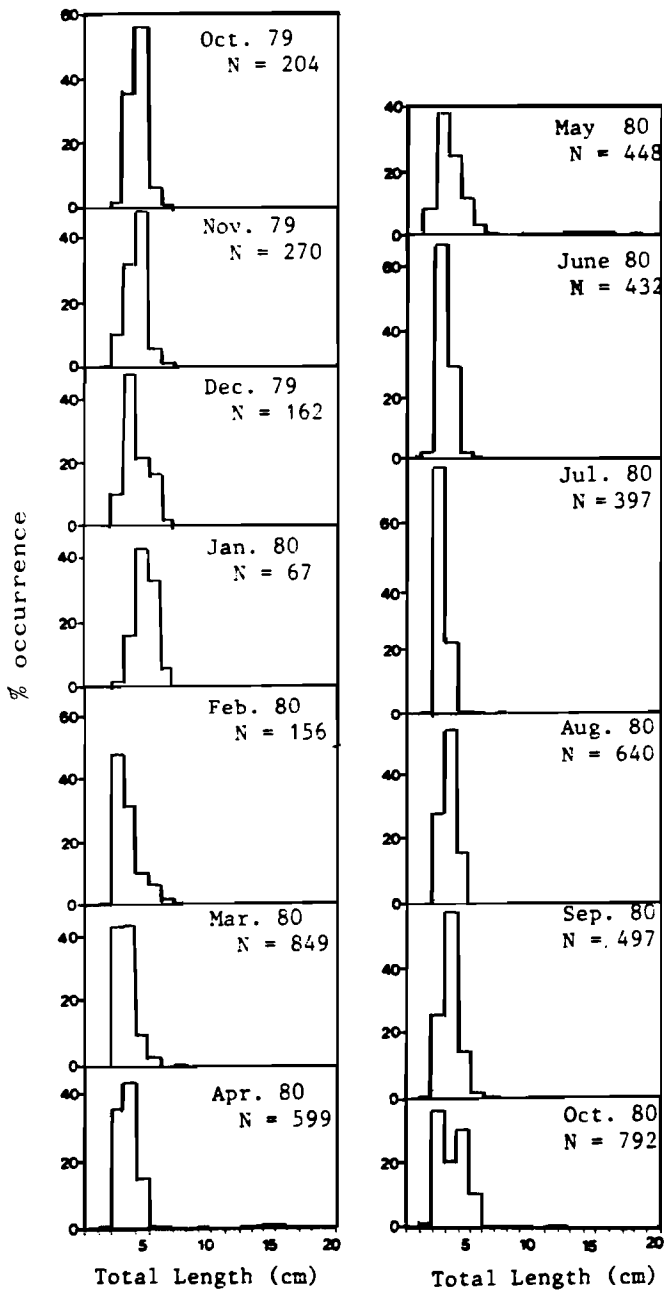

Figure 3 Monthly length-frequency histograms for *Pomadasys olivaceum* for the fine-meshed seine net. .

