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DISTRIBUTION OF SCULPINS IN THE CLEARWATER RIVER BASIN, IDAHO

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ABSTRACT.— The distributions of *Cottus bairdi*, *C. rhotheus*, and *C. beldingi* exhibited a highly significant positive degree of association. Conversely, the distribution of *C. confusus* exhibited a highly significant negative association with the distributional complex, *C. bairdi*, *C. rhotheus*, and *C. beldingi*. These species of sculpins can be grouped into two assemblages; one based on the distribution of *C. confusus* and the other based on the combined distributions of the other three species. The factor or factors limiting the downstream distribution of *C. confusus* or the upstream distribution of the other three species could not be positively identified. However, we hypothesize that competition between *C. confusus* and one or more members of the *C. bairdi*, *C. rhotheus* and *C. beldingi* complex is involved. In the area of overlapping distributions among *C. bairdi*, *C. rhotheus*, and *C. bairdi* we hypothesize that resource partitioning is occurring. However, the data did not allow evaluation of this hypothesis.

Species that are closely related and morphologically similar are often assumed to compete. It is further often assumed that simultaneous occurrence at a given location indicates little or no competition, whereas exclusion from a site indicates intense competition. Although this hypothesis is largely untested, the coordinated or contiguous distributions of closely related species suggests the opportunity to gain insight into species interactions where such a phenomenon occurs.

Competitive interaction between species of the same genus *Cottus* is probable, and information on the distribution of several species over a large area is available (Maughan 1976). The objective of this paper is to assess the degree of contiguity in the distribution of four species of sculpins from the Clearwater drainage in north central Idaho as a clue to the intensity of interspecific interactions.

Materials and Methods

Fish were collected from 114 locations from June to September in 1969 and 1970. Collection sites were approximately 10 miles apart, and collections were made using a small Y net (Bond 1963) or a 6-ft seine in conjunction with a backpack electroshocker. In the Selway Bitterroot Wilderness area, only a seine was used. Fish were preserved in 10 percent formalin, and later transferred to 70 percent alcohol.

Repetitive Chi-square tests for species association (Kershaw 1971) were conducted between individual species and various species complexes in an attempt to elucidate the associative distributions of *C. bairdi*, *C. rhotheus*, *C. beldingi*, and *C. confusus*.

Results

The distributions of *C. bairdi* and *C. rhotheus* exhibited a highly significant positive degree of association (Table 1). These two species occurred together in 68 percent of all samples in which either species was taken. Likewise, the distribution of *C. beldingi* demonstrated a highly significant positive association with the distributional complex of *C. bairdi* and *C. rhotheus* (Table 1). *Cottus beldingi* occurred in 92 percent of all

TABLE 1. Chi-square values for tests of species association of four species of cottids from the Clearwater River drainage 1969–70.

Species comparisons	X^2	df
C. bairdi vs. *C. rhotheus*	49**	1
C. beldingi vs. *C. bairdi*, *C. rhotheus*	44**	3
C. confusus vs. *c. beldingi*, *C. bairdi*, *C. rhotheus*	19.25**	7

**(P<0.01)

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collections in which either *C. bairdi* or *C. rhotheus* was taken and in addition appeared in 30.8 percent of all collections in which neither *C. bairdi* nor *C. rhotheus* was taken (Table 2, Fig. 1).

The distribution of *C. confusus* exhibited a highly significant negative association with the distributional complex of *C. bairdi, C. rhotheus,* and *C. beldingi* (Table 1). *Cottus confusus* appeared in only 13 percent of all collections in which either *C. bairdi* or *C. rhotheus* or *C. beldingi* was taken, but was present in 42.2 percent of all samples in which none of the other three species occurred (Table 3, Fig. 2).

TABLE 2. Distributional frequency of occurrence of *C. beldingi* and the complex of *C. bairdi* and *C. rhotheus.**

C. beldingi	+	30	15	20
	–	1	3	45
		$^{+}1^{+}2$**	$^{+}1^{-}1\cdot{}^{-}1^{+}2$	$^{-}1^{-}2$
			C. bairdi and *C. rhotheus*	

*The Chi-square contingency table presented is a modified form of the 2×4 contingency table utilized in the analysis of *C. beldingi* vs. *C. bairdi* and *C. rhotheus.* The combinations of either *C. bairdi* or *C. rhotheus* occurring while the other was absent were collapsed into one cell for illustrative purposes.

