

Metazoan Parasites of Some Commercially Important Fish along the Kenyan Coast

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Abstract—The parasitic fauna of some commercial fish species along the Kenyan coast was investigated at four localities between August 2001 and March 2002. The study was carried out to establish the extent of parasitisation of different fish species and quantify the relationship between the parasites and their fish hosts. Fish samples were collected once a month from four landing beaches. Sixteen fish species were examined out of which only eight were infested with ecto- and endo parasites. The infested fish species included: the rabbitfish (*Siganus sutor*), the mackerels (*Selar crumenophthalmus*, *Scomberomorus commerson* and *Rastrelliger kanarguta*), parrot fish (*Leptoscarus vagiensis*), sardine (*Sardinella gibbosa*), tuna (*Thunnus* sp.) and needle fish (*Hemiramphus far*). Of the eight species, *Si. sutor* was most infested with parasites while *Sardinella* and *Leptoscarus* were primarily infested with ectoparasites (isopods). Intensity of infestation increased with age (size), especially in *Si. sutor*, where very young fish had a low infestation rate, while adults were heavily infested ($P < 0.01$). No significant differences were observed in the intensity of infestation between sexes in *Si. sutor* ($P > 0.05$).

INTRODUCTION

Marine fish parasitology is a rapidly developing field of aquatic science. This is due to the growing importance of marine aquaculture, concerns on pollution effects on fish health and a generally increasing interest in marine environmental biology (Moller & Anders, 1986).

The marine environment encompasses a wide variety of biological, chemical and physical parameters, which if altered beyond acceptable limits, such as under culture conditions, may weaken the fish leading to disease outbreaks (Roberts, 1989). Parasitic diseases, either alone or in conjunction with other environmental stresses, may influence weight or reproduction of the host, alter its population characteristics, and affect its economic importance (Rhode, 1993). It is important, therefore, that there is information on the

occurrence of parasites of marine fish in their natural habitats (Roberts, 1989).

Although there is a large body of literature on parasites of marine fish, most of the information is on economically important species of northern temperate seas (Holmes, 1983). A substantial proportion of the above literature is descriptive and restricted to one or a few taxa.

In Africa only scanty information is available on parasites infesting marine fish species (Paperna, 1980). Most of the reports are from southern, central and western Africa, with very few from northern and eastern Africa (Douellou, 1992). In Kenya, little information is available on marine fish parasitology (Martens & Moens, 1995) with most of the work having been carried out in freshwater (Malvestuto & Ogambo-Ongoma 1978; Aloo, 1995; Aloo, 2002).

The study reported here, which was conducted

over four months, provides baseline information on the biodiversity of marine fish parasites along the Kenyan coast.

MATERIALS AND METHODS

Study area

The Kenyan Coast (Fig. 1) is situated immediately south of the equator; it covers a distance of about 500 km while the actual length of the seafont is about 600 km. The coastline forms part of the western border of the Indian Ocean and has an almost continuous fringing coral reef. Other features of the Kenyan coast include mangrove forests and estuaries as well as a number of islands to the south, which protect several embayments and harbours.

Approximately one million people inhabit the Kenyan coastal areas, at a density of 100–200 persons/km². Of these, about 400,000 live in Mombasa, Kenya's major seaport and second-largest urban area. The marine environment

provides this population with employment and food in the form of shell and finfish. Fish contributes over 70% of the protein consumed by the coastal inhabitants (Richmond, 1997).

Fish sampling

Initially fish samples were collected using traps and gillnets from four sampling stations which were selected based on availability of laboratory space. The stations were: Vanga, Shimoni and Gazi (South Coast) and Kilifi (North Coast) (Fig. 1). This did not provide the sample sizes and variety of species that the study required, therefore the procedure was changed to purchasing fresh fish from fishermen operating in the same stations. Fish were transported to the Kenya Marine and Fisheries Research Institute laboratories located at the sampling stations. In the laboratory, fish samples were sorted into taxonomic groups and a sub-sample of each species drawn based on the sex and size of the fish.

