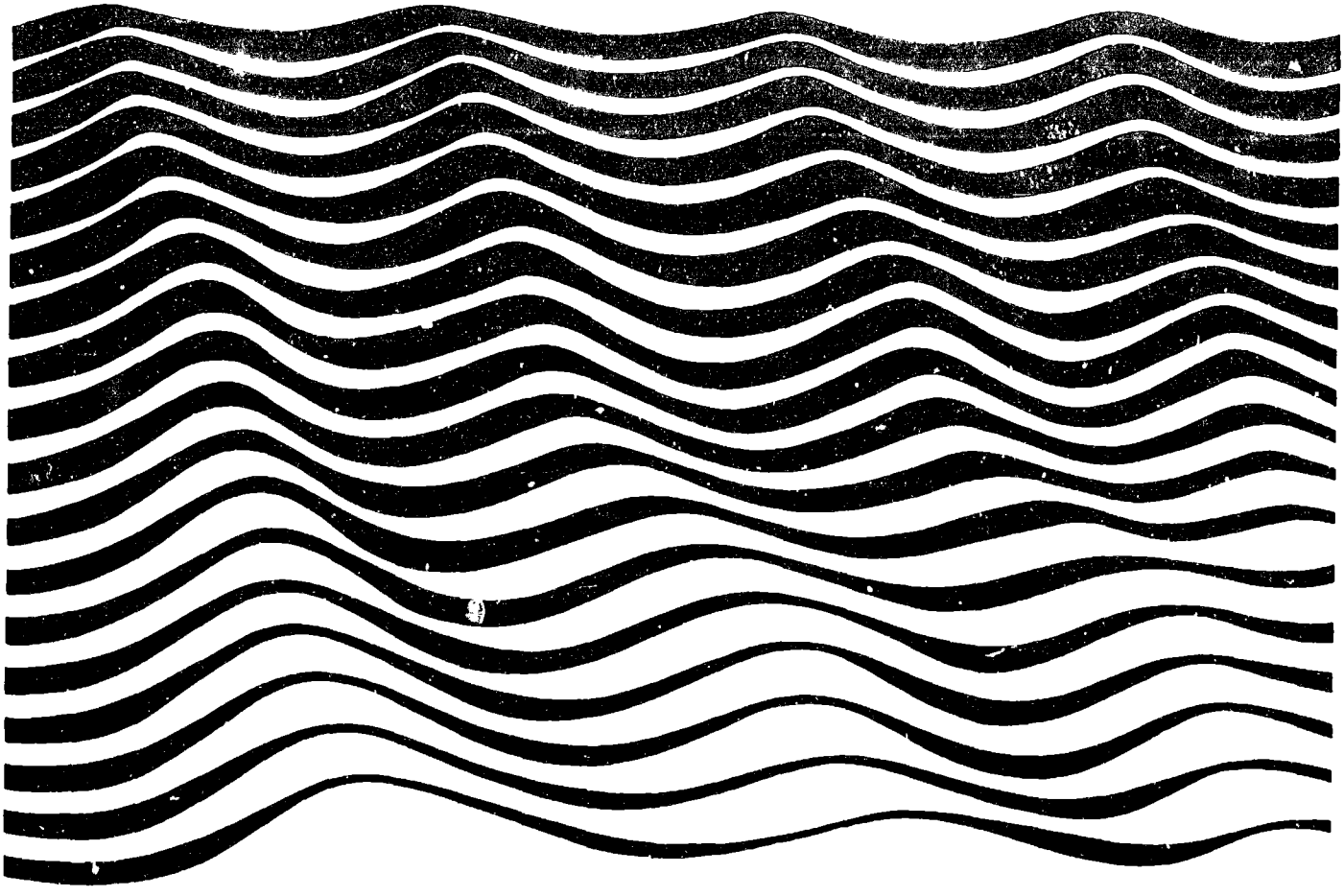
Unesco reports
in marine science 65

Ichthyoplankton study in Guinean and Senegalese coastal and estuarine waters

Results of surveys: 1988-1992
Prepared within the framework of
the African Coastal Marine Programme
(COMARAF)



UNESCO 1994

UNESCO REPORTS IN MARINE SCIENCE

For availability in microfiche form please write to:
UNESCO (DIT/AM), 7, place de Fontenoy, 75352 Paris 07 SP, France.
Out of stock titles are listed on the back cover.

No.		Year
4	Syllabus for training marine technicians. Report of an IOC/UNESCO workshop held in Miami, Florida, 22-26 May 1978. Available in English, French, Russian and Spanish	1979
5	Marine science syllabus for secondary schools. Report of an IOC workshop held at United World College of the Atlantic, United Kingdom, 5-9 June 1978. Available in Arabic, English, French, Russian and Spanish	1979
6	Organization of marine biological reference collections in the Mediterranean Arab countries. Expert meeting held in Tunis, 20-23 September 1978. Available in Arabic, English and French	1979
8	The mangrove ecosystem: Human uses and management implications. Report of a UNESCO regional seminar held in Dacca, Bangladesh, December 1978. English only	1979
9	The mangrove ecosystem: scientific aspects and human impact. Report of the seminar organized by UNESCO at Cali, Colombia, 27 November-1 December 1978. Available in English and Spanish	1979
10	Development of marine science and technology in Africa. Working Group of Experts sponsored by ECA and UNESCO, Addis Ababa, 5-9 May 1980. Available in English and French	1980
14	Marine science and technology in Africa: present state and future development. Synthesis of UNESCO/ECA survey missions to African coastal states, 1980. Available in English and French	1981
15	Fishery science teaching at the university level. Report of a UNESCO/FAO workshop on university curricula in fishery science, Paris, May 1980. Available in Arabic, English, French, Russian and Spanish	1981
20	Quantitative analysis and simulation of Mediterranean coastal ecosystems: The Gulf of Naples, a case study. Report of a workshop on ecosystem modelling, Ischia, Naples, Italy, 28 March to 10 April 1981. Organized by the United Nations, Educational, Scientific and Cultural Organization (UNESCO) and the Stazione Zoologica, Naples. English only	1983
21	Comparing coral reef survey methods. A regional UNESCO/UNEP workshop, Phuket Marine Biological Centre, Thailand, December 1982. English only	1983
22	Guidelines for marine biological reference collections. Prepared in response to a recommendation by a meeting of experts from the Mediterranean Arab countries. Available in English, French and Arabic	1983
23	Coral reefs, seagrass beds and mangroves: their interaction in the coastal zones of the Caribbean. Report of a workshop held at West Indies Laboratory, St Croix, U. S. Virgin Islands, May 1982. English only	1983
24	Coastal ecosystems of Latin America and the Caribbean. The objectives, priorities and activities of UNESCO's COMAR project for the Latin America and Caribbean region, Caracas, Venezuela, 15-19 November 1982. Available in English and Spanish	1983
25	Ocean engineering teaching at the university level. Recommended guidelines from the UNESCO/IOC/ECOR workshop on advanced university curricula in ocean engineering and related fields, Paris, October 1982. Available in English, French, Spanish, Russian, Arabic and Chinese	1983
26	Global survey and analysis of post-graduate curricula in ocean engineering. English only	1984
28	Oceanographic modelling of the Kuwait Action Plan (KAP) Region. Report of symposium/workshop, University of Petroleum and Minerals, Dhahran, Kingdom of Saudi Arabia, 15-18 October 1983. English only	1984
29	Eutrophication in coastal marine areas and lagoons: a case study of 'Lac de Tunis'. Report prepared by Dr M. Kelly and Dr M. Naguib. English only	1984
30	Physical oceanography of the Eastern Mediterranean: an overview and research plan. Report of a workshop held in Lerici, La Spezia (Italy), September 1983. English only	1984
31	MABAHISS/John Murray 50th anniversary: Marine science of the North West Indian Ocean and adjacent waters. Report of a symposium on the occasion of the 50th anniversary of the MABAHISS/John Murray Expedition (1933/34), University of Alexandria, Egypt, 3 to 7 September 1983. English only	1985
32	L'estuaire et la mangrove du Sine Saloum. Résultats d'un Atelier régional UNESCO-COMAR tenu à Dakar (Sénégal) du 28 février au 5 mars 1983. French only	1985
33	Coral taxonomy. Results and recommendations of a regional UNESCO (COMAR)/UNEP workshop with advanced training Phuket Marine Biological Centre, Thailand, 10-26 February 1984. English only	1985
34	Bibliography on coastal lagoons and salt marshes along the Southern Mediterranean coast (Algeria, Egypt, Libya, Morocco, Tunisia). Available in Arabic, English and French	1985
37	Principles of Geological Mapping of Marine Sediments (with special reference to the African continental margin). Available in English and Russian	1986
39	Development of marine sciences in Arab Universities. Meeting of experts held at the Marine Science Station Aqaba, Jordan, 1-5 December 1985. Available in Arabic, English, French	1986
40	Human induced damage to coral reefs. Results of a regional UNESCO (COMAR) workshop with advanced training, Diponegoro University, Jepara and National Institute of Oceanology, Jakarta, Indonesia, May 1985. English only	1986
41	Caribbean coastal marine productivity. Results of a Planning Workshop at Discovery Bay Marine Laboratory, University of the West Indies, Jamaica, November 1985. English only	1986
42	The application of digital remote sensing techniques in coral reef, oceanographic and estuarine studies. Report on a regional UNESCO/COMAR/GBRMPA Workshop, Townsville, Australia, August 1985. English only	1986
43	Quaternary coastal geology of West Africa and South America. Papers prepared for the INQUA-ASEQUA Symposium in Dakar, April 1986. Available in English only	1987
44	Physical oceanography of the Eastern Mediterranean (POEM): Initial Results UNESCO/IOC First POEM Scientific Workshop, Erdemli, Turkey, 16-20 June 1986. English only	1987
45	Marine science teaching and training at first degree (undergraduate) level. Recommended guidelines from a UNESCO workshop on university curricula, Paris, November 1986. Available in Arabic, Chinese, English, French, Russian, Spanish	1987
46	Comparison between Atlantic and Pacific tropical marine coastal ecosystems: community structure, ecological processes, and productivity. Results and scientific papers of a UNESCO/COMAR workshop, University of the South Pacific, Suva, Fiji, 24-29 March 1986. English only	1987
47	Temperate coastal systems of Latin America. Report on meeting on COSALC Pilot Project No. VII, November 1986. Spanish only	1987
48	Coastal marine ecosystems of Africa. Objectives and strategy of the COMARAF Regional Project English only	1988

Cont'd on inside of back cover

UNESCO reports
in marine science 65

Ichthyoplankton study in Guinean and Senegalese coastal and estuarine waters

Results of surveys: 1988-1992
Prepared within the framework of
the African Coastal Marine Programme
(COMARAF)

M. Y. Tamoikine
Institute of Biology of the Southern Seas
Academy of Sciences of the Ukraine
2 Nakhimov Avenue
Sevastopol, 33500 Crimea
The Ukraine

D. Pandaré
Département de Biologie Animale
Faculté des Sciences et Techniques
Université C.A. Diop de Dakar
Senegal

UNESCO 1994

ISSN 0253-0112

Published in 1994
by the United Nations Educational,
Scientific and Cultural Organization,
7, place de Fontenoy, 75352 Paris 07 SP
Printed in UNESCO's workshops.

PREFACE

UNESCO Reports in Marine Science are designed to serve specific programme needs and to report on developments in projects conducted in the context of UNESCO's marine science-related activities.

Designed to serve as a complement to the *UNESCO Technical Papers in Marine Science*, the systematic distribution of *Reports* **is restricted to libraries** of oceanographic institutions and governmental authorities, and documentation centres. Individual requests from specialists will, however, be examined by the Marine Information Centre and dealt with on a selective basis.

Requests for specific titles or additions to the mailing list should be addressed to:

Marine Information Centre
UNESCO
1 rue Miollis
75732 Paris Cedex 15
France

Abstract:

From 1988 to 1992 ichthyoplankton investigations were carried out in Guinea and Senegal, in shallow coastal and estuarine brackish or fresh waters, using a newly developed horizontal-traction fishing gear with microscopic meshes, thus allowing to collect embryonic stages of ichthyofauna (eggs), larvae and juveniles.

The areas investigated include the marine shallow coastal waters of Kaloum (Conakry), Cap Vert (Dakar) and coastal rivers such as Casamance, Sénégal, Fatala, Konkouré and Tabounsou Rivers, the salinity rates of which are very variable.

Of the ichthyoplanktonic samples, we found common groups that are caught by artisanal and industrial fisheries in West Africa, from Mauritania to Nigeria. The identification and spatio-temporal distribution of ichthyoplanktonic population have been done taking account of abiotic factors prevaling in the areas surveyed. The various larval and juvenile stages were clearly specified as well as morphometric and meristic data of 15 of the 40 fish families sorted.

Keywords: West Africa, Guinea, Senegal, Ichthyoplankton, larva, juvenile, estuarine, mangrove, distribution, composition, horizontal traction, quantitative estimate, catch level.

Résumé:

Des recherches ichtyoplanctoniques ont été conduites en Guinée et au Sénégal dans les eaux côtières et estuariennes peu profondes, marines, saumâtres ou douces. La pêche a été effectuée grâce à un nouveau type de filet ichtyoplanctonique à traction horizontale et à mailles microscopiques permettant de récolter des oeufs, larves et juvéniles de poissons.

Les zones prospectées comprennent les eaux côtières marines peu profondes des presqu'île du Kaloum (Conakry), du Cap-Vert (Dakar) et les fleuves côtiers comme la Casamance, le Sénégal, le Fatala, le Konkouré et le Tabounsou dont les taux de salinité sont très variables.

Dans les captures, nous avons trouvé des groupes communs exploités largement en pêche artisanale et industrielle en Afrique de l'Ouest, de la Mauritanie au Nigéria. L'identification des espèces de même que leur distribution spatio-temporelle ont été associées aux paramètres abiotiques régnant dans les zones étudiées. Les différents stades larvaires rencontrés ont été précisés de même que les analyses morphométriques et méristiques de 15 des 40 familles recensées.

Mots clefs: Afrique de l'Ouest, Guinée, Sénégal, Ichtyoplancton, juvénile, estuarien, mangrove, distribution, composition, traction horizontale, estimation quantitative, niveau de capture.

Resumen:

Entre 1988 y 1992 se llevaron a cabo investigaciones sobre el ictioplancton en aguas costeras poco profundas y de estuario, salobres y dulces, de Guinea y Senegal, utilizando un nuevo aparejo de pesca de tracción horizontal con redes microscópicas que permiten capturar ejemplares de la ictiofauna en estado embrionario (huevas), larvas y alevines.

Las zonas estudiadas comprendían las aguas costeras marinas poco profundas de Kaloum (Conakry) y Cap-Vert (Dakar) y ríos costeros como el Casamance, el Senegal, el Fatala, el Konkoure y el Tabounsou, cuyos niveles de salinidad son muy variables.

Entre las muestras de ictioplancton, encontramos grupos comunes como los que explotan las pesquerías artesanales e industriales de Africa occidental, de Mauritania a Nigeria. La identificación de la población de ictioplancton y su distribución espacio-temporal se efectuaron tomando en cuenta los factores abióticos predominantes en las zonas estudiadas. Se precisaron claramente las diferentes fases de larvas y alevines y los datos morfométricos y merísticos de 15 de las 40 familias de peces identificadas.

Palabras clave: Africa occidental, Guinea, Senegal, ictioplancton, larva, alevín, estuario, manglar, distribución, composición, tracción horizontal, estimación cuantitativa, nivel de captura.

Резюме:

С 1988 г. по 1992 г. в Гвинее и Сенегале в малосоленых и пресных водах прибрежного мелководья и эстуариев проводилось изучение их ихтиопланктона. При этом использовался новый тип невода горизонтальной проводки с микроскопическими ячейками, что позволило обеспечить сбор их ихтиофауны на стадии эмбрионов (икра), личинок и мальков.

Обследованные районы включали морское мелководье прибрежных районов Калума (Конакри), Зеленого Мыса (Дакар), а также такие прибрежные реки, как Казаманс, Сенегал, Фатала, Конкуре и Табунсу, с самыми различными уровнями солености.

В заборах ихтиопланктона были обнаружены группы общего характера, служащие объектом промышленного и полупромышленного рыболовства в Западной Африке, от Мавритании до Нигерии. Идентификация и пространственно-временное распределение популяции ихтиопланктона осуществлялись с учетом абиотических факторов, превалирующих в обследованных районах. Были уточнены различные стадии созревания личинок и мальков, а также морфометрические и меристемные данные в 15 из 40 отобранных семейств рыб.

Ключевые слова: Западная Африка, Гвинея, Сенегал, ихтиопланктон, личинка, малек, эстуарий, мангровые, распределение, состав, горизонтальная проводка, количественная оценка, уровень улова.

مستخلص

أجريت من عام ١٩٨٨ الى عام ١٩٩٢ في غينيا والسنغال، في المياه الساحلية الضحلة ومياه المصبات الخليجية المالحة أو العذبة، استقصاءات بشأن العوالق السمكية، باستخدام جهاز للصيد أفقي السحب جرى تطويره مؤخرا وهو مزود بشباك مجهرية الفتحات، مما يتيح جمع كائنات من الأحياء السمكية في المراحل الجنينية (البيض) واليرقات وصغار السمك.

ومن بين المناطق التي تم الاستقصاء فيها المياه الشاطئية البحرية الضحلة في كالوم (كوناكري)، والرأس الأخضر (داكار) والأنهار الساحلية مثل كازامانس والسنغال وفاتاليه وكونكوريه وتابونسو، وهي أنهار تتسم بمعدلات من الملوحة شديدة التباين.

وفي عيّنات العوالق السمكية، وجدنا مجموعات مألوفة يتم صيدها بأساليب الصيد الحرفية والصناعية في افريقيا الغربية، من موريتانيا الى نيجيريا. ولقد جرى تحديد مجتمعات العوالق السمكية وتوزيعها مكانيا وزمنيا بمراعاة العوامل اللاحيوية السائدة في المناطق المدروسة. وقد حددت بوضوح مختلف مراحل نمو اليرقات وصغار السمك وكذلك البيانات الخاصة بقياس الشكل والتطور الهيكلي لخمسة عشر صنفا من أصناف الأسماك التي تم حصرها. الكلمات التي تستخدم لمداخل: افريقيا الغربية، غينيا، السنغال، العوالق السمكية، يرقة، صغار السمك، المصبات الخليجية، المنغروف، التوزيع، التركيب، السحب الأفقي، التقدير الكمي، مستوى الصيد.

摘　　要

自1988年至1992年，在几内亚和塞内加尔的沿海和河口半咸水浅水域或淡水域进行了鱼类浮游生物考察，由于采用的是带微小网眼的新式卧式牵引渔具，因此收集到了胚胎阶段的鱼卵（卵细胞）、幼体和初生鱼。

考察地区包括卡卢姆（科纳克里）、佛得角（达喀尔）沿海浅水域和诸如卡萨芒斯河、塞内加尔河、法塔拉河、孔库雷河和 Tabounsou河等沿海河流，这些地区的含盐量差别很大。

从这些鱼类浮游生物标本中，我们发现，从毛里塔尼亚到尼日利亚的这个西非地区，手工渔场和工业渔场捕捞到的鱼类浮游生物是相同的。我们已对这些鱼类浮游生物作了鉴定并调查了它们的时空分布情况，同时也调查了考察地区的非生物的情况。我们还对幼体和初生鱼的各阶段作了明确划分并对40种鱼类中的15种鱼类的形态测定数据和鱼体分节数据进行了整理。

主题词：西非、几内亚、塞内加尔、鱼类浮游生物、幼体、初生物、河口、红树林、分布、组成、卧式牵引、定量测定、捕捞量。

INTRODUCTION

The purpose of this paper is to present a preliminary ichthyoplanktonic survey in West Africa, from the Guinean to the Senegalese coastal and estuarine shallow waters. The investigations focused more particularly on ichthoplanktonic composition and distribution, in order to better assess the areas of spawning, growing and nursery concentration commercially important for artisanal and industrial fisheries.

Shallow coastal and estuarine areas represent very important spawning and nursery habitats for many fishes (Dovel, 1971; Weinstein, 1979; Weinstein and Brooks, 1983; Boesch and Turner, 1984; Boehlert and Mundy, 1988). Estuaries in both northern and southern hemispheres are the locus for the development of a range of marine species (Cronin and Mansueti, 1971; Dando, 1984; Wallace *et al.*, 1984). Although some of these species migrate into the systems as juveniles (e.g. de Silva, 1980; Potter *et al.*, 1988; and 1990), others enter as larvae (Misitano, 1977; Beckley, 1986; Miskiewiez, 1986; Whitfield, 1989). Upstream movement and retention of larvae within estuaries depend to a large extent on mechanisms involving active and/or passive tidal transport (Weinstein *et al.*, 1980; Fortier and Leggett, 1982; Norcross and Shaw, 1984; Roper, 1986; Boehlert and Mundy, 1988). The distance these larvae have to cover from the spawning areas to their nursery habitats within the estuarine systems is insignificant in the case of species spawning near or within estuary mouths (Gaughan *et al.*, 1990). Typically only a few species spawn within the main bodies of estuaries (Haedrich, 1983; Dando, 1984). Many studies focus on the use of estuarine habitats by juveniles rather than by specimens at earlier life stages. The spatio-temporal distribution of fishes at early life stages has been reported in sounds and bays (Pearcy and Richards, 1962; Herman, 1963; Crocker, 1965; Dovel, 1981; Dokken *et al.*, 1984; Roper, 1986; Bourne and Govoni, 1985), in seagrass beds (Carr and Adams, 1973; Olney and Boehlert, 1988), in intertidal brooks (Shenker and Dean, 1979; Weinstein, 1979; Bozeman and Dean, 1980), in high marsh pools (Kneib, 1984; Talbot and Able, 1984), and in surfing zones (Modde and Ross, 1981; Ruple, 1984). All these habitats appear to be important for the staging and growth of fishes. As far as ichthyoplankton food, and protection from predators are concerned, the respective role of these habitats is still unclear (Boesch and Turner, 1984; O'Neil and Weinstein, 1987).

Most estuarine ichthyoplankton studies have been based on time series of about one year, with the exception of Able (1978), and Holt and Strawn (1983), who compared the patterns of larval fish abundance over periods of about 3 years. Long-term investigations are essential in documenting and interpreting interannual variations of the timing and magnitude of larval recruitment (Allen and Barker, 1990).