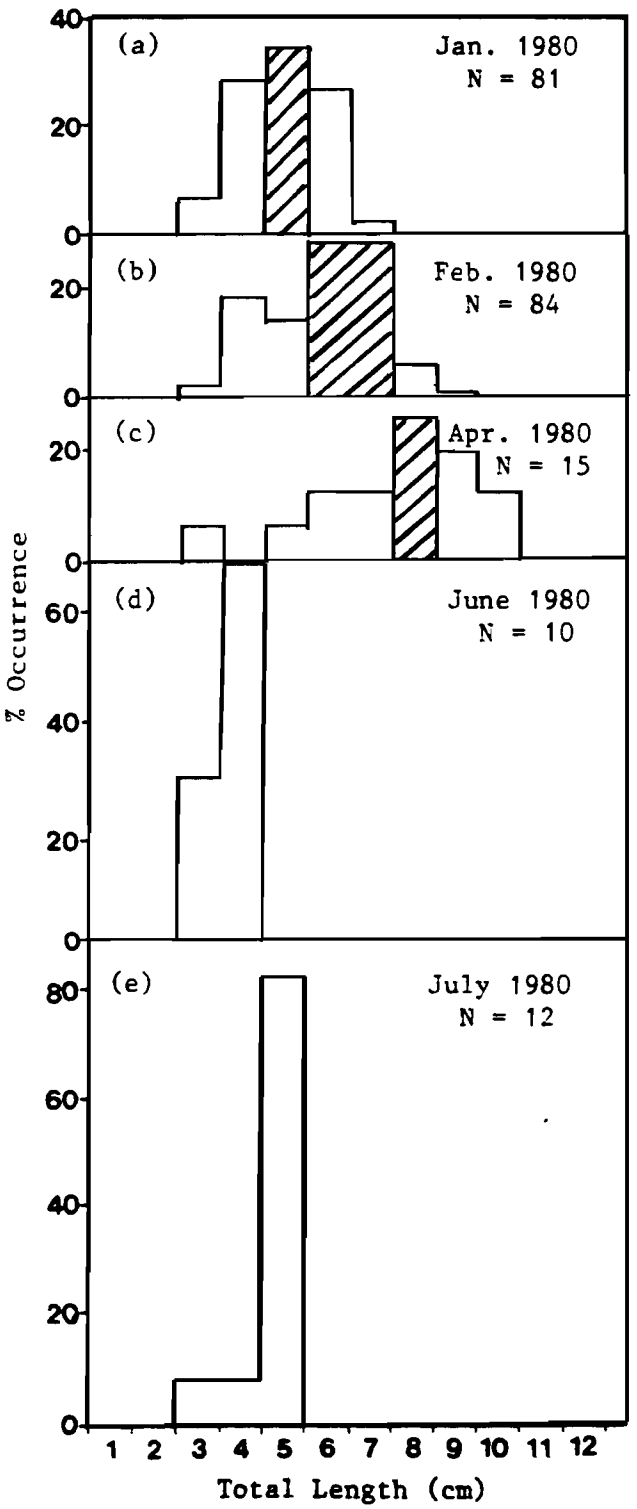

Figure 4 Length-frequency histograms for *Rhabodsargus globiceps* from the fine-meshed seine net.

modal length class increased from 5 cm to 8 cm (Figure 4) indicating a growth rate of 0,75 cm month^{-1} during this period.

Sarpa salpa

Fry < 4 cm total length were caught at King's Beach between August and November 1980. The major recruitment of new fry was recorded in August and September 1980 (Figure 5). Between November 1979 and April 1980 the monthly modal length class increased from 4 cm to 10 cm, indicating a growth rate of 1,2 cm per month in the summer. Length-frequency histograms for the coarse-meshed net (Figure 6) indicate a further modal progression. From September 1978 to July 1979 the modal length increased