**Subscripts of 1, 2 correspond to *C. bairdi* and *C. rhotheus*, respectively.
+ = presence – = absence

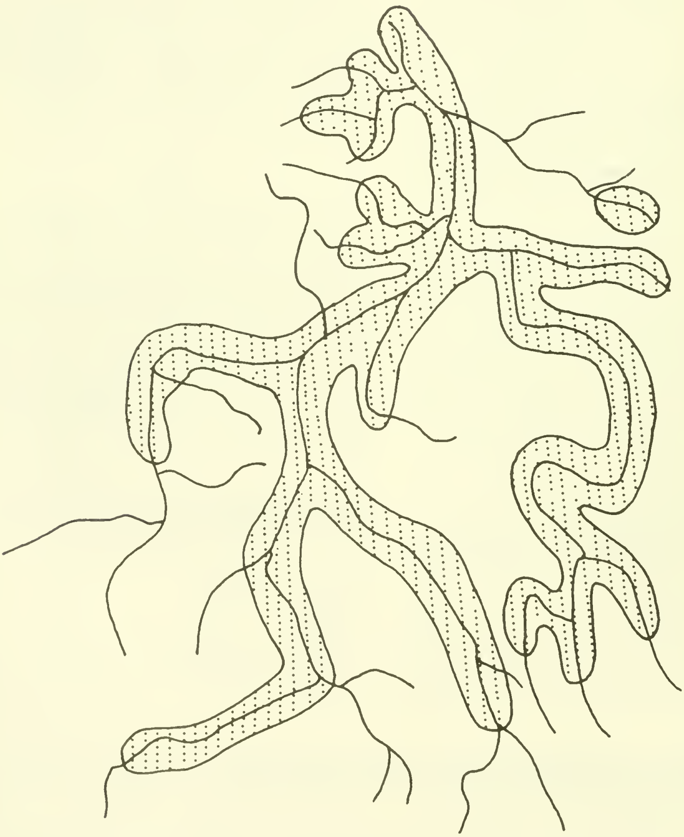

Fig. 1. Area of the Clearwater River basin occupied by one or more of the species *C. beldingi, C. bairdi,* and *C. rhotheus.*

TABLE 3. Distributional frequency of occurrence of *C. confusus* and the complex of *C. bairdi*, *C. rhotheus*, and *C. beldingi*.*

C. confusus	+	2	7	19
	–	28	32	26
		$^{+}1^{+}2^{+}3$**	$^{+}1^{+}2^{-}3$... $^{-}1^{+}2^{+}3$	$^{-}1^{-}2^{-}3$
		C. bairdi, *C. rhotheus*, and *C. beldingi*		

*The Chi-square contingency table presented is a modified form of the 2×8 contingency table utilized in the Chi-square analysis of *C. confusus* vs. *C. bairdi*, *C. Rhotheus*, *C. beldingi*. All possible combinations of *C. bairdi*, *C. rhotheus*, and *C. beldingi* (except all present or all absent) have been collapsed into one cell.

**Subscripts of 1, 2, 3 = *C. bairdi*, *C. rhotheus*, and *C. beldingi*, respectively.

+ = presence – = absence

DISCUSSION

The findings of this study indicate that species of sculpins in the Clearwater system can be grouped into two major assemblages based on the distribution of *C. confusus* vs. the distribution of the *C. rhotheus*, *C. bairdi*, and *C. beldingi* complex. The data did not allow identification of the factor or factors limiting each species group. However, C. rhotheus, C. bairdi, and *C. beldingi* would appear to be generally responding to the same factor or factors. We believe that partitioning of resources is probable among *C. bairdi*, *C. rhotheus*, and *C. beldingi* in areas of coexistence, and that extreme competition occurs between that complex and *C. confusus* (X^2

Fig. 2. Area of Clearwater River basin occupied by *C. confusus*.

19.25**). This competition is responsible for the exclusion of *C. confusus* from areas occupied by one or more of the other species.

Repetitive analyses on the same data (i.e., testing several nonindependent hypotheses with the same data) increase the probability of exposing a significant result on the basis of chance alone (Type I Error) and increase the alpha level an undetermined amount. However, the highly significant Chi-squares encountered in these analyses (e.g., $X^2_1 = 49$) make it extremely unlikely that these results could be contributed by chance alone, even with an inflated alpha level.

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