External lesions and flesh parasites in commercial fishes of Nigerian inshore waters

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Received April 24, 1992; accepted June 22, 1992.

Obiekezie A.I., K. Anders, R. Lick, H. Möller, H. Palm. *Aquat. Living Resour.*, 1992, 5, 173-183.

Abstract

Commercial fish species from the east Nigerian coast were examined for external lesions and flesh parasitic infections that may affect their consumability. Altogether, 2 886 specimens from 43 species representing 34 genera were sampled. The occurrence of lymphocystis disease in the pleuronectiform *Cynoglossus senegalensis* is here reported for the first time from an African marine teleost. Other external lesions of fishes encountered were fin rot, granulomas, pseudotumours and ulcers with total prevalences not exceeding 1%. The following commercial fish species were infected by muscle parasites at the given prevalences: *Cynoglossus browni* (metacercariae, 18%, *Capillaria spinosa* eggs, 27%; *Echinocephalus sinensis* L3 larvae, 9%; *Philometra beninensis*, 27%); *C. senegalensis* (*Kudoa* sp., 10%; metacercariae, 87%); *Pseudotolithus brachygnathus* (*Hysterothylacium* sp. larvae, 2%); *P. senegalensis* (*Poecilancistrum* cf *caryophyllum* plerocercoid, 1%; *Philometra beninensis*, 1%); *P. typus* (*Kudoa* sp., 3%); *Synaptura cadenati* (*Echinocephalus sinensis*, 12%); *Stromateus fiatola* (trypanorhynch plerocercoid, 44%); *Epinephelus aeneus* (didymozoid trematode, 44%; *Hysterothylacium* sp. larvae, 6%). *Capillaria* and *Echinocephalus*, representing helminths with zoonotic potential, present low risks to public health due to their low prevalences and the local methods of preparing fish for consumption. Apart from *C. spinosa* eggs in soles and trypanorhynch plerocercoids in *S. fiatola*, none of the other flesh parasites are likely to affect the market value of their hosts at the recorded levels of occurrence. Carcharhinid sharks influence the occurrence in the locality of most flesh-parasitic helminths for which they serve as definitive hosts. The absence of the third stage larvae of zoonotic Anisakidae common in marine fishes from many other parts of the world is related to the unavailability of suitable hosts. Compared to the results from most temperate locations where similar studies have been carried out, the present study shows remarkably low prevalences and diversity for external lesions and flesh parasites in West African marine fishes.

Keywords: Nigeria, fish diseases, lymphocystis, myxosporeans, cestodes, nematodes, food hygiene.

Lésions externes et parasites de la chair des poissons commerciaux des eaux côtières du Nigéria.

Résumé

Des poissons commerciaux de la côte est du Nigéria ont été examinés pour les lésions externes et les infections parasitaires de la chair qui pourraient rendre leur consommation impropre. Au total, 2 886 spécimens de 43 espèces représentant 34 genres ont été échantillonnés. La fréquence de la maladie de la lymphocystis chez le pleuronectiforme *Cynoglossus senegalensis* est ici rapportée pour la première fois chez un téléostéen marin africain. D'autres lésions externes des poissons ont été rencontrées, décomposition de la nageoire, granulomats, pseudotumeurs et ulcères avec une fréquence totale n'excédant pas 1 %. Les espèces de poissons commerciaux suivantes étaient infectées par des parasites du muscle aux fréquences données : *Cynoglossus browni* (métacercaires, 18 %; œufs de *Capillaria spinosa*, 27 %; larves L3 d'*Echinocephalus sinensis*, 9 %; *Philometra beninensis*, 27 %); *C. senegalensis* (*Kudoa* sp., 10 %; métacercaires, 87 %); *Pseudolithus brachygnathus* (larves d'*Hysterothylacium* sp., 2 %); *P. senegalensis* (plérocercoïdes de *Poecilancistrum* cf *caryophyllum* 1 %; *Philometra beninensis*, 1 %); *P. typus* (*Kudoa* sp., 3 %); *Synaptura cadenati* (*Echinocephalus sinensis*, 12 %); *Stromateus fiatola* (plérocercoïdes de trypanorhynchidés, 44 %); *Epinephelus aeneus* (trématodes didymozoïdes, 44 %; larves d'*Hysterothylacium* sp., 6 %). *Capillaria* et *Echinocephalus*, représentant des helminthes à zoonoses potentielles, présentent des risques faibles pour la santé publiques dus à leur faible fréquence et aux méthodes locales de préparation pour la consommation. A l'exception des œufs de *C. spinosa* dans les soles et des plérocercoïdes de trypanorhynchidés dans *S. fiatola*, aucun des autres parasites de la chair est susceptible d'affecter la valeur marchande de leurs hôtes aux niveaux de fréquence enregistrés. Les requins carcharhinides influencent la fréquence, dans cette zone, de la plupart des helminthes parasites de la chair pour lesquels ils servent d'hôtes définitifs. L'absence du 3ᵉ stade larvaire d'Anisakidae susceptible de zoonose, commun chez les poissons marins des autres parties du monde, est liée à la non disponibilité d'hôtes appropriés. Comparée aux résultats de la plupart des zones tempérées où des études similaires ont été conduites, cette étude montre des fréquences et une diversité remarquablement basses pour les lésions externes et les parasites de la chair chez les poissons marins de l'Afrique de l'ouest.