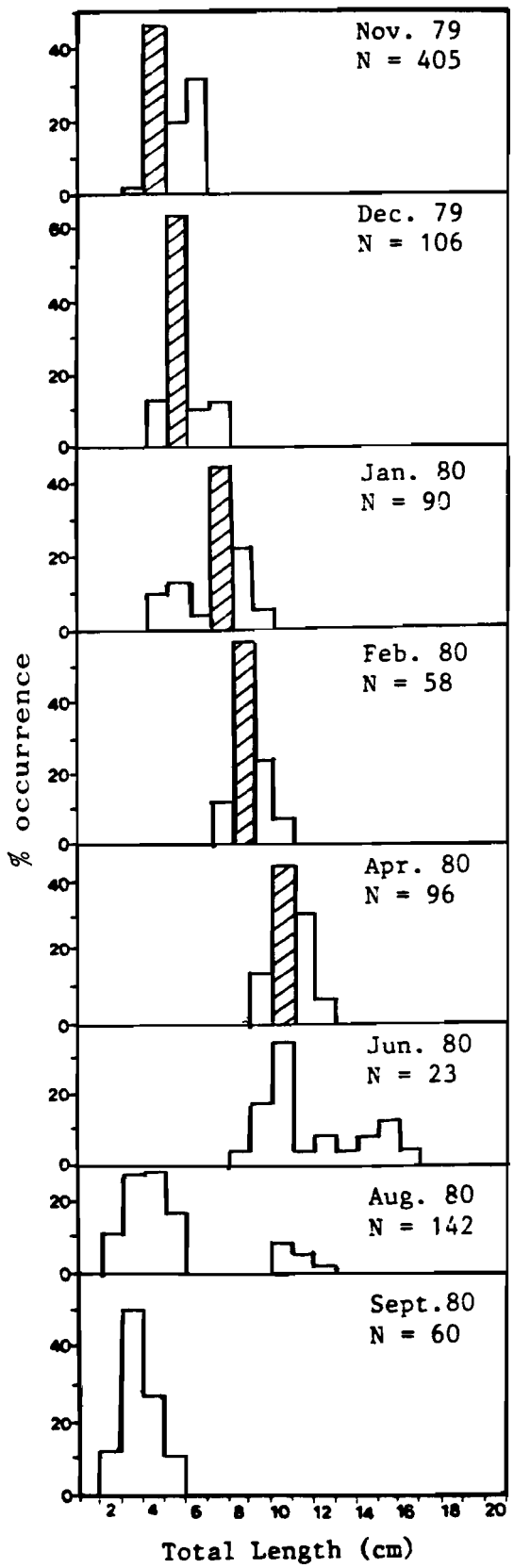

Figure 5 Monthly length-frequency histograms for *Sarpa salpa* from the fine-meshed seine net.

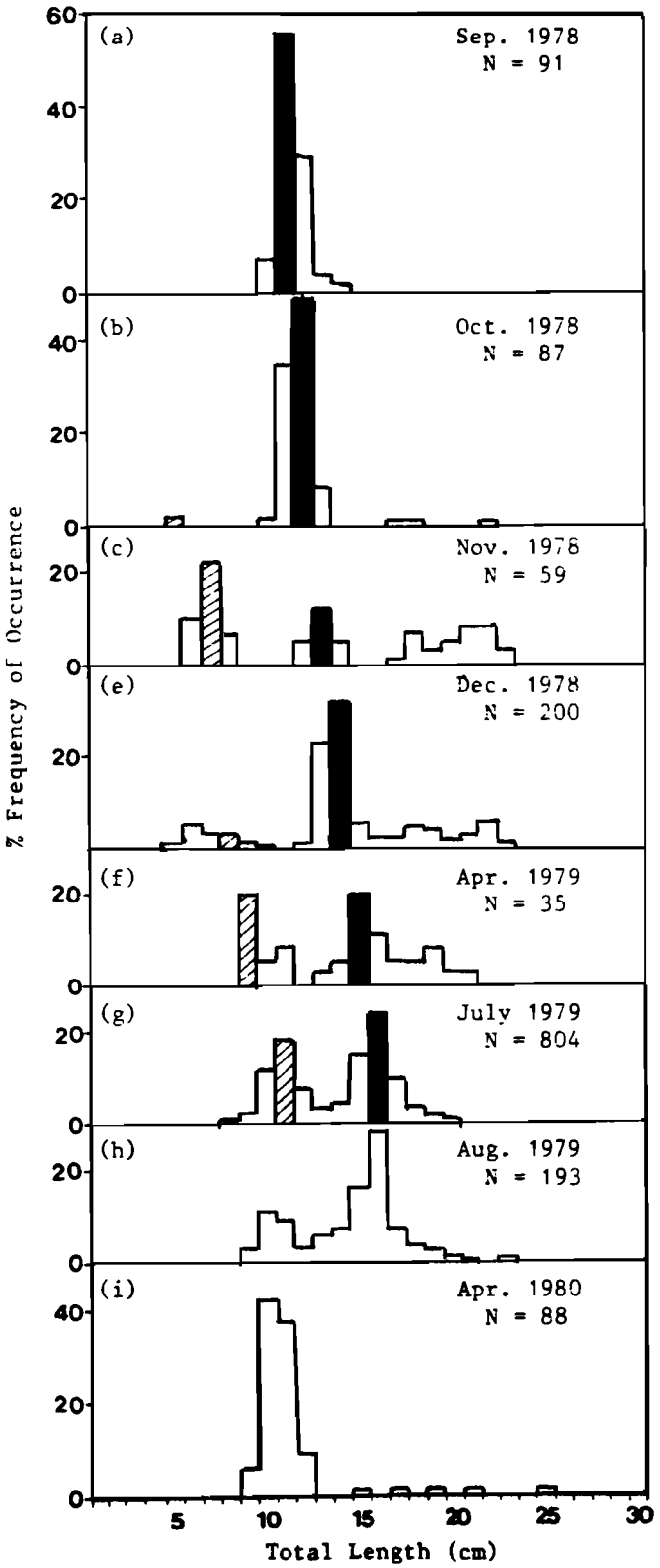

Figure 6 Monthly length-frequency histograms for *Sarpa salpa* (a – i) from the coarse-meshed seine net.

