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Jill A. Anderson
University of Nebraska - Lincoln

Kimberly J. Blazek
University of Nebraska - Lincoln

Tamara J. Percival Cook
Sam Houston State University, tcook@shsu.edu

John J. Janovy Jr.
University of Nebraska - Lincoln, jjanovy1@unl.edu

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RESEARCH NOTES

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The Niche of the Gill Parasite *Dactylogyrus banghami* (Monogenea: Dactylogyridae) on *Notropis stramineus* (Pisces: Cyprinidae)

Jill A. Anderson, Kimberly J. Blazek, T. J. Percival, and J. Janovy, Jr., School of Biological Sciences, University of Nebraska–Lincoln, Lincoln, Nebraska 68588-0118

ABSTRACT: Distribution of the monogenean *Dactylogyrus banghami* on the gills of the fish *Notropis stramineus* (Cyprinidae) was described by calculation of mean relative positions and Levins' niche breadths on the linear spatial resource gradients gill filament length and gill arch length. Thirty fish with 276 worms were examined; only 1 of the fish had an additional gill parasite species (*Trichodina* sp). Worms were more broadly and evenly distributed across the length of the gill arch than they were on the filament (breadths of 0.91 and 0.67, respectively). Mean worm positions were near the center of both resources: 54% of the distance from the arch cartilage on the filament, and 54% from the ventral end of the arch itself. The results are considered consistent with predictions about the niche structures of species in unsaturated noninteractive specialist communities.

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, 1981). Site specificity in Monogenea has been studied by many workers and quantified in various ways that include counting worms in arbitrarily established zones such as regions of gills, gill arches, fins, or body surface; measurements of relative distances from gill arch cartilages; and use of nearest neighbor techniques (Hanek and Fernando, 1978; Ramasamy et al., 1985; Harris, 1988; Cone and Cusack, 1989; Janovy et al., 1991; Koskivaara et al., 1992). In the case of *Salsuginus thalkeni*, a parasite of the killifish *Fundulus zebrinus*, site specificity has been described by treating gill filament and arch lengths as resources in the Hutchinsonian model of a multi-dimensional ecological niche, then calculating the dimensions of the parasite's niche on these resources (Hutchinson, 1957; Janovy et al., 1991). Comparative data have not been published, however, that would reveal whether the distribution on spatial resources described for *S. thalkeni*, an ancyrocephalid, is similar to that of other monogeneans. The purpose of this study was to make such a comparison, using *Dactylogyrus banghami* on the

gills of the minnow *Notropis stramineus* in the South Platte River of Nebraska.

Sand shiners, *N. stramineus* (Pisces: Cyprinidae), were collected from the South Platte River 5 km west of Roscoe, Nebraska, and taken to the Cedar Point Biological Station, 13 km north of Ogallala, Nebraska, for dissection. Thirty fish were examined during a 3-wk period from 13 June 1992 to 2 July 1992. These fish were parasitized by 276 *D. banghami*.

Fish were processed according to the methods of Janovy et al. (1991). Each arch was removed, laid front face up in a sequence on a slide, and examined microscopically (100 $\times$) for the presence of *D. banghami*. Magnification was reduced to 40 $\times$ for the purpose of measuring worm positions on the filament and arch. The relative filament position for each parasite was determined by measuring the distance of the midhaptor from the gill arch cartilage, then measuring the length of the filament itself, using an ocular micrometer. The same procedure of measurement was made for the arch position, recording the distance of the worm from the ventral end of the arch, then measuring the arch length itself. The gills were then turned over, and the posterior face was examined in the same manner.

Measurement ratios that included filament position:filament length and arch position:arch length were converted into decimal fractions, multiplied by 10, and then rounded to the nearest integer and summed for each unit. The summed data resulted in frequency distributions of worms on 2 linearly measured resources, filament length and arch length. Niche breadths on these resources were calculated according to Levins (1968), whose breadth index B takes into account both numbers of units in a resource set and evenness of a species' distribution among those units.

Mean filament and arch positions and variances were calculated, and frequency distributions of parasites on the linearly measured resources were tested for goodness of fit against

TABLE I. Relative position and niche breadth of *Dactylogyrus banghami* on gill filaments and gill arches of *Notropis stramineus*.

