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BIOLOGY OF TELEOST FISH, WITH PARTICULAR REFERENCE TO ST.LUCIA

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BIOLOGY OF TELEOST FISH, WITH PARTICULAR REFERENCE TO ST. LUCIA.

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ABSTRACT

The main aspects of the biology of estuarine fishes are outlined with particular reference to St. Lucia. Parameters discussed include the length composition of the St. Lucia population; the seasonality and migrations of the species of major importance; exploitation of these species in the lake in relation to the coastal populations as a whole and in relation to management; reproduction in relation to season, areas of spawning and recruitment of young into the lake; and the importance of St. Lucia as a juvenile fish nursery. Some possible directions for future research are suggested.

INTRODUCTION

Research on the teleost fish of the St. Lucia system was conducted by the Oceanographic Research Institute during the years 1969-1972 as part of its programme on the biology of the estuarine fish of the East Coast of South Africa. Results have been published in the form of ORI Investigational Report Nos. 40, 41 & 42, and are based on sampling in many Natal estuaries and in the marine environment along most of the Natal coast. Additional results have been collated but are as yet unpublished on the feeding of adults and juveniles of numerous species in St. Lucia (qualitative data, with indexes of abundance), as well as on the ageing of the spotted grunter (Pomadasys commersonni) and the cob (Argyrosomus hololepidotus). In the text which follows the basic features of the biology of this group of fishes are summarized, and where necessary, additional details specific to the St. Lucia system have been included. The subject headings used correspond with those in the ORI Investigational Reports so as to facilitate reference to greater detail if this is required.

Response 1..... 2

Response to conditions of hypersalinity.
(Wallace 1975a, pages 18 & 19).

The salinity ranges of species commonly caught in gill nets are indicated in Fig. 1. This shows that some species can adapt to extremely high salinities, but it is significant that ten species had their upper limits of distribution within the salinity range 65-75°/oo. The inverse relationship between species diversity and salinity in the north lake is shown graphically in Wallace 1975a (Fig. 10). Fish mortalities in the high salinity areas were rare, the fish populations apparently moving out of an area before its salinity reached lethal levels. No difference in salinity tolerance was detected between juveniles and adults.

Length composition in the estuarine and marine environments.
(Wallace 1975a).

The length composition of the most important species in St. Lucia, other estuaries and the marine environment is shown in Fig. 2 (for the fauna as a whole see also Table 4, Wallace 1975a).

The following general points emerge :

(1) Most estuarine fish are inshore and shallow-water continental shelf species.

(2) Adult populations tend to occur mainly at sea, only a relatively small proportion entering estuaries.

(3) Juvenile fishes are much more abundant in estuaries than adults. Catches decline rapidly as the size of juveniles increases. This appears to be largely attributable to mortality caused by bird and fish predation.

(4) Adolescent fish are poorly represented in estuarine catches and this is largely due to emigration to sea in preparation for the adult reproductive phase of life.

(5) / ...3...

(5) The abundance of juveniles in estuaries, and the absence of positive evidence of their widespread occurrence at sea, leads to the conclusion that the most important function of estuaries in the biology of these species is the provision of a nursery habitat for juveniles.

The following points are worth noting about the St. Lucia population.

(1) Juveniles migrate into the lake at a very small size (in most cases at between 2-4 cm.), and given favourable conditions, spread along the length of most of its shores.

(2) Vast numbers of juveniles are involved.

(3) A greater proportion of large adult fish occur in St. Lucia than in other estuaries (eg. A. hololepidotus, Mugil cepholus, P. commersonni and Rhabdosargus sarba). Angling benefits accordingly.

(4) In St. Lucia there also seems to be a clearer distinction between the juvenile and adult stages than in smaller estuaries where intermediate length classes are better represented. The greater distance of St. Lucia lake from the sea and the effects of this upon migration between the estuarine and marine environments are probably responsible for these characteristics.

SEASONAL ABUNDANCE AND MIGRATIONS.

(Wallace 1975a).

The following general points emerge :

(1) The first migration undertaken by most species is the movement of fry from the sea into estuaries.

(2) Species such as P. commersonni, R. sarba and R. holubi start to return to sea after about a year, at which stage they are still sexually immature.