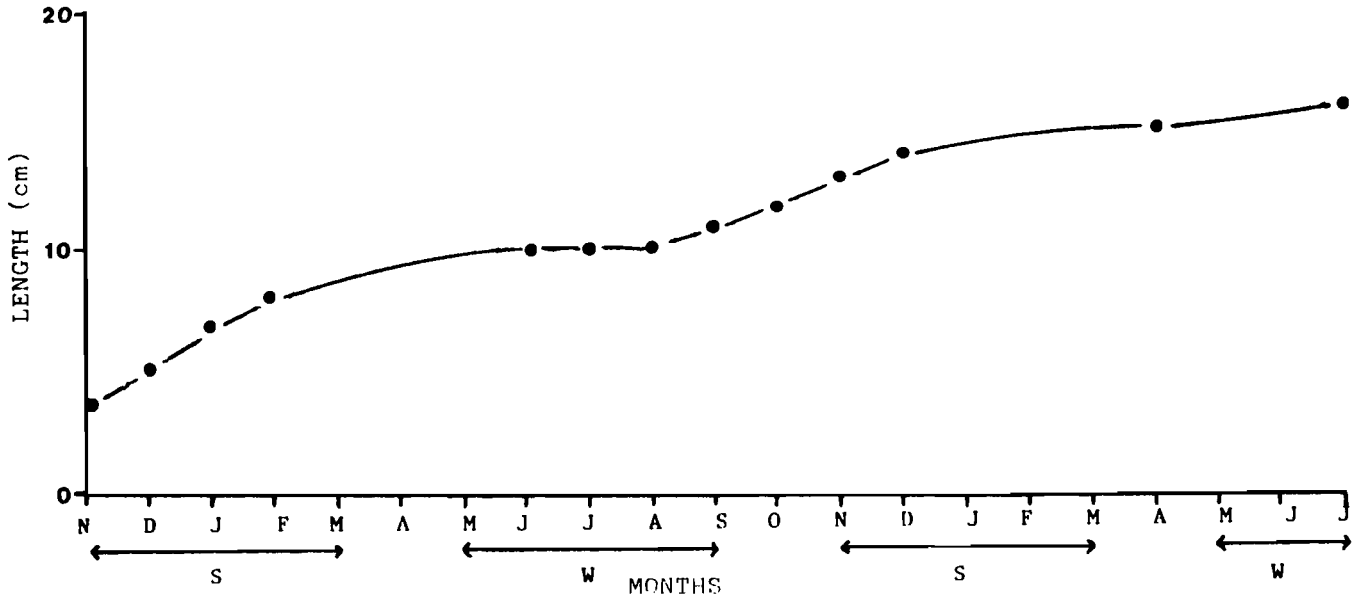

Figure 7 Modal lengths and empirical growth curve for *Sarpa salpa*.

from 11 cm to 16 cm indicating a monthly increment of 0,5 cm. An empirical growth curve (Figure 7), compiled from data relating to both nets, indicates that the growth rate is not constant but maximal in summer and minimal in winter. On this basis the annual growth rate is estimated to be 9 cm in juveniles within this size range.

Trachurus capensis

The marsbanker was most abundant during the summer months with occasional specimens being caught in May and June. Fry < 5 cm were poorly represented in collections from King's Beach. As in the case of *D. sargus* this could reflect either net selectivity and/or their absence. Between November 1979 and April 1980 the monthly modal length class increased from 6 cm to 8 cm indicating a monthly increment of 0,4 cm in the summer (Figure 8).

Discussion

Larval and post-larval fish probably enter the King's Beach area passively as a result of inshore currents. The low numbers encountered (Lasiak 1981), coupled with sporadic occurrence, indicates that the majority of species do not remain in the surf zone. According to Luckhurst & Luckhurst (1977) the sporadic occurrence of new recruits is to be expected. In most species of reef fish, recruitment is brought about by the arrival of small numbers of solitary individuals, which subsequently settle into suitable habitats. This phenomenon probably applies to all 'open' marine systems.

The monthly length-frequency histograms compiled for the most abundant species at King's Beach, *P. olivaceum*, indicated that new recruits of this species remained in the surf zone for periods of two to three months at the most. *P. olivaceum* of > 5 cm total length were rarely caught in either the coarse- or fine-meshed nets. However, large numbers of fish < 5 cm were caught throughout the year at King's Beach, which suggests that this environment is important for small juveniles. Predation by piscivorous birds and fish may account for the reduction in the numbers of juvenile *P. olivaceum*, although it is unlikely to result in their virtual elimination. The most likely explanation is that fish

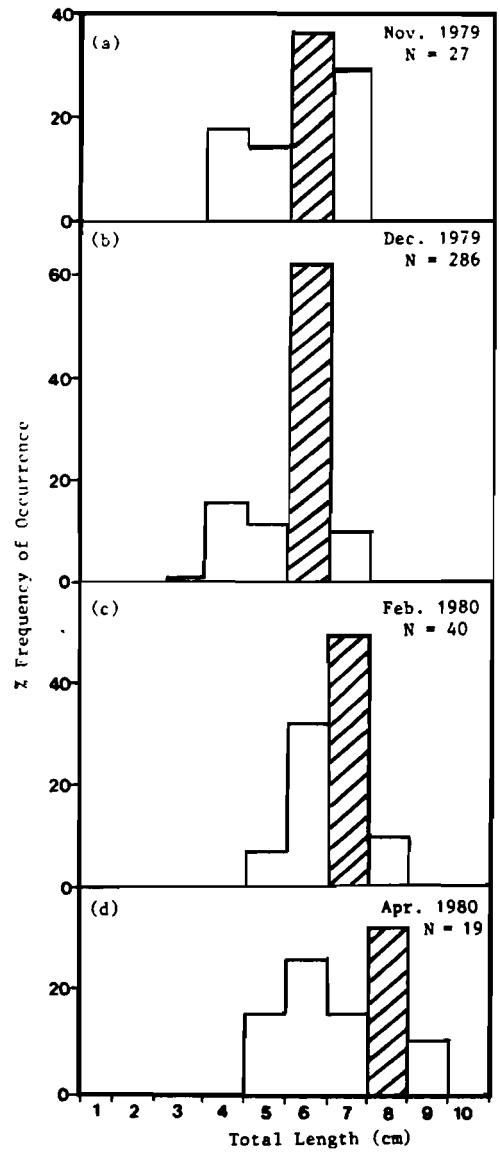

Figure 8 Monthly length-frequency histograms (a – d) for *Trachurus capensis* from fine-meshed seine hauls.

of > 5 cm move away from the beach, possibly offshore.

The summer – autumn months (February – May) mark the major recruitment periods of *D. sargus, L. mormyrus, R. globiceps* and *T. capensis*. Monthly length-frequency histrograms for *D. sargus* (Figure 1) revealed two recruitment periods, February – April 1980 and July – August 1980. Studies on the reproductive activity of *D. sargus* demonstrated the presence of ripe fish over an extended period (June – November) at King's Beach (Lasiak 1982). The lack of modal progressions in the histograms suggests that *D. sargus* has an extended recruitment period, possibly resulting from an extended breeding period. However, the dual recruitment pattern may simply reflect two peaks in spawning, or a sampling artifact. Such a phenomenon has been recorded in the mullet *Liza dumerili* in the eastern Cape (van der Horst & Erasmus 1978).

Wallace & van der Elst (1975) found there was a delay of 1 – 3 months before offspring of 'estuarine-associated' fish in Natal started migrating into estuaries after spawning. This delay period is influenced not only by the proximity of nursery and spawning grounds, but also reflects net selectivity. Fish can not be caught until they have exceeded the retention range of the collecting gear. Comparison of data on spawning and recruitment of *L. mormyrus* at King's Beach indicated a delay of three months between records of ripe adults and the appearance of recruits. The spawning period probably extends from November to February (Lasiak 1982) while the recruitment period extended from February to May. Talbot (1955) found that in the western Cape *R. globiceps* spawned from August to February and recruitment took place in January and February. At King's Beach the major recruitment period was established as January to April. No information is available on the spawning period of *R. globiceps* in the eastern Cape. Hecht (1976) recorded ripe individuals of *T. capensis* in Algoa Bay from June to November, there being evidence of two spawning peaks (July – August and November – December). One recruitment peak was observed for *T. capensis* at King's Beach, taking place between November and April. This suggests a delay of three months before recruits started to appear inshore. Sale (1980) pointed out that in 'open' systems the recruitment of new individuals to a study site may result from reproductive activity over a far wider area. Consequently the delays noted above may be variable due to large-scale movements.