Mots-clés : Nigéria, maladies des poissons, lymphocystis, myxospores, cestodes, nématodes, hygiène alimentaire.

INTRODUCTION

The West African coast is characterized by the highly diverse fish fauna, as is typical of most tropical regions of the world. More than 490 species from 115 families have so far been described (Fisher *et al.*, 1981). Principal commercially exploited species belong to the families Clupeidae, Carangidae, Scombridae, Sciaenidae, Polynemidae and Cynoglossidae. Their exploitation in regions such as the coastal waters of east Nigeria is rapidly expanding although sufficient background knowledge of their biology is generally lacking.

The growing worldwide trade in fresh and processed fish products has also improved the opportunities for the export of high quality seafood products from West African countries. Already considerable quantities of tongue soles (*Cynoglossus*) and shellfish exported from the Nigerian coast find markets in Europe and America. Continued demand for these products would, however, depend on the extent to which they satisfy the fairly high standards of quality required by these markets. One problem is the possible presence in the consumable parts of the fish of parasites or lesions, which may disgust consumers or which are capable of inducing health problems (Ishikura and Namiki, 1989; Möller and Anders, 1986; Williams and Jones, 1976).

Studies on the diseases and parasites of fishes from the West African coast in general and of Nigerian inshore waters in particular are scarce and consist mainly of systematic descriptions of some species (Obiekezie, 1987; Obiekezie *et al.*, 1987; Reimer, 1984; 1989; Szuks *et al.*, 1975). Observation by Obiekezie *et al.* (1988), however, have shown that highly valuable species such as the estuarine catfish *Chrysichthys nigrodigitatus* may be affected by serious ulcerative lesions at very high prevalences during certain seasons. Banning (1980) identified irregular brown spots in fillets of *Cynoglossus browni* as egg masses of the nematode *Capillaria spinosa* which resulted in the rejection of the fish exported to the Netherlands. Although a couple of other isolated observations have been made on parasites which infect the musculature in some West African marine fish species (Kovaleva *et al.*, 1979; Reimer, 1984; Szuks *et al.*, 1975), there have been no studies on external lesions and flesh parasites in the diverse fish populations of this regions.

Without emphasizing systematic aspects, the present study was designed to screen as many fish species as possible. The aim was to obtain an initial general overview of where problems could be expected regarding the occurrence of external lesions as well as flesh parasites which might interfere with processing and marketing of the fish. Additionally, the study presents baseline information on the health status of a diverse fish fauna from a relatively unpolluted tropical coastal zone. The results not only enable comparison with other regions where similar studies have been carried out, but might also prove useful for assessment of any future environmental changes using fish diseases and parasites as biological indicators.

MATERIALS AND METHODS

Over a two-year period, November 1988 to October 1990, a total of 1 120 fish from 43 species and 24 families were examined for external lesions and flesh parasites. An additional 1 766 fish from 3 species were inspected for external lesions only. Parasites of the body cavity were collected irregulary. All fish were caught by commercial bottom trawlers operating between 8°10′ and 8°25′E; 4°25′ and 4°35′N in and off the mouth of the Cross River, east Nigeria (*fig.* 1). They were landed at the Federal Fisheries Terminal in Ebughu. The fish were stored on ice upon capture and kept in this condition on board the trawlers for up to 10 days, before landing. Fish were identified to species level with the help of the FAO identification sheets for fishes of the Eastern Central Atlantic (Fisher *et al.*, 1981). All fishes were measured to the nearest *mm* total length and weight was recorded to the nearest *g* before and after evisceration. Macroscopically visible external lesions, such as fin rot, ulcerations, swellings, and ectoparasites were recorded. The mouth cavity (excluding gills) was searched for parasites and lesions using a ×50 stereo microscope. The fish was then filleted (including belly flaps) and skinned, thick fillets being sliced lengthwise. Fillets, or slices thereof were pressed between two glass plates of 20×30 cm in size and placed on a candling table over a fluorescent light source. Flesh parasites were easily discernible against the white muscle background. In some cases, especially cestode larvae were still alive. Parasites were removed, counted and preserved in formaldehyde-solution or a mixture of 70% ethanol and 5% glycerol. Were necessary for further elucidation, parasite specimens and sections of abnormal and ulcerative tissue were appropriately fixed for histopathological studies as well as for scanning (SEM) and transmission electron microscopy (TEM).

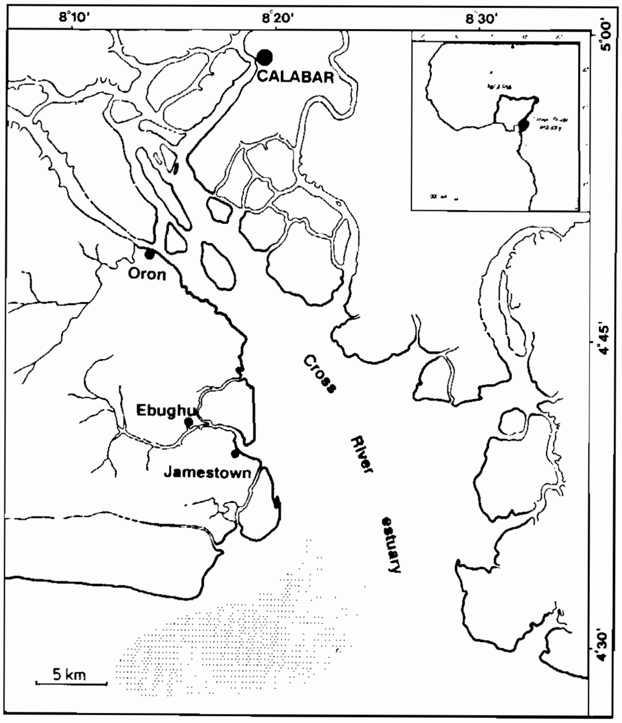

Figure 1. – Map showing part of Nigerian coast and trawling grounds for commercial fish samples (stipled area).

RESULTS

External lesions

Table 1 summarises the external lesions encountered during the present investigation and their prevalences in the affected fish species. They are further documented in *fig.* 2 *A-F*. Less than 1% of the fishes examined suffered from any external lesion. No case of skin ulceration, or tumours, were recorded in the purely marine species examined.

Table 1. – External lesions in marine commercial fishes from the Nigerian coast.

Type of lesion	Affected fish species	Prevalence in % (Number examined)
Pseudotumours	*Ethmalosa fimbriata*	0.2 (1 210)
Lymphocystis	*Cynoglossus senegalensis*	0.6 (342)
Fin rot	*Arius heudeloti*	0.5 (214)
	Cynoglossus senegalensis	0.6 (342)
	Pentanemus quinquarius	16.7 (6)
Thickening of dorsal fin rays	*Trichiurus lepturus*	33.3 (3)
Skin nodules due to metacercariae	*Cynoglossus senegalensis*	87.0 (342)
Skin lesions	*Chrysichthys nigrodigitatus*	13.3 (15)

In 2 out of 15 freshly caught *Chrysichthys nigrodigitatus*, severe destruction of the skin was noted. The lesions were of conspicuous yellow colouration and covered most of the body surface (*fig.* 2 *C*). Progressive degeneration of collagenous tissue down to the musculature was observed histologically. Light microscopy revealed no evidence of the involvement of pathogenic agents.

Lymphocystis pseudotumours consisting of clumps of enlarged connective tissue cells (*fig.* 2 *A*) were found in two out of 342 specimens of *Cynoglossus senegalensis* examined but not in any other species. Typical lymphocystis iridovirus particles could be demonstrated by TEM. This represents the first report of lymphocystis from the genus *Cynoglossus* and from an African marine fish.

A further case of pseudotumour was recorded in two out of 1 210 of the pelagic clupeid *Ethmalosa fimbriata* examined for external lesions. The abnormal tissue mass was located on both lateral sides of the caudal peduncle at about the point of bifurcation of the caudal fin (*fig.* 2 *D*). Histological examination revealed numerous spore-like particles embedded in a

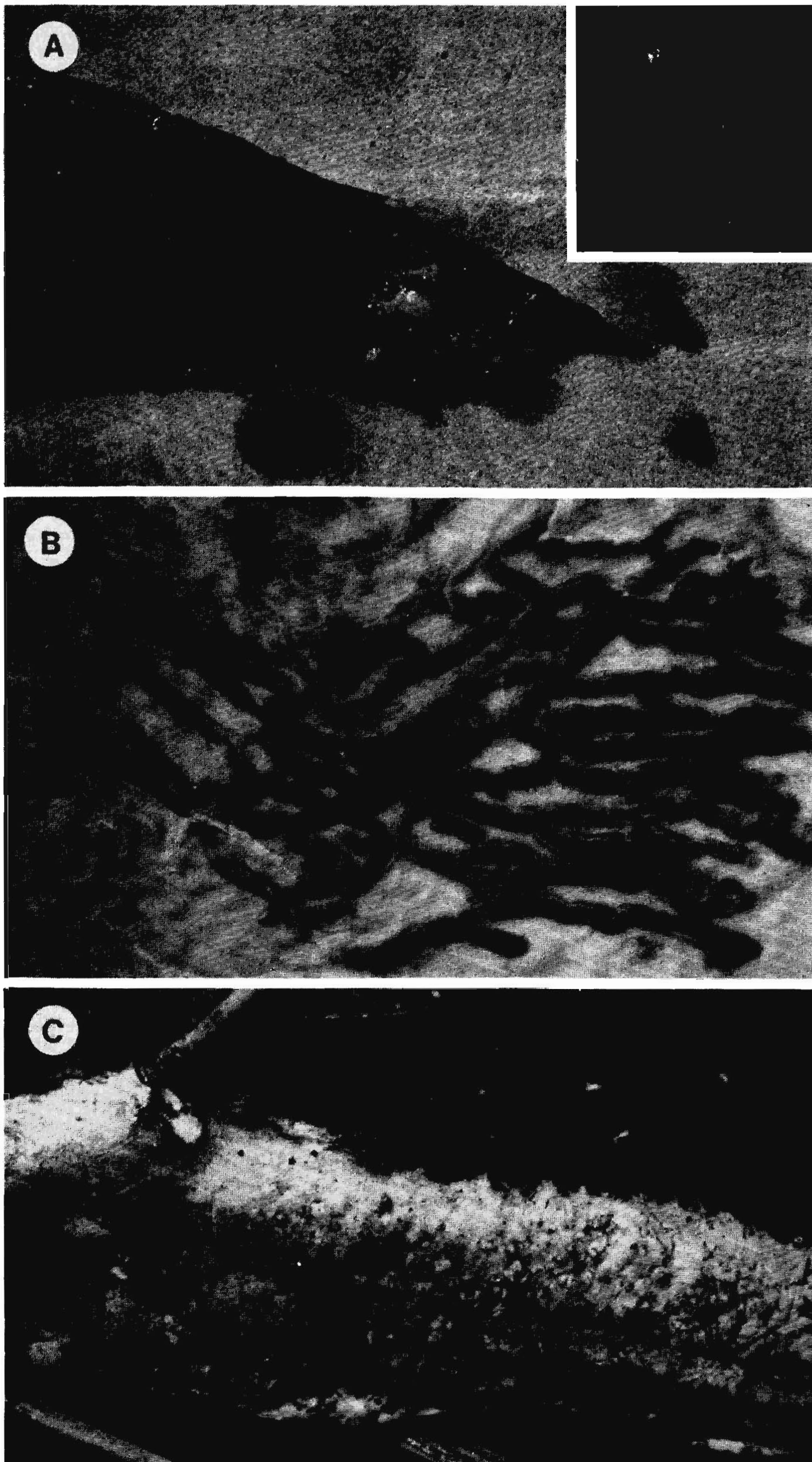

Figure 2.

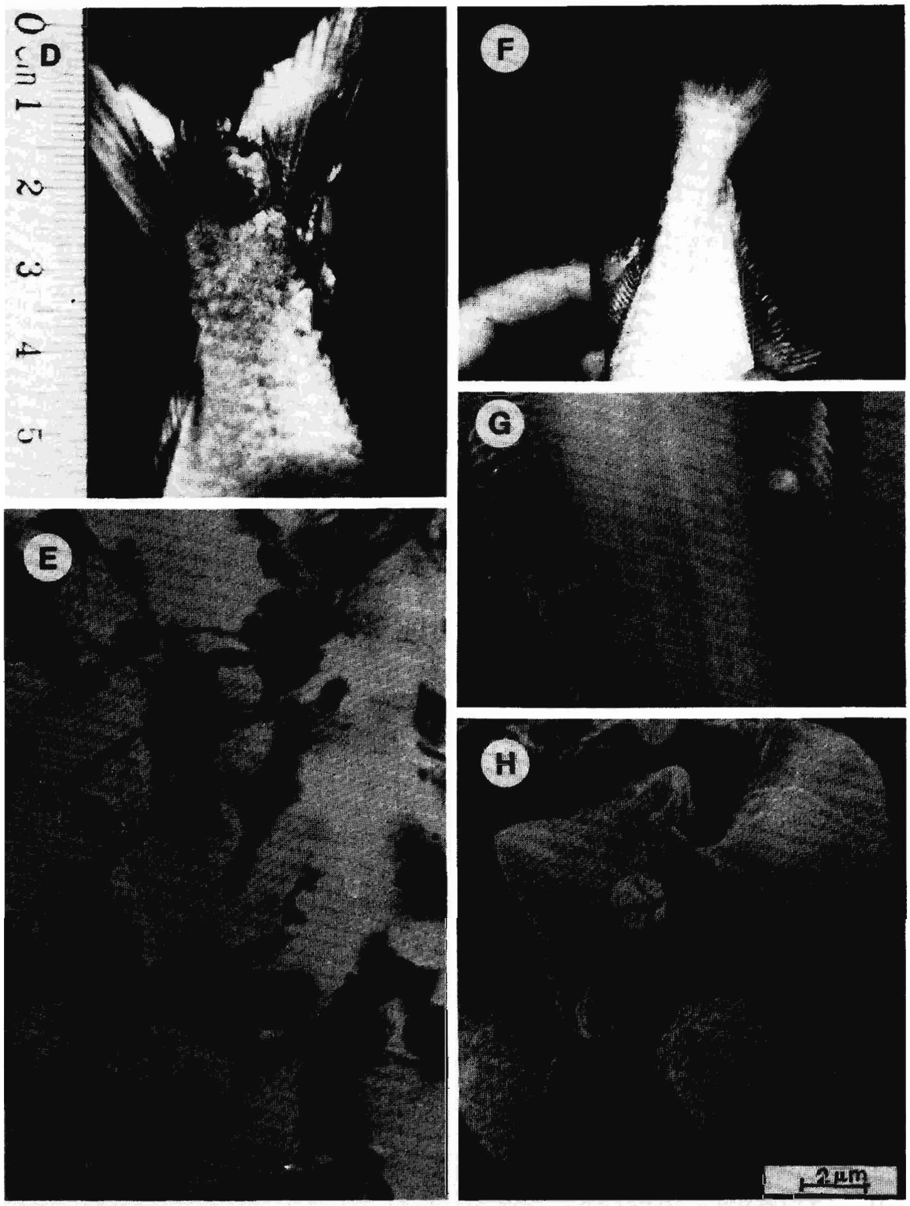

Figure 2. – *Contd.*

Lesions and parasites in skin and flesh: A. Lymphocystis disease of tongue sole, *Cynoglossus browni* - large pseudotumours on tail and on dorsal fin (inset) (× 1); B. Didymozoid trematode under skin of *Epinephelus aeneus* (× 1); C. Degenerative skin lesions on *Chrysichthys nigrodigitatus* (× 0.75); D. Pseudotumour in caudal region of *Ethmalosa fimbriata*; E. Spore-like particles within pseudotumorous tissue in *Ethmalosa fimbriata*. (H&E × 700); F. Fin rot in *Pentanemus quinquarius*. (× 0.5); G. Pseudocysts of *Kudoa* sp. on lateral sides of the tongue sole, *Cynoglossus senegalensis*; H. SEM of *Kudoa* sp. spores.

meshwork of abnormal tissue (*fig.* 2 *E*). Similar cases of abnormal tissue growth suggestive of spontaneous neoplasms but actually caused by protozoans have been found to lead to external protrusions on the head of the sheepshead minnow due to the presence of *Myxobolus linstowi* (Overstreet and Howse, 1977).