The specific objectives of this study are to:

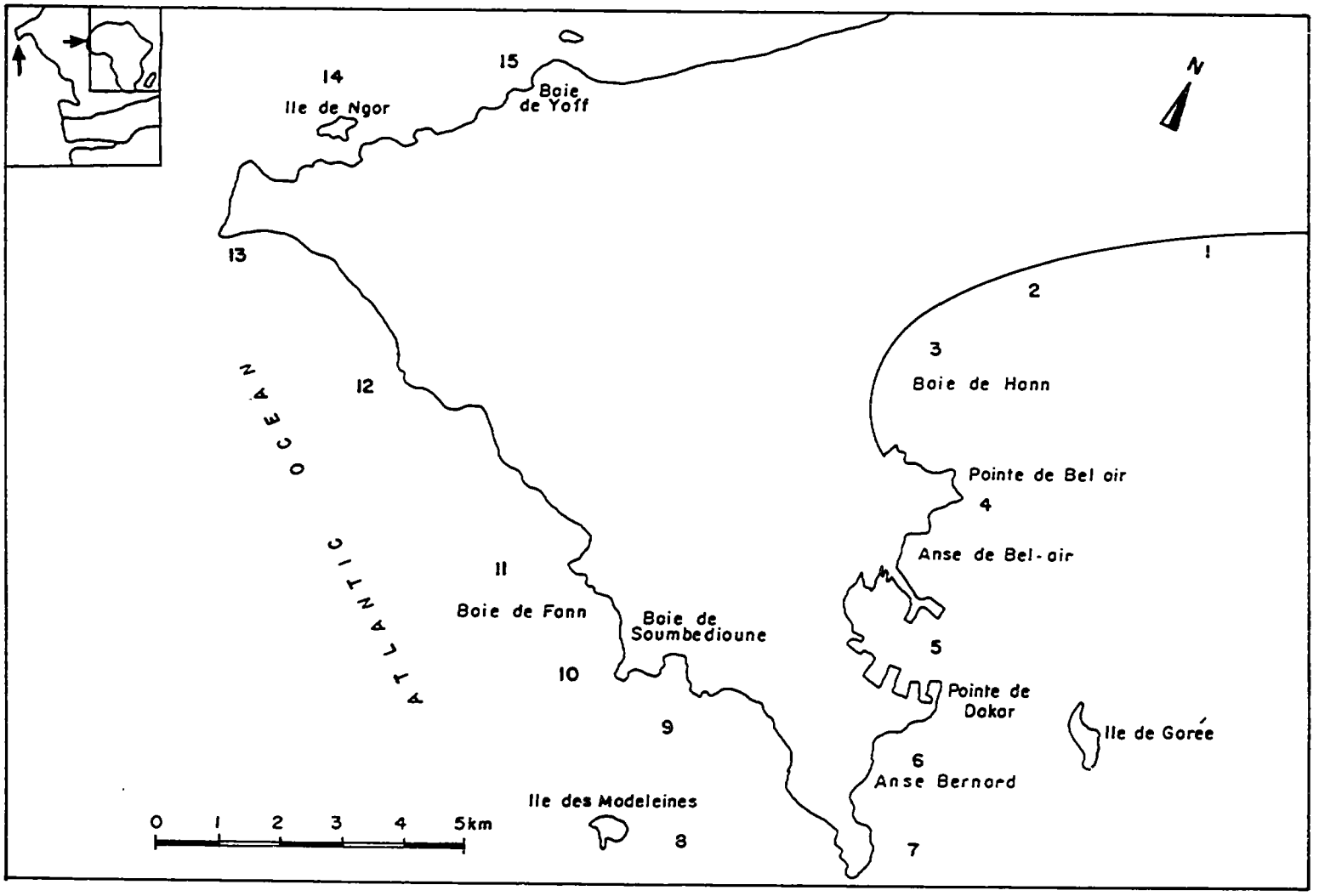


FIG. I - SAMPLING STATIONS AROUND CAP VERT PENINSULA (DAKAR)

1°) describe the species or family composition of fish larvae found in the areas prospected;
2°) establish their comparative abundance in all areas studied; and,
3°) describe the spatio-temporal distribution of ichthyoplankton in relation to the physical characteristics of the sites studied.

During investigations the team collected many samples, using a new fishing net with an horizontal traction gear well adapted to very shallow coastal and estuarine waters.

MATERIALS AND METHODS

The areas prospected include two different ecologycal types:

1 - open coastal marine areas of the Cap-Vert (Fig. 1) and Kaloum (Fig. 2) Peninsulae, respectively in Dakar and in Conakry. The mean salinity is constant year-round, about 35‰;
2 - estuarine mangrove zone in Guinea: Fatala, Konkouré and Tabounsou Rivers (Fig. 2 and 3) and estuarine damaged mangrove zone in Senegal: Casamance and Senegal Rivers (Fig. 4 and 5).

For each site prospected the following data were collected: date, hour, tidal process, season, distance from the coast, trawled distance, depth (before and after trawling), trawled area, trawling duration, bottom-, middle- and surface-layer salinity, pH, concentration rate of dissolved oxygen, temperature, type of sediments, etc.

The trawling technique was applied in such a way as to make possible the sampling at different levels, from surface to bottom. Implementing this new technique has been possible thanks to the horizontal-traction gear of the fishing net, thus allowing a larger sampling volume. The net is referred to as Towed Closing Ichthyoplankton Trap (TCIT), and was developed by Tamoikine and Sy-Savane (1989) (Fig. 6). It may also be used in other aquatic environments (lagoons, bays, etc.).

Sampling is done in a determined water column, thus making it is easy to estimate the trawled volume for a quantitative and qualitive evaluation of species sampled (Pandaré and Tamoikine, 1993). There are two TCIT types: TCIT -1 with a surface of 0.1 m^2 (0.5 m x 0.2 m) and TCIT-2 with a surface of 0.2 m^2 (0.8 m x 0.25 m). The size of a mesh is 336 μm. Hauls of 5 or 10 minutes have been made at collection localities, at constant speed. The hauls were horizontal, and the hauls depth and collecting level were taken.

TCIT-1 was used for collection (Fig. 6) with the needed modifications. The right-angle form of the mouth and arches about lateral sides were the major modifications.

Ichthyoplanktonic investigations using TCIT-1 were carried out with small boats and manual winches. For a good escapement of materials at a low speed, it is preferable to use

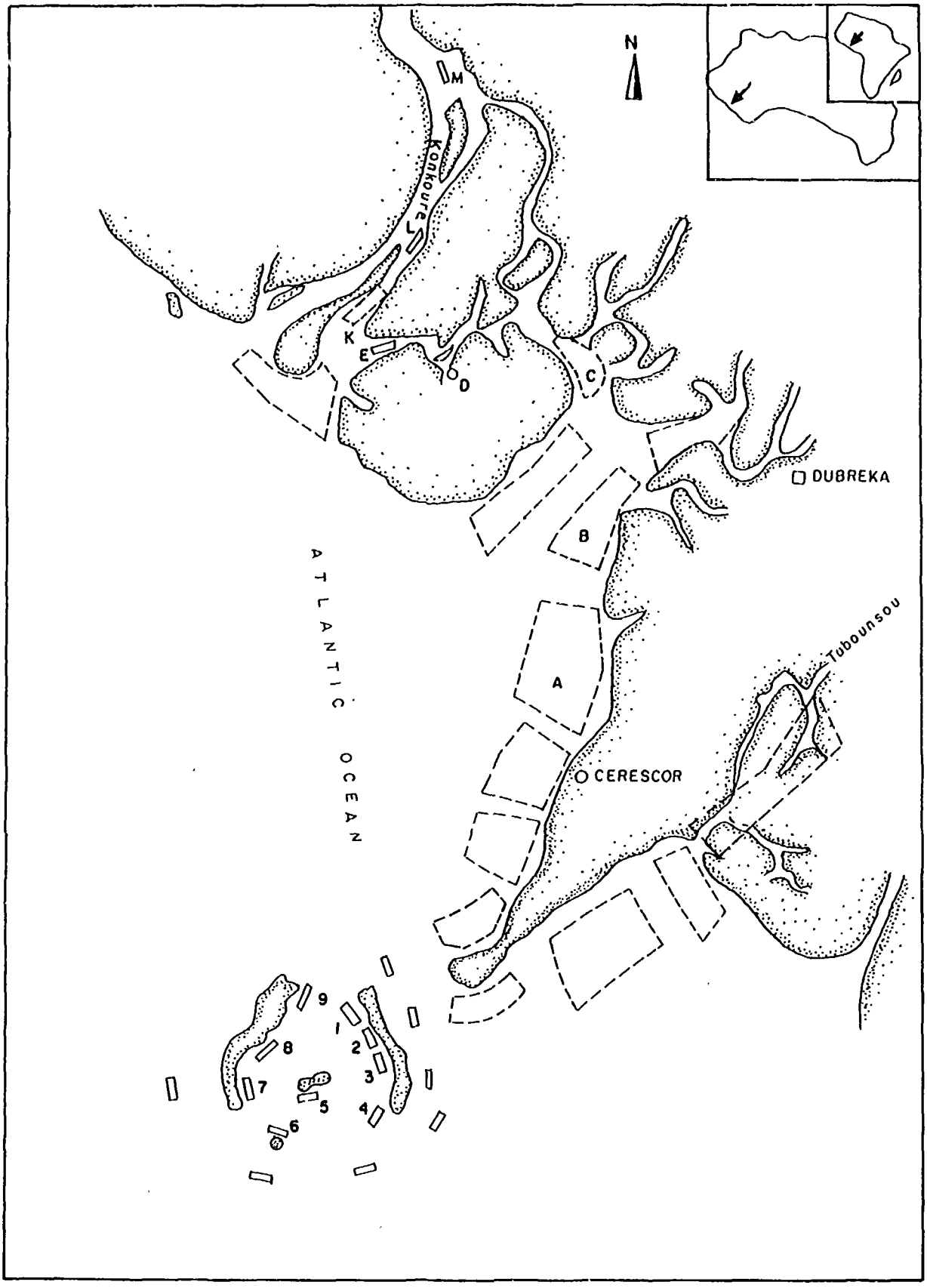


FIG. 2 - STUDY SITE IN THE LOOS ISLANDS, THE KONKOURE AND TABOUNSOU ESTUARIES

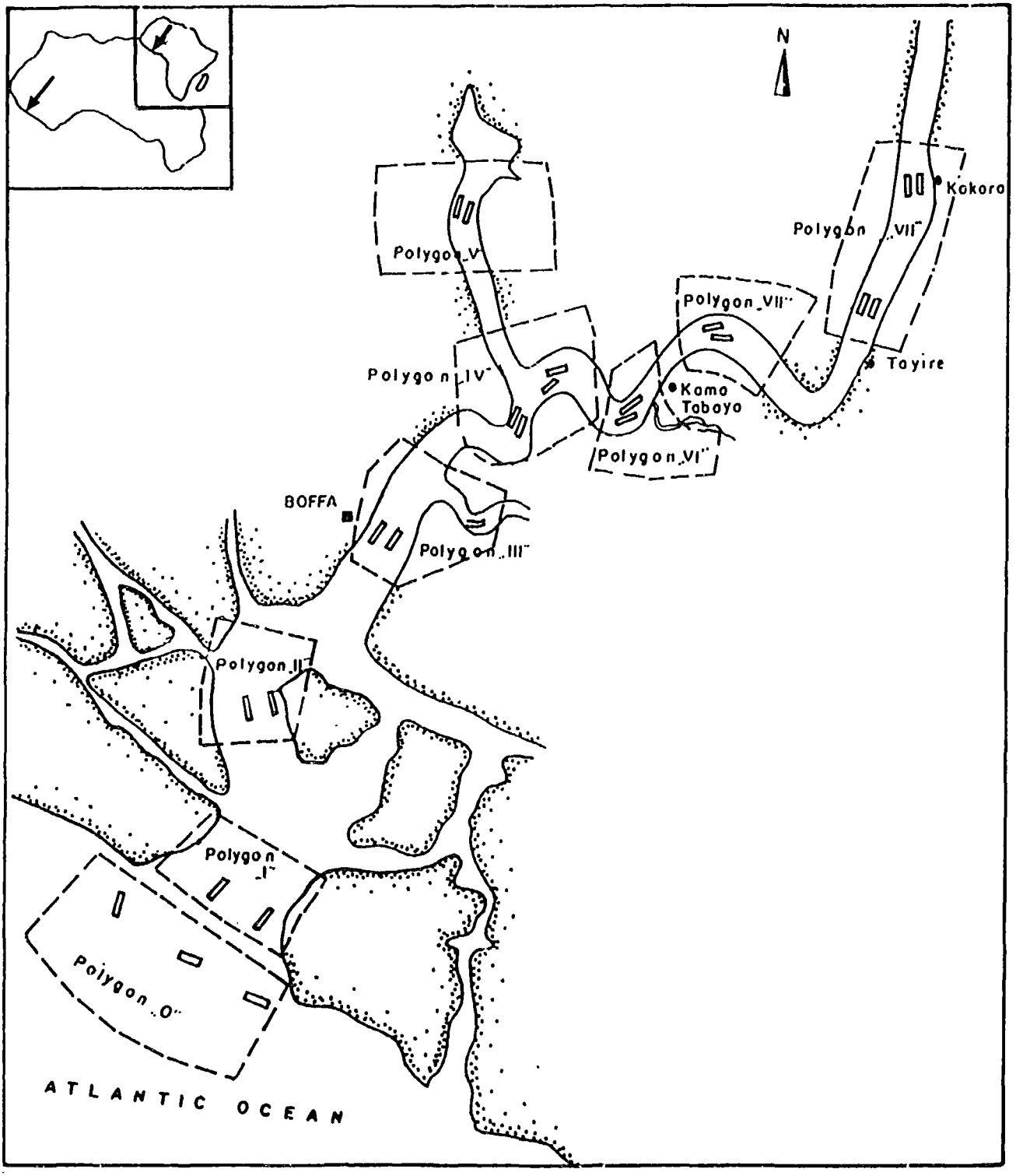


FIG. 3 - SAMPLING STATIONS IN THE FATHALA RIVER AND NEAR-SHORE MANGROVE ZONE

artificial penoplast as floater; valuable results were obtained with this gear in all types of shallow coastal marine zones in Guinea, Senegal, and also in the Black Sea.

The TCIT-2 is equipped with electric winches and the catching capacity is approximately 200 kg. The mouth area may vary from 0.6 m^2 to more. Big boats or vessels are needed for using this net.

Also included in the equipment used are:

- a general oceanic flowmeter, trade mark 2030, with rotor standard SC 030-R filtered at the middle of the trap's mouth;
- manual winches with a reel of 0.5 mm of diameter;
- plasticized mettallic cables of diameter of 5.5 mm;
- an hydrobiological lens, GOST 05652 model;
- a saddling load (0.8 - 1.2 kg);
- a protractor;
- a depth-meter, ECHOTEST 200 model;
- a funnel for the sampled collection, and bottles containing formalin solution;
- equipment for the observation of abiotic factors such as pH, temperature, salinity, oxygen, conductivity, etc.

The collecting level is obtained using the following formula:

$$H = L.\cos \alpha, \text{ where:}$$

H represents the catching level (depth):
L the total length of the line or cable; and
α the angle between the towed cable and the vertical line of the cable.

In fact, the towing level is closely connected with both the length of cable and the angle formed by this latter with respect to water surface; H depends on the length of released cable and the angle formed by the cable, which depends on the speed of the boat.

For the total filtreted water, the coefficient F is determined using two flowmeters located inside and outside the trap, as advised by Trauter and Smith (1968), and by Morrison-Cassie (1968):

$$F = \frac{W}{A \cdot D} = \frac{V'}{V} \text{ . where:}$$

A is the sampling mouth area;
D the towed distance ;
V the towing velocity;

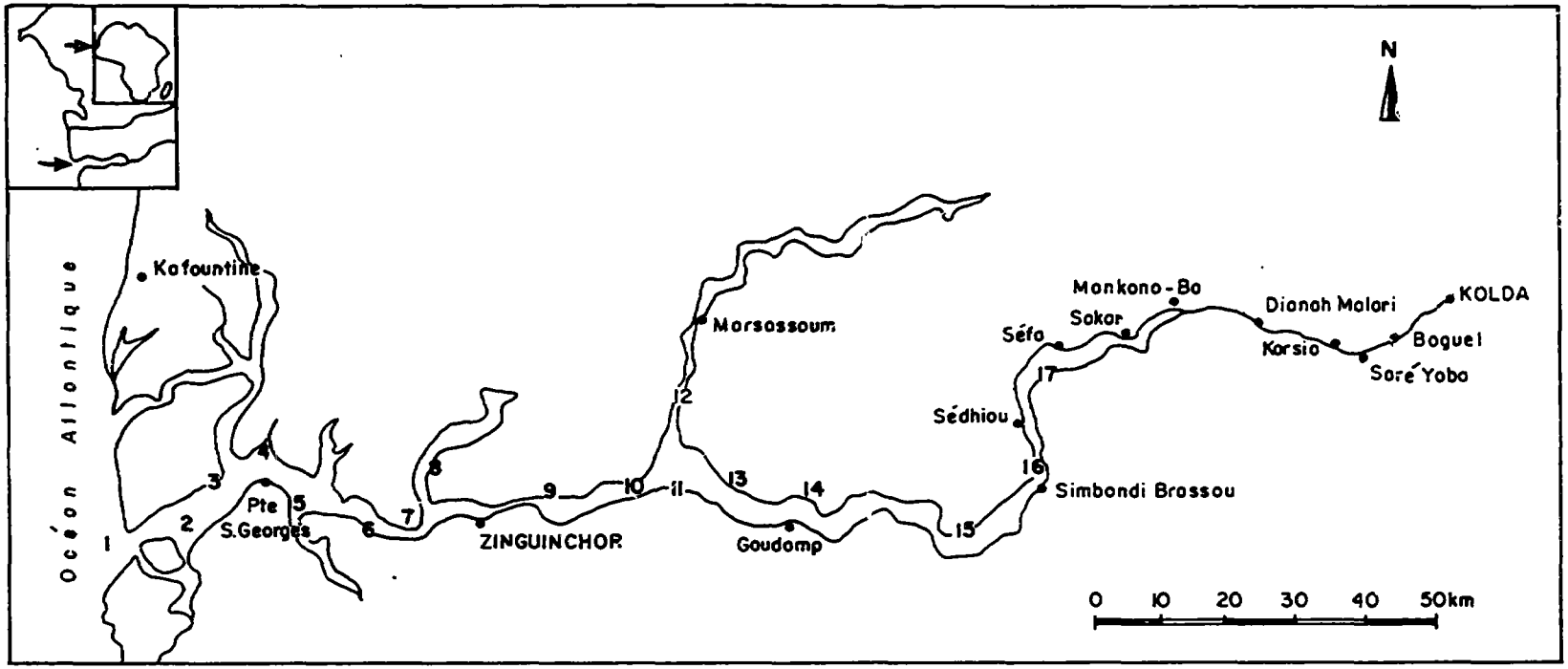


FIG.4 - SAMPLING STATIONS IN CASAMANCE RIVER

V' is the mean velocity of the flow through the sampling mouth. It is accepted that for the gears used, F is respectively about 0.84 and 0.68 for TCIT-1 and TCIT-2.

The collecting efficiency (C) is expressed by the following equation:

$$C = \frac{x}{y \cdot s}$$, where

x is the quantity of plankton collected;
y the number of specimens caught in natural conditions; and,
s, mesh selectivity.

Table 1 - Approximate Meanings of the TCIT Collecting Efficiency (C).

	CLASS SIZE OF PLANKTON IN MM				
	≤ 2.0	2.1 - 10.0	10.1 - 20.0	20.1 - 40.0	≥ 40.1
TCIT - 1	0,86	0,79	0,71	0,56	0,47
TCIT - 2	0,86	0,77	0,60	0,40	0,30

Furthermore, it is possibile to use these traps for investigations in other hydrobiological regions. Qualitatively and quantitatively, planktonic organisms were very important. In addition to the ichthyoplankton, there were many species of macro- and meso-zooplankton such as Polychaeta, Copepoda, Decapoda, Stomatopoda, lobsters, larvae and juveniles, adult crabs, and many other specimens. The optimal size of the hydrobionts caught ranged from 8 to 15 mm for fishes, shrimps, lobsters, Cephalopods and crabs.

A quantitative estimation of the collection was done. The fish samples were identified in laboratory, through binocular lenses. The samples belong to four main groups in relation to their life history with tidal zone. Some proposals for developing the methodology so as to obtain better quantitative estimations have been suggested for the next survey.

The taxonomic identification, the developing stages and the short description of some morphometric and meristic characteristics have been made using a binocular microscope (family, genus and species). The lengths were taken in mm: total length (L), standard length (l), head length (lH), preanal length (lA), body height (Hm), eye diameter (Ø). The fins are represented by initials: D (dorsal), A (anal), C (caudal), P (pectoral) and V (pelvic) (*See Table on morphometric and meristic data in Annex I*).

Four larval stages were distinguished. The different stages were specified and are present in more or less advanced state:

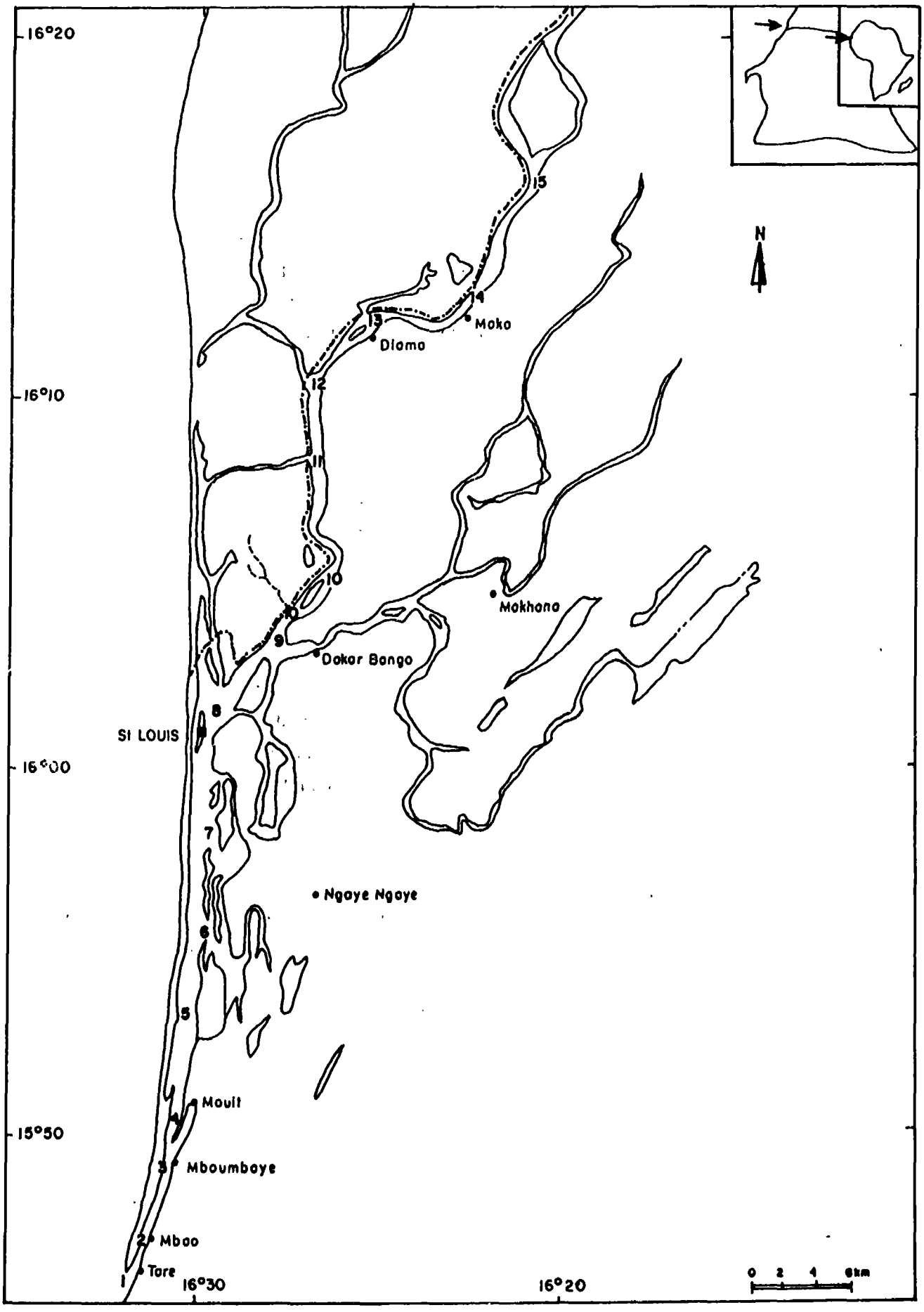


FIG. 5 - SAMPLING STATIONS IN SENEGAL RIVER

- Stage I: pre-larvae or larvae after the stage of embryonic development, characterized by the disappearance of the yolk sac or double feeding. Fins run most of the length of the body and unite with the caudal fin, except for the pectoral fins.

- Stage II: larvae with the rays of the dorsal fins taking shape, later on the other fins.