The use of monthly modes often leads to overestimation of growth rate since estimates are based on increments equivalent to the length-class interval. Wallace & van der Elst (1975) considered mean lengths of successive catches to give a better indication of growth. However, this method is severely biased by non-normal distributions typically encountered as a result of net selectivity. To avoid any bias from differential growth rates in summer and winter, estimates have been made per month over a specific period. Over the summer-autumn period the estimated growth rate of new recruits was 0,60 cm month^{-1} for *L. mormyrus*, 0,75 cm month^{-1} for *R. globiceps* and 0,40 cm month^{-1} for *T. capensis*. An average annual growth rate of 0,75 cm month^{-1} was obtained from the empirical growth curve for *S. salpa*. Using the progression of modal length, Talbot (1955) obtained growth rates of 6 – 12 cm year^{-1} (0,5 – 1,0 cm month^{-1}) for *R. globiceps* in the Klein River estuary. The estimate for white stumpnose from King's Beach falls within this range. Davies (1957) gives an estimated growth rate for *T. capensis* on the west coast of 16 cm year^{-1} (1,3 cm month^{-1}), which far exceeds the estimate made in the present study.

Recruitment patterns must clearly influence 'community structure'. In the long term the species successfully recruiting into a particular area will determine the composition and relative abundance of the resident species (Sale 1980). This mixture of recruits may include species that are not currently resident. At King's Beach the juvenile *R. globiceps* and *T. capensis* recorded were not the progeny of resident adult populations since no adults of these species have been recorded from the surf waters. Consequently seasonal cycles in the reproductive activity of species not resident in the surf zone may modify the numbers and types of species recruiting into these areas.

Acknowledgements

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References

DAVIES, D.H. 1957. The South African pilchard (*Sardinops ocellata*) and maasbanker (*Trachurus trachurus*). Young fish survey, 1955 – 1956. *Investl Rep. Div. Fish. S. Afr.* 29: 1 – 36.

HECHT, T. 1976. The general biology of six major trawl fish species of the eastern Cape coast of South Africa, with notes on the demersal fishery, 1967 – 1975. Ph.D. thesis, University of Port Elizabeth, South Africa, 353 pp.

LASIAK, Theresa A. 1981. Nursery grounds of juvenile teleosts: evidence from the surf zone of King's Beach, Port Elizabeth. *S. Afr. J. Sci.* 77: 388 – 390.

LASIAK, Theresa A. 1982. Structural and functional aspects of the surf-zone fish community in the eastern Cape. Ph.D. thesis, University of Port Elizabeth, South Africa, 459 pp.

MARAIS, J.F.K. 1976. Comparative studies on the nutritional ecology of mullet in the Swartkops estuary. Ph.D. thesis, University of Port Elizabeth, South Africa. 136 pp.

LUCKHURST, B.E. & LUCKHURST, K. 1977. Recruitment patterns of coral reef fishes on the fringing reef of Curacao, Netherlands Antilles. *Can. J. Zool.* 55: 681 – 689.

RUSSELL, B.C., ANDERSON, G.R.V. & TALBOT, F.H. 1977. Seasonality and recruitment of coral reef fishes. *Austr. J. Mar. Freshwater Res.* 28: 521 – 528.

SALE, P.F. 1980. The ecology of fishes on coral reefs. *Oceanogr. Mar. Biol. Ann. Rev.* 18: 367 – 421.

TALBOT, F.H. 1955. Notes on the biology of the white stumpnose *Rhabdosargus globiceps* (Cuvier) and on the fish fauna of the Klein River estuary. *Trans. Roy. Soc. S. Afr.* 34: 387 – 407.

VAN DER HORST, G. & ERASMUS, T. 1978. The breeding cycle of male *Liza dumerili* in the mouth of the Swartkops estuary. *Zool. Afr.* 13: 259 – 273.

WALLACE, J.H. 1975. The estuarine fishes of the east coast of South Africa. 1. Species composition and length distribution in the estuarine and marine environments. 2. Seasonal abundance and migrations. *Investl Rep. Oceanogr. Res. Inst.* 40: 1 – 72.

WALLACE, J.H. & VAN DER ELST, R.P. 1975. The estuarine fishes of the east coast of South Africa 4. Occurrence of juveniles in estuaries. 5. Ecology, estuarine dependence and status. *Investl Rep. Oceanogr. Res. Inst.* 42: 1 – 63.

WINTER, P.E.D. 1980. Studies on the distribution, seasonal abundance and diversity of the Swartkops estuary ichthyofauna. M. Sc. thesis, University of Port Elizabeth, South Africa. 184 pp.