Protozoa

Two species of flesh-parasitic myxosporeans of the genus *Kudoa* were found in fish of the families Cynoglossidae and Sciaenidae. Ten of the *Cynoglossus senegalensis* examined were infected by a *Kudoa* species

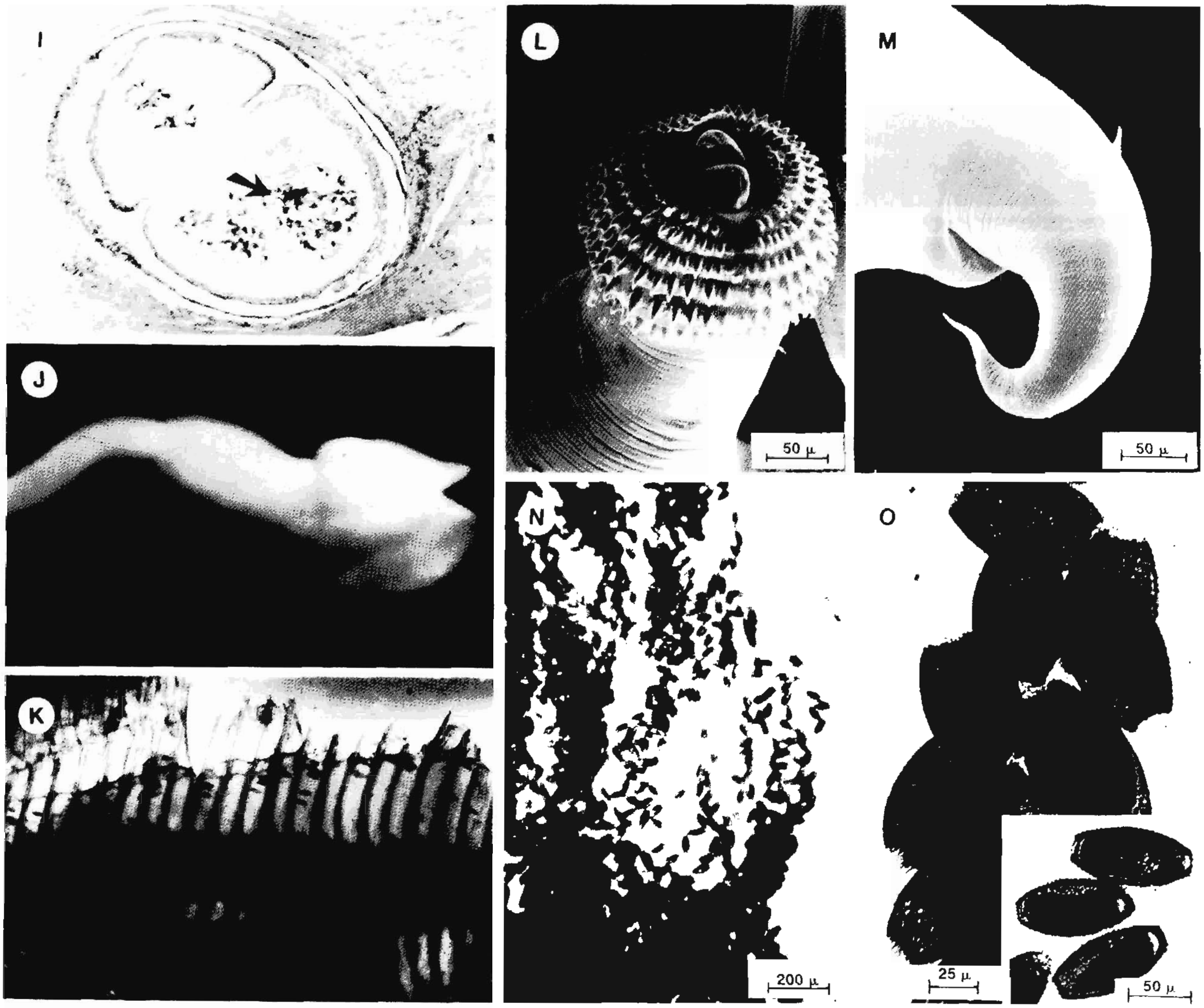

Figure 2. – *Contd.*

I. Section through uterus of didymozoid trematode in skin of *Epinephelus aeneus* - note cellular reaction around trematode. (H&E × 169); J. Scolex of *Poecilancistrum* from musculature of the croaker, *Pseudotolithus senegalensis* (× 25); K. *Otobothrium* sp. plerocercoids in musculature between vertebral spines of *Stromateus fiatola* (× 1); L. SEM of the head region of *Echinocephalus sinensis* third stage larva in musculature); M = tail region; N. *Capillaria spinosa* egg mass in fillet of tongue sole, *Cynoglossus browni*; O. *C. spinosa* eggs at two magnifications to show their spiny nature.

which forms elongate spindle-shaped pseudocysts near the fin edges on the blind side of the host (*fig.* 2*G*). Cysts occasionally occur in the ventral but never in the dorsal musculature. SEM of the spores showed features of the valves not hitherto observed in species of the genus (*fig.* 2*H*). No host tissue reaction was elicited around the pseudocyst and the plasmalemma of the developing plasmodium abuts directly on host cells without any evidence of post-mortem jellification of host musculature. The specific characterization of the present specimen will form the subject of a separate communication.

