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SHORT NOTE

Size-Selective Predation on Mysids by Birds (Plovers)

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ABSTRACT: A re-analysis of size-frequency data presented by Moran and Fishelson (1971) showed that plovers *Charadrius hiaticula* do not take mysids randomly with respect to size. More powerful statistical tests showed that *C. hiaticula*, like other shorebirds, selects larger prey. The power of a statistical test needs to be considered when a null hypothesis cannot be rejected, especially if sample sizes are small.

Selection of larger prey is predicted by several models of foraging behavior based on energy intake (MacArthur and Pianka, 1966; Krebs, 1978). Size selective predation can also have important consequences for prey populations, including a predicted effect on population stability through the provision of refugia from a predator (Murdoch and Oaten, 1975). In this light, and in light of frequent reports of size selectivity by predators in general (Griffiths, 1975) and shorebirds in particular (Goss-Custard, 1977; Bengtsen et al., 1978), any instance of size independent predation is especially interesting. A recent review of the ethology of predation (Curio, 1976) cites one such case (Moran and Fishelson, 1971), who report nonselective predation by two *Charadrius hiaticula* feeding on the mysid *Gastrosaccus sanctus*. However, the data presented suggest that both plovers selected large prey relative to the size of available prey. Since a null hypothesis may be falsely accepted when sample sizes are as small as those in the plover study, the data were reanalyzed using more powerful statistical tests.

A row by column contingency test was apparently used by Moran and Fishelson (1971) to compare the size distribution of mysids found in stomachs to the size of mysids in the foraging area, for each bird. However, my computation shows that a row by column contingency test has insufficient power to avoid a Type II error, acceptance of a false null hypothesis. That is, the number of prey taken by each bird was so small that the null hypothesis could never be rejected, even in the extreme case of all (rather than most) prey falling into the largest size category.

A way of obtaining a more powerful test, one less susceptible to a Type II error, is to combine the 2 sets of data (size of prey in both stomachs compared to size of prey from both sets of environmental samples). When the diets of the 2 plovers were combined, their size distribution differed significantly from that of prey in the environment, using a row by column contingency test ($X^2 = 16.0$, d.f. = 2, p = .0003) The difference was in the direction of selective capture of larger prey.

A second solution is simply to combine the probabilities obtained from analysis of each of the 2 birds (Fisher, 1954). The X^2 value for the first bird was computed from the data presented by Moran and Fishelson (1971) in their Table 1, and found to be 13.08, rather than 5.8 as reported. For 2 degrees of freedom, the probability of a value this high is .0014. The X^2 value and the probability value were obtained from 2 programmed routines for an HP-67 hand calculator. Both routines were checked against text examples (Sokal and Rohlf, 1969) and tabulated values (Rohlf and Sokal, 1969). For the second bird only 1 degree of freedom was legitimately available, since the expected value of juvenile mysids was zero (no juveniles in either stomach or sand sample). The X^2 value was 2.87 for a 2 × 2 contigency test, which yielded a probability level of .0902. The combined statistic was thus $-2[\ln(.0014) + \ln(.0902)] = 17.95$, which is distributed as X^2 with two degrees of freedom. The null hypothesis (size-independent predation) was again rejected for a conservative criterion of p = .001.

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