- Stage III: post-larvae with all the fins distinctly individualized and other signs characteristic of adult fish are also noticeable, e.g. small scales present on some parts of the body, greasy eyelid - uncommon when full development is achieved pigmentation, etc). Sometimes rudimentary larval elements can be seen. The pigmentation of the body differs from adults'.

- Stage IV: juveniles with features of adult fish: all the morphological and anatomic characteristics are present. The difference, however, lies in factors such as the proportions of the body, behaviour, and physiology (feeding, reproduction, etc.). At this level sexual maturity is not reached.

The taxonomic identification is made using manuals (Marchal, 1969 ; Blache, Cadenat and Stauch, 1970; Aboussouan,1972a and b; 1974; 1975; Moser, 1981; Vidy and Frank, 1987; Tamoikine, 1990; Seret and Opic, 1990; Levêque, Paugy and Teugels, 1990; 1992). Samples of ichthyoplankton were kept in bottles containing a mixed solution of 40% formaldehyde so as to obtain a 5-7% final concentration after addition of sea water. These samples were stored in a 70-75% alcohol solution in laboratory. Then the ichthyoplankton was sorted thanks to a dissecting microscope, MBS/9 to 10 type (magnification 1 x 8, 2 x 8, 4 x 8 and 7 x 8).

The quantitative estimation of signs was done counting myomere rays, coloured with alizaryn eosin, in addition to KOH. We also used yellow, green and blue light filters adapted to microscopes. The eggs were not identified but their quantity and types were determined. For larvae and juvenile the description of all important signs such as morphometrical and meristic characteristics was made.

Of the 40 fish families we have found in the areas prospected, only 15 were selected for a careful study. Data on their larval and juvenile stages are given.

RESULTS AND DISCUSSION

This paper is mainly based on taxonomic data. During the investigations, however, the characteristics of the areas prospected were taken into consideration.

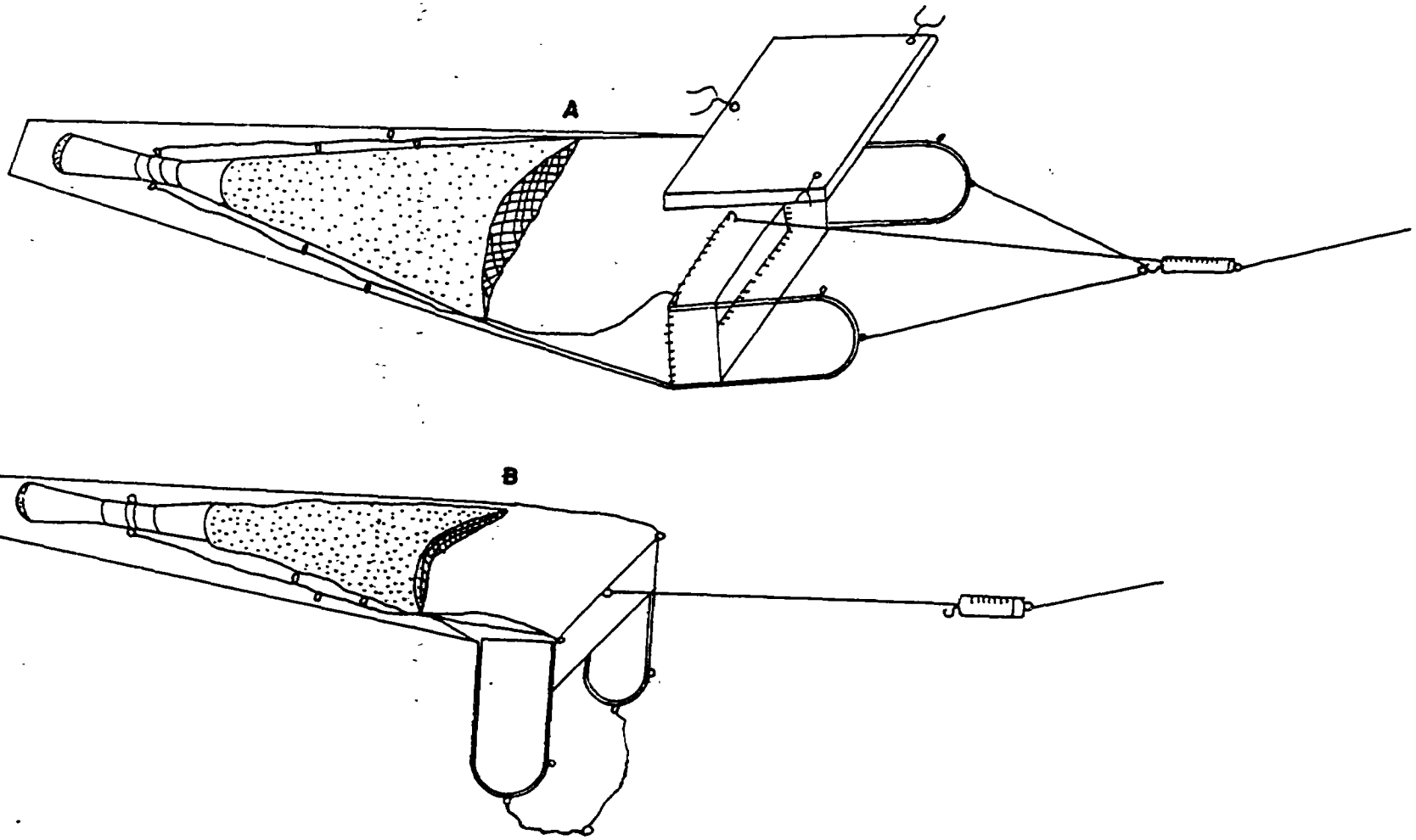


FIG.6 - THE USED ICHTHYOPLANKTONIC TRAP (TCIT)
A (open) B (closed)

(from TAMOIKINE and SY SAVANE, 1989)

The spatio-temporal ichthyoplanktonic distribution depends on abiotic factors prevailing in the zones studied. Accordingly, a short survey of these main characteristics will provide a better knowledge of the biotopes.

1.- Brief Presentation of the Zones Prospected

There are two types: the coastal marine zone (Cap-Vert and Kaloum Peninsulae) and the estuarine mangrove zone (coastal rivers: Fatala, Konkouré and Tabounsou in Guinea, and Casamance and Senegal, in Senegal).

In Guinea rainfall is very important. The rainy season lasts from May to October. The areas prospected are located in the coastal zone (sector corresponding to the natural region of *Guinée maritime* or Seaboard Guinea). The samples were collected in the Kaloum Peninsula, where Conakry is located (Fig. 2), and in three rivers: Fatala (Fig. 3), Konkouré and Tabounsou (Fig. 2). The mangrove is in the best conditions and estuaries present a normal salt gradient. Downstream, salinity decreases, unlike Senegalese rivers, where the salinity coefficient is reversed. In the Guinean coastal zone, the continental shelf is wide and shallow (depth: 15-20 m, width 8-10 miles). Various bays, estuaries, islands, sand banks, etc. were identified in this zone.

The tidal wave progression is higher than 2.5 m/s and covers up to 40 km inland all along the coastal rivers. It is precisely within the area of tidal fluctuation, however, that an important exchange of substance has been noticed (Ivanov and Camara, 1988; Bezborodov *et al.*, 1988; Kouzmenko and Ava, 1988).

The Guinean continental shelf can be divided into three great different units (Fig. 7) :

- Sector 1: corresponding to the seaboard, near the oceanic zone. There is an important activity of water, which is rich in substances from the lands and the tidal front.

- Sector 2: intermediate coastal sector with bays and gulfs, characterized by a lack of fresh water during the dry season. This zone was named inter-estuary by V.P. Oussenko (oral discussions).

- Sector 3: estuary and/or mangrove, permanently characterized by the prevalence of fresh water, with variable intensity (rainy or dry season).

In Senegal, the coastal area investigated is the Cap-Vert (Fig. 1) Peninsula (Dakar). It presents some similarities with those identified all along the Guinean coast. The rivers studied are the Casamance (Fig. 4) and the Senegal (Fig. 5), which are characterized by the fact that they function as "inverse estuaries" (Pandare *et al.*, 1987). Even during the rainy season, from Goudomp to Sedhiou (Fig. 4), the water remains hyperhaline, with salinity rates about 70‰. For the Senegal River there is a very particular situation due to the building of dams in Diama

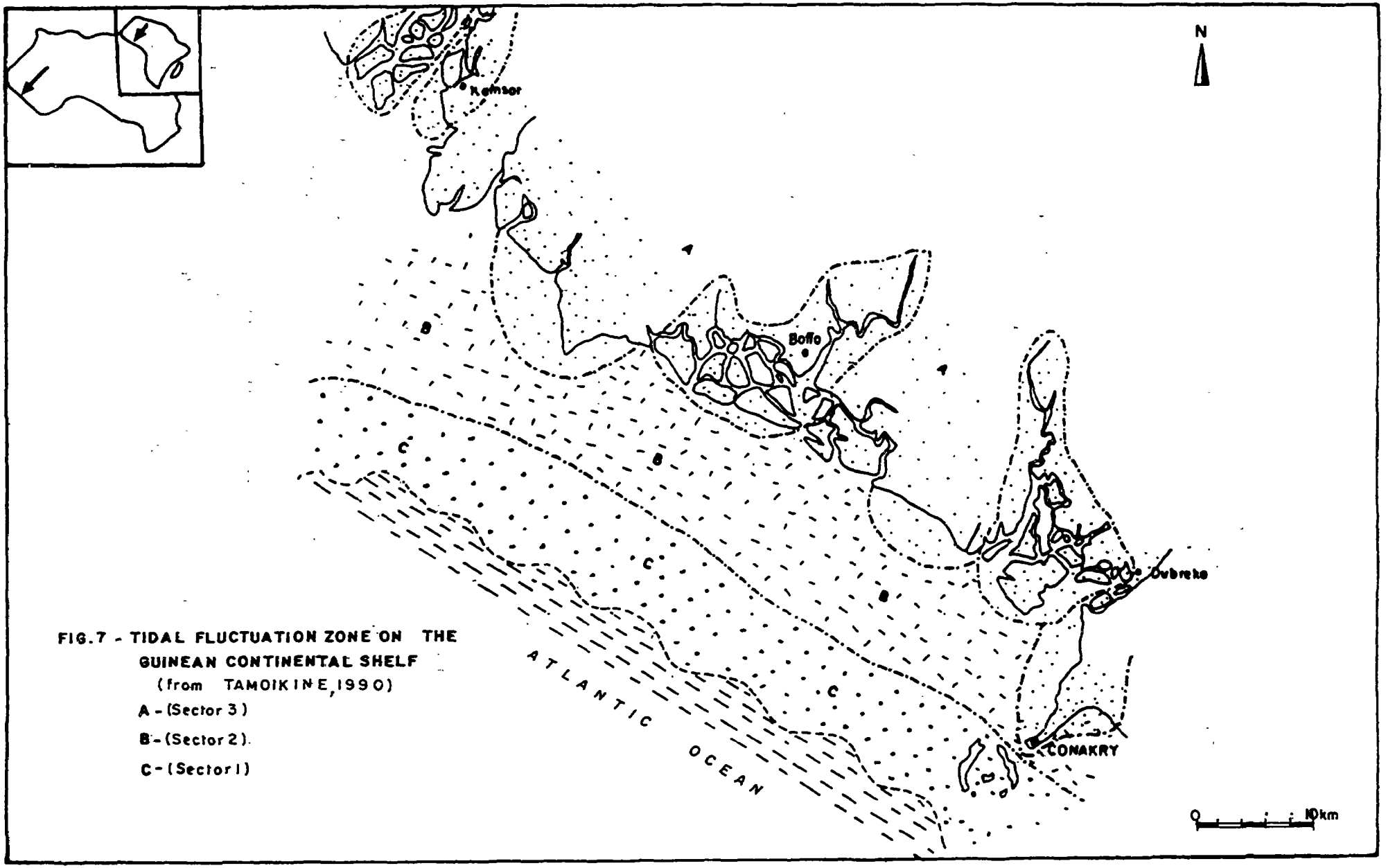


FIG.7 - TIDAL FLUCTUATION ZONE ON THE GUINEAN CONTINENTAL SHELF
(from TAMOIKINE, 1990)

A - (Sector 3)

B - (Sector 2)

C - (Sector 1)

(downstream) and Manantali (upstream). Before the building of these dams, the salinity rate was higher in the estuary than in the sea. Now the flowing system is systematically transformed.

Data on abiotic factors were collected during the investigations. These parameters are diverse and various. For each station and during all the collection they were taken into account.

2.- Ichthyoplankton Stocks

The samples obtained contain many different to fish and other aquatic animal eggs such as molluscs (Cephalopods) and shell fishes (shrimps, prawns, sea-crayfishes, etc.). Only the larval and juvenile fish stages, however, were examined.

It was possible to clearly see embryos thanks to the transparency of the shell. The identification of eggs, however, has not been made. It is planned to carry out a study of eggs because of their abundance.

The larvae collected were of four different postembryonic stages, corresponding to accurate morphological and anatomical characteristics. Many plates indicate the types observed. Some are based on microscopic observations and photographs obtained through binocular lens analysis.

2.1.- Taxonomic Composition

Basically, about 140 fish species belonging to 80 genera and 40 families were found during the investigations (Tabl. II). Many of these species are commercially important in artisanal and industrial fisheries in West Africa, from Mauritania to Nigeria, and even down to South Africa. They are very well appreciated and play an important role in the diet of rural as well as urban populations.

The ichthyoplankton stocks reflects the distribution of adult fishes. The most important groups include bonefishes, combtooth blennids, jacks, pompanos, herrings (shads, sardines, menhadens), tonguefishes, sleepers, gobies, mullets, threadfins, drums (croakers), sea basses, porgies, barracudas, pipefishes, seahorses, and puffers.

From the synthetic table (Tab. II), one may note that Guinean waters present a biodiversity higher than Senegalese waters. Thus, we practically found 20 families in the four Guinean areas prospected (Conakry peninsula, Fatala, Konkouré and Tabounsou Rivers), whereas there are less than 15 families in the Senegalese regions (Dakar Peninsula, Casamance and Senegal Rivers). There are about 10 families in each collection locality in Senegal. Some of these fishes are found in all the zones surveyed: combtooth blennids, jacks, pompanos, herrings, tonguefishes, sleepers, gobies, mullets, drums (croakers), sea basses and pipefishes.

Tab. 2 - Fish families found in the areas prospected (1 = Conakry; 2 = Dakar; 3 = Casamance; 4 = Senegal; 5 = Fatala; 6 = Konkouré; 7 = Tabounsou; + = Present)

STATION ⇒ FISH FAMILY ⇓	1	2	3	4	5	6	7
ALBULIDAE				+	+	+	
ARIOMMIDAE				+			
BALISTIDAE		+					
BLENNIIDAE	+	+		+	+	+	+
BOTHIDAE		+			+	+	
BRAMIDAE	+						
BRANCHIOSTEGIDAE	+						
CARANGIDAE	+	+				+	+
CENTROLOPHIDAE	+						+
CLUPEIDAE	+	+	+	+	+	+	+
CONGRIDAE	+	+				+	
COTTUNCULIDAE							+
CYNOGLOSSIDAE	+	+			+	+	+
CYPRINODONTIDAE				+	+		
ELEOTRIDAE	+		+	+	+	+	+
EMMELICHTHYIDAE							+
ENGRAULIDAE							+
EXOCOETIDAE	+						
GERREIDAE					+		
GOBIIDAE	+			+	+	+	+
KUHLUDAE	+						
MALACANTHIDAE	+						
MICRODESMIDAE	+					+	
MORONIDAE	+					+	+
MUGILIDAE	+	+	+	+	+	+	+
PERIOPHTHALMIDAE				+	+		
POLYNEMIDAE	+				+	+	+
RACHICENTRIDAE							+
SCIAENIDAE	+		+		+	+	+
SCOMBRIDAE	+	+					
SERRANIDAE		+	+	+	+		+
SOLEIDAE	+	+			+	+	
SPARIDAE	+	+				+	
SPHYRAENIDAE	+	+			+		
SYNBRANCHIDAE			+		+	+	
SYNGHNATIDAE	+		+		+	+	+
TETRAODONTIDAE	+	+			+		+
TRICHIURIDAE	+						
TRIGLIDAE	+						+
	26	14	7	10	19	18	19

Some others are only present in two or three localities: bonefishes, lefteye flounders, medusafishes, killifishes (toothcarps), flyingfishes, wolffishes, temperate basses, mackerels, tunas, swampeels and sea robins. Certain species are found in one station only: leatherjackets, pomfrets, rovers, mojarras, aholeholes, tilefishes and cutlassfishes.

From this wide range, only 15 families were selected for a careful taxonomic study. These groups are either abundant in the collected samples or in the areas prospected. Most of them are commercially important for artisanal and industrial fisheries. They live in large and shallow marine coastal or estuarine water.

We agree with Postma (1992) who states that coastal ecosystems represent an almost infinite variety of niches in which the creatures abundantly develop with respect to both their specific composition and their quantitative and qualitative distribution.

In seaboard countries, where artisanal fisheries are the main sector, about 80% of the aquatic resources are derived from the coastal zone (Lasserre, 1992). In each of the zones prospected, the specific fish composition of existing species was taken into consideration and the taxonomic identification carried out in descending order (family, genus and species).

2.2.- Taxonomic Identification

Of the 40 families found, only 15 were selected for this study. In many cases specimens obtained do not cover the four stages described . The information on quantitative signs and a brief description are given. The families selected are the following.

- Family ALBULIDAE: bonefishes (Pl. 1)

This fish was found in Sénégal, Koukouré and Fatala Rivers. There is only one species of this family belonging to the genus *Albula*, species *vulpes*. It is the only species yet found in Guinean and Senegalese rivers.

Albula vulpes (Linnaeus, 1758) is widespread in tropical seas and occurs rather in shallow bottoms (depth of a few dozen meters). There is only one stage sampled: St. II (Pl. 1). About 73 myomeres. Some of the fins are present and their rays distinguishable: D=20 and A=18-19. There are 53 myomeres for D, 33 for P, and 58 for A.

At this stage the larva has the shape of a ribbon, the mouth is inferior, the anus in the caudal region, the ventral fins (pelvic) appear and are in the center of the body. The pigmentation is represented by only an interrupted black line reaching the ventral region (Pl. 1).

- Family BLENNIIDAE: combtooth blennies (Pl. 1)

They occur in marine water (rarely in fresh or brackish water), primarly in tropical or subtropical areas. The samples are of an undetermined species but there are two different stages (Pl. 1).

Many blenniids are involved in mimetic associations with other fishes, being similar in external appearance to the other species (Springer and Smith-Vaniz, 1972).

At an early stage, the larva presents 22-23 black pigmentary points corresponding to the myomeres and located in the ventral and caudal parts of body. The eyes are well developed and the fins appear as a ribbon about the middle and caudal regions. The pectoral fins are present and they do not reach the ventral part. Myomeres can be indistinctly noticed. In the stomacal region there are some dark parts. The black points are in the ventral region.

At a later stage, all fins are present. However, only the pectoral fins are individualized. The eyes are well developed and the stomach is stocky. The fins are situated before the central vertical line of the body. It is easy to notice again the presence of some dark points in the stomachal region, before the anus. There are also some black points on the top of the head, on the head and the ventral region(Pl. 1).

- Family CARANGIDAE: jacks and pompanos. Marine, rarely brackish (Pl. 1-2).

Carangids are extremely variable in body shape, ranging from the shallow-bodied *Decapturus* and *Elagatis* to the extremely thin and deep-bodied *Selene*. This family contains some very important food species.

Important systematic and osteological studies on species of this family include Smith-Vaniz and Staiger (1973), and Suzuki (1962). In a study of the cranial nerve patterns, Freihofer (1978) states that Carangids, Rachycentrids, Echeneidids, and Coryphaenids have a shared, derived specialization in features of the two prenasal canals, apparently a rare specialization in teleosts. This bears testimony of the fact that these groups are interrelated (Nelson, 1984). Four species belonging to two genera were found: *Caranx crysos, Caranx hippos, Caranx senegallus* and *Seriola dumerili*.

+ *Caranx hippos* (Linnaeus, 1766)

This is a pelagic species referred to as a great carangid because of its impressive size: 1.5 m for 32 kgs. There is the kingfish or yellow jack, occuring in the Eastern Atlantic, from Portugal to South Africa and in the Western Atlantic, from New Scotland to Urugay.

Specimens found cover two larval stages:

- Stage I: with two types (Pl. 1). Fins run most of the length of the body and unite with the caudal fin, except for the pectoral fins, which are individualized and on which rays are present. The head and the mouth are well developed; the opercle is also present. The cephalothorax is large.

- Stage II (Pl. 1): At early stage II the fins are also continuous but rays begin to appear. The black pigments are always present and thicker. At late stage II all the fins are individualized and have their rays. The lateral line is marked.

The larva has the shape of a drop. The anus is situated after the middle of the body. The head is well developed and the opercle presents sharp thorns on the lower part.The ventral fins are not well developed; the dorsal and anal fins are united with the caudal fin . The pigmentation is conspicuous, located in the centre and caudal portions of the body. Fin rays can be counted: D 8 + 19, A 2 + (17-18) and C 20.

+ *Caranx senegallus* Valenciennes, 1833

This species is confined to the Western coasts of Tropical Africa.

Three larval stages were represented (Pl. 1).

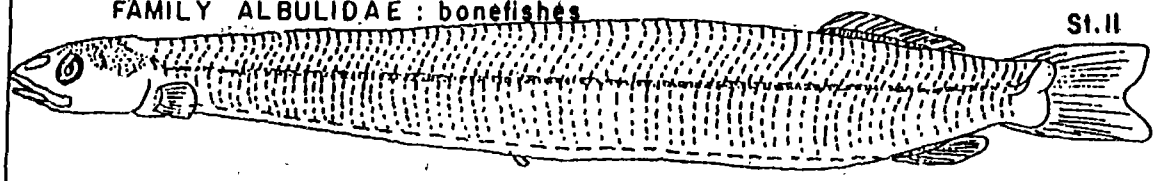
- Stage I: The quantitative signs are not determined. At early stage I the larva has the shape of a comma but at late stage I it has the shape of a liquid drop or also a comma. Only the pectoral fins are present.
  The yolk sac is not resorbed at early stage I. Small spines can be noticed on the opercle. The bowel is short and tube-like at the end. Some small black points can be observed on the pectoral fins.
  Aboussouan (1975) contends that the sagittal section on the top of the head is specific. Only the pectoral fins are developed and the lateral line has the shape of an arch at the beginning. Small black points can be seen on the pectoral fins as well as big black star-like points on the opercle (Pl. 1).

- Stage II (Pl. 1): The myomeres are present (26-28) as well as the anal fin, with 19-20 rays. At this stage the larva has the shape of a drop.The sagittal section is present on the top of the head. All the fins are represented, though the pelvic fins are just beginning to appear. Above the eyes we can see the eyebrows. Some separated black points are on the opercle, the pectoral fins, the stomach and near the anal base.

- Stage III (Pl. 1): At this stage all the fins have their rays: A 3 + 17, D 8 + (22-23), P (19-21). The opercle presents a specialization, in the form of small spines on the lower portion. The lateral line is arch-like at the beginning (Pl. 1). Many small black points are located in the body and the fins.

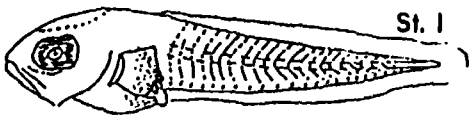
+ *Caranx crysos* (Mitchill, 1815)

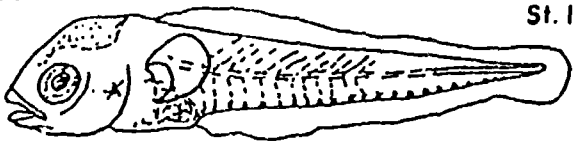
FAMILY ALBULIDAE : bonefishes



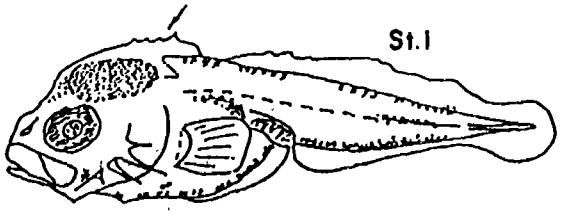
Albula vulpes (LINNAEUS, 1758)

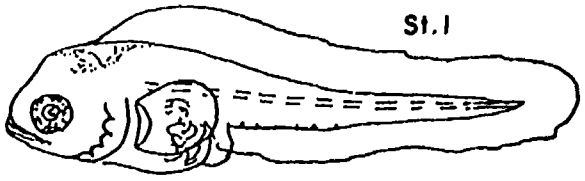
FAMILY BLENNIIDAE combtooth blennies

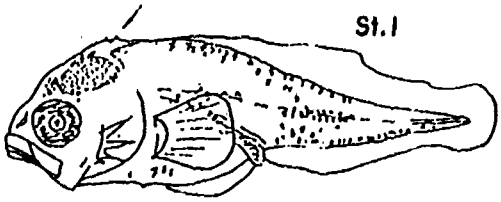


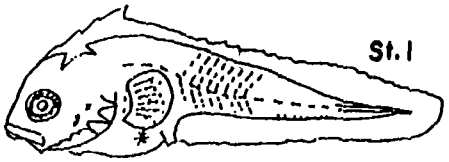


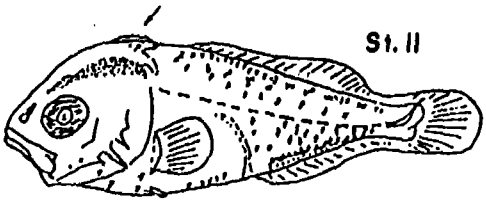
FAMILY CARANGIDAE : Jacks and pompanos

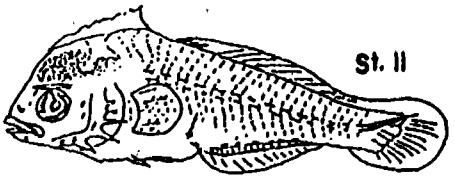


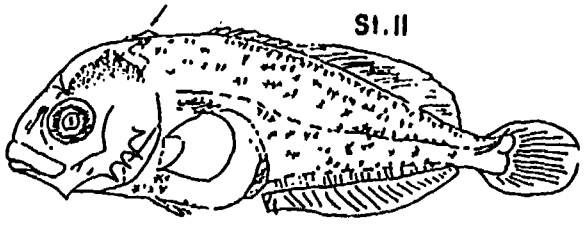


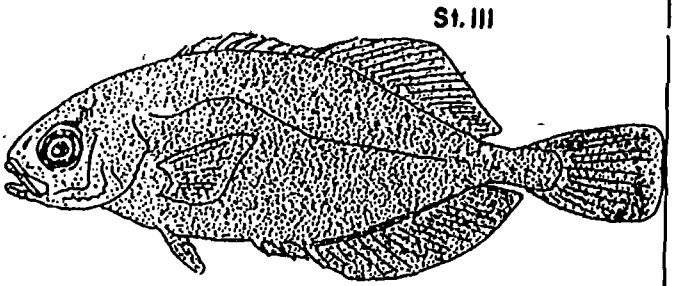












Caranx chrysos (MITCHILL, 1815)

Caranx senegallus VALENCIENNES 1833

PI. I - FAMILY ALBULIDAE BLENNIIDAE AND CARANGIDAE

This Carangid is a common pelagic species, usually schooling in the continental shelf zone. The stage found is stage IV, with practically adult morphology. The rays are present on all the fins: A 3 + 23, D 8 + 26 and V 5. The mouth is small and superior, and stops before the vertical line of the middle of the eyes. All the fins are developed. The first dorsal ray is directed forward. The lateral line is slightly arch-like at its beginning (Pl. 2). Many black points can be observed on the dorsal portion of the body and on the caudal fin.

+ *Seriola dumerili* (Risso, 1810)

This fish is amber-coloured, pelagic and perhaps cosmopolitan in warm water. It lives in the tropical or subtropical seas of the Atlantic and the Indo-Pacific. There is the greater amberjack, present in the Eastern Atlantic, from the Bay of Biscay to Angola.

Three larval stages were represented:

- Stage I: with two samples. The larva has the shape of a drop (Pl. 2), the stomach is divided into two parts and the bowel has the shape of a bag. Only the pectoral fins and the fin ribbon surrounding the middle and caudal parts of the body are present. The other fins are united. At early stage I the quantitative signs are also undetermined. Four spines, however, can be noticed on the opercle (Pl. 2).

  At late stage I, the shape is still drop-like. Only the pectoral fins can be seen but the dorsal and pelvic fins emerge. Except for the caudal part, the pigmentation is well expressed.

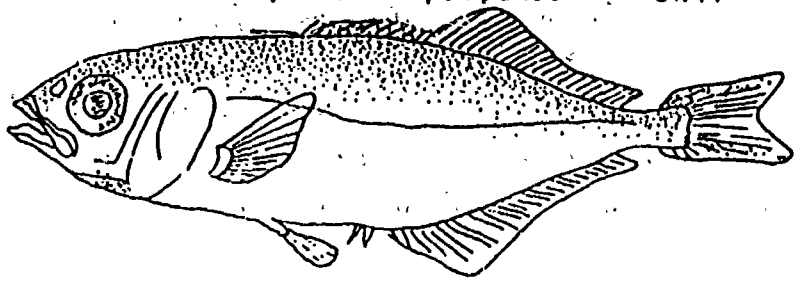
- Stage II: The drop-like shape is still present, fin rays too: D > 25, with about 16 soft, A 3 + 16, and P 17. Denticles can be seen in the mouth. The eyes are well developed and above them the eyebrows can be noticed (Pl. 2). The lateral line appears clearly on the thorax. Except for the caudal fin, there are many black points all over the body.

- Stage III: There is little difference with the previous stage. The dorsal and anal fins are respectively 7-19 and 3 + 16 rays. The eyes are bigger and the mouth stops after the middle of the eyes. Many long spines are present on the opercle. All over the body the pigmentation is well expressed, except for the caudal, pectoral, pelvic, dorsal (soft rays) and anal fins.

- Family CLUPEIDAE (Pl. 3-5): herrings (shads sardines, and menhadens).

FAMILY CARANGIDAE : jacks and pompanos

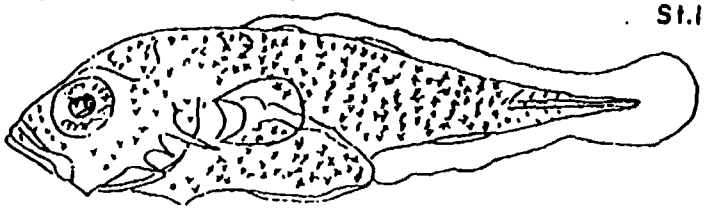
St. IV



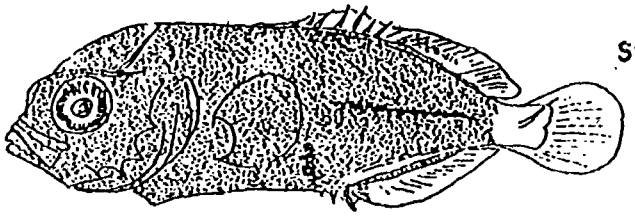
Caranx hippos (LINNAEUS, 1766)

St. I

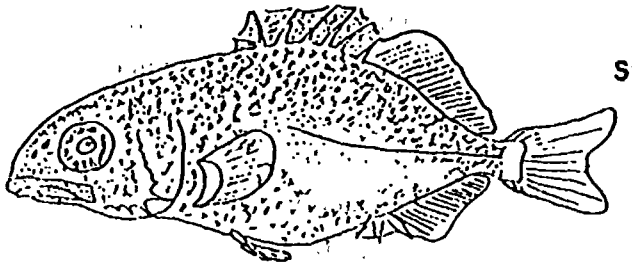
St. I



St. II



St. III



Seriola dumerili (RISSO, 1810)

PI. 2 - FAMILY CARANGIDAE

Primarily living in marine water, sometimes in fresh water, and anadromous, worldwide, mostly tropical (Nelson, 1984).

A valuable commercial fishery exists for Clupeids in many parts of the world. Most species form schools and swim near the surface, usually in the coastal water, feeding on plankton.

This family occurs in all the areas prospected and is represented by five species and four genera *(Ethmalosa, Ilisha, Pellomula* and *Sardinella). Sardinella* and *Ethmalosa* are very important for artisanal and industrial fisheries in West Africa.

+ *Ethmalosafimbriata* (Bowdich, 1825)

This fish is a truly coastal species in West Africa and may also be found in estuaries and lagoons during the dry season (Seret and Opic, 1990).

Larvae of various stages were collected in all the areas prospected in Guinea as well as in Senegal (Pl. 3). This shows that *Ethmalosafimbriata* reproduces in various estuaries. Three stages were observed (Pl. 3) :

- Stage I: The myomeres can be noticed; they total up to 44-46 elements. Except for the pectoral fins, all the others are united with the caudal fin. The larva has an elongate body surrounded by the fins forming an uninterrupted ribbon.The bowel is opened at the 36th myomere. The mouth is small and superior.

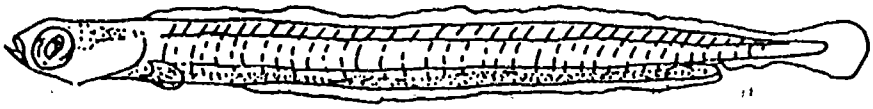
- Stage II: The number of myomeres is constant (about 44-46 elements). The dorsal fin begins to appear at the 24th-25th myomeres. The anus is placed on the 35th-36th myomeres. The bowel has the shape of a narrow tube and the pigmentation is expressed by an interrupted line on the ventral region. A few black points can be observed on the caudal fin.

  At early stage II the dorsal fin is well developed and it is easy to notice 14-15 rays. The caudal and dorsal fins are individualized. The dorsal fin is situated on the 25th miomer; the anus at the 35-36th myomeres. At the middle of the bowels (on 15-16th myomeres) the air-bladder can be seen. For the pigmentation there are only an interrupted line in the ventral region and some black points on the caudal fin (Pl. 3).

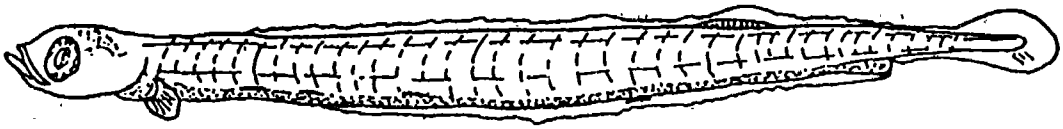
- Stage III: the peculiarity here is the greater number of myomeres (44). All the fins are present with their rays: A 21, D 18 and V 8. The pelvic fins begin at the 15-16th myomeres. The greasy eyebrow is undeveloped but can be noticed. The pigmentation is very massive and represented by black points in the caudal region and the lower jaw (Pl. 3).

FAMILY CLUPEIDAE : herrings

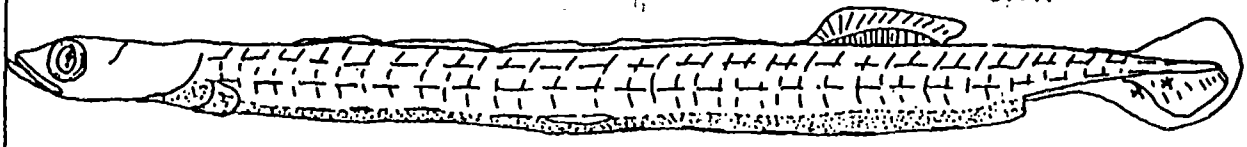
St. I



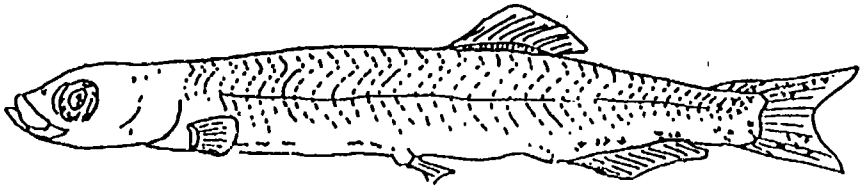
St. II



St. II



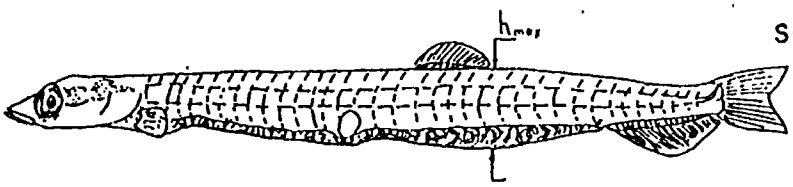
St. III



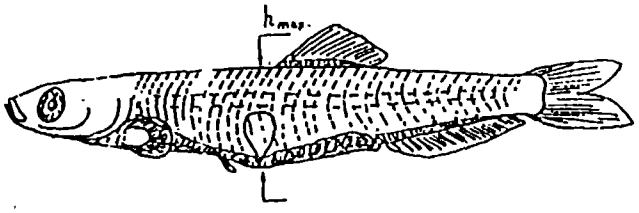
Ethmalosa fimbriata (BOWDICH,1525)

St II

St II



St. III



Ilisha africana (BLOCH 1795)

Pl. 3- FAMILY CLUPEIDAE

+ *Ilishaafricana* (Bloch, 1795)

This fish is a very common pelagic species in the western coasts of Tropical Africa. Abundant in the fishery, it has no trading value.

Only stages II and III were represented (Pl. 3).

- Stage II: About 31 myomeres. The larva has an elongate body with well developed eyes. The dorsal fin emerges. The pigmentation is characterized by black points along the bowel. At late stage II, the individualization of the fins can be noticed (Pl. 3) and the rays appear clearly: A > 44 (about 45-47), D 13-14, about 38 myomeres.
  The air bladder can be clearly seen as well as the bowel. Only some vague pigments are present on the ventral region.

- Stage III: The ventral fins appear and the larva is bigger (Pl. 3). The anal and dorsal fins have respectively 45-48 and 13-14 rays. Pigmentation is only characterized by some separate points situated before the pectoral and above the anal bases.

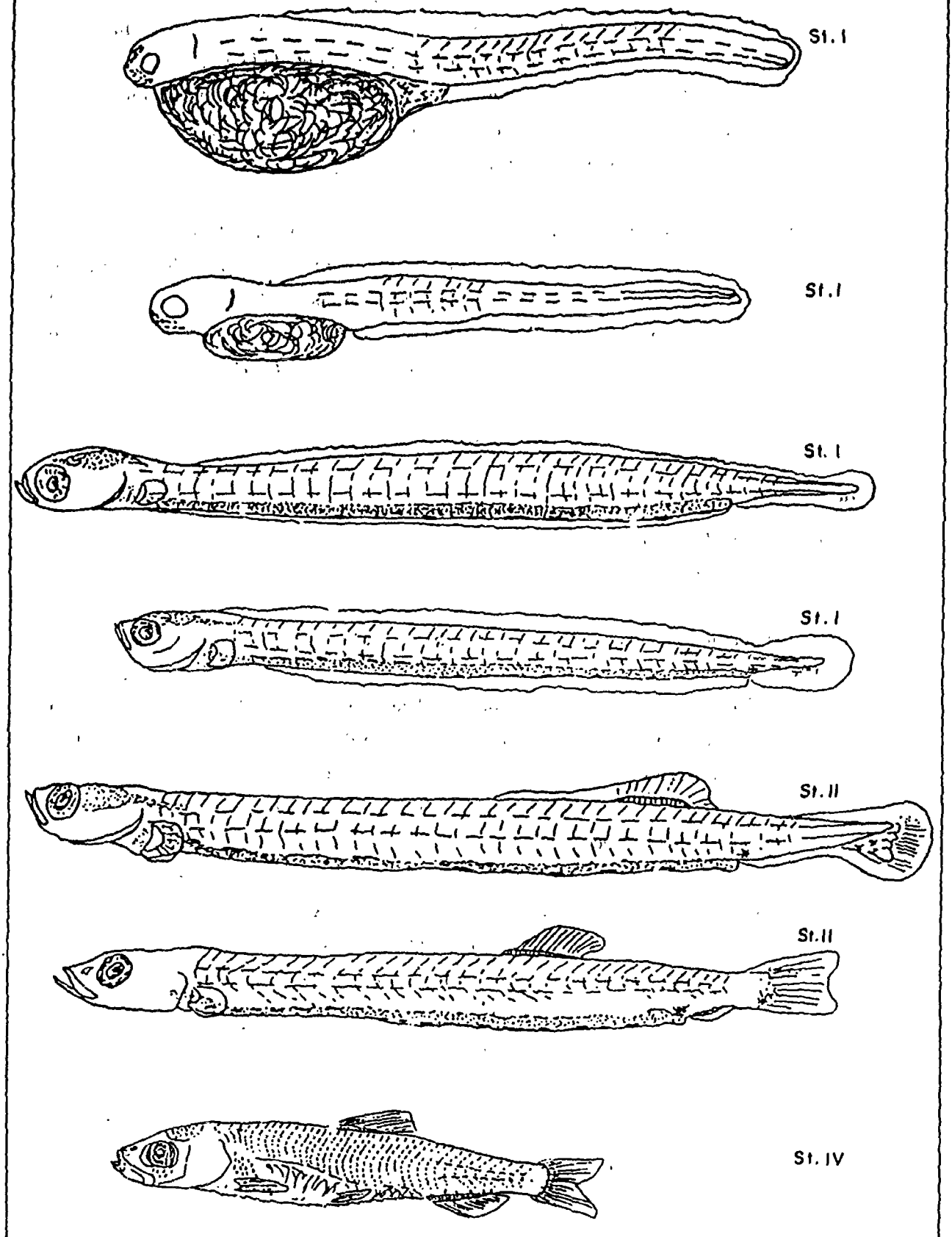
+ *Pellonula leonensis* Boulenger, 1916

It is a small fish occuring in fresh water, rarely in brackish water. The stages found are I, II and IV (Pl. 4).

- Stage I: The quantitative signs are not determined. Feeding is supplied by a distinguishable vitelline sac. There are no pigments in the eyes. The mouth takes shape. The fins surround the body, forming a continuous ribbon. In the youngest stages the yolk sac is very important but in the oldest it is insignificant (Pl. 4). At late stage I the inner feeding does no longer exist. Myomeres are present, about 39-41 elements. The muscle structure also begins to take shape.
  Only the pectoral fins are marked. The fins constitute a ribbon about the body. The anus is at the 36-37th myomeres. The mouth is close to the eyes. The interrupted black line corresponding to the pigments is present on the ventral region. Eyes are well developed. Some dark spots can be noticed above the anus and the rearmost portion.

- Stage II: The dorsal fin presents approximately 9 rays and the caudal fin 12. There are 42 myomeres.

FAMILY CLUPEIDAE : herrings



Pellonula leonensis (BOULENGER, 1916)

Pl. 4 - FAMILY CLUPEIDAE

The pelvic and anal fins have not yet appeared. The fins are united and form an incipient ribbon about the body. The anus is on the 36th miomer. The dorsal fin begins at the 26th miomer. There is an interrupted black line on the ventral part of the body and some pigments can be noticed in the caudal region.
The mouth is directed upwards and all the fins are visible. Big black points are located before and after the anal and caudal bases.

- Stage IV: Adult features are achieved. All the fins are present, with distinguishable rays (Pl. 4): D (17-18), A 23, and about 40-42 myomeres. Sharp scales are present on the ventral region. The eyelid is very greasy and the mouth is directed upwards. Some small black points are present on the head, on the stomachic region (near the pectoral fins) and near the anal and caudal regions.

+ *Sardinellaaurita* Valenciennes, 1847

S. aurita is always sympatric with *S. maderensis* . These fishes are very common in the artisanal fishery of tropical and subtropical regions. They are pelagic species occuring in Northern and Southern Atlantic.

Only two larval stages were represented (Pl. 5).

- Stage II: The myomeres are present (40-41). The anus is located between the 38th and the 40th myomeres. Only the pectoral fins are individualized. Some ribbon-like fins extend along the body. At advanced stage II the dorsal fin bud is noticeable. A few rays appear more or less distinctly on the caudal fin; the eyes are well developed.

- Stage III: The rays on the fins can be determined : D 17, A 21-23 and V 9. The number of myomere is the same as in stage II (about 42-44).
All the fins appear but the pelvic fins are not yet developed. A small dorsal fin emerges near the vertical line of the ventral region. The eyelids are greasy. Some small black points are present on the ventral part and on the caudal fin.

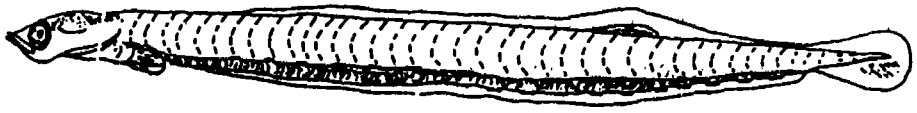
+ *Sardinella maderensis* (Lowe, 1839)

Three larval stages of this species were collected (Pl. 5).

- Stage I: The quantitative signs are not determined. Except for the pectoral fins all the others are united. The larva is elongate. Only the pectoral fins are individualized; the other fins are united and form a ribbon about the body.

FAMILY CLUPEIDAE : herrings

St. II



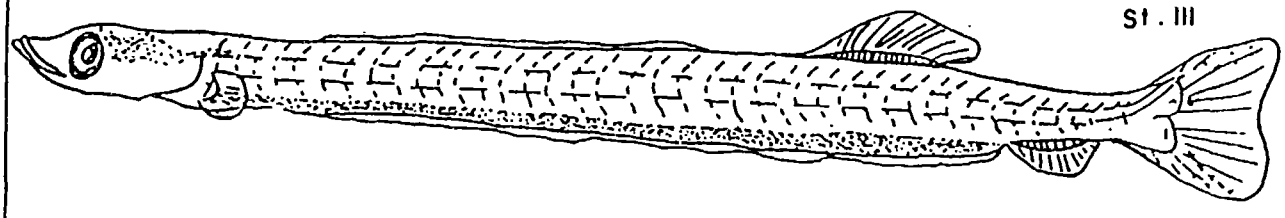
St. II

St. III

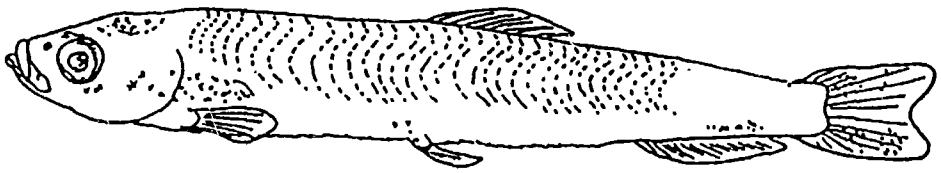
Sardinella aurita VALENCIENNES, 1847

St. I

St. II



St. III



St. IV

Sardinella maderensis (LOWE, 1839)

PI. 5 - FAMILY CLUPEIDAE

Myomeres are not distinguishable. An interrupted line is noticeable above the bowel, in the front of the body.

- Stage II: The quantitative signs can be determined. The dorsal fin appears about the 24th-26th myomeres. The fins form a continuous ribbon around the body. The anus opens at the 36-37th myomeres. There is an interrupted line, located in the ventral part. Also present are some black points in the caudal region.
  At late stage II, 44-46 myomeres can be noticed. D≈14 rays, A 15-17.

- Stage IV (Pl. 5): This stage corresponds practically to the adult's morphology. All the fins appear clearly with their rays: V 8, D 18-20, A 18-21. There is no modification of the number of myomeres (42-45).
  The eyelid is not greasy. Hard scales appear in the ventral region. Some black points are present on the head and near the pectoral, pelvic, anal and caudal fins.
  As far as this species is concerned, the specimens found represent all larval stages, which means that it has complete reproductive activities in the areas prospected.