Kudoa cysts in the sciaenid *Pseudotolithus typus*, on the other hand, are embedded deeply in the musculature of the host and are only evident on filleting. The prevalence was very low, occurring in only 2 out of 78 specimens. There is not connective tissue delimitation of the spore mass, and host musculature directly abutting the pseudocysts shows signs of disintegration. The features of the spore valves and the unequal

Table 2. – Occurrence of parasites in flesh of marine commercial fishes from the Nigerian coast (%).

			Protozoa	Digenea	Cestoda	Nematoda			
Host species	Length (cm)	Number examined	*Kudoa*	Didymozoidae	Plerocercoids	*Capillaria*	*Echino-cephalus*	*Hystero-thylacium*	*Philometra*
Ariidae									
Arius heudeloti	21-63	49	0	0	0	0	0	0	0
A. latiscutatus	23-35	38	0	0	0	0	0	0	0
Bagridae									
Chrysichthys nigrodigitatus	18-29	15	0	0	0	0	0	0	0
Batrachoididae									
Batrachoides liberiensis	13-20	13	0	0	0	0	0	0	0
Carangidae									
Caranx senegallus	18-40	11	0	0	0	0	0	0	0
C. hippos	17-34	28	0	0	0	0	0	0	0
Chloroscombrus chrysurus	22-24	5	0	0	0	0	0	0	0
Selene dorsalis	19-28	5	0	0	0	0	0	0	0
Clupeidae									
Ethmalosa fimbriata	21-23	8	0	0	0	0	0	0	0
Ilisha africana	10-18	8	0	0	0	0	0	0	0
Cynoglossidae									
Cynoglossus browni	32-61	11	0	0	0	3 (27.3)	1 (9.1)	0	3 (27.3)
C. senegalensis	23-52	80	8 (10)	0	0	0	0	0	0
Drepanidae									
Drepane africana	14-21	6	0	0	0	0	0	0	0
Elopidae									
Elops lacerta	25-37	8	0	0	0	0	0	0	0
Ephippidae									
Chaetodipterus goreensis	22-29	3	0	0	0	0	0	0	0
Lobotidae									
Lobotes surinamensis	18-49	5	0	0	0	0	0	0	0
Mormyridae									
Petrocephalus bane	10-15	23	0	0	0	0	0	0	0
Mugilidae									
Mugil sp.	16-18	10	0	0	0	0	0	0	0
Monodactylidae									
Psettias sebae	14-21	50	0	0	0	0	0	0	0
Mullidae									
Pseudopenaeus prayensis	20-24	4	0	0	0	0	0	0	0
Polynemidae									
Polydactylus quadrifilis	21-55	56	0	0	0	0	0	0	0
Galeoides decadactylus	11-31	81	0	0	0	0	0	0	0
Pentanemus quinquarius	17-20	6	0	0	0	0	0	0	0
Pomadasyidae									
Brachydeuterus aurita	15-18	10	0	0	0	0	0	0	0
Pomadasys jubelini	15-34	51	0	0	0	0	0	0	0
P. peroteti	17-41	50	0	0	0	0	0	0	0
Plectorhynchus macrolepis	22-39	12	0	0	0	0	0	0	0
Psettodidae									
Psettodes belcheri	12-30	4	0	0	0	0	0	0	0
Sciaenidae									
Pseudotolithus elongatus	19-36	93	0	0	0	0	0	0	0
P. epipercus	11-25	31	0	0	0	0	0	0	0
P. brachygnathus	22-57	50	0	0	0	0	0	1 (2.0)	0
P. moorii	20-37	70	0	0	0	0	0	0	0
P. senegalensis	10-51	79	0	0	1 (1.3)	0	0	0	1 (1.3)
P. typus	23-49	78	2 (2.6)	0	0	0	0	0	0
Pteroscion peli	15-17	3	0	0	0	0	0	0	0

Table 2. – Contd.

Host species	Length (cm)	Number examined	Protozoa: *Kudoa*	Digenea: Didymozoidae	Cestoda: Plerocercoids	Nematoda: *Capillaria*	Nematoda: *Echinocephalus*	Nematoda: *Hysterothylacium*	*Philometra*
Scombridae									
Scomberomerus tritor	33-39	5	0	0	0	0	0	0	0
Soleidae									
Synaptura cadenati	23-38	16	0	0	0	0	2 (12.5)	0	0
Sparidae									
Dentex filosus	18-34	5	0	0	0	0	0	0	0
Pagellus bellottii	18-31	4	0	0	0	0	0	0	0
Sphyraenidae									
Sphyraena guachancho	32-41	8	0	0	0	0	0	0	0
Stromateidae									
Stromateus fiatola	21-36	9	0	0	4 (44.4)	0	0	0	0
Serranidae									
Epinephelus aeneus	25-40	16	0	7 (43.8)	0	0	0	1 (6.3)	0
Trichiuridae									
Trichiurus lepturus	60-66	3	0	0	0	0	0	0	0
Total		1 120	10	7	5	3	3	2	4

sizes of the polar capsules permit identification of the species as *Kudoa thyrsites* Gilchrist, 1924. This parasite is known to cause "pap" condition in the Cape John Dory (*Zeus capensis*) and the hake *Merluccius capensis* in South Africa (Davies and Beyers, 1947; Gilchrist, 1924). Anecdotal evidence from the local people points to the pappiness and off-taste condition of some large croakers when prepared several hours after capture.