(3) / ...4

(3) M. cephalus appears to remain in the St. Lucia system for an estimated 3 - 4 years before sexually mature adults undergo a seaward spawning migration.

(4) Migrations and changes in seasonal abundance of sexually mature fish tend to be associated with the spawning season and many migrants are in pre- and post-spawning condition. However some species migrate between these environments during the inactive phase of their reproductive cycles.

(5) Since spawning is with few exceptions at sea, there is a general exodus of sexually mature specimens from estuaries prior to the spawning season.

The following points are worth noting about St. Lucia. M. cephalus :

This species occurs very widely in the lake, even under hypersaline conditions. During the summer months shoaling begins to intensify and a general southward movement starts. Gonad development also starts at about this time. Data covering the seven years 1968-1974 show that sexually mature mullet arrived in the estuary between 12th April and 12th May. (Sexually immature stages remain in the lake).
These large shoals in the estuary comprise migrants from the lake and marine shoals, all fish being reproductively "ripe" and ready to spawn . Spawning occurs in the inshore environment.

It is important to state that big as the migratory populalation from St. Lucia is, it actually makes a relatively small contribution to the total population which during the winter months has been observed in the surf zone (and well beyond) from the Mozambique border to the south coast of Natal. The spawning population is probably distributed more widely —— these limits were merely those recorded during sampling. Since M. cephalus is exploited at a very low level in South Africa, it is suggested that the netting in St. Lucia lake

should/....5

should not be regarded with too much concern from the overall point of view. These mullet are obviously a valuable source of food and since the St. Lucia population forms only a small part of the total spawning population, heavy exploitation in the lake would seem unlikely to be significant from the point of view of depletion of stocks or reducing juvenile recruitment into the system. It should be noted that very few adult M. cephalus in post-spawning condition migrate back into St. Lucia lake.

P. commersonni.

The annual spring/summer"run" into St. Lucia consists of sexually mature specimens. Spawning occurs in the inshore zone along the Zululand and Natal coasts. The shoals which move in and out of the estuary consist of both pre- and post-spawners, but the fish which migrate into the lake have already completed their spawning (gonads in spent condition in the main).

The magnitude of the St. Lucia "run" is likely to depend upon the size of the spawning shoals in the adjacent inshore zone. However, it also depends upon the size of the St. Lucia mouth; the wider and deeper this is the more likely it is to favour large scale movement of shoals.

Exploitation at St. Lucia estuary is heavy during the grunter "run". Although unlikely to have a serious effect on the overall Natal/Zululand population, it seems clear that over-fishing of the inward migrating population at the estuary will reduce the number of fish able to reach the lake. This is deemed undesirable ecologically and from the point of view of angling in the lake. Continued and even more stringent control over the "grunter mania" which grips anglers at the estuary would seem desirable, particularly as their numbers increase from year to year.

R. sarba, A. hololepidotus, Acanthopagrus berda and Elops machnata.

No marked seasonal migrations were detected.

REPRODUCTION / ...6..

REPRODUCTION

(Wallace 1975b.)

The following general points emerge:

(1) Most species spawn at sea despite the fact that they are adapted to the variable environmental conditions typical of estuaries. It is suggested that this is because the relatively stable marine environment is more suitable for the survival of egg and larval stages.

(2) Evidence is presented to show that the spawning grounds of the dominant estuarine species are located inshore and in the vicinity of estuary mouths.

(3) Spawning is likely to occur in this environment so as to increase the chances of juveniles migrating into East Coast estuaries, instead of becoming transported to the less favourable South Coast region by the Agulhas Current.

(4) Certain small species do spawn in estuaries and seem to have overcome the problems associated with spawning in this environment by developing specialised reproductive mechanisms.

(5) The spawning season of the dominant estuarine species is during late autumn, winter and spring (May to November) (Fig.3.). It is suggested that this enables juveniles to migrate into estuaries before the summer rainfall season of strong river outflow.

(6) The dominant estuarine species have extended spawning seasons lasting 4 - 8 months. This prolongs the period of juvenile recruitment and appears to have a 'buffering' action against failure of recruitment as a result of droughts or unseasonal floods.