Circumstance	Filament position* (variance)	Breadth on filament†	Arch position* (variance)	Breadth on arch†	Number of worms
All worms	5.4 (3.6)	0.67	5.4 (6.4)	0.91	276
Front face	5.5 (3.6)	0.66	5.3 (5.6)	0.91	156
Rear face	5.4 (3.6)	0.67	5.5 (7.5)	0.94	120
First arch	5.5 (3.8)	0.64	5.1 (7.6)	0.94	70
Second arch	5.4 (3.0)	0.61	5.6 (7.7)	0.90	73
Third arch	5.4 (3.9)	0.67	5.5 (4.3)	0.70	80
Fourth arch	5.6 (3.8)	0.64	5.5 (6.2)	0.86	53

* Relative position is the mean of the frequency distribution produced when filament or arch lengths are divided into 10ths; then the number of parasites occurring in each of these 10ths is plotted on the vertical axis, the 10ths being units on the horizontal axis.

† Breadth entries are niche breadths calculated according to Levins (1968) using the 10ths as units of a resource set.

discrete approximations of normal distributions by use of the chi-square statistic. Mean filament and arch positions were tested for differences using analysis of variance.

Distribution of *D. banghami* on the gill arches and mean positions and niche breadths on the gill arches and filaments for both front and rear arch faces are given in Table I. There was no statistical difference between the mean filament or mean arch position on any of the 4 arches or on either face. All parasite frequency distributions under all circumstances on the gill filaments were described accurately by a discrete approximation to the normal distribution. The observed circumstances on the arch positions were described best by a discrete approximation to the normal curve distribution; however, only the first, third, and fourth arch observed frequency distributions could be described accurately by the discrete approximation to the normal, when goodness of fit was tested using chi-square at a significance level of 0.05. More worms were located on the front than on the rear arch faces, and this difference was significant at the 0.05 level when tested using the chi-square statistic.

Previous work on *D. banghami* has been limited to description, host specificity, and locality of parasite (see Hoffman, 1967). This paper is the first to describe quantitatively the niche of *D. banghami* on the gills of *N. stramineus*. The results indicate that as in the case of *S. thalkeni*, the niche of *D. banghami* on the gill filament is narrower than that on the arch (Table I). In comparison to *S. thalkeni*, *D. banghami* has a broader niche on the filament, a niche of identical breadth on the arch, but is located further out

on the filament, on the average (cf. Table I and Janovy et al. [1991: table I]). Only 1 of the 30 fish in this study had other gill parasites, in this case protozoans of the genus *Trichodina*, so it was impossible to determine whether potential site competitors affected worm position and niche breadth. A much richer assemblage of gill parasites occurs on *F. zebrinus* than on *N. stramineus*, and these were shown to have no effect on worm position on the former host (Janovy et al., 1991).

The Hutchinsonian view of an ecological niche as a species-specific hypervolume defined by occupied regions of resource sets is a concept most meaningfully applied to the organisms whose resources are described easily by linear measurements, i.e., in terms of temperature, humidity, concentrations of certain compounds or elements, food particle size, flowing water speed, etc. Many parasite species, although quite site specific, occupy environments that are very difficult to describe in linear terms. It might be asked, for example, whether the various body surface regions of a fish are qualitatively, or quantitatively, different, and if they are to be treated as resources in the Hutchinsonian sense, where should measuring begin and what should be measured. Experimental work such as that of Harris (1988) and Cone and Cusack (1989) on *Gyrodactylus* species suggests that an anterior to posterior gradient exists along a fish's body. Thus it may be valid to consider body length a resource and segment occupied a dimension, but such consideration implies a biologically active component to the gradient, e.g., some compound or strength of current.

The problem of comparative resource description for parasites becomes more difficult when, for example, the difference between a cestode and a flea in/on the same host individual is considered. Each parasite occupies a distinct site, and, according to the Hutchinsonian definition, a species-specific ecological niche, but the identification and measurement of shared resources is exceedingly difficult. This illustration of the problem suggests that for parasites meaningful ecological comparison using the Hutchinsonian model might be confined to species that occupy different regions of an obvious gradient. In such cases, the definitions of fundamental and realized niches, i.e., dimensions on resources in the absence and presence of potential competitors, respectively, would be consistent with those used for free-living organisms. The ultimate problem for ecol-

ogists using host/parasite systems then becomes one of resource identification and measurement.

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