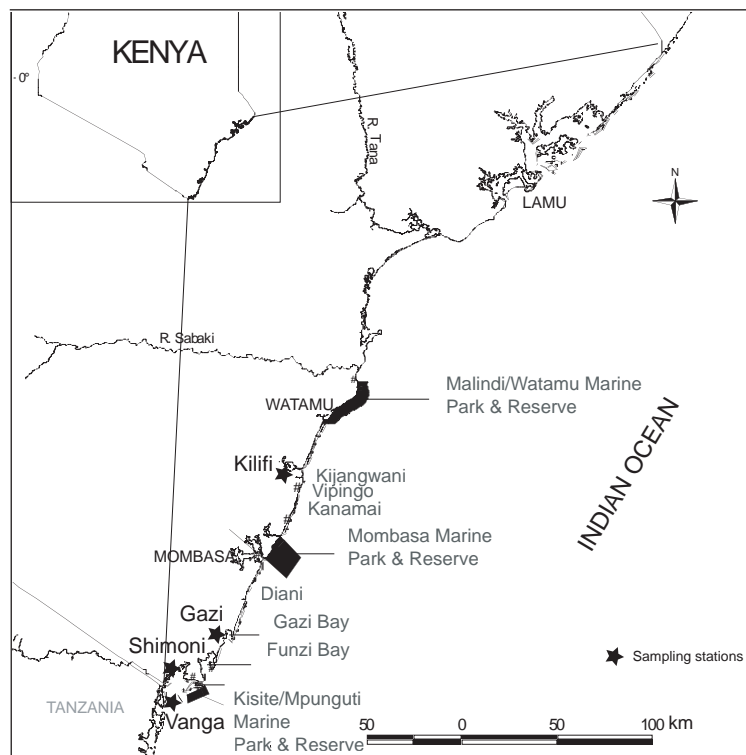


Fig. 1. Kenya's coastline with sampling stations marked with stars

Parasitological studies

The sub-sampled fish were examined for both ectoparasites and endoparasites as illustrated in Fig. 2.

Ectoparasites

The external surface of the fish was examined thoroughly using a hand lens. Areas around the fins, nostril, operculum and the buccal cavity were

examined for external parasites (monogeneans and crustaceans). Gills were removed and examined whole under a dissecting microscope. Gill smears were also made and examined under the microscope. Pieces of gills were placed in 4% formalin in vials, shaken and the sediment examined under a dissecting microscope. Small fish were placed in containers of 4% formalin, shaken and the sediment examined for parasites.

