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Remora remora
Blue shark *Prionace glauca*
Parasitic copepods

Relationship between echeneidid fish *Remora remora (L.)* and shark *Prionace glauca (L.)*

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Abstract

Twenty one blue sharks *Prionace glauca* were examined and four *Remora remora* were collected from the gill cavities. Stomach contents of remoras were examined and parasitic copepods of family *Pandaridae* in different degree of digestion were found. In four sharks remoras were found in the gill cavities. Three of these sharks had no copepods, in one shark one copepod *Gangliopus pyriformis* was found in the gill cavity.

1. Introduction

Remora remora is a species in the family *Echeneididae*. All echeneidids are marine species commonly inhabiting tropical and subtropical waters. This group of fishes is characterized by the cephalic laminated adhesive disk which enables them to attach to many different marine animals and other objects. Most adult echeneidids attach to the external body surface of their host but their juveniles invade the gill cavity. *Remora remora* feed on plankton, primarily crustaceans, and are active ectoparasite pickers.

The important publications about echeneidids are of Cressey and Lachner (1970) who describe some species of echeneidids and their mutualistic relationship with the host. Schwartz and Lindquist (1987), Schwartz (1992) describe effects of parasitic behavior of echeneidids.

2. Materials and methods

Twenty one blue sharks *Prionace glauca* were examined (Tab. 1) and four *R. remora* were collected from the gill cavities. The sharks were caught in the central Atlantic (Fig. 1) in 1989 for technological purposes by the vessel 'Wieczno' of the Sea Fisheries Institute in Gdynia. They were stored frozen for a considerable time. The sharks were thawed on shore in the laboratory and examined.

Table 1. Data on copepods from examined sharks *Prionace glauca*

Shark No	Species of copepods	Gill cavity right	Gill cavity left	Total
1	*Kroyeria lineata*	73	62	
	Gangliopus pyriformis	5	5	145
2	*Kroyeria lineata*	23	11	
	Gangliopus pyriformis	5	3	51
3	*Kroyeria lineata*	142	68	
	Gangliopus pyriformis	9	4	
	Phyllothyreus cornutus	–	2	225
4	*Kroyeria lineata*	32	16	
	Gangliopus pyriformis	2	7	57
• 5	*Kroyeria lineata*	8	16	24
6	*Kroyeria lineata*	77	88	
	Gangliopus pyriformis	3	2	170
7	*Kroyeria lineata*	17	20	
	Gangliopus pyriformis	5	4	46
8	*Kroyeria lineata*	97	105	
	Gangliopus pyriformis	–	2	204
9	*Kroyeria lineata*	35	24	
	Pandarus bicolor	1	1	61

Table 1. continued

Shark No	Species of copepods	Gill cavity right	Gill cavity left	Total
10	*Kroyeria lineata*	59	40	
	Gangliopus pyriformis	1	4	
	Pandarus bicolor	1	–	105
11	*Kroyeria lineata*	2	3	
	Gangliopus pyriformis	27	36	
	Pandarus bicolor	3	1	72
• 12	*Kroyeria lineata*	9	4	
	Gangliopus pyriformis	4	1	
	Pandarus bicolor	–	1	19
13	*Kroyeria lineata*	36	8	
	Gangliopus pyriformis	2	2	48
14	*Kroyeria lineata*	40	87	
	Pandarus bicolor	5	5	137
15	*Kroeyria lineata*	148	237	
	Pandarus bicolor	4	1	390
16	*Kroyeria lineata*	48	36	
	Pandarus bicolor	2	1	87
17	*Kroyeria lineata*	48	37	
	Gangliopus pyriformis	2	1	91
• 18	*Kroyeria lineata*	10	22	
	Pandarus bicolor	–	1	33
• 19	*Kroyeria lineata*	–	9	
	Gangliopus pyriformis	2	9	
	Pandarus bicolor	4	6	30

Table 1. continued

Shark No	Species of copepods	Gill cavity		Total	
		right	left		
20	*Kroyeria lineata*	34	25		
	Gangliopus pyriformis	8	6		
	Pandarus bicolor	10	11	94	
21	*Kroyeria lineata*	18	1		
	Gangliopus pyriformis	1	3		
	Pandarus bicolor	4	1	28	