- Family CONGRIDAE: conger eels

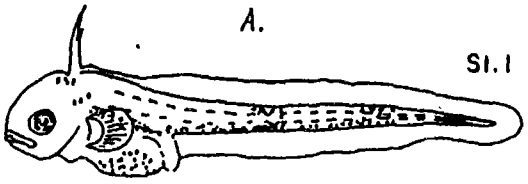
These fishes live in marine waters (Atlantic, Indian and Pacific Oceans). Their body is scaleless and a pectoral fin is usually present (Nelson, 1984). In this family, four subfamilies with 42 genera and about 109 species were recognized. For Nelson (1984), the families Nettastomatidae, Macrocephenchelyidae and Colocongridae are closely related to the Congridae and may eventually be found to be best placed with it.

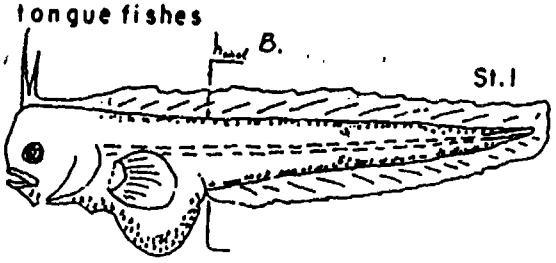
The specimen found is undetermined; it is illustrated by a young larval stage I (as shown in Pl. 7). It has about 75 myomeres. The larva has the shape of a narrow, elongate ribbon. Only the pectoral fins with the ribbon of united fins around the body are present. The mouth is outstanding, upward-pointing, with a long sharp tooth. The anus is situated in the caudal portion. There are some separate black points located in the lower region of the body, from the head to the caudal portion.

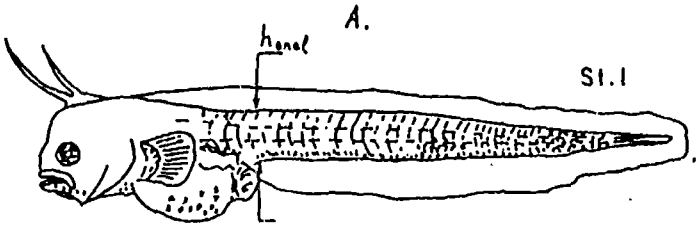
- Family CYNOGLOSSIDAE: tonguefishes

They occur in tropical and subtropical marine water (some in fresh water). They have sinistral eyes and usually only the left pelvic fin is developed. Pectorals are absent. Most of them burrow into soft bottoms. Menon (1977) described many species occuring in the Old World, from the Eastern Atlantic to the Western Pacific. We found two species (Pl. 6):

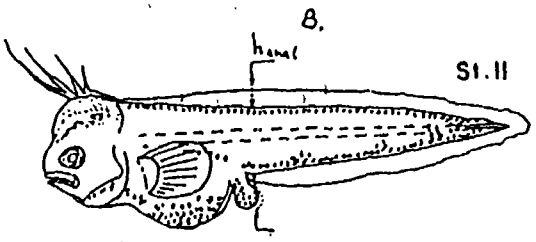
FAMILY CYNOGLOSSIDAE : tongue fishes



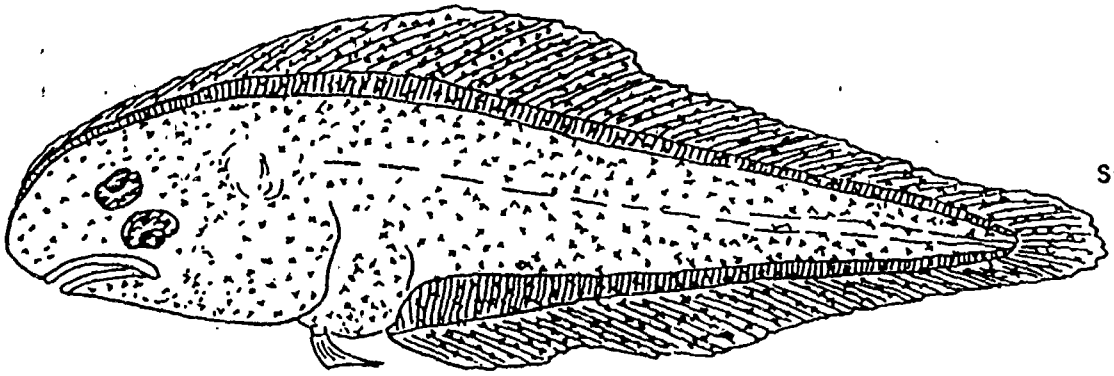


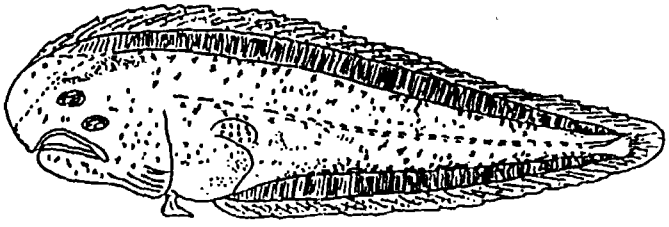


Cynoglossus sp A



Cynoglossus sp B





Cynoglossus monodi CHABANAUD, 1949

Pl. 6 - FAMILY CYNOGLOSSIDAE

+ *Cynoglossus* sp. A and *Cynoglossus* sp. B

The samples collected include two stages (St I and II), and two types (Pl. 6). Their morphometric characteristics can be noticed on Plate 6 (A & B).

+ *Cynoglossus monodi* Chabanaud, 1949

This tonguefish is represented by a few samples at stage III only. This species is more developed than *Cynoglossus sp.* Thus, the quantitative signs can be observed on the fins: D may have up to 130 rays and A more than 95.

- Family ELEOTRIDAE

These fishes, also called sleepers, are common in marine, brackish and fresh water in most tropical and subtropical areas (rarely temperate areas). Sleepers and gobies cannot always be nearly separated on the basis of the degree of union or separation of the pelvic fins alone.

Two species are morphologically distinguishable (Pl. 7).

+ *Eleotris senegalensis* samples represented three larval stages :

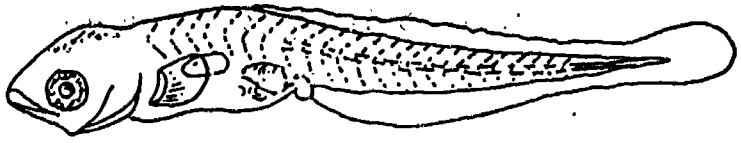
- Stage I: There are approximately 24 distinguishable myomeres. The larva is elongate. Only the pectoral fins and a ribbon about the body are present. The anus has the shape of a bag and stops before the middle of the body. It is only before the anal and on the lower caudal regions that black lines can be noticed.

- Stage II: The quantitative signs clearly appear, in particular on the fins. The dorsal fin comprises two parts: the forward portion with 5-6 rays, and the rearmost portion with 10-11. The anal fin has 10-12 rays and the caudal fin about 25. Furthermore, there is little difference between stages I and II. Thus, we found the following numbers: D (5-6) + (9-11), A (10-12) or 11, P (14-15), with approximately 25-26 myomeres.

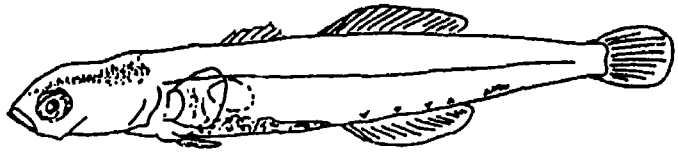
+ *Eleotris sp.* is similar to *E. darganensis*, though not absolutely. As for quantitative signs, 24 myomeres can be noticed, and the second dorsal fin has 11-12 rays.

- Family GOBIIDAE: gobies

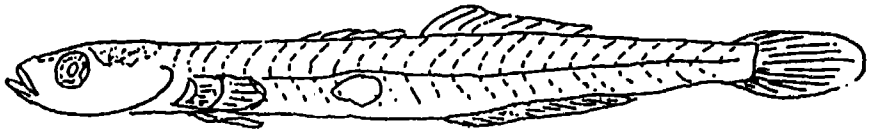
FAMILY ELEOTRIDAE : sleepers



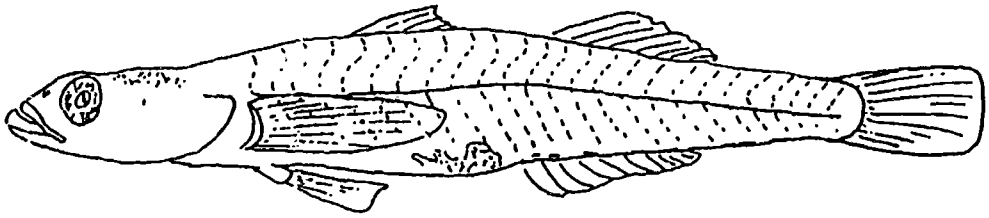
St. I



St. II

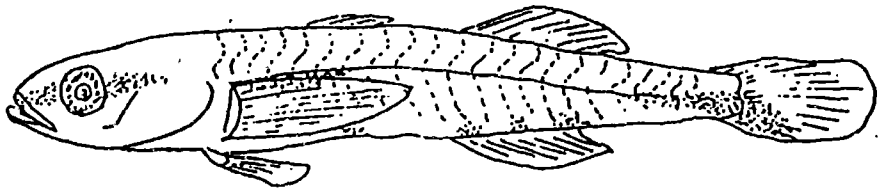


St. III



St. III

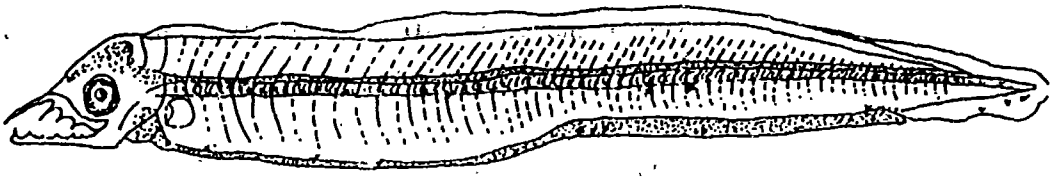
Eleotris senegalensis (STEINDACHNER, 1870)



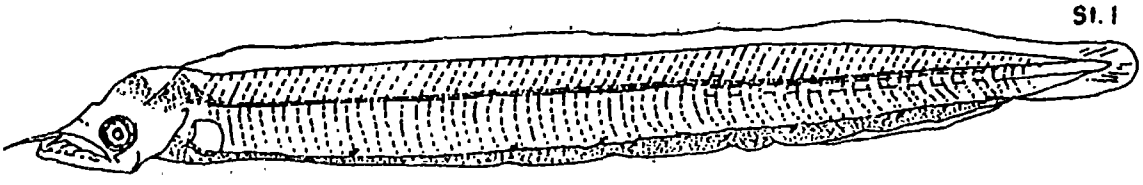
St. III

Eleotris sp

FAMILY CONGRIDAE



St. I



St. I

Genus undetermined

PI. 7 - FAMILY ELEOTRIDAE AND CONGRIDAE

They occur in marine, brackish, and occasionally in fresh water, mostly in tropical and subtropical areas. This is the largest marine fish family. Some species that occur in fresh water spawn in the ocean, and are thus catadromous like Anguillids.

Recent contributions to the systematics and taxonomy of gobiids include Birdsong (1975). This family countains the world's smallest fishes (and vertebrates): maximum length up to 50 cm, minimum length about 10 mm.

Two genera and three species were found during investigations (Pl. 8).

+ *Stenogobius thomasi* (Boulenger, 1916)

They were represented at stages III and IV, displaying some quantitative signs such as myomeres (23) and fins (D 6 + 9, A > 10, P 18). At stage IV all the fins, along with scales, are present. Pigmentation is noticeable and small black points can be seen on the body and the fins.

+ *Gobius rubropunctatus* Delais, 1951

Stage III only was represented, with some characteristics found in Stenogobins. A (11) and second D (12 - 13), with 22 conspicuous myomeres.

+ *Gobioides ansorgii* - Boulenger 1903

For this species, we also found stage III only, with the following characteristics: about 27 myomeres are present; the larva is elongate; all the fins appear, with the ventral and the pectoral fins on the ventral line; the mouth is upward-pointing. The lateral line reaches the middle of the body; the anus is also located in the middle of the body; it has no pigmentation.

- Family MUGILIDAE: mullets

They occur in coastal marine and brackish water (some in fresh water) in tropical and temperate areas.

Thomson (1964) recognizes 13 generic names and 70 valid species (with 32 more of doubtful status) from a list of 281 nominal species (Nelson, 1984).

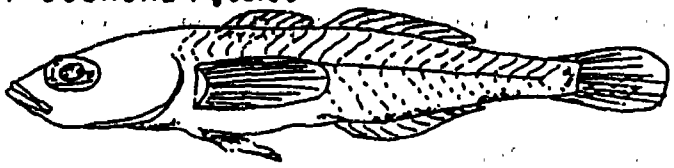
Five species were collected, among which one is undetermined. The species found were at stage III, save the indetermined one and *Liza grandisquannis* at stage I (Pl. 8).

+ *Liza sp. dumerili:* (Steindachner, 1870)

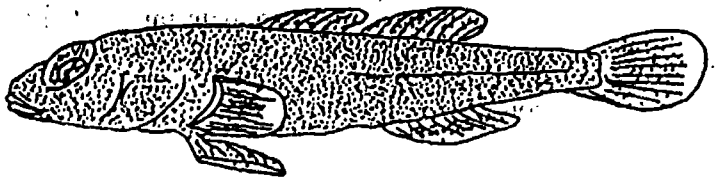
The quantitative signs are not determined. The larva has the shape of a droplet. Only the pectoral fins are individualized, with a ribbon representing other fins about the body. The anus

FAMILY GOBIIDAE : gobies

St. III



St. IV

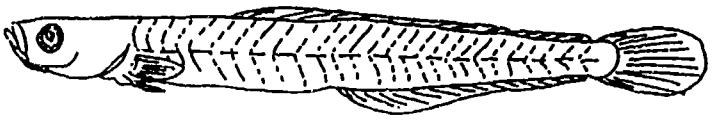


Stenogobius thomasi (BOULENGER, 1916)

St. III

Gobius rubropunctatus DELAIS, 1951

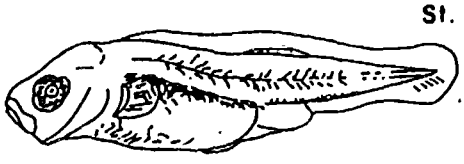
St. III



Gobioides ansorgii BOULENGER, 1909

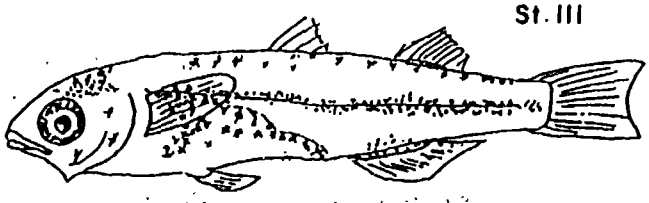
FAMILY MUGILIDAE : mullets

St. I



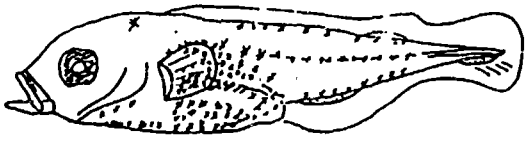
Genus undetermined

St. III



Liza ramada RISSO, 1826

St. I

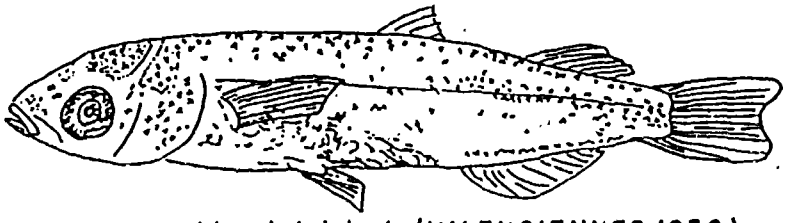


Liza grandisquamis (VALENCIENNES, 1836)

St. III

Liza aurata (RISSO, 1870)

St. III



Liza falcipinnis (VALENCIENNES, 1836)

PI. 8 - FAMILY GOBIIDAE AND MUGILIDAE

is located in the rear of the body. Beside the vitelline sac, there is another sac in the caudal region (Pl. 8). The mouth is superior. The eyes are big. The pigmentation is conspicuous, except for the head.

+ *Liza ramada:* (Risso, 1826)

Represented at stage III. Their quantitative signs were determined: D I (4), II (1 + 7), A (3 + 9), V (5 + 6). Thus, all the fins are individualized; the mouth is terminal.

The pigmentation is conspicuous. There are only separate star-like points all over the body, except for the fins.

+ *Liza grandisquannis* (Valenciennes, 1836)

This fish is represented at stage I only. The quantitative signs are not determined. The larva has the deep and compressed shape. Only the pectoral fins are developed, other fins forming a ribbon about the body. The mouth is superior. The urostyle takes shape.

The pigmentation is conspicuous. There are shining black points on the top of the head.

+ *Liza aurata:* (Risso, 1810)

The samples found were at stage III and had all their fins. The mouth is small and superior. Pigmentation is very well expressed. There are 3 + 9 rays on the anal fin.

+ *Liza falcipinnis:* (Valenciennes, 1836)

Here again, the samples were at stage III. The fins are all present. Some small scales can be noticed on the dorsal portion of the body. The pigmentation is well expressed, except for the fins. A ≈ 3 + 11 rays.

- Family POLYNEMIDAE: threadfins

They occur in marine and brackish water (some in rivers), all of them in tropical and subtropical seas.

Two genera and two species were found: *Galeoides decadactylus* and *Pentanemus quinquarius* (Pl. 9).

+ *Galeoides decadactytus* (Bloch, 1795)

The stages found are I, II and III.

At stage I the quantitative signs are undertemined. Only the pectoral fins are developed, other fins forming a ribbon about the body. The mouth is sizeable. Many big black points can be seen in the middle of the stomach, near the anus and the anal fin bud (Pl. 9).

At stage II, some developed characteristics are present: myomeres (23-25); the dorsal and anal fins take shape; the pigmentation is well expressed, with star-like points on the stomach, the top of the head, before and after the anal fin bud, and on the opercle (Pl. 9).

At stage III, a few modifications take place (e.g. the number of rays on the fins: D 8 + 14 and A 3 + 12).

+ *Pentanemus quinquarius* (Linnaeus, 1758)

The following larval stages were observed :

- Stage I: quantitative signs are undetermined (Pl. 9). The larva has the shape of a drop. Only the pectoral fins are present. The anus is located in the region before the middle of the body. The mouth is sizeable. The pigmentation is well expressed, with black lines located in the ventral part and near the dorsal fin bud.

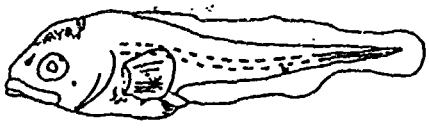
- Stage II: two specimens were examined. It is difficult to determine quantitative signs at this level. Approximately 17 rays can be noticed on the anal fin. In contrast, it is very easy to give a brief description of this stage. Only the pectoral fins are developed. The skeletons of the dorsal and anal fins, and the rays of the caudal fins are perceptible; the anal fin is more developped than the other fins. The urostyle is present and divided into two elements. The anus is located before the middle of the body.
  The pigmentation is faintly expressed, with two lines of star-like black points beginning behind opercle and ending in the caudal region.

- Stage III: here, quantitative signs are conspicuous and it is easy to count the fin rays: D 7 + (16-18), and A 28–30. All the fins are present, even though the ventral fins are very distinct. The mouth is sizeable, with denticles. Pigmentation is characterized by only two black spots located in the anal fin base.

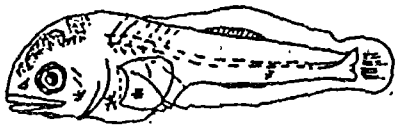
- Family SCIAENIDAE: drums (croakers)

They occur in marine, brackish and fresh water in the Atlantic, Indian and Pacific Oceans, particularly in South America (Nelson, 1984). These fishes are characterized by a long dorsal fin, with a deep notch between spinous from soft portion (rarely separate), the first with 6-13

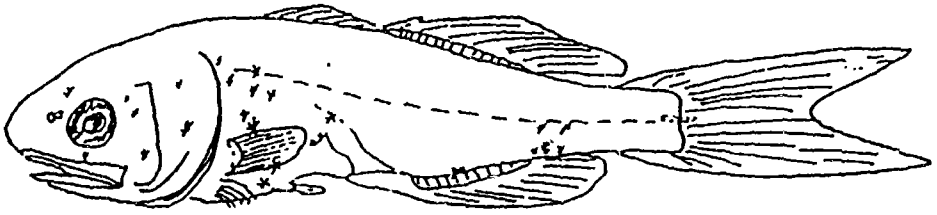
FAMILY POLYNEMIDAE : *threadfins*



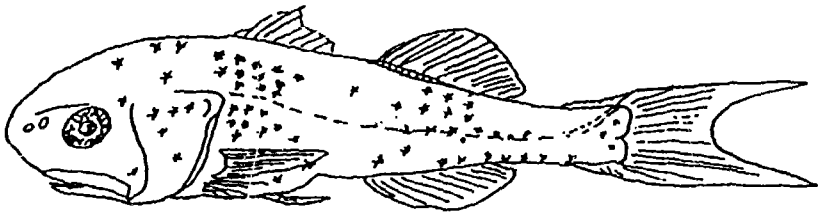
St. I



St. II

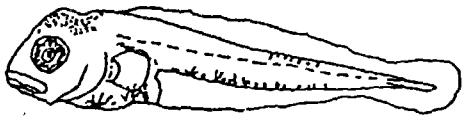


St. III

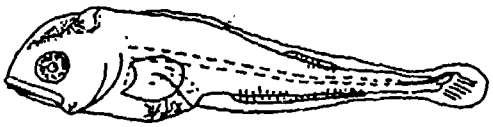


St. III

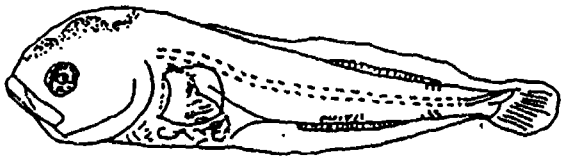
Galeoides decadactylus (BLOCH, 1795)



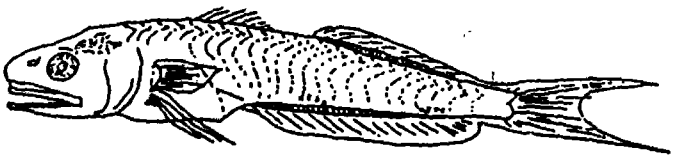
St. I



St. II



St. II



St. III

Pentanemus quinquarius (LINNAEUS, 1758)

Pl. 9 - FAMILY POLYNEMIDAE

spines and the second with one or two spines and usually 20-35 soft rays. Five species were found during investigations (Pl. 10-11).

+ *Pseudotolithus brachygnathus* Bleeker, 1863.

This is a coastal species, widespread in Western African shores, from Senegal to Angola (Seret, 1990).

Three larval stages were observed:

- Stage I: with two different specimens. It was impossible to determine quantitative signs of the first one (Pl. 10A).

  The pectoral fins and the ribbon about the body can be noticed. The bowel has the shape of a small sac. The mouth is terminal and denticles appear. The air bladder can be noticed above the brain. The lateral line is also present, with an arch-like shape at its end. As for pigmentation, there is only a dark spot on the anal base.

  On the second specimen (Pl. 10), quantitative signs are not determined. The larva has the shape of a drop; some rays can be seen on the caudal fin as well as myomeres in the centre of the body. The bowel is pipe-like. Some black points can be noticed in the ventral portion, near the dark spot on the anal fin, before the bowel, and under the base of pectoral fins.

