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NEGLIGIBLE FEEDING RESPONSES BY BIRDS TