

Spatial distribution of *Microcotyle sebastis* (Monogenea: Microcotyliidae) on Gills of the Cultured Korean Rockfish, *Sebastes schlegeli*

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Distribution of a monogenean helminth *Microcotyle sebastis* on the gills of cultured Korean rockfish (*Sebastes schlegeli*) was investigated with regard to gill arches, sides of gill hemibranches (anterior or posterior), and their sections (dorsal, medial and ventral). *M. sebastis* has a significant preference for the second and third pair of gills, and shows marked affinity for anterior hemibranches of each gill branch, and medial sections of each gill hemibranch. The results suggest that the larger volume of water flows and surface area of the second and third pair of gills might affect the distribution of *M. sebastis*, and the concentrated distribution of *M. sebastis* on the anterior medial section of gills would be related with the increasing chances of mating by niche restriction.

Key words: *Microcotyle sebastis*, Korean rockfish, Distribution, Niche

Most species of parasites are restricted not only to particular host species but also to sites on or in the host. Site specificity is often presumed to result from active site selection by the parasite (Holmes, 1973; Rohde, 1979), and Price (1980) argued that the generality of this observation was the consequence of highly specialized organisms exploiting complex environments with steep gradients in environmental conditions or resources.

The complex anatomy of fish gills offers parasites a heterogenous environment composed of numerous potential attachment sites, each easily envisaged as a separate ecological niche (Benz and Dupre, 1987). Site specificity in Monogenea has been studied by numerous workers (Hanek and Fernando, 1978; Cone and Cusack, 1989; Janovy *et al.*, 1991; Seong

and Seng, 1991), and the results suggest that monogeneans partition the spatial resources provided by fish gills and show the spatial preferences for various parts of gills.

Microcotyle sebastis Goto, 1894, is a pathogenic polyopisthocotylean monogenea of cultured Korean rockfish, *Sebastes schlegeli*. The present study was to analyze quantitatively the spatial distribution of *M. sebastis* on gills of cultured Korean rockfish.

Materials and Methods

On 15 April 1997, seventy-four individuals of netpen reared Korean rockfish (body length: 17-26 cm) were obtained from a local rockfish producer in Jangheung, Korea. Fish were transported to the laboratory in live state, and the weight and body length were recorded. The gills were compartmentalized according to the method of Hanek and

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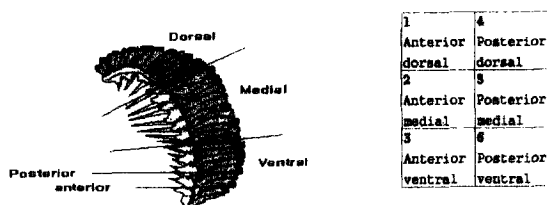


Fig. 1. The arbitrary division of gill arch according to Hanek and Fernando (1978).

Fernando (1978). Namely, gill archs were numbered I-IV anterioposteriorly, sides of hemibranchs were designated as anterior and posterior, and each was subequally divided into 3 sections (dorsal, medial, ventral), thus giving 6 subequal sections per gill arch (Fig. 1). Gill archs were separated and placed individually in small Petri dishes in filtered sea water, and the number of *M. sebastis* obtained from each section was recorded.

Statistical differences were analysed by ANOVA (SPSS statistical program), and terminology is consistent with that recommended by Margolis *et al.* (1982).

Results

A total of 869 *M. sebastis* was recovered from the gills of *S. schlegeli*, and the prevalence was 100%, the mean intensity was 11.74. Numbers of recovered worms on each compartment of gills are shown in Table 1.

Comparison between left and right gills

The total number of *M. sebastis* from the left gills was 432, and from the right gills was 437. There was no significant difference ($p > 0.05$) in the distribution of *M. sebastis* between the left and right gills.

Comparison among gill arches

Results of ANOVA showed the distribution of *M. sebastis* was significantly different ($p < 0.01$) among gill arches. *M. sebastis* showed significant

Table 1. Numbers of *M. sebastis* recovered from each compartment of the gills in cultured Korean rockfish

Compartment	Gill Arches								Sum
	Left				Right				
	I	II	III	IV	I	II	III	IV	
1	10	10	18	2	7	18	24	1	90
2	30	61	105	10	25	66	131	15	443
3	23	23	28	3	12	18	27	4	138
4	8	9	5	0	4	8	8	0	42
5	13	22	29	0	11	19	31	0	125
6	9	5	9	0	3	2	3	0	31
Sum	93	130	194	15	62	131	224	20	869

(1: anterior dorsal, 2: anterior medial, 3: anterior ventral, 4: posterior dorsal, 5: posterior medial, 6: posterior ventral).

preference for arches II and III (especially arch III) (Table 2).