(7) Emigration of adult fish from estuaries is usually related to the need to spawn at sea. Many species migrate into estuaries during the post-spawning and inactive phases of their reproductive cycles.

The following points are worth mentioning about St. Lucia:

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(1) Spawning in the vicinity of St. Lucia estuary has been recorded for the main species as follows:

Species	Locality	Evidence
M. cephalus	Along local beaches and over narrow continental shelf.	Strong circumstantial.
P. commersonni	As above	Ripe running specimens.
R. saba.	" "	" "
Liza macrolepis	In vicinity of mouth	" "
Liza dumerili	" " " "	" "
A. berda	" " " "	" "
R. holubi	Along local beaches and over narrow continental shelf.	Circumstatial.
Valamugil cunnesius	Inshore in vicinity of mouth	Ripe running specimens

The above suggests that there might be a close relationship between inshore spawning in the vicinity of St. Lucia estuary and recruitment of juveniles into the system. However, the small size of the continental shelf in this area makes it probable that most of the recruits to St. Lucia are derived from spawning elsewhere. Evidence is presented by Wallace and van der Elst (1975; pages 21 & 22) which suggests this is more likely to be from the Tugela/Richards Bay continental shelf area than from the wide continental shelf in the vicinity of Delagoa Bay to the north.

(2) Evidence of spawning in the lake has been obtained for the following species:

Ambassis natalensis, Gilchristella aestuareus, Hyporhamphus knysnaensis, Solea bleekeri, Thryssa vitrirostris, and species of Gobiidae.

(3) Lengths at Sexual Maturity.

Data are summarized in Wallace 1975b (Table 4 and Fig.19).

Occurrence/....8

OCCURRENCE OF JUVENILES IN ESTUARIES
(Wallace & v.d Elst, 1975).

The following general points emerge:

(1) Juveniles of 54 species of fish have been recorded in Natal estuaries. Of these, twenty are angling species and ten non-angling species valuable as human food. Most of these species occur in St. Lucia.

(2) Estimates of early growth rates have been made for M. cephalus, P. commersonni, R. sarba, R. holubi and A. berda.

(3) Shallow areas that support marginal and submerged aquatic vegetation form particularly favourable habitats for juvenile fishes and play a major role in the function of estuaries as fish nurseries.

(4) Attention is drawn to the fact that juveniles of a number of important species start migrating into Natal estuaries at lengths of less that 2cm and complete their most active recruitment phase by the time a length of 5cm is attained. An additional 21 species start entering estuaries at lengths of between 1 - 6cm (Wallace & van der Elst, Figs. 22 & 23).

(5) In open estuaries most immigration takes place during winter and spring when river outflow is at a minimum and begins to increase at the start of the wet season.

(6) Evidence is presented to show that very large numbers of juveniles utilise the estuarine environment and then return to sea to supplement the marine stocks.

The following points are worth noting about St. Lucia:

(1) The lake forms the most important juvenile fish nursery area on the East Coast.

(2) In order to support a juvenile population it is essential that the access route from the sea is open during the winter and spring months of major estuarine recruitment.

(3) The size of the juvenile population is related to the extent

of / 9

of the submerged macrophytic and partially submerged marginal vegetation.

(4) Under hypersaline conditions the lake supported a large juvenile fish fauna relative to that in other Natal estuaries. The important ecological role of hippo in maintaining the nursery function under these circumstances has been described (Wallace & van der Elst 1975, Pages 15 & 16).

(5) In view of the size of the north lake relative to the south, and because juveniles of the most important species occur throughout the system, the overall productivity of St. Lucia is in large measure determined by hydrological conditions north of Fanies Island.

(6) Successful management of the north lake so as to maintain its viability as a fish nursery has a significance that extends to the whole of the Natal/Zululand coast, and beyond. The lake constitutes the major nursery area on the South African East Coast, and because all available evidence points to the dependence of the adult marine stocks upon estuarine juvenile stages, it can be predicted to have a very important role in maintaining the sport angling and food fish populations which constitute an as yet little exploited marine resource.

RECOMMENDATIONS FOR FUTURE RESEARCH

(1) Provided adequate funds and personnel can be made available, a tagging programme would be most worthwhile as it would serve to verify parameters assessed by other methods, such as growth rates, duration of utilization of St. Lucia lake by the different species, age at maturity, movements in and out of the lake and longshore migratory habits. Quantitative estimates of population size would be very valuable and an investigation into the feasibility of obtaining meaningful estimates would be worth considering.