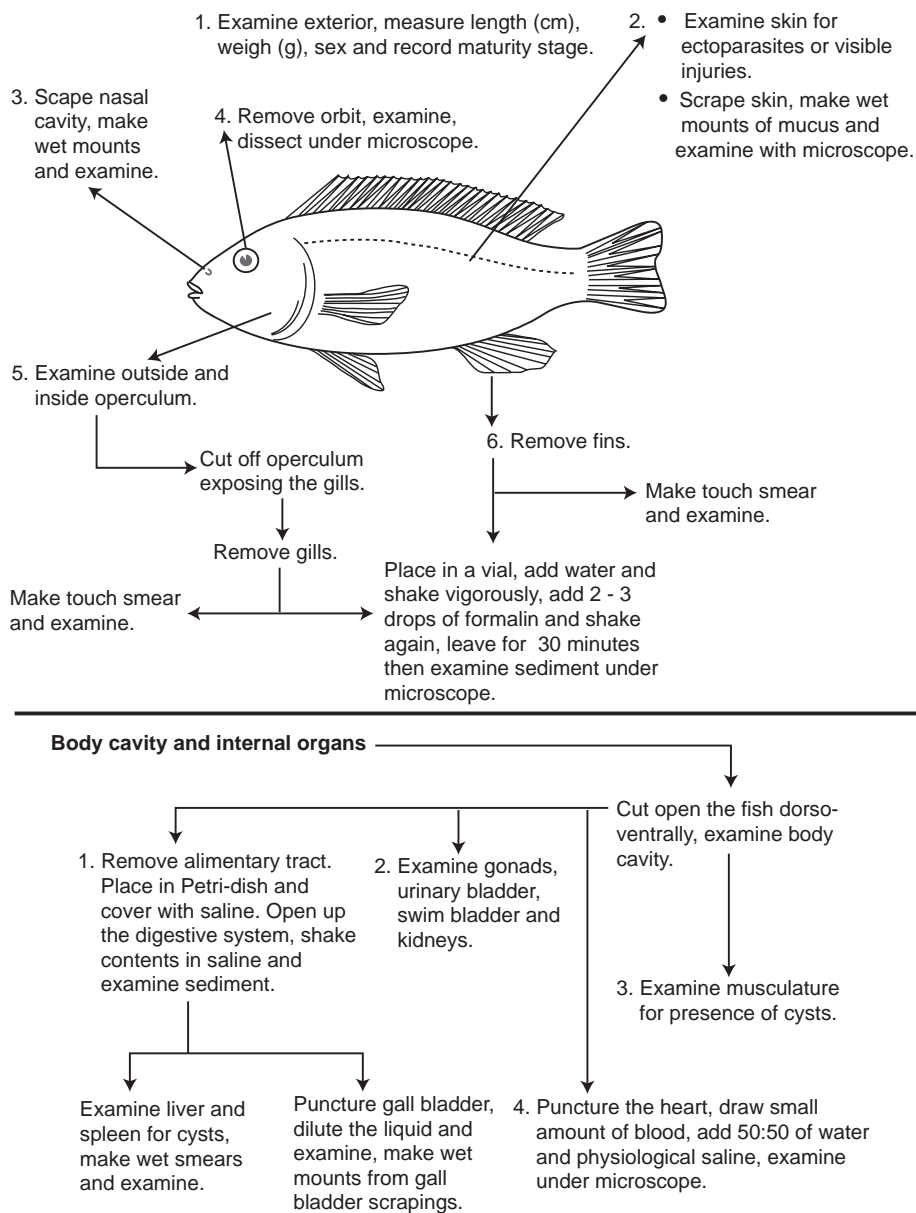


Fig. 2. Parastological examination of fish

Endoparasites

Each fish was opened dorso-ventrally and its internal organs examined for parasites. The entire digestive system was removed and placed in a Petri dish with physiological saline, and the gut was divided into sections. The gonads, liver, heart, gall bladder and the pericardial cavity were also examined. Parasites were treated as follows:

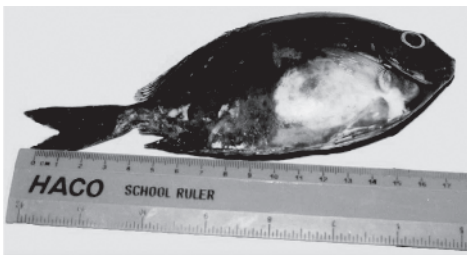
Nematodes were boiled in water to straighten them for measurement and taxonomic studies. Cestodes were placed in distilled water in vials and left overnight in a refrigerator. This relaxes them and their scolex, which is of taxonomic importance, extrudes. Trematodes were pressed between two glass microscope slides with glacial acetic acid (GAA) which renders them transparent and allows their internal organs to be examined.

All parasites were preserved in 70% alcohol after individual treatments.

RESULTS

Out of 16 fish species examined for parasites, with a sample size of 60 fish per species, only 8 were infested with ecto- and endoparasites. The fish species harbouring the most parasites were: the rabbit fish (*Siganus sutor*), mackerel (*Selar crumenophthalmus*, *Scomberomorus commerson* and *Rastrelliger kanagurta*), parrot fish (*Leptoscarus vaigiensis*), sardine (*Sardinella gibbosa*), tuna (*Thunnus* sp.), and needle fish (*Hemiramphus far*) (Plates 1–5).