Occasionally, isolated cysts of *Myxobolus* sp. were found within the integument of the lower jaw in *Cynoglossus senegalensis*.

Digenea

In the grouper *Epinephelus aeneus*, conspicuous light to dark brown labyrinth-like ducts beneath the skin become visible after skinning of the fillets (*fig.* 2 *B*). The ducts were occupied by an unidentified species of didymozoid trematode. Prevalence reached 43.8%. Histological sections (*fig.* 2 *I*) show egg-filled uteri and some cellular reaction around the worms. Three species of the didymozoid trematode *Gonapodasmius* have been described from the gills of *Epinephelus* (Reimer, 1980) but none so far have been recorded from the flesh or skin.

An unusually high prevalence of metacercarial infestation was observed in the fins of *Cynoglossus senegalensis*. 87% of the 342 individuals sampled were affected.

Cestoda

Plerocercoids of two different trypanorhynch cestode species occur in the flesh of two species of fish. Seven other different species were found encapsulated on the mesenteries and visceral organs of various fish hosts.

In the sciaenid *Pseudotolithus senegalensis* two plerocercoids of *Poecilancistrum* were found in the dorsal musculature, below the first dorsal fin. The plerocercoids were coiled up in blastocysts within muscle tissue. The scolices (*fig.* 2 *J*) (without the long appendix) measured 3 mm. The morphology of the specimens, including the relative lengths of the pars bothridialis, pars vaginalis and pars bulbosa, place them in the genus *Poecilancistrum* Dollfus, 1929. Although species identification could not be confirmed, due to the invaginated tentacles, they belong most probably to *P. caryophyllum* (Diesing, 1850) Dollfus, 1929 which is the only recognized valid species in this monotypic genus. The species is a widespread muscle parasite of sciaenid fishes which serve as its principal second intermediate hosts. The geographic range spans the western Atlantic Ocean, the Gulf of Mexico, and the Indian Ocean (Goldstein, 1963). The present finding is an additional host and locality record for the parasite.

A different trypanorhynch larva was encountered frequently in *Stromateus fiatola*. All 4 host specimens sampled during the dry season in November 1988 harboured more than 100 larvae each in the dorsal musculature and between the vertebral spines (*fig.* 2 *K*). Five juvenile fish sampled during the rainy season were uninfected. A similar type of cestode larvae was found in high numbers in the flesh of *Stromateus fiatola* in Senegal and was identified as belonging to the genus *Otobothrium* (Reimer, 1984).

Nematoda

Three species of nematodes to be dealt with below were encountered in the musculature of the fish examined. In addition, *Hysterothylacium* sp. larvae were found in the body cavities of 21 of the 43 fish species sampled. This was the most prevalent nematode species in this locality with intensities reaching 600 per fish in some sciaenid hosts. Muscle invasion by these larvae was, however, not common and could be detected only in one species, *Pseudotolithus brachygnathus*.

Echinocephalus sinensis larvae

The larval stages of this gnathostomid nematode were found in the fillets of the two flatfishes, *Cynoglossus browni* (9%) and *Synaptura cadenati* (12%), as well as in the body cavity and visceral organs of the four species *Psettias sebae* (9%), *Pomadasys peroteti* (5%), *Pseudotolithus moori* (6%), and *Pseudotolithus elongatus* (2%). In the flatfish hosts, the larvae were located in the musculature close to the anterior part of the abdominal cavity. The intensity of infection was generally low with no more than 2 worms per infected fish. Nine species of *Echinocephalus* Molin, 1858 are considered valid (Beveridge, 1985). The present larvae were identified as *E. sinensis* Ko, 1975 based on the characters of the head bulb, the cephalic papillae, pseudolabia, and tail as demonstrated by SEM (*fig.* 2 *L*, *M*). Adult *Echinocephalus sinensis* are known from the ray *Aetobatis flagellum* from Hong Kong and southern China, with early larval stages in the oyster (Ko, 1975). The present finding represents a new locality record for this nematode which previously was unknown from any African coasts, and further extends the range of intermediate hosts. Larval echinocephalids have been reported previously mainly from the mesentery and omentum of hosts in South Australia (Johnston and Mawson, 1945). Our finding seems to be the first report of active larval penetration of fish flesh for the genus.

Capillaria spinosa eggs

Elongate dark stripes and scattered black spots visible macroscopically in fillets of *Cynoglossus browni* were found in 27% of the fish examined. Microscopic examination confirmed that the spots consisted of masses of nematode eggs (*fig.* 2 *N*, *O*). On account of the spined shell and plugs at both poles, they are identified as *Capillaria spinosa* Read, 1948 eggs reported earlier by Banning (1980) in fillets of the same fish species imported into the Netherlands from Senegal and also described from the shark *Carcharchinus milberti* by McCallum (1925). 80 specimens of *Cynoglossus senegalensis* examined from the same general locality were not infected.