• – shark with remora

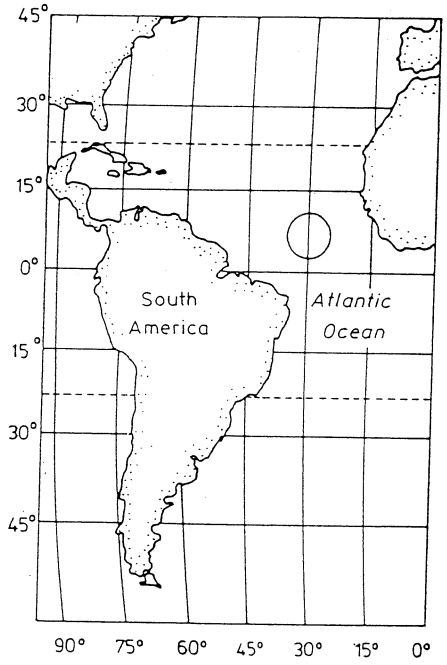

Fig. 1. ○ Capture area of *Prionace glauca*: 3°20'– 8°21' N and 21°10' – 32°14' W

3. Results

The gill arches I–V were examined and *Remora remora* were found between the gill arches I–IV. These specimens were small juveniles ranging in size from 72 to 85 mm. Stomach contents from remoras were examined and parasitic copepods of Pandaridae were found to be an important part of the diet. Copepods were in different degrees of digestion. In three

Table 2. Data on parasitic copepods from sharks *Prionace glauca* with *Remora remora*

Shark No		Gills I	II	III	IV	V
5	L	–	Kl 8	Kl 3	Kl 4	Kl 1
	P	Kl 3	Kl 4	*Remora remora*		Kl 1
12	L	Kl 1	Kl 3 Gp 1	*Remora remora*		Pc 1
	P	Gp 2 Kl 6	Gp1	Kl 1	Gp 1	Kl 2
18	L	Kl 2	Kl 5	Kl 13 Pb 1	Kl 1	Kl 1
	P	*Remora remora*		–	Kl 9	Kl 1
19	L	Kl 1 Pb 1	Gp 3	Kl 6 Gp 2 Pb 2	Kl 1 Gp 3	Kl 1 Pb 3 Gp 1
	P	Gp 1	*Remora remora* Gp 1		Pb 3	Pb 1

Kl – *Kroyeria lineata*, Gp – *Gangliopus pyriformis*, Pc – *Phyllothyreus cornutus*, Pb – *Pandarus bicolor*

sharks, in the gills with remoras parasites were absent and in one shark (No. 19) with a remora one Copepoda *Gangliopus pyriformis* was found (Tab. 2). The total number of copepods living in the gill cavities and on the surface of the body is lower for sharks with remora than for sharks without remora (Tab. 1).

4. Discussion

The small samples do not provide definitive information on the importance of parasitic copepods in remora diet. These observations agree with previous reports, Szidat and Nani (1951), Maul (1956), Cressey and Lachner (1970) who reported the occurrence of parasitic copepods in the remoras' stomachs. According to these authors younger individuals of remoras are more active ectoparasite pickers and the relationship between them and their hosts is very strongly mutualistic, relatively stable and of long duration.

The most important function is cleaning out but remoras are the cause of mechanical pressure on gill filaments and impede undesirable water flow across gill cavity. Remora seeks the gill cavity not only for parasitic food but also to protect itself from other predators. Perhaps small individuals leave the body and seek the gill cavity to avoid the competition from larger remoras, Cressey and Lachner (1970).

Sometimes they are the cause of abrasion on the skin or scales all to the muscles of their hosts, Schwartz and Lindquist (1987), Schwartz (1992) thereby becoming parasites.

Croll (1977) describes the relationship between remora and their host as commensalism. This author gives some variety of commensalism (cleaning, protection, transport). Whole this variety is realized in very complicated and specific interaction between a remora in the gill cavity and a shark.

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