The eight fish species harboured three species of ectoparasites and three of endoparasites. The sardine *Sa. gibbosa* was host to one isopod species (*Aega* sp.) which only occurred on the ventral side of the host and each fish harboured only one parasite (Plate 6). *Leptoscarus vaigiensis* was host to one isopod species (*Nerocila* sp.) (Plate 7),



1: *Siganus sutor*



2: *Selar crumenophthalmus*



3: *Leptoscarus vaigiensis*



4: *Sardinella gibbosa*



5: *Hemiramphus far*

Plates 1–5. Fish species from the Kenyan coast that were infested with ecto- and endoparasites

which occurred in the mouth of the host. It was observed that most of the parasites infesting *L. vagiensis* were fecund females with ripe eggs or larval parasites. *Nerocila* sp. was more prevalent in parrot fish from Gazi station compared to the other stations. *Hemiramphus far* had one unidentified isopod on the dorsal part of its head (Plate 5).

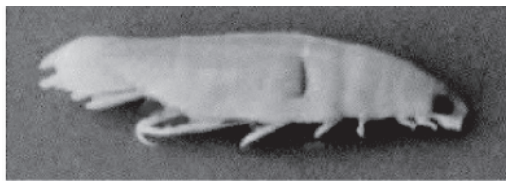
Siganus sutor, *Se. crumenophthalmus*, *R. kanaguta*, and *Thunnus* sp. were all infested with endoparasites at different intensities. *Siganus sutor* was the most heavily infested with cestodes and nematodes, but rarely with trematodes. The nematode *Procamallanus sigani* (Plate 8) was observed to occur abundantly in the intestines of *Si. sutor* from Kilifi (maximum intensity = 60 worms). The nematodes were red, suggesting that perhaps they feed on the host's blood. *Siganus sutor* also harboured an unidentified cestode, whose abundance varied among stations, with fish from Shimoni and Gazi being more heavily infested than those from other stations (mean

intensity of 51 and 38 respectively) ($P < 0.001$). The trematode *Opisthogonoporoides* was also isolated mainly from *Si. sutor* obtained from Shimoni and Kilifi (Fig. 3).

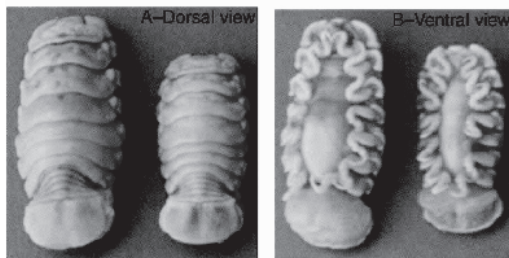
The mackerels, *Sc. commerson*, *R. kanagurta* and *Se. crumenophthalmus* and *Thunnus* sp. were only infested by the nematode *Camallanus* sp. (Plate 9). The parasite was recovered from below the gonads, in the intestine, liver, pericardial cavity and sometimes encysted under the skin. Of the three hosts, *Camallanus* sp. showed preference for *Se. crumenophthalmus*, in which it occurred in large numbers (maximum intensity = 29 worms) in a male fish from Kilifi (Table 1).

Overall, intensity of infestation was observed to increase with the size of the host in *Si. sutor*, where juvenile fish were rarely infested but adults were heavily so ($P > 0.01$) (Fig. 4). There was a slight variation in mean intensity with the sex of the host, where males showed a slightly heavier parasite burden, though this was not statistically significant ($P > 0.05$) (Table 2). Infestation rate also varied with stations; for example, *Si. sutor* from Shimoni and Gazi had a higher parasite prevalence than those from the other stations ($P < 0.01$).

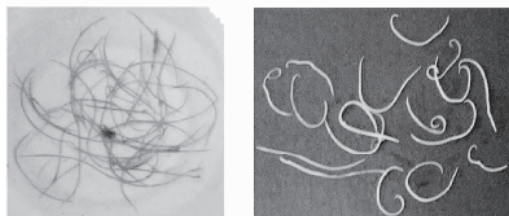
Nematodes were not recorded in *Si. sutor* from Gazi, while *Se. crumenophthalmus* from Gazi had low nematode infestation compared with those from other stations. Apart from variation in prevalence with station, the diet of *Si. sutor* was also observed to vary with station. Fish from Shimoni, which had higher infestation rates were



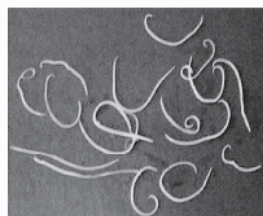
6: An isopod (*Aega* sp.) infesting *Sardinella gibbosa*



7: An isopod parasite (A-dorsal view and B-ventral view)



8: *Procamallanus sigani*



9: *Camallanus* sp.

Plates 6–9. Parasites found infesting fish from the Kenyan coast

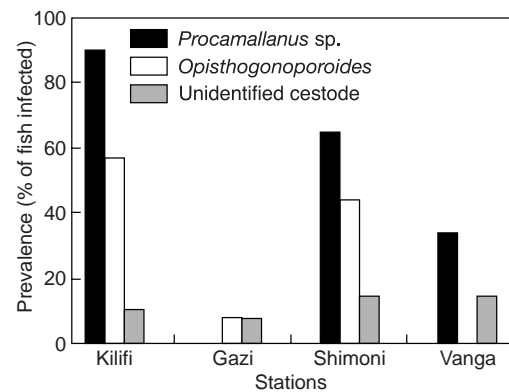


Fig. 3. Variation in the prevalence of three parasites in *Siganus sutor* with sampling station

Table 1. Metazoan parasites of fish from the Kenyan coast

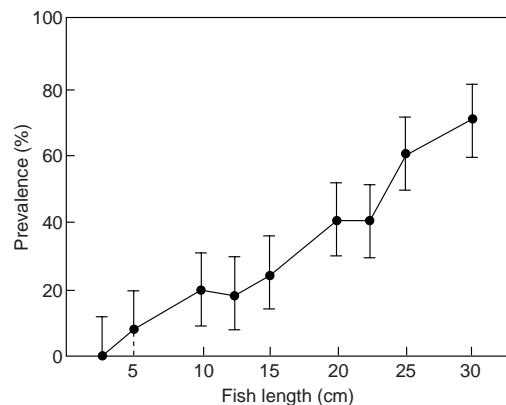
Fish species	Parasite	Organ/area infested	Max. intensity	Prevalence (% of fish infested)
<i>Siganus sutor</i>	<i>Procamallanus</i> (nematode)	Intestines	60	72.0
	Cestode (unidentified)	Intestines	127	49.8
	<i>Opisthogonoporoides</i> (trematode)	Intestines	4	61.2
<i>Selar crumenophthalmus</i> <i>Rastrelliger kanarguta</i> <i>Scomberomorus commerson</i>	<i>Camallanus</i> (nematode)	Below ovary/testis, within liver, under the skin	29	59.1
<i>Thunnus</i> sp.	<i>Camallanus</i> sp.	Under the skin	5	12.3
<i>Sardinella gibbosa</i>	<i>Aega</i> sp. (isopod)	Ventral side of the body on the skin	1	14.6
<i>Leptoscarus vagiensis</i>	<i>Nerocila</i> sp. (isopod)	Inside the mouth/ on skin	2	48.3
<i>Hemiramphus far</i>	Unidentified isopod	Forehead	1	20.6

observed to feed mainly on the alga *Ulva* sp., while those from Kilifi fed on a variety of food items including coral materials.

Table 2. Variation in intensity of parasitic infestation of *Siganus sutor* by sex

Sex	N	TP	TO
Males	30 (62) ⁺	128	41
Females	38 (54)	95	3

N, No. of fish examined; TP, total no. of *Procamallanus*; TO, total no. of *opisthogonoporoides*. ⁺Numbers in parentheses indicate percentage of fish infested

**Fig. 4. Variation in intensity of parasitic infestation with the size of *Siganus sutor***

DISCUSSION

Polyanski (1961) reported that the main factors determining the fish parasite fauna as well as intensity and prevalence of infestation in marine environments can be summarised as being: The diet of the host, lifespan of the host, the mobility of the host throughout its life including the variety of habitats it encounters, its population density (or 'gregariousness') and the size attained, with large hosts providing more habitats suitable for parasites than small ones.

In this study, *Si. sutor* was observed to have the richest gastrointestinal helminth community. Two parasite species (cestodes and trematodes) were found in almost all populations examined, regardless of the station.

The intensity of infestation was correlated with the size of the host in *Si. sutor*. There are several possible explanations for this observation, but one major reason is that as the fish grows, the amount of food it consumes, which includes the larval stages of the parasites, increases (Paling, 1965; Mashego, 1989; Davey & Gee 1976). An analysis of food items in the gut of *Si. sutor* revealed that it feeds mainly on seaweed (especially *Ulva* spp.) and coral remains. The fish perhaps become infested when they consume larval stages of the parasites from the seaweed during feeding.

Although male and female *Si. sutor* were

almost equal in number, males tended to harbour more parasites. Similar findings have been reported in many freshwater fish species (Thomas, 1964; Batra, 1984; Mbahinzireki, 1984; Aloo, 2001; Aloo, 2002) and the main reason for the differences in parasitic load with sex is thought to be physiological. However, endoparasites have been reported to infest the two sexes differentially because male and female fish often have different feeding habits (Rohde, 1993).

The parasites did not seem to affect the health status of their hosts. However, those occurring in vital organs such as liver and gonads may affect their functioning. In the mackerels, especially *Se. crumenophthalmus*, the nematodes were specifically recovered from around the gonads and within the liver. This suggests that the worms have a preference for the two areas, and probably derive certain nutrients from these organs. The main effects of parasites on their host organs as discussed by Reichenbach-Klinke (1973; in Rohde, 1993) are as follows: intestinal parasites inhibit the digestive activity of the host and indirectly inhibit vitamin and blood sugar metabolism and growth; parasites in the liver affect glycogen metabolism and growth. Whereas parasites of the gonads and coelomic cavity may lead to complete castration, reductions in egg numbers have so far been found to be due only to parasites of the body cavity.

The subject of organ specificity among fish parasites has been studied by various researchers; for example, William and Jones (1994) reported that host and organ specificity is determined by physiological requirements of the hosts and the parasites. Site specificity, at least in some species, may be due wholly or partly to physiological factors. In other cases, morphological adaptations are at least partly responsible for site preference (Rohde 1993).

Parasitic infestation of *Si. sutor* varied among sampling stations. At Kilifi, the fish was heavily infested with the nematodes, while helminths occurred in very low numbers. At Shimoni and Gazi, it was heavily infested with cestodes, while the other parasites occurred in low numbers or were absent. No siganids from Gazi harboured any nematode parasites. Among the mackerels, those from Kilifi were more heavily infested with nematodes. This is probably due to the effect of

pollutants from Kilifi town which might stress the fish and at the same time enhance the increase in parasite population. Moller and Anders (1986) stated that fish in polluted waters tended to harbour more endoparasites than those from less polluted environments.

During this study *Si. sutor*, which was the most heavily infested, was observed to feed mainly on a particular type of seaweed (*Ulva* sp.) and coral materials. Fish from Shimoni that fed purely on the seaweed had a heavier parasite burden compared to those from Kilifi which fed on a variety of food items but mainly coral materials. Therefore, there seem to be an association between the seaweed and parasite burden of *Si. sutor*.

Three species of ectoparasites were observed to infest the fish, and all were host-specific. One species infested the sardine, *Sa. gibossa* with only one parasite per host. The second parasite occurred in *L. vagiensis* while a third one occurred on *H. far*. In *L. vagiensis*, the isopod occurred on the skin and inside the mouth but the majority were recovered from inside the mouth and were fecund females or had juvenile parasites. These observations suggest an association between the breeding habit of the parasite and that of *Leptoscarus*. Ectoparasites of most marine fish are usually low in species number due to high salinity (Dubinnin, 1958).

The four-month survey has shown that marine fish species from the Kenyan coast harbour a wide range of both ecto- and endoparasites, including cestodes, trematodes, as well as nematodes, and has established that siganids, mackerels, parrot fish, sardine and needle fish are the most commonly infested. These findings agree with those of Holmes (1990), that community richness of marine helminths varies greatly, with more species being present than in communities of freshwater fish. Further longer-term investigations are needed.

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