(2) The biology of small species which breed in the lake was

only ./...10

only touched upon in the ORI programme. These species are very important to the ecology of the lake (eg. as food for predatory birds and fish) and could make a most worthwhile field of research yielding results applicable to management. Specializations enabling these species to breed under estuarine conditions would be interesting to study.

(3) Feeding studies designed to provide data for the investigation of energy flow would be desirable.

ACKNOWLEDGEMENTS

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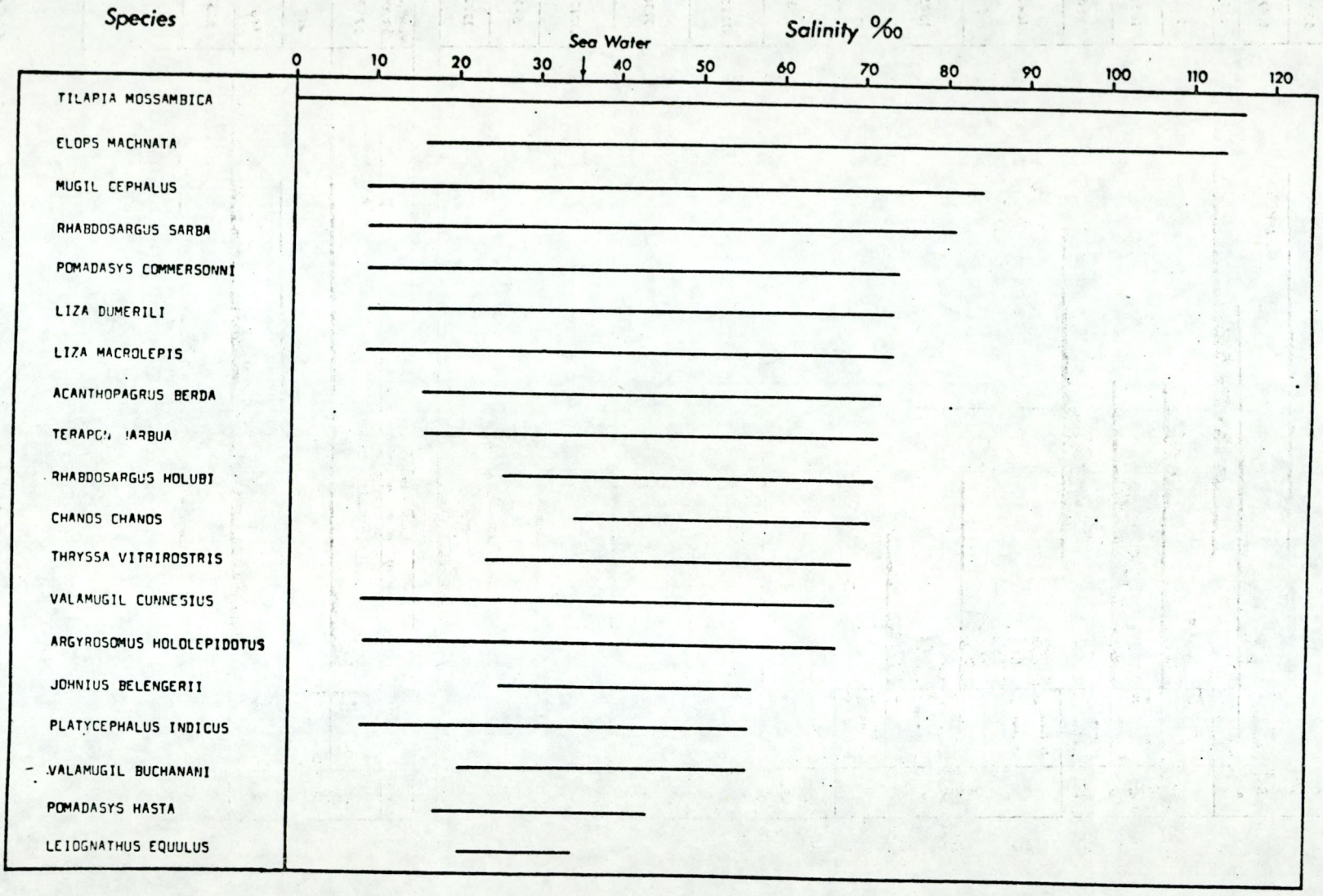

Figure 1. Ranges of salinity tolerance of species recorded in the St. Lucia lake system.