- Stage II: (Pl. 10) and III (Pl. 10).

  There is little difference between these two stages. The main evolution concerns quantitative signs, with the appearance of individualized rays on the dorsal (> 20) and anal (≈ 9) fins at stage III.

  At this level the larva is bigger. All the fins are present, although the pelvic fins are not developed. The ribbon representing fins about the body is also present.

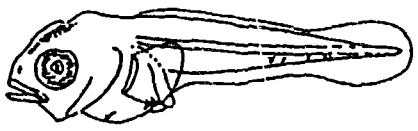
+ *Pseudotolithus elongatus* (Bowdich, 1825)

This species occurs in coastal water, at a depth of 15-45 m, often foraying into estuaries and lagoons; it is widespread in African waters, from Senegal River to the mouth of Congo River.

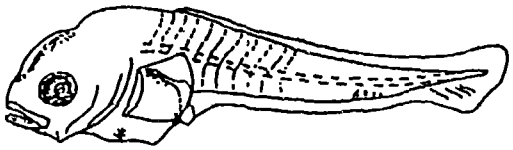
Only stages II and III were observed.

- Stage II: the larva presents quantitative signs such as rays on the anal fin, and about 22 myomeres (Pl. 10). Some dorsal, anal and caudal rays begin to appear. The

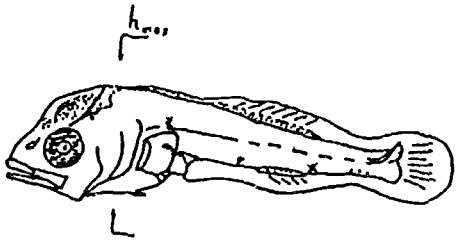
FAMILY SCIAENIDAE : *drums (crookers)*



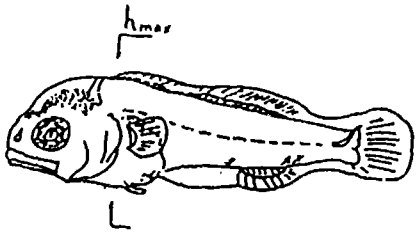
St. I



St. I



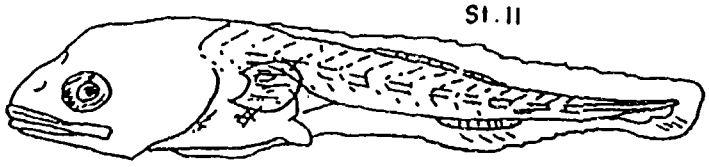
St. II



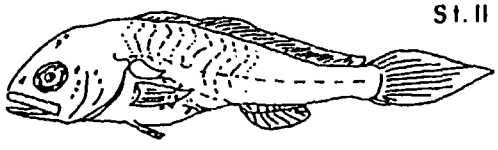
St. II

Pseudotolithus brachygnathus BLEEKER, 1863

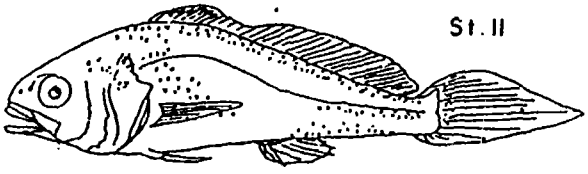
St. II



St. II

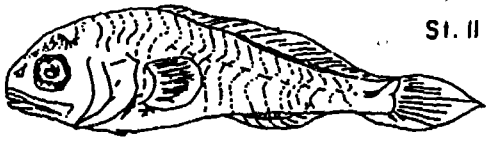


St. II

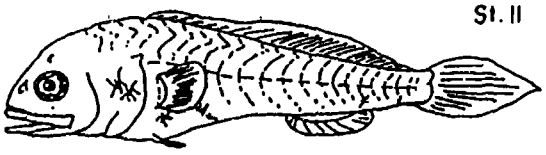


Pseudotolithus elongatus (BOWDICH, 1825)

St. II

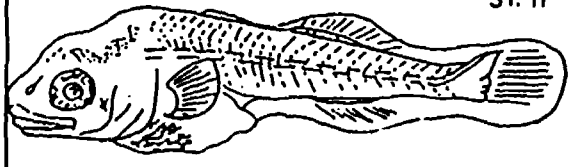


St. II

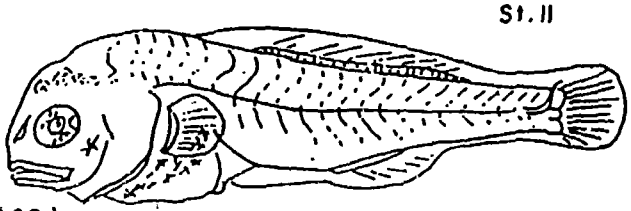


Pseudotolithus epipercus (BLEEKER, 1863)

St. II



St. II



Pseudotolithus moori (GUNTHER, 1869)

PI. 10 - FAMILY SCIAENIDAE

mouth is sizeable. The bowel appears like a small sack. Some elements can be seen in the urostyle. Some separate black points can be noticed on the stomach and after the anal region (Pl. 10).

- Stage III: two species were represented (Pl. 10), with many aspects in common.
  The dorsal and anal fins have 10 + 32 and 2 + 6 rays respectively. All the fins are expressed. As for pigmentation, some small and big star-like black points can be noticed on the lips, the head and the stomach. Sometimes scales appear on the dorsal region. At more advanced level, pigmentation appears clearly in the form of black spots and points on the head, the body, the caudal and first dorsal fins.

+ *Pseudotolithus epipercus* (Bleeker, 1863)

It is also a coastal species represented by specimens of two stages only, II and III (Pl. 10).

- Stage II: Quantitative signs can be determined (Pl. 10), such as myomeres (> 22) and the anal fin rays (9).
  The larva has the shape of a drop and a sizeable mouth; the ventral fins emerge. Pigments are found on the pectoral fins, in the form of black points; a black spot can be noticed before and on the pectoral fin base.

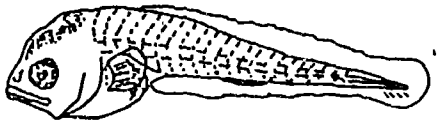
- Stage III (Pl. 10): At this level many quantitative signs can be determined. Thus, it is easy to determine the number of rays on the dorsal (9 + 36) and anal (2 + 7) fins. 22-24 muscular segments can be noticed. All the fins are present. The mouth is sizeable and some denticles can be noticed. Big star-like points are present on the opercle, the stomach and the pectoral fins, faintly expressed sometimes. Separate points are situated above the eyes and after the the anal fin base.

+ *Pseudotolithus moori* (Gunther, 1865)

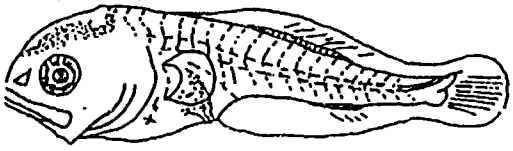
This species is represented by specimens at stage II (Pl. 10). The number of fin rays is as follows: A ≈ 9, D > 13, and C ≈ 13. The total number of myomeres is 23-24. The larva has the shape of a drop. Only the first dorsal and the ventral fins are not yet individualized. The mouth is sizeable. Pigments are noticeable on the stomach (before and under the pectoral fins); some points are located before and after the anal fin. At late stage II, the larva has a bigger dorsal fin.

+ *Pseudotolithus typus* (Bleeker, 1863)

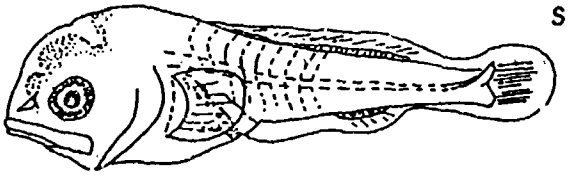
FAMILY SCIAENIDAE: drums (croakers)



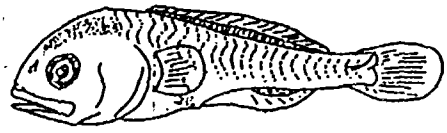
St. I



St. II



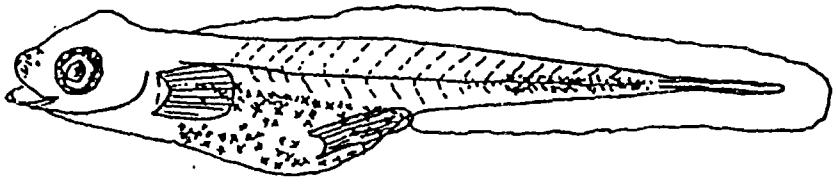
St. II



St. II

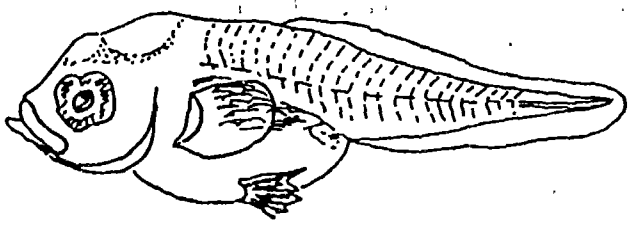
Pseudotolithus typus BLEEKER, 1863

FAMILY SERRANIDAE · sea basses

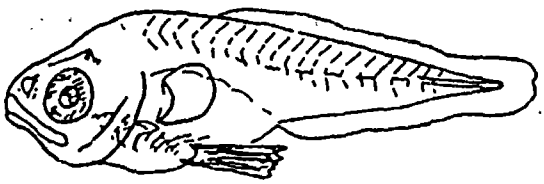


St. I

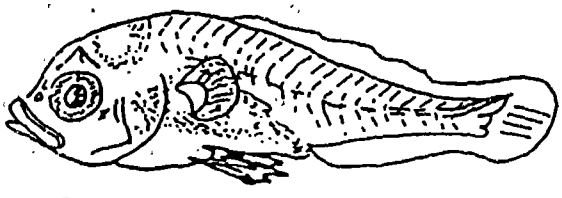
Genus Sp. sp.



St. I



St. I



St. II

Paracentropristis heterurus (CADENAT, 1963)

PI. II - FAMILY SCIAENIDAE AND SERRANIDAE

This species is coastal and occurs in muddy or rocky bottoms, at a depth of 12-70 metres. This fish is widespread, from Senegal to Angola (Seret, 1984). The specimens collected represent wo stages.

- Stage II: three specimens collected (Pl. 11). There are 22 to 24 myomeres. The dorsal, anal and caudal fins have some rays. The most developed fins are the pectoral and the ventral fins. Only one black point is present after the anal fin. This latter has 9 rays. The number of dorsal fin rays is not less than 28, with a maximum of about 37.

- Family SERRANIDAE: sea basses

They occur in tropical and temperate marine water (a few in fresh water). They are characterized by an opercle having three spines: the main spine with one above it and one below it.

Systematic revisions of component group include Kendal (1979), Randall (1980) and Smith (1971). Several subfamilies are often recognized.

This family includes coastal and demersal fishes occuring in tropical and subtropical waters, and rarely in temperate water. Many of them are of high commercial value.

Genus sp. (undetermined species)

- Stage I: samples collected include this stage (Pl. II). The larva has 21 myomeres in the middle of the body, and a dual feeding mechanism. The yellow sac has not yet disappeared while at the same time the mouth takes shape. The pectoral and pelvic fins are well developed. Some shining black star-like points can be noticed before the eyes, on the stomach, and in the ventral and caudal portions (Pl. 11).

+ *Paracentropristis heterurus* Cadenat, 1937

Only one species has been found in African tropical Atlantic by Cadenat in 1937. Two stages were observed.

- Stage I (Pl. 11). The myomeres are present (22-24). The pectoral and pelvic fins are visible. The eyebrow can be seen above the eyes. The ventral fins are black and some dark pigments appear from the nape to the anal fin.

- Stage II (Pl. 11): There are slight differences with stage I. Some rays appear on the caudal and dorsal fins. The pectoral and pelvic fins are well developed. The urostyle has two or three elements. Pigmentation is very well expressed before and after the eyes, on the stomach and the ventral fins (Pl. II).

- Family SPHYRAENIDAE: barracudas

They are pelagic and occur in marine, tropical and subtropical, temperate and warm water in the Atlantic, Indian and Pacific Oceans. An undetermined species of the gernus *Sphyraena* has been observed (Pl. 12). The specimens collected represent three larval stages .

- Stage I (Pl. 12): Quantitative signs are not determined at this stage. The larva is elongate. Only the pectoral fins are present. The mouth is sizeable. On the top of the head, the air bladder can be noticed. The bowel is elongate and tube-like. Some pigments in the form of black points can be noticed in the middle of the body.

- Stage II (Pl. 12): Quantitative signs appear and about seven rays are found on both the second dorsal and the anal fins. All the fins are present except for the ventral and the first dorsal. The larva has outstanding eyes and a sizeable mouth. The pigmentation is clearly expressed on the body, with the exception of the fins.

- Stage III (Pl. 12): The dorsal fins with (4 + 5) + (7 + 8) rays and the anal fin with 7 rays are present. The first dorsal and ventral fins appear. Denticles can be seen in the mouth. The pigmentation is expressed in the form of a large stripe extending from the mouth and the caudal region to the anus.

- Family SYNGNATHIDAE: pipefishes and seahorses

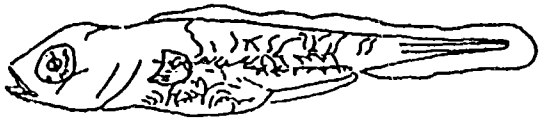
They occur in marine water (some in brackish and fresh water) in the Atlantic, the Indian and the Pacific Oceans. Syngnathids are usually confined to shallow water. Most of the species are found in warm temperate or tropical water. Certain pipefishes, however, thrive in relatively cool water. A few species are confined to fresh water but most are marine or euryhaline.

Samples belonging to two species were collected, representing stages II and III only.

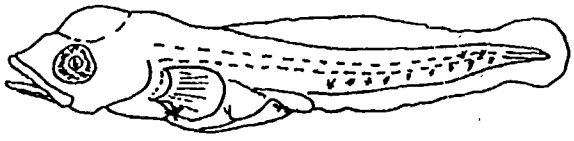
+ *Syngnathus pelagicus* Linnaeus 1758

This species is represented at stage II (Pl. 13). The dorsal fin has about 28 rays. The body has about 50 small spines (Pl. 13).

FAMILY SPHYRAENIDAE : barracudas

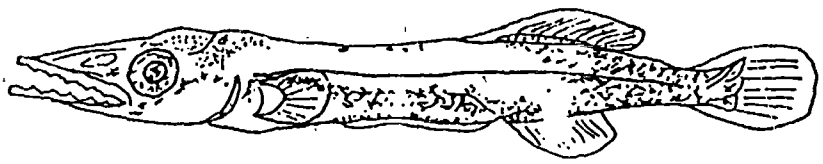


St. I

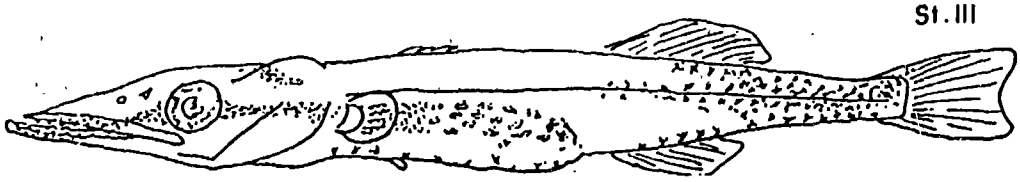


St. I

St. I

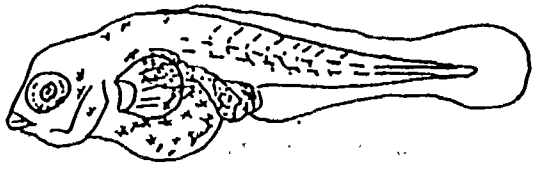


St. II

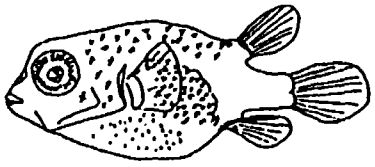


St. III

Sphyraena sp



St. I



St. III

Ephippion guttiferum (BENNET, 1831)

PI. 12 - FAMILY SPHYRAENIDAE AND TETRAODONTIDAE

+ *Syngnathus kaupi* Bleeker 1863

Only stages II and III were collected.

- Stage II (Pl. 13): The dorsal and caudal fins are expressed with respectively 23-24 and 9 rays. The pelvic fins have not yet appeared. The pectoral fins emerge but not near the end of the opercle. The air bladder is distinguishable. The anus is located on the vertical line of the dorsal fin. Some pigments can be seen: small points are present in the ventral and caudal portions of the body.

- Stage III: The total number of the rays is the same as in stage II: D 23-24, and C 9 . The pelvic fins appear but are very small. Pigmentation is clearly expressed by small black points and vertical stripes (Pl. 13).

- Family TETRAODONTIDAE: puffers

They occur in marine water (sometimes foraying in brackish and fresh water); in tropical and subtropical waters of the Atlantic, the Indian and the Pacific Oceans. The specimens ccollected seem to be *Ephippion guttiferum*, representing stages I and III.

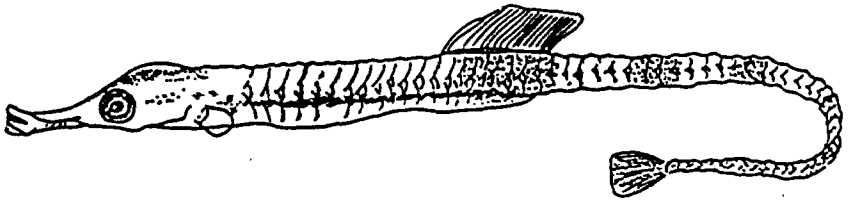
- Stage I: there are no quantitative signs. The larva is comma-like; only the pectoral fins are present at this stage. The ribbon representing fins runs about the body. The mouth is small. The bowels have the shape of a big open sac at the middle of the body. Pigmentation is very distinguishable on the opercle, the stomach and after the head.

- Stage II: All the fins are present and the larva is spherical. It has big eyes. Pigmentation is well developed and corresponds to the shining black points (some are big, some others are small) on the opercle, the stomach and the dorsal region of the body with the exception of the fins and the caudal region.

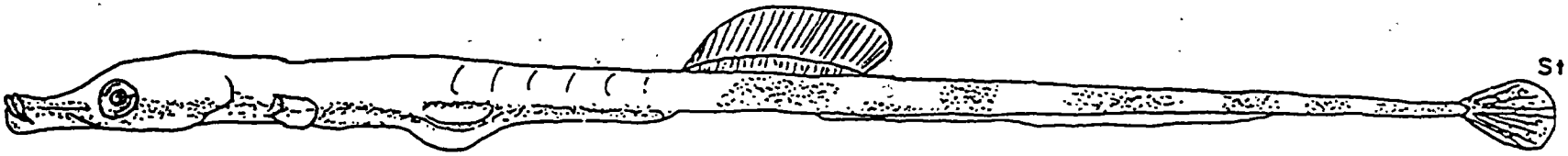
3.- Ichthyoplanctonic Distribution

The samples collected during the investigations in Guinea and Senegal can be divided into three major ecological groups: pelagic, demersal and benthic fishes. Some of them are caught all the year round by artisanal fisheries and seem to be sedentary, while others appear seasonally, which means that they are migratory.

FAMILY SYNGNATHIDAE : pipefishes and sea-horses



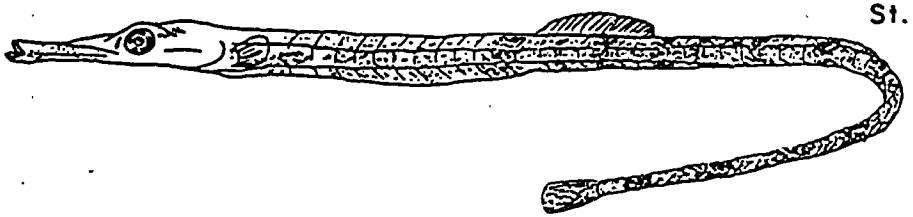
St. II



St : II

Syngnathus pelagicus (LINNAEUS, 1758)

St. II



St. III

Syngnathus kaupi BLEEKER, 1863

PI. 13 - FAMILY SYNGNATHIDAE

- Pelagic group (Pl. 14 and 15): Carangidae (jacks and pompanos), Clupeidae (herrings), Mugilidae (mullets), Scombridae (mackerels and tunas) and Sphyraenidae (barracudas).
- Demersal group (Pl. 16 and 17): Gerreidae (mojarras), Sciaenidae (drums), Serranidae (sea basses), Sparidae (porgies), Polynemidae (threadfins), Eleotridae (sleepers).
- Benthic group (Pl. 18): Blenniidae (combtooth blennies), Bothidae (lefteye flounders) Cynoglossidae (tongue fishes), Soleidae (soles) and Trichiuridae (cutlassfishes).

Some species in these three groups are catadromous or amphidromous, with essential cyclic movements between salt water and fresh water, whereas others are marine or estuarine species often found in fresh water; yet, these do not need foraying in fresh water to complete their life cycle.

All these fishes constitute an important asset for both artisanal and industrial fisheries. There have been more investigations in Guinean than in Senegalese waters (Tab. III).

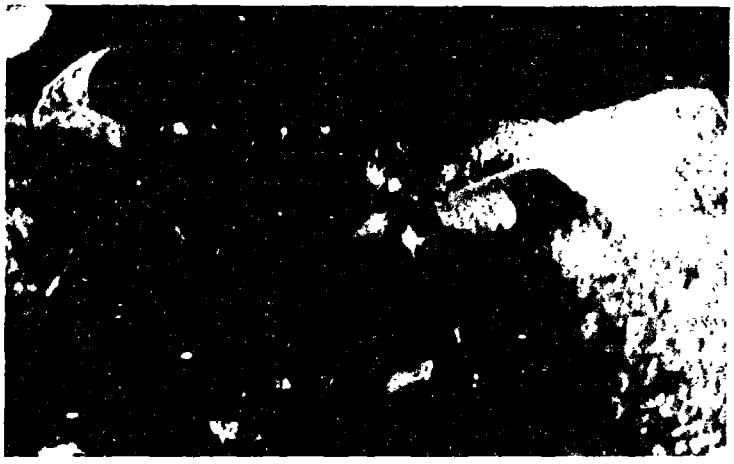
Table 3 - Samples obtained during investigations, from 1988 to 1992

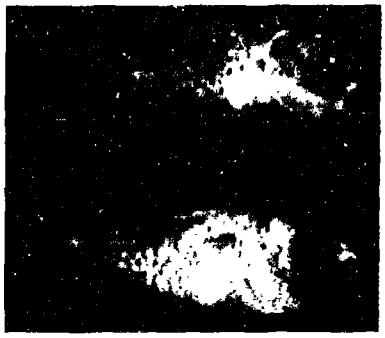
Collection Site	1988		1989		1990		1992		Trap Used	
	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	TCIT-1	TCIT-2
Tabounsou River	2* --- 26**		10 --- 164	4 --- 89	7 --- 88	2 --- 36			+	
Loos Islands	2 --- 31		11 --- 183	6 --- 70	7 --- 82	3 --- 39	2 --- 38		+	+
Sangarea Bay	2 --- 7		3 --- 24	4 --- 61	5 --- 63	3 --- 27	4 --- 29		+	+
Konkouré River near-shore zone				3 --- 41	4 --- 49	3 --- 37	2 --- 31		+	
Fatala River and near-shore zone							1 --- 36	5 --- 164	+	
Casamance River								1 --- 39	+	
Senegal River							1 --- 37		+	
Dakar Bay								1 --- 36	+	

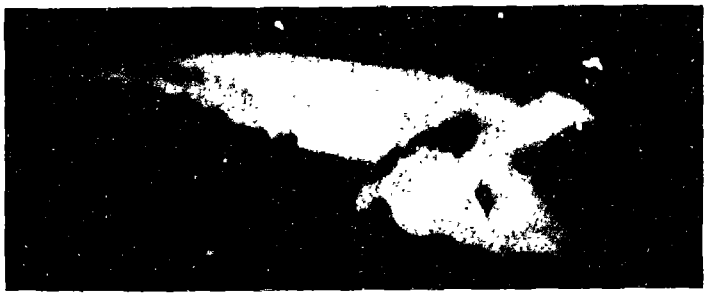
NB:* number of missions carried out

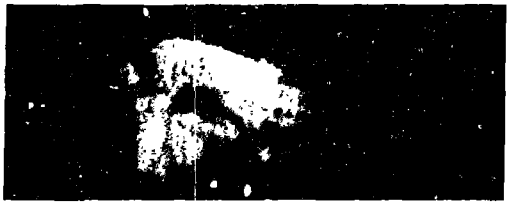
**quantity of fish samples in coastal and estuarine West African waters (Guinea and Senegal).