Philometra beninensis adults

Non-gravid females of *Philometra beninensis* were found in the fillets of *Cynoglossus browni* (27%) and *Pseudotolithus senegalensis* (1%). Only one worm was present in the musculature of each infected fish. The nematode is common in the body cavity and pectoral fins of Polynemidae in the Cross River estuary (Obiekezie, 1987). Its occurrence in the flesh of the two fish species recorded in this study represents accidental infections as the worms do not attain the gravid stage in these locations.

DISCUSSION

The present study, which represents the first screening of Nigerian coastal fish, has revealed the presence of five different types of external lesions and seven species of flesh parasites. The generally low prevalences of external lesions, which affected only 6 of the 43 species, or 0.4% of the 2 886 specimens investigated, is remarkable. These figures do not include the estuarine catfish *Chrysichthys nigrodigitatus* which is the only non-marine species included in this survey. It was affected by a previously unknown peculiar type of skin lesion of unknown origin. Earlier this species had been found to suffer heavily from fin rot during the rainy season (Obiekezie *et al.*, 1988).

The absence of true tumours, ulcerations, and skeletal anomalies stands in contrast to findings from surveys in boreal waters. Particularly in the northeast Atlantic, where most studies of this type have been carried out, prevalences of such lesions above 5% are common for a number of fish species (Dethlefsen, 1990; Möller, 1979; Möller and Anders, 1992; McVicar *et al.*, 1988; Vethaak, 1985). Along the coasts of North America, high disease prevalences have also been reported (McCain *et al.*, 1978; Murchelano, 1982; Overstreet and Howse, 1977; Sherwood and Mearns, 1977). The low diversity and prevalences of such lesions in Nigerian waters conforms with observations made in other tropical coastal areas, such as the Great Barrier Reef, northeastern Brazil and the southern Philippines (Möller and Anders, 1992; unpublished data). The reasons for this situation are not known, but among the possible explanations are: 1) the relatively stable aquaclimate, particularly the constant water temperatures, 2) the low levels of chemical pollutants in the water, and 3) a relatively natural predator-prey system which leaves no possibility of survival for an individual which has been disabled by disease or by parasites. The last explanation might be seen in the context that in the North Atlantic, predatory fish species have been largely depleted by intensive fisheries.

The prevalence of muscle parasites in Nigerian inshore fish communities is also comparatively low and not as diverse as has been reported from some other coastal areas. The absence of anisakid nematodes such as *Anisakis* sp. and *Pseudoterranova decipiens* removes the risk of human infection by these, otherwise widespread, zoonotic parasites. Low densities of suitable intermediate hosts and absence of final hosts in the shallow Nigerian shelf areas might be responsible for this situation. Worthy of note, however, are larvae of the gnathostomid nematode *Echinocephalus sinensis*, encountered in the musculature of *Cynoglossus browni* and *Pseudotolithus brachygnathus*. Transmission to mammals could be achieved experimentally (Ko, 1976), so that a potential risk to humans does exist. The myxosporeans and trypanorhynch cestodes found in this survey represent no risk to human health according to the present state of knowledge.

There are major problems due to flesh parasites in the sciaenid, *Pseudotolithus typus*, the grouper, *Epinephelus aeneus*, and in flatfish of the genus *Cynoglossus*. The presence of *Kudoa* in the sciaenid leads to deterioration of the flesh, in both texture and taste, a few hours post-mortem. *Kudoa* cysts were found in 10% of this species although higher prevalences can not be ruled out since only macroscopically visible cysts were recorded. Although found in only one individual, the presence in the sciaenid fish community of *Poecilancistrum* sp. plerocercoids deserves attention in view of the commercial losses which could be caused by this cestode (Collins *et al.*, 1984; Overstreet, 1977).

Infection of the grouper with large didymozoid trematodes may remain undetected in many cases if the fish is prepared whole, as is traditional in many tropical countries. Filleting, however, as practiced in most western cultures, will make the parasites visible and thus reduce the value of affected fish, particularly for the export market. Similarly, the high intensity of infection with cestode plerocercoids in *Stromateus fiatola* may lead to rejection by consumers.

The hygienic significance of metacercarial infection in *Cynoglossus senegalensis* cannot be evaluated as the parasite species could not be identified. Mass infection, however, is visible externally and may discourage consumers and present marketing problems particularly in view of the high prevalences (87%). Macroscopically visible egg masses of *Capillaria spinosa* in the fillets of *C. browni*, which were found in up to 27% of individuals sampled, present further marketing problems. The presence of nematodes or their eggs make fish flesh unacceptable to many foreign markets. This situation is particularly problematic as West African tongue soles, due to their size and taste, provide a possible alternative to the highly-prized Dover sole and might constitute an important export item for the region.

Acknowledgements

We are grateful to the management of the fishing company, Meid Farms Ltd. and particularly to the production manager, Mr. Robert Okerete, for access to fish samples and for permission to use their excellent quality control laboratories at the Federal Fishing Terminal, Ebughu. Dr. S. Kerstan and Mrs. Kierspel assisted with the processing of samples. Financial support was provided by the GKSS Forschungszentrum, Geesthacht, Germany within the Framework of a German/Nigerian cooperation in aquatic research.

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