Comparison between anterior and posterior hemibranchs

A marked effect regarding sides of hemibranchs was observed for *M. sebastis*. The number of worms recovered from anterior hemibranch was always significantly higher ($p < 0.05$) than those from posterior hemibranch in each gill arch.

Comparison among each compartment

The anterior medial region of each gill branch was significantly higher ($p < 0.05$) in number of *M. sebastis* than the other compartments of gill branches. The posterior medial region, also, was significantly different ($p < 0.05$) from the posterior dorsal and ventral regions.

Table 2. The values of significance among gill arches calculated by Tukey test

Gill arches	Left gill arches				Right gill arches			
	I	II	III	IV	I	II	III	IV
I	-	0.506	0.001	0.018	-	0.050	0.000	0.399
II	-	-	0.076	0.000	-	-	0.003	0.000
III	-	-	-	0.000	-	-	-	0.000

Discussion

The results of the present study indicate that *M. sebastis* has a significant preference for the second and third pair of gills, and shows marked affinity for anterior hemibranches of each gill branch, and medial compartments of each gill hemibranch.

Several studies have indicated that some parasites of fish exhibited a site specificity for particular gill arches. According to the report of Wiles (1968), *Diplozoon paradoxum* occurred most often on gill arches I and II of *Abramis brama*. Hanek and Fernando (1978) found that several gill monogenean species showed a well-defined preference for gill arches, in descending order, II, III, I, and IV arches of *Lepomis gibbosus*. Seng and Seng (1991) indicated that the second pair of gill arches were the preferred sites of *Haliotrema* spp. in *Lutjanus johni*.

The factors determining the site specificity of monogeneans are not clearly elucidated. Suydam (1971) suggested that the direction of the ventilating current may influence the position of monogeneans on the gills. Hughes and Morgan (1973) also indicated that the degree of infection of the gills is directly related to the ventilation volume and the pattern of current flow over the gills. Benz and Dupre (1987) suggested that copepod attachment is positively correlated with the volume of respiratory water passing over various gill portions and with the surface area. Paling (1968) indicated that most of the respiratory current flows over the second and third pair of gills, less flows over the first pair and least of all across the most posterior pair of gills in brown trout. Wooten (1974) also showed that a larger volume of water flows over the second and third gills compared with the first or fourth gills of *Gymnocephalus cernua*.

It can be conjectured, therefore, that the larger volume of water flows and surface area of the second and third pair of gills might affect the distribution of *M. sebastis* resulting higher number

of *M. sebastis* on those two gill pairs.

Ktari (1971) suggested that narrow microhabitats increase the chances of the monogeneans to mate and Rohde (1976, 1977) gives several examples to show that niche restriction does lead to intraspecific contact. Therefore, the concentrated distribution of *M. sebastis* on the anterior medial section of gills would be related with the increasing chances of mating by niche restriction.

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양식 조피볼락의 아가미에 기생하는 *Microcotyle sebastis*의 공간적 분포

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양식 조피볼락에 기생하는 단생흡충류인 *Microcotyle sebastis*의 분포패턴을 아가미 새궁별, 새엽별(전방과 후방) 및 등면, 중앙면, 복면으로 구분하여 조사하였다. 조사 결과 *M. sebastis*는 제 2 및 제 3 새궁에 유의성 있는 선호도를 나타냈으며, 후방보다는 전방부의 새엽과 중앙 부위에서 집중적으로 발견되었다. 이러한 결과로 부터 각 아가미 새엽으로 들어오는 물의 양과 아가미의 표면적이 *M. sebastis*의 분포에 영향을 미칠 수 있는 것으로 여겨지며, 또한 전방 중앙부에 집중적으로 기생하는 원인은 미소서식처의 범위를 좁힘으로써 개체간의 접촉을 증가시키고, 이를 통해 교미의 효율을 높이기 위한 것으로 사료된다.

Key words: *Microcotyle sebastis*, Korean rockfish, Distribution, Niche