FAMILY CARANGIDAE : jacks and pompanos









FAMILY CLUPEIDAE: herrings

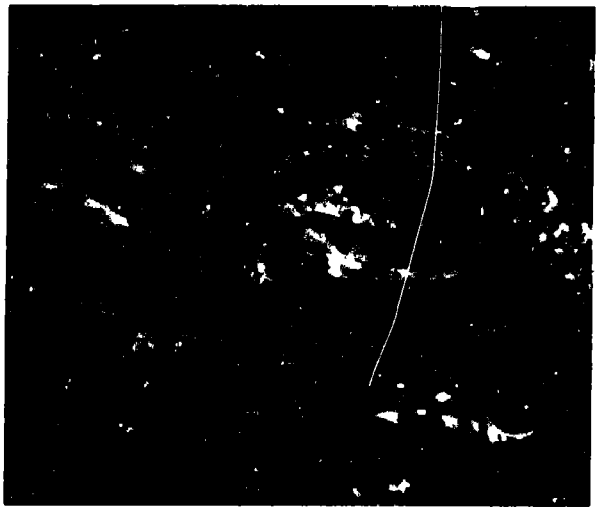
Sardinella moderensis (LOWE, 1839)

Ethmalosa fimbriata (BOWDICH, 1825)

Pl. 14- PELAGIC FISHES

FAMILY CONGRIDAE

FAMILY MUGILIDAE



FAMILY SCOMBRIDAE

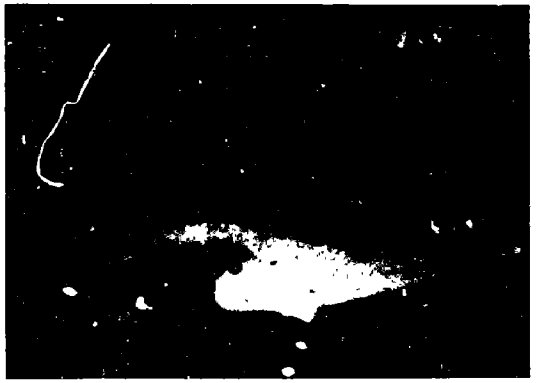
FAMILY SPHYRAENIDAE

PI. 15- PELAGIC FISHES

FAMILY GERREIDAE : mojarras

FAMILY SCIANIDAE : drums (CROAKERS)

FAMILY SERRANIDAE: sea basses

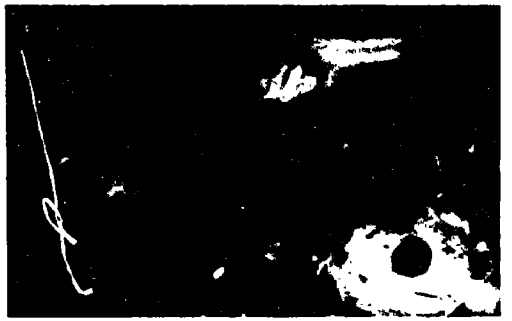


Paracentropristis heterurus CADENAT, 1937

FAMILY SPARIDAE : porgies

Oblada melanura (LINNAEUS, 1758)

FAMILY POLYNEMEIDAE : threadfins



Galeoides decadactilus (BLOCH, 1795)

PI. 16 - DEMERSAL FISHES

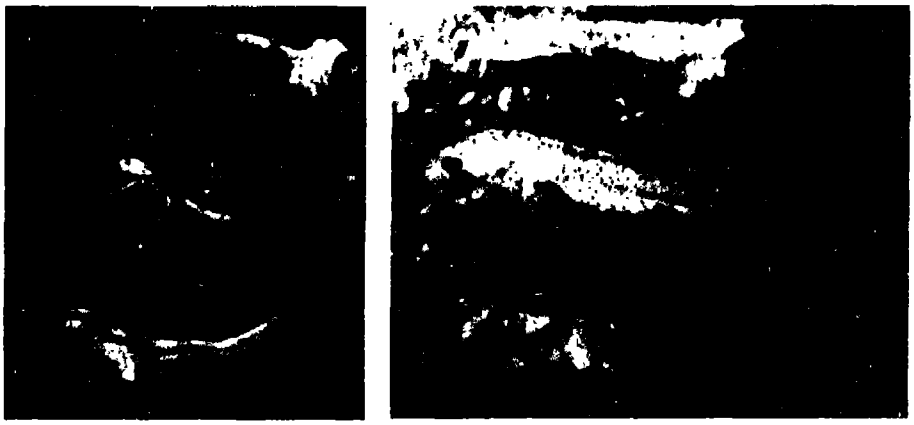
FAMILY ELEOTRIDAE : sleepers

PI. 17 - DEMERSAL FISHES

FAMILY BLENNIIDAE : combtooth blennies

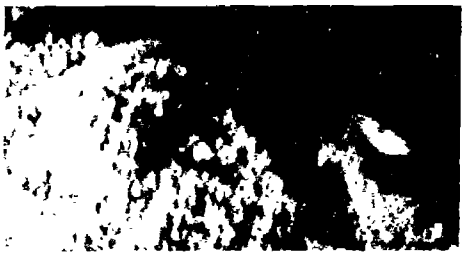
FAMILY BOTHIDAE : lefteye flounders

FAMILY CYNOGLOSSIDAE : tongue fishes



FAMILY SOLEIDAE : soles

FAMILY TRICHIURIDAE



Cutlass fishes

PI.18 - BENTHIC FISHES

The table of ichthyoplanktonic distribution shows many variations in relation to the tidal process (Tab. 4 and 5) and the season (Tab. 6 and 7).

Thus, in Loos Islands, species of fish larvae and juveniles collected vary with the tide: some families are found during low tide (Tab. 4): Bramidae, Branchiostegidae, Congridae, Kuhlidae, Malacanthidae, Mugilidae, Polynemidae, Scombridae, Sphyraenidae, Tetraodontidae and Triglidae. Others are present only during high tide (Tab. 4): Centrolophidae, Gobiidae. Yet many families can be found during both low and high tides (Tab. 4): Blenniidae, Carangidae, Clupeidae, Cynoglossidae, Sciaenidae and Syngnathidae.

This observation is equally valid with respect to Konkouré River and near-shore zones (Tab. 4). The same families have different behaviours, depending on whether they are in rivers or in the sea. Thus, Blenniidae, Bothidae, Microdesmidae, Moronidae, Soleidae and Syngnathidae are present only during low tide. There is no behavioural change with Carangidae, Clupeidae, and Scianidae, unlike Cynoglossidae, Gobiidae, Mugilidae, and Polynemidae.

Table 4 - Ichthyoplanktonic Distribution around Loos Islands

FISH FAMILY		FEBRUARY 1992		APRIL 1992	
		LOWTIDE	HIGH TIDE	LOWTIDE	HIGH TIDE
1	Blennidae	9, 1, 6, 5	7, 3, 2	1,3,4,6,9,2	6, 7
2	Bramidae	9			
3	Branchiostegidae	9			
4	Carangidae	1, 6, 5	7	1,3,4,6,8,9	6, 5, 7
5	Centrolophidae		7		
6	Clupeidae	9, 1, 6, 5	7	3,6,8,9,2,	5
7	Congridae	6			
8	Cynoglossidae	1, 6, 5	7, 3	1,3,4,6,8	6
9	Eleotridae			3	7
10	Gobiidae		1		
11	Kuhlidae			6	
12	Malacantidae	6			
13	Mugilidae	1, 6, 5		1, 3, 4	
14	Polynemidae	6, 5		4	
15	Sciaenidae	1, 6, 5	7, 3, 2	1, 3, 2	
16	Scombridae	6			
17	Sphyraenidae	6		6	
18	Syngnathidae		3	3	
19	Tetraodontidae	1		1	
20	Triglidae	6,5			

Ichthyoplanktonic Density around Loos Island (Number/100 m^3)

	FISH FAMILY	FEBRUARY 1992		APRIL 1992	
		LOWTIDE	HIGH TIDE	LOWTIDE	HIGH TIDE
1	Blennidae	18,0	10,5	9,1	5,4
2	Bramidae	1,2			
3	Brachiostegidae	1,4			
4	Carangidae	38,0	5;0	30,0	12,4
5	Centrolophidae		10,4		
6	Clupeidae	9,2	8,3	2,2	1,7
7	Congridae	1,7			
8	Cynoglossidae	32,4	4,6	4,9	4,5
9	Eleotridae			2,9	2,8
10	Gobiidae		3,5		
11	Kuhlidae			1,6	
12	Malacantidae	1,3			
13	Microdesmidae				
14	Mugilidae	8,3	2,4	5,1	
15	Polynemidae	25,5		1,5	
16	Sciaenidae	129,6	4,4	4,8	
17	Scombridae	0,7			
18	Sphyraenidae	3,7		6,1	
19	Syngnathidae		1,3	1,4	
20	Tetraodontidae	1,3		1,5	
21	Triglidae	2,6			
22	Eggs (number/stages) N ex. / 100 m^3	1 - 4 / 191	2 - 3 / 369	2 - 3 / 198	2 - 3 / 95

Table 6 - Ichthyoplanktonic Distribution In Konkouré River and Near-Shore Mangrove Zone

	FISH FAMILY	FEBRUARY 92		APRIL 92	
		LOWTIDE	HIGH TIDE	LOWTIDE	HIGH TIDE
1	Blenniidae			K	
2	Bothidae			C	
3	Bramidae				
4	Branchiostegidae				
5	Carangidae	C	K	C, L, K	
6	Clupeidae	B, C, D	A, E, K	C, L	M
7	Cynoglossidae	D	A		
8	Eleotridae	B, C, D	A, E, K	C, D, L	E, K, L, M
9	Gobiidae	C, D	E, K	L, K	E, K, L
10	Kuhlidae				
11	Malacantidae				
12	Microdesmidae			C	
13	Moronidae	D			
14	Mugilidae	C	A, E	D	
15	Polynemidae	B, C, D	A, E, K	C, D, L, K, E	K, L
16	Sciaenidae	B, C, D	A, E, K	C, D, L, K	E, K, L
17	Soleidae	C			
18	Sparidae			K	E
19	Syngnathidae	C			

Table 7 - Ichthyoplanktonic Density In Konkouré River and Near-Shore Zone (Number of Specimens/100 m^3)

	FISH FAMILY	FEBRUARY 92		APRIL 92	
		LOWTIDE	HIGH TIDE	LOWTIDE	HIGH TIDE
1	Blenniidae			10,3	
2	Bothidae			1,3	
3	Carangidae	2,2	3,2	1,7	
4	Clupeidae	12,4	14,1	15,2	30,8
5	Cynoglossidae	2,6	5,0		
6	Eleotridae	10,4	24,6	18,8	5,6
7	Gobiidae	32,1	6,3	1,9	30,2
8	Malacantidae				
9	Microdesmidae			1,3	
10	Moronidae	2,4			
11	Mugilidae	1,6	2,8	2,7	
12	Polynemidae	15,4	71,3	38,8	2,1
13	Sciaenidae	30,9	107,3	11,3	35,6
14	Soleidae	2,2			
15	Sparidae			1,8	
16	Syngnathidae	1,1			
17	Tetraodontidae				
18	Triglidae				
19	Eggs (number/stages*) Specimen /100 m^3)	absent	1/30	absent	absent

The quantitative estimation of ichthyoplankton in the zones surveyed was done for every 100 cubic meters (Tab. 5 and 6). In the oceanic area of Loos Islands, Sciaenidae, Carangidae, Cynoglossidae and Polynemidae constitute the most important fish group (Tab. 8). These fishes are more abundant during low tide than during high tide. As for Clupeidae and Tetraodontidae, low or high tide have no impact on their number. In Koukouré River and near-shore zone, the situation is practically the same. With respect to tidal changes, Sciaenidae and Polynemidae are more abundant than Carangidae and Cynoglossidae (Tab. 9).

These observations are applicable to the other areas prospected in Guinea and Senegal. The periods are not the same and are discontinuous (Tab. 3); a survey over a long period is essential to document and interpret interannual variations in relation to the timing and growth of ichthyoplankton in the zones prospected.

There is, to some extent, a degree of similarity as regards species widespread in all the areas prospected. The community index defined by Tchekanov-Sierencene (1982) shows a few variations between the estuarine mangrove zone of Konkouré River and the coastal marine zone of Loos Islands at different tidal periods. During high tide it was 0.71 and during low tide -0.76 (1: total likeness, O: only one common taxon). The generalized index is - 0.77.

For the same period, larvae and juveniles found in the estuarine mangrove zone are bigger than specimens found around Loos Islands. In fact, in the latter case, there are mainly earlier larval stages (more than 80% of the population). In contrast, this proportion drops to about 20% in mangrove zones. The maximum length of fishes collected is 80-88 mm (Polynemidae and Sciaenidae collected in the estuarine area: Konkouré) and the smallest samples have a length of 10-12 mm (Congridae and Syngnathidae found in the marine zone, Loos islands).

Ichthyoplanktonic distribution depends on collecting level (Tab.10). Species diversity is more important in bottom than in surface water. But in many sites and at different collecting levels, some families are always found: Sciaenidae, Mugilidae, Cynoglossidae and Clupeidae. A few groups were found only in one (Tetraodontidae and Blenniidae) or two localities (e.g. Blenniidae) (Pandaré *et al*, 1992a).

In the marine zones, there are many eggs with various embryonic stages during high tide, however, we only caught embryonic stages near the mouth of Konkouré River. The other hydrobionts caught during the prospection were shell fishes (shrimps, lobsters, crabs), Cephalopods (squids, cuttlefishes) and other invertebrates. Some spatio-temporal variations of ichthyoplankton samples have been noticed (Pandaré *et al.*, 1990).

Regarding quantitative estimation for embryos collection periods and localities, it seems that the spawning area and the first ontogenic steps of embryonic development in coastal fish species takes place in the tidal marine area during dry season, near the Kaloum Peninsula (Conakry). On the other hand, later larval and juvenile stages develop in estuarine and mangrove zones of Konkouré River.

The ichthyoplanktonic species in Cap-Vert Peninsula (Dakar) and Casamance River can be subdivided into three main groups (Tab. 8) (Pandaré *et al.*, 1992b).

- Group 1: bottom and mid-depth fishes such as Balistidae, Bothidae, Carangidae, Congridae, Sciaenidae, Scombridae, Serranidae and Sphyraenidae;

- Group 2: surface water or near-surface fishes such as Synbranchidae and Tetraodontidae.

- Group 3: fishes living both in bottom and in surface water such has Blenniidae, Clupeidae, Cynoglossidae, Eleotridae, Mugilidae, Soleidae, Sparidae and Syngnathidae.

Tab.8: Ichthyoplanktonic Distribution in Senegal: Dakar and Casamance.

FISH FAMILY	DAKAR		CASAMANCE	
	SURFACE	BOTTOM	SURFACE	BOTTOM
Balistidae		+		
Blenniidae	+	+		
Bothidae		+		
Carangidae		+		+
Clupeidae	+	+	+	+
Congridae		+		
Cynoglossidae	+	+		
Eleotridae			+	+
Mugilidae	+	+	+	+
Sciaenidae				+
Scombridae		+		
Serranidae		+		
Soleidae		+		
Sparidae	+	+	+	
Sphyraenidae		+		
Synbranchidae				+
Syngnathidae			+	+
Tetraodontidae	+			

The more we move upstream the more species diversity decreases, with a tremendous monospecific population increase. Near the mouth of the river or shore, there are many species.

CONCLUSION

Ichthyoplanktonic composition and distribution are more diversified in Guinean than in Senegalese coastal and estuarine shallow waters. Biodiversity is more important in Guinea than in Senegal. This situation can be explained by environmental conditions in Sahelian regions, which are characterized by a critical rainfall deficit (Senegal). Various developing stages have been found: eggs with embryos, larvae, juveniles, and sometimes adult-fishes.

Abiotic factors such as salinity, dissolved oxygen, collection level and period are important in the spatio-temporal ichthyoplanktonic distribution.

The tidal zone is divided into two sub-zones with specific ichthyofauna. It is hoped that in other West African countries this survey will enable researchers to gain insight into fish development in coastal and estuarine mangrove zones.

The ichthyoplanktonic investigations are very important in relation to ecological, environmental and aquacultural researches, not only in determining fish spawning and growing areas but also in devising and enforcing protection measures so as to mitigate anthropogenic pressure. This study may also serve as a guide for proposing the creation of reserved marine zones, presently inexistent in West Africa. It would thus be possible to analyze optimal conditions for spawning, feeding and growing, and determine scientific bases for aquacultural practices, a common concern to developing countries.

A followed up and well conducted study of ichthyoplanktonic stocks would provide precious information on the potential of the areas prospected, the biological diversity of fish species and optimal conditions for their development, relationships among reproductive areas, nursery grounds and fishing zones located in coastal marine, estuarine, mangrove and near shore zones. This requires an interdisciplinary approach.

ACKNOWLEDGEMENTS

We wish to thank UNESCO and the COMAR-COMARAF Programme, CERESCOR, the Institute of Southern Seas, CRH-Bousoura, ORSTOM, the Faculty of Sciences of the University C.A. DIOP, Dakar and the Direction des Parcs Nationaux, Sénégal for their support and guidance.

We also thank E. Baran from ORSTOM, P. Koivogui from CERESCOR and S. Niang from IFAN-C.A. DIOP for their collaboration, as well as R. Faye for the English review and correction of this paper.

BIBLIOGRAPHY

ABLE, K.A. 1978. Ichthyoplankton of the St. Lawrence estuary: composition, distribution and abundance. *J. Fish. Res. Bd Can.* 35: 1518-1531.

ABOUSSOUAN, A. 1972a. Oeufs et larves de téléostéens de l'Ouest Africain. XI. Larves serraniformes. *Bul. I.F.A.N., 34, Sér. A,* n° 2: 485-502.

ABOUSSOUAN, A., 1972b. Oeufs et larves de téléostéens de l'Ouest africain. XII. Larves *d'Heterostomata* récoltées aux environs de l'Ile de Gorée (Sénégal). *Bul. I.F.A.N., 34,* série A, n° 4: 974-1003.

ABOUSSOUAN, A., 1975. Contribution à l'identification des larves de Carangidae. *Bul. I.F.A.N., 37,* sér. A, n° 4: 899-938.

ALLEN, D.M. and BARKER, D.L. 1990. Interannual variations in larval fish recruitment to estuarine epibenthic habitats. *Mar. Ecol. Prog. Ser., 63* : 113-125.

BECKLEY, L.E. 1986. The ichthyoplankton assemblage of the Algoa Bay nearshore region in relation to coastal zone utilization by juvenile fish. *South African Journal of Zoology, 21:* 244-252.

BEZBORODOV, A.A., BOULGAKOV, N.P., EREMEV, V.N. and CAMARA, C. 1988. "Hydrologie et hydrochimie de la zone frontale côtière "*in* Atlantique Tropicale: Zone Guinéenne Kiev, Naoukova Doumka, p. 187-202.

BLACHE, J., CADENAT, J. and STAUCH, A. 1970. Clés de détermination des poissons de mer signalés dans l'Atlantique oriental, entre le 20e parallèle Nord et le 15e parallèle Sud. Faune tropicale XVIII: 479 p., 1152 fig., O.R.S.T.O.M., Paris.

BOEHLERT, G.W. and MUNDY, B.C. 1988. Roles of behavioral and physical factors in larval and juvenile fish recruitment to estuarine nursery areas. *Am. Fish. Soc. Symp., 3 :* 57-67.

BOESCH, D.F. and TURNER, R.E. 1984. Dependence of fishery species on salt marshes: The role of food and refuge. *Estuaries, 7:* 89-97.

BOURNE, D.W. and GOVONI, J.J. 1988. Distribution of fish eggs and larvae and patterns of water circulation in Narraganssett Bay, 1972-1973. *Am. Fish. Soc. Symp. 3:* 132-148.

CARR, W.E.S., ADAMS, C.A. 1973. Food habits of juvenile marine fishes occupying seagrass beds in the estuarine zone near Crystal River Florida. *Trans. Am. Fish. Soc. 102:* 511-540.

CROKER, R.A., 1965. Planktonic fish eggs and larvae of Sandy Hook Estuary. *Chesapeake Sci. 6* : 92-95.

CRONIN, L.E., and MANSUETI, A.J. 1971. The biology of the estuary. *In* "A Symposium on the Biological Significance of Estuaries". (Eds P.A. Douglas and R.H.B. Stroud), p. 24-39 (Sport Fishing Institute: Washington, D.C.).

DANDO, P.R. 1984. Reproduction in estuarine fishes. *In* "Fish Reproduction: Strategies and Tactics". (Eds G.W. Poots and R.J. Wooton), p. 155-170 (Academic Press: London).

De SILVA, S.S. 1980. Biology of juvenile grey mullet: a short revew. *Aquaculture 19*: 21-36.

DOKKEN, Q.R., MATLOCK, G.C., and CORNELIUS, S. 1984. Distribution and composition of larval fish populations with Alazan Bay, Texas. *Cont. mar. Sci. 27:* 205-222.

DOVEL, W.L. 1971. Fish eggs and larvae of the upper Chesapeake Bay. *NRI Spec. Rep. 4, Nat. Res. Inst., Univ. Maryland, Contrib. 460* ; 71 p.

DOVEL, W.L. 1981. Ichrhyoplankton of the lower Hudson Estuary, New York, *N.Y. Fish. Game. J. 28* : 21-39.

FORTIER, L., and LEGGETT, W.C. 1982. Fickian transport and the dispersal of fish larvae in estuaries. Can. *J Fish. Aquat. Sci. 39:* 1150-1163.

FREIHOFER, W.C. 1978. Cranial nerves of a perioid fish, *Polycentrus schomburgkii* a contribution to the morphology and classification of the order Perciformes. *Occ. Pap. c.r. Acad. Sci. 128:* 78 p.

GAUGHAN, D.J., NEIRA, F.J., BECKLEY, L.E. and POTTER, I.C. 1990. Composition, seasonality and distribution of the ichthyoplankton in the Lower Swan Estuary, South-Western Australia. *Aust. J. Mar. Freshwater Res., 41* : 529-543.

HAEDRICH, R.L. 1983. Estuarine fishes. In "Estuaries and Enclosed Seas" (Ed. B.H. Ketchum), p. 183-207 (Elsevier: Amsterdam).

HERMAN, S.S. 1963. Planktonic fish eggs and larvae of Narraganssett Bay. *Limnol. Oceanogr. 8*: 103-109.

HOLT, J. and STRAWN, K. 1983. Community structure of macrozooplankton in Trinity and Upper Galveston Bays, Texas. *Estuaries 6* : 66-75.

IVANOV, L. and CAMARA, M. 1988. Variation du niveau de la mer et vitesse des courants dans la zone littorale de la République de Guinée. Prévision 1989-1990, Conakry: preprint CERESCOR, 75 p.