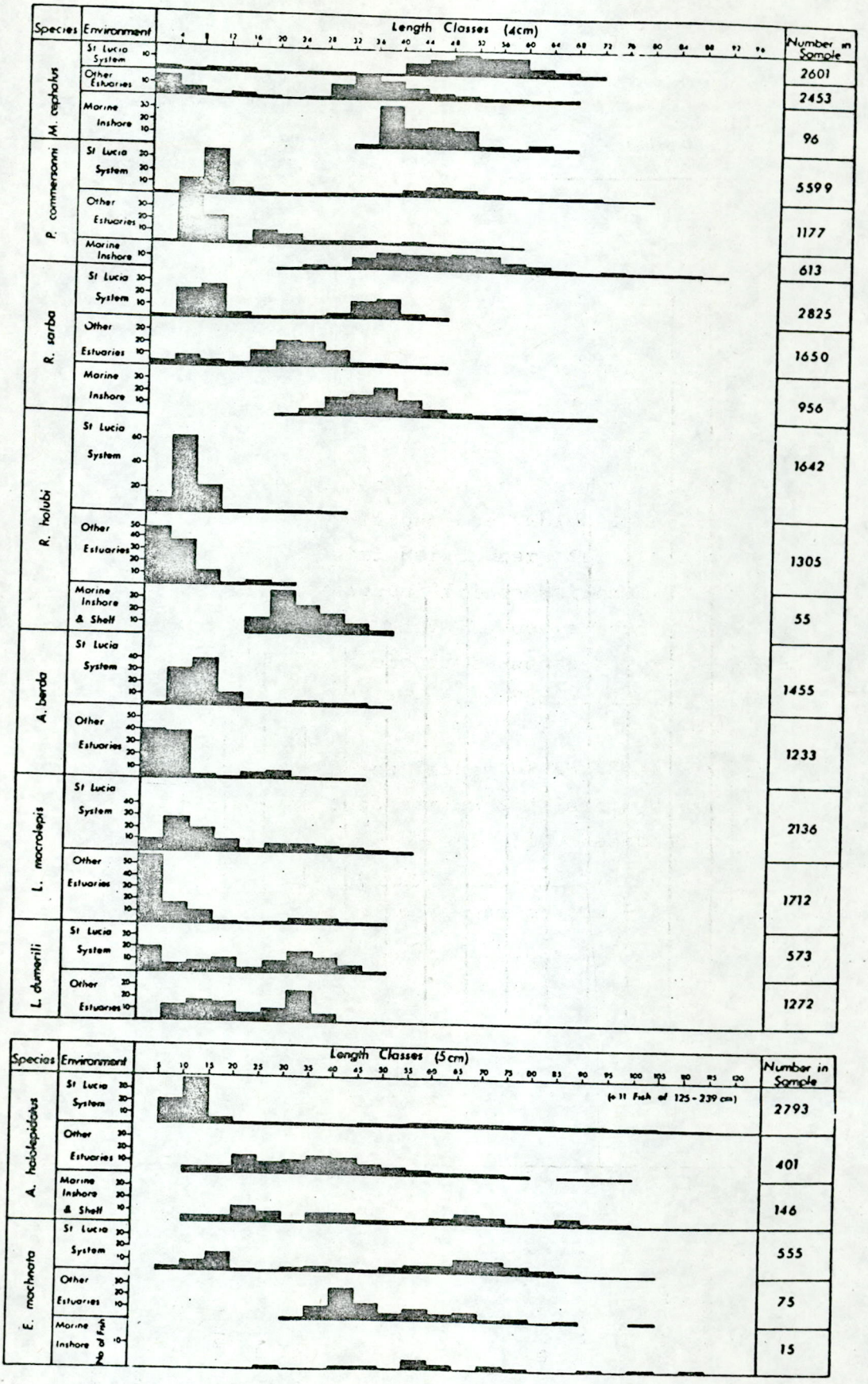

Figure 2. Percentage length composition of catches from different Natal environments.