KENDAL, A.W. Jr. 1979. Morphological comparisons of North American sea bass larvae (Pisces: Serranidae). *NOAA Tech. Rept. NMFS Circ. 428:* 1-50

KNEIB, R.T. 1984. Patterns in the utilization of the intertidal salt marsh by larvae and juveniles of *Fundulus heteroclitus* (Linnaeus) and *Fundulus luciae* (Baird). *J. exp. mar. Biol. Ecol., 83:* 41-51.

KOUZMENKO, L.V. and AVA, S.R. 1988. Phytoplancton, matière primaire, chlorophylle. In Atlantique Tropicale. Zone Guinéenne. Kiev, Naoukova Doumka, p. 243-249.

LASSERRE, P. 1992. Marine biodiversity, sustainable development and global change. In "UNESCO Technical papers in Marine Sciences N° 64: 38-55.

LEVEQUE, C., PAUGY, D. and TEUGELS, G.G. 1990. The fresh and brackish water fishes of West Africa, vol. 1, *Collection Faune tropicale n° XXVIII,* 384p.

LEVEQUE, C., PAUGY, D. and TEUGELS, G.G. 1992. The fresh and brackish water of West Africa, vol. 2., *Collection Faune tropicale n° XXVIII,* 518p.

MARCHAL, E.L. 1969. Clé provisoire de détermination des oeufs et larves de Clupeidae et Engraulidae dans l'Ouest africain. *Rep. Publ. Kaliningrad* : Atlant. Niro., 14p.

MENON, A.G.K., 1977. A systematic monograph of the tongue soles of the genus *Cynoglossus*; Hamilton-Buchanan (Pisces: Cynoglossidae). *Smithsonian Contrib. Zool. 238,* 129 p.

MISITANO, D.A. 1977. Species composition and relative abundance of larval and post-larval fishes in the Columbia River estuary, 1973. *Fishery Bulletin (US) 75 :* 218-222.

MISKIEWIEZ, A.G., 1986. The season and length at entry into a temperate Australian estuary of the larvae of *Acanthopagrus australis, Rhabdosargus sarba* and *Chrysophrys*

auratus (Teleostei: Sparidae). In "Indo-pacific Fish Biology: Proceedings of the 2nd International Conference on Indo-pacific Fishes". (Eds. T. Uyeno, R. Arai, T. Taniuchi and K. Matsuura), p. 740-747 (Ichthyological Society of Japan: Tokyo).

MODDE, T. and ROSS, S.T. 1981. Seasonality of fishes occupying a surf zone habitat in the northern Gulf of Mexico. *Fish. Bull. U.S. 78* : 911-921.

MOSER, M. 1981. Morphological and functional aspects of marine fish larvae. *In* "Marine fish larvae", Univ. Washington Press, p. 91-131.

NELSON, J.S. 1984. Fishes of the world. New York: Wiley-Interscience. 523 p.

NORCROSS, B.L. and SNAW, R.F. 1984. Oceanic and estuarine transport of fish eggs and larvae. *A review. Trans. Am. Fish. Soc. 113 :* 153-165.

OLNEY, J.E. and BOEHLERT, G.W. 1988. Nearshore ichthyoplankton associated with seagrass beds in the lower Chesapeake Bay. *Mar. Ecol. Prog. Ser. 45:* 33-43.

O'NEIL, S.P. and WEINSTEIN, M.P. 1987. Feeding habitats of spot, *Leistomus xanthurus*, in polyhaline versus meso-oligohaline tidal creeks and shoals. *U.S. Fish Bull. 85:* 785-796.

PANDARE, D., SY-SAVANE, S. and ADITE, A. 1990. Résultats préliminaires sur l'ichthyofaune du Konkouré et de la façade maritime de Conakry (Guinée). *Rapport final* , 20 p.

PANDARE, D., TAMOIKINE, M.Y., NIANG, S. and BOUSSO, T., 1992a. Premières investigations ichtyoplanctoniques sur la façade maritime de Dakar et le fleuve Casamance en saison pluvieuse. *Rapport final,* 23 p.

PANDARE, D., TAMOIKINE, M.Y., KOVOIGUI, P. and BARAN, E. 1992b. Observations ichtyoplanctoniques du fleuve Fatala (Guinée Conakry) en Juin 1992. *Rapport final,* 18 p.

PANDARE, D. and TAMOIKINE, M.Y. 1993. Observations préliminaires des peuplements ichtyoplanctoniques des zones d'estuaires et de mangroves de l'Afrique de l'Ouest : Cas de la Guinée et du Sénégal. *COMARAF. Série Documentaire n° 10,* 44 p.

PARIN, N.V. and BEKKER, V.E. 1973. Gempylidae. In J.C. Hureau and T. Monod (Eds.) *Check-list of the fishes of the north-eastern Atlantic and of Mediterranean.* Clofnam I. Paris: UNESCO: 457-460.

PEARCY, W.G. and MYERS, S.S. 1974. Larval fishes of Yaquina Bay, Oregon: A nursery ground for marine fishes ? *U.S. Fish. Bull. 72* : 201-213.

POSTMA, H. 1992. Conference on coastal systems studies and sustainable development. Coastal marine systems. *In* "UNESCO Technical papers in marine Science N° 64, Paris 6, 7 p.

POTTER, I.C., CHEAL, A.J. and LONERAGAN, N.R., 1988. Protracted estuarine phase in the life cycle of the marine pufferfish *Torquigener pleurogramma. Marine Biology (Berlin) 98* : 317-329.

RANDALL, J.E. 1980. Revision of the fish genus *Plectranthias* (Serranidae: Anthiinare) with descriptions of 13 new species. *Microncs. 16:* 101-187.

ROPER, D.S. 1986. Occurrence and recruitment of fish larvae in a northern New Zeland estuary. *Estua. coast. and Shelj Sci., 22* : 705-717.

RUPLE, D.L. 1984. Occurrence of larvae fishes in the surf zone of a northern Gulf of Mexico Barrier Island. *Estuar. coast. Shelf Sci. 18* : 191-208.

SERET, B. and OPIC, P. 1990. Poissons de mer de l'Ouest africain. Initiations-documentations techniques n° 49. ORSTOM-PARIS 1981. Réédition 1990; p. 450.

SHENKER, J.M. and DEAN, J.M. 1979. The utilization of an intertidal salt marsh creek by larval and juvenile fishes. Abundance, diversity and temporal variation. *Estuaries 2* : 154-163.

SMITH, C.L. 1971. A revision of the American groupers: *Epinephalus* and allied genera. *Bull. Ann. Mus. Nat. Hist. 146:* 69-241.

SMITH-VANIZ W.F. and STAIGER, J.C. 1973. Comparative revision of *Scomberoides, Oligoplites, Parona,* and Hypacanthus with comments of the phylogenetic position of *Campogramma* (Pisces: Carangidae). *Proc. Calif. Acad. Sci.,* Ser. 4, *39: 185-256.*

SPRINGER. V.G. and SMITH-VANIZ, W.F. 1972. Mimetic relationships involving fishes of the family Blenniidae. *Smithsonian Contrib. Zool. 112 :* 36 p.

SUZUKI, K. 1962. Anatomical and taxonomical studies on the carangid fishes of Japan. *Rep. Fac. Fish. Prefecture Univ. Mie. 4* (2): 45-232.

TALBOT, C.W. and ABLE, K.W. 1984. Composition and distribution of larval fishes in New Jersey high marshes. *Estuaries 7* : 434-443.

TAMOIKINE M.Y. and SY-SAVANE, S. 1989. Méthodes de recherchede l'ichtyoplancton de la zone mangrovienne et des eaux basses du plateau continental de la République de Guinée, Conakry. *Bull. CERESCOR n° 7:* 59-73.

TAMOIKINE M.Y. 1990. Détermination préliminaire d'espèces de larves et de juvéniles du plateau continental de la République de Guinéec Conakry. *Bull. CERESCOR,* 92 p.

THOMPSON, S.M. 1964. A bibliography of systematic references to the grey mullets (Mugilidae). *Div. Fish. Oceanogr. Tech. Pap. 16, Commonwealth Sci. Ind. Res. Org., Australia,* 127 p.

TUCKER, D.W. 1956. Studies as the trichiuroid fishes. 3. A preliminary revision of the family Trichiuridae. *Bull. Br. Mus. Nat. Hist. (Zool.) 4* (3): 73-130.

VIDY, G. and FRANC. 1987. Ressource naturelle en alevins de Mugilidae en Tunisie. Rapport ORSTOM / INSTOP, Dec., 105-213.

WEINSTEIN, M.P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish, Cape Fear River, North Carolina. *Fish Bull., U.S. 77* : 339-357.

WEINSTEIN, M.P. and BROOKS, H.A. 1983. Comparative ecology of nekton residing in a tidal creek and adjacent seagrass meadow: Community composition and structure. *Mar. Ecol. Prog. Ser. 12* : 15-27.

ZŸLSTRA, J.J. 1972. On the importance of the Waddensea as a nursery area in relation to the conservation of the southern North Sea fishery resources. *Symp. Zool. Soc. Lond. 29:* 233-258.

Annex 1 : Some morphometric and meristic data of the ichtyoplanktonic community in the prospected areas

(see p. 6 for the legend. Myom. = myommeres, undet. = undetermined)

FAMILY	GENUS	SPECIES	STAGE	L	l	l.H	lA	Hm	Ø	A	C	D	P	V	Myom.
Albulidae	*Albula*	*vulpes ?*	II	41,4	36,8	3,85	26,7	8,8		18 - 19		20		+	73
Blenniidae	*undet.*	*undet.*	I	2,8	2,8	0,62	1,0						+		
	undet.	*undet.*	I	4,1	4,0	0,95	1,5		0,4				+		
Carangidae	*Caranx*	*hippos*	I	3,0	2,86	0,95	1,5								
			I	3,6	3,5	1,20	2,0								
			II	6,2	5,4	1,72	3,15	2,15		> 15	19 - 22	> 20	+		
			II	7,4	6,2	2,15	3,4			2 + (17-18)	20	8 + 19			
	Caranx	*senegallus*	I	2,0	1,9	0,52	1,0		0,22				+		
			I	2,8	2,71	0,76	1,44						+		
			II	4,8	4,3	1,7	2,32	1,8		19 - 20	16	+	+	+	26 - 28
			III	18,5	15,5	5,4	3,0	7,0		3 + 17		8 + (22-23)	19 - 21		
	Caranx	*crysos*	IV	34,2	28,2	8,4	14,2		2,5	3 + 23		8 + 26		5	
	Seriola	*dumerili*	I	2,5	2,3	0,9	1,6		0,3						
			I	4,2	4,05	1,15	2,5		0,45				+		
			II	5,8	4,7	1,9	2,7			3 + 16		> 25	17		
			III	14,5	11,6	4,15	7,6		1,35	3 + 16	+	7 + 19	+	+	
Clupeidae	*Ethmalosa*	*fimbriata*	I	4,75	4,67	0,51	4,02		0,14				+		
			II	5,8	5,6	0,62	4,9		0,18		+	+			44 - 46
			II	9,0	8,7	1,03	7,8		0,22		+	14 - 15	+		44 - 46
			III	24,8	20,8	5,1	14,7		1,25	21		18		8	44
	Ilisha	*africana*	II	5,8	8,8	1,6	7,3	0,7							31
			II	11,5	10,5	2,1	8,5	1,35		>44 (44-47)	+	13 - 14	+		38
			III	18,8	15,9	3,85	10,5	2,82		45 - 48		13 - 14	+	+	
	Pellonula	*leonensis*	I	2,0	2,0	-	0,75								
			I	3,8	3,8	-	0,9								
			I	4,52	4,52	0,5	3,84		0,17				+		39 - 41
			I	6,4	6,15	0,9	5,4		0,21						36 - 38
			II	9,3	9,0	1,17	1,2		0,28		12	9			42
			II	14,5	12,7	2,15	11,3		0,42	+	14 - 17	+	+		38 - 41
			IV	20,9	17,5	4,9	13,3	3,1		23	17 - 18	+	+	+	40 - 42

Clupeidae	*Sardinella*	*aurita*	II	6,9	6,5	0,85	5,55				+	+	+		40 - 41
			II	8,0	7,8	0,85	6,9				+	+			39 - 42
			III	20,3	17,3	3,96	13,6			21 - 23		17	+	9	42 - 44
	Sardinella	*maderensis*	I	4,4	4,35	0,54	3,7		0,14				+		
			II	6,7	6,6	0,75	5,6		0,18	+		+	+		43 - 44
			II	12,0	10,8	1,6	9,2		0,31	15 - 17		14			44 - 46
			IV	25,1	21,5	6,0	16,5		1,6	18 - 21	+	18 - 20	8	+	42 - 45
Congridae	*undet.*	*undet.*	I	7,6	7,58	1,2	5,9	1,15					+		75
			I	8,6	8,5	1,33	7,5	0,96					+		72
Cynoglossidae	*Cynoglossus*	*sp A*	I	2,45	2,4	0,42	0,95								
			I	5,6	5,5	1,1	2,18	0,37							
	Cynoglossus	*sp B*	I	5,1	5,0	1,1	2,1	0,62							
			I	6,3	6,1	1,1	2,4	1,1							
	Cynoglossus	*monodi*	III	8,3	7,55	2,12	2,3	1,9	0,32	> 95		> 130			
			III	9,3	8,3	2,7	2,9	4,3		102		134			
Eleotridae	*Eleotris*	*senegalensis*	I	3,15	3,0	0,7	1,3		0,21				+		24
			II	6,8	5,5	1,65	3,1			10 - 12	~ 25	(5-6) (10-11)			
			III	9,3	7,7	2,1	4,4		0,44	10 - 12		(5-6) (9 - 11)			~ 25-26
			III	15,5	12,8	3,0	6,8		0,6	11		5 + (9 - 11)	14 - 15		~ 25-26
	Eleotris	*sp.*	III	8,5	6,7	2,1	3,7		0,4			11 - 12			24
Gobiidae	*Stenogobius*	*thomasi*	III	8,9	6,86	2,28	3,8		0,61	> 10		D_1 : 6			23
			IV	22,6	18,0	5,0	9,2		1,5	11	+	6 + 9	18	+	
	Gobius	*rubropunctatus*	III	13,7	11,4	2,9	6,1		11			D_2 : 12 - 13			22
	Gobioides	*ansorgii*	III	20,6	18,4	3,7	9,5			+	+	+	+	+	27
Mugilidae	*undet.*	*undet.*	I	2,9	2,7	0,9	1,85						+		
	Liza	*ramada*	III	7,8	6,0	1,6	3,6			3 + 9	+	D1 : 4 ;	+	5 - 6	
	Liza	*grandisquamis?*	I	4,0	3,9	1,05	2,5	2,25				D2 : 1 + 7	+		
	Liza	*aurata*	III	11,3	8,8	3,2	10,1			3 + 9	+	+	+	+	
	Liza	*falcipinnis*	III	13,7	10,7	3,2	6,9		1,1	3 + 11	+	+	+	+	
Polynemidae	*Galeoides*	*decdactylus*	I	3,35	3,1	0,94	1,58						+		
			II	4,8	4,3	1,45	1,95		0,4	+		+	+		23 - 25
			III	9,0	6,2	2,72	3,4			15		8 + 14			
			III	16,0	10,8	3,7	5,8			3 + 12		8 + 14			
	Petanemus	*quinquarius*	I	3,1	2,94	0,91	1,3						+		
			II	5,0	4,8	1,5	2,16			+	+	+	+		
			II	5,65	5,5	1,55	2,3			17					
			III	14,0	10,8	3,4	5,0			28 - 30	+	7 + (16 - 18)	+	+	

Sciaenidae	*Pseudotolithus*	*brachygnathus*	I	2,85	2,64	0,84	1,1						+		
			I	3,4	3,0	1,0	1,25				+		+		
			II	6,4	5,5	1,9	2,5	1,7							
			III	6,5	5,5	1,9	2,6	2,1		~ 9	+	> 20	+		
	Pseudotolithus	*elongatus*	II	5,1	5,0	1,33	2,0		0,46	18	+	+			
			III	10,8	7,7	3,0	4,4			2 + 6	+	10 + 32	+	+	
			III	31,2	22,0	8,0	13,0			2 + 6	+	10 + 32	+	+	
	Pseudotolithus	*epipercus*	II	7,8	6,2	2,1	3,2			9			+		> 22
			III	10,4	8,0	2,87	4,2			2 + 7	+	9 + 36	+		22 - 24
	Pseudotolithus	*mori ?*	II	5,0	4,5	1,55	2,3		0,4	~ 9	+	> 13	+		> 22
			II	6,7	5,5	1,8	2,5		0,51	+	~ 13	> 13	+		~ 24
	Pseudotolithus	*typus*	I	3,1	3,05	0,93	1,4			+					21 - 23
			II	4,2	4,0	1,15	1,65			+	+	+			21 - 23
			II	5,4	4,4	1,35	2,15			9		> 28			
			II	6,9	5,7	2,17	2,65			9		~ 37			~ 24
Serranidae	*undet.*	*undet.*	I	2,7	2,7	0,6	1,3		0,21				+	+	~ 21
	Paracentro - - pristis	*heterurus*	I	2,2	2,2	0,73	1,45		0,23				+	+	~ 24
			I	3,55	3,45	1,12	1,68		0,4				+	+	22 - 24
			II	4,7	4,3	1,4	2,4		0,5		+	+	+	+	~ 24
Sphyraenidae	*Sphyraena*	*sp.*	I	2,3	2,3	0,7	1,5		0,21				+		
			I	3,0	3,0	0,98	1,5								
			I	4,3	4,1	1,34	2,85						+		
			II	8,4	7,3	2,7	5,3		0,6	~ 7	+	D_2 : 7	+		
			III	13,1	11,4	4,1	8,0		0,81	7	+	(4-5) + (7-8)	+	+	
Syngnathidae	*Syngnathus*	*pelagicus*	II	11,6	11,0	1,6	4,4					~ 28			
	Syngnathus	*kaupi*	II	9,0	8,5	1,35	3,6		0,25	+	9	23 - 24	+		
			II	21,1	20,0	2,1	7,2		0,33	+	9	23 - 24	+		
			III	41,0	39,8	5,6	14,5			+	9	25	+	+	
Tetraodontidae	*Ephippion*	*guttiferum*	I	2,5	2,36	0,54	1,0		0,26				+		
			III	6,1	4,45	2,0	3,35	2,4		8	11	11			

UNESCO REPORTS IN MARINE SCIENCE

Cont'd from inside of front cover

No.		Year
49	Eutrophication in the Mediterranean sea: receiving capacity and monitoring of long-term effects. Report and proceedings of a Scientific Workshop, Bologna, Italy, 2 to 6 March 1987. Sponsored by: UNESCO, FAO, UNEP, Regione Emilia Romagna and University of Bologna. English only	1988
50	Marine Geology of the West African shelf zone. Available in English and Russian	1988
51	Physical oceanography of the Eastern Mediterranean (POEM): Programme for 1988/89. English only	1988
52	Year 2000 challenges for marine science training and education worldwide. Available in Arabic, Chinese, English, French, Russian, Spanish	1988
53	Physical oceanography of the Eastern Mediterranean (POEM): The intercalibrated POEM data set and the emerging picture of the circulation, POEM Scientific Workshop, Trieste, Italy, 31 May-4 June 1988. English only	1990
54	Relative sea-level change: a critical evaluation. UNESCO (COMAR) Working Group on Mean Sea-Level Rise and its Influence on the Coastal Zone. English only	1990
55	Physical oceanography of the Eastern Mediterranean (POEM): The new phenomenology of the Eastern Mediterranean. POEM Scientific Workshop, Cambridge, Massachusetts, USA, 29 May-2 June 1989. English only	1991
56	Geological and geophysical investigations in the Mediterranean and Black Seas. Initial results of the 'Training through Research' Cruise of RV Gelendzhik in the Eastern Mediterranean and the Black Sea, June-July 1991. English only	1992
57	Physical oceanography of the Eastern Mediterranean (POEM): The scientific plan for the second phase of POEM. Fourth POEM Scientific Workshop, Venice, Italy, August-September 1990 English only	1992
58	Geological development of the Sicilian-Tunisian Platform. Proceedings of the International Scientific Meeting held at the University of Urbino, Italy, 4-6 November 1992. English only	1993
59	Artificial radioactivity of the Black Sea. English only	1993
60	Inventory of innovative learning materials in marine science and technology. English only	1993
61	Impact of expected climate change on mangroves. UNEP-UNESCO Task Team Report of the First Meeting, Rio de Janeiro, 1-3 June 1992. English only	1993
62	Geological/geophysical investigations of Western Mediterranean deep sea fans. Initial results of the UNESCO-ESF 'Training-through-Research' Cruise of RV *Gelendzhik* in the Western Mediterranean (June-July 1992). English only	1993
63	Sandy coast monitoring: The Dominica example (1987-1992). Prepared for the UNESCO COMAR/COSALC-I Project. English only	1994
64	Mud volcanism in the Mediterranean and Black Seas and shallow structure of the Eratosthenes Seamount. Initial results of the geological and geophysical investigations during the Third UNESCO-ESF "Training-through-Research" Cruise of RV Gelendzhik (June-July 1993). English only	1994

UNESCO REPORTS IN MARINE SCIENCE

Title of numbers which are out of stock

No.		Year
1	Marine ecosystem modelling in the Eastern Mediterranean. Report of a UNESCO workshop held in Alexandria, Egypt, December 1974. English only	1977
2	Marine ecosystem modelling in the Mediterranean. Report of the Second UNESCO Workshop on Marine Ecosystem Modelling. English only	1977
3	Benthic ecology and sedimentation of the south Atlantic continental platform. Report of the seminar organized by UNESCO in Montevideo, Uruguay, 9-12 May 1978.	1979
7	Coastal ecosystems of the Southern Mediterranean: lagoons, deltas and salt marshes. Report of a meeting of experts, Tunis, 25-27 September 1978.	1979
11	Programa de Plancton para el Pacífico Oriental. Informe final del Seminario Taller realizado en el Instituto del Mar del Perú. El Callao, Perú, 8-11 de septiembre de 1980.	1981
12	Geologia y geoquimica del margen continental del Atlantico Sudoccidental. Informe final del Taller de Trabajo organizado por la UNESCO en Montevideo, Uruguay, 2-4 de diciembre de 1980.	1981
13	Seminario Latinoamericano sobre Enseñanza de la Oceanografía. Informe final del Seminario organizado por la UNESCO en São Paulo, Brasil, 17-20 de noviembre de 1978.	1981
16	Marine and coastal processes in the Pacific: ecological aspects of coastal zone management. Report of a UNESCO seminar held at Motupore Island Research Centre, University of Papua New Guinea, 14-17 July 1980.	1981
17	The coastal ecosystems of West Africa: coastal lagoons, estuaries and mangroves. A workshop report, Dakar, 11-15 June 1979.	1981
18	Coral reef management in Asia and the Pacific: some research and training priorities. Report of a UNESCO workshop held in Manila, Philippines, 21-22 May 1981. English only.	1982
19	Mareas rojas en el Plancton del Pacífico Oriental. Informe del Segundo Taller del Programa de Plancton del Pacífico Oriental, Instituto del Mar Callao, Perú, 19-20 de noviembre de 1981. Spanish only	1982
27	Productivity and processes in island marine ecosystems. Recommendations and scientific papers from the UNESCO/ICC sessions on marine science co-operation in the Pacific, at the XVth Pacific Science Congress, Dunedin, New Zealand, February 1983. English only	1984
35	Physical oceanography of the Eastern Mediterranean (POEM): A Research Programme. Reports of the Organizing Committee Meeting, Paris, August 1984, and the Scientific Workshop, Lucerne, October 1984. English only	1985
36	Méthodologie d'étude des lagunes côtières. Résultats d'un atelier régional réuni à Abidjan du 6 au 11 mai 1985. French only	1986
38	Marine Sciences in CMEA countries. Programme and results of co-operation. Available in English and Russian	1986