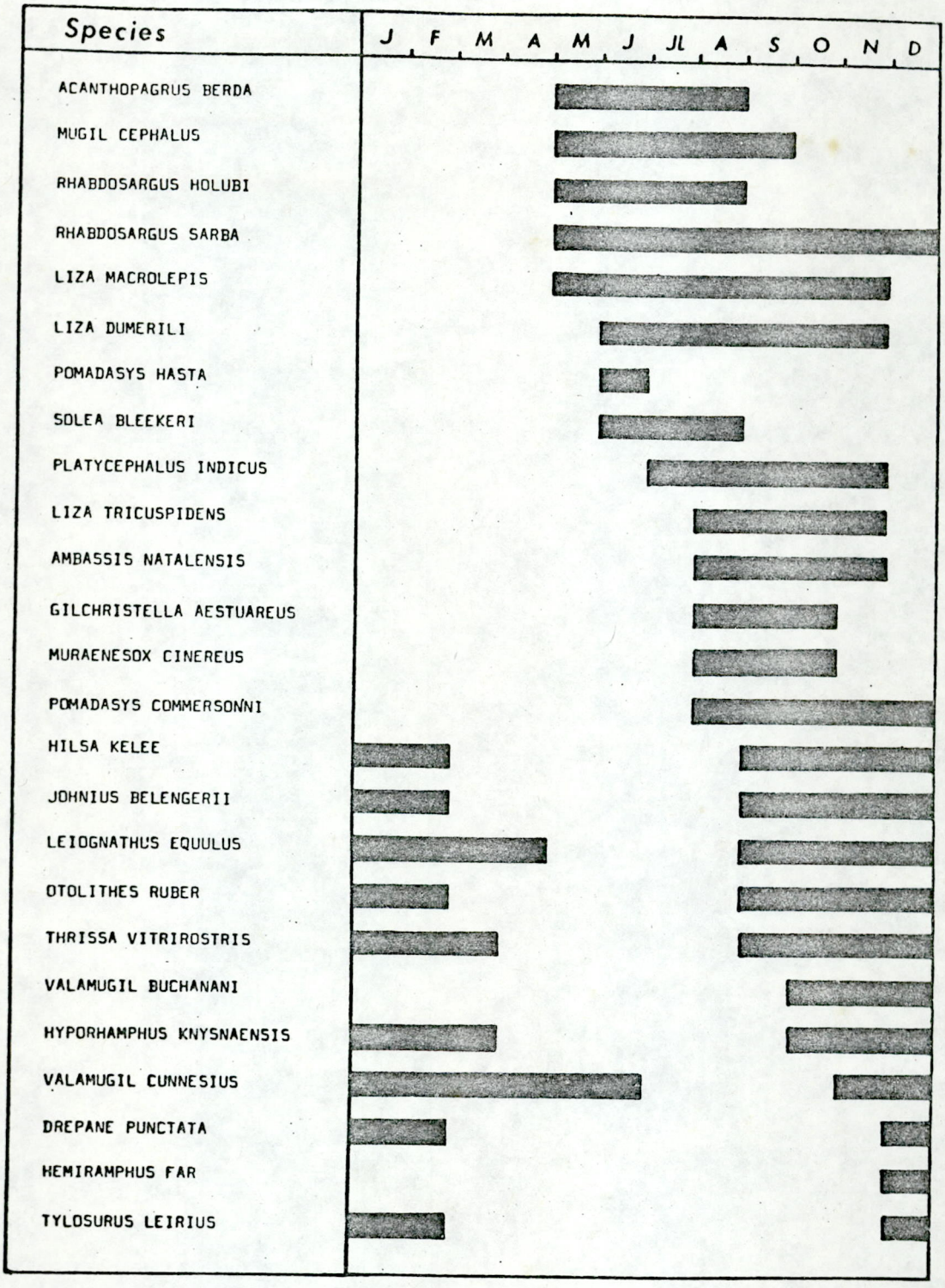

Figure 3. Synoptic presentation of data obtained on months of spawning of fish that occur in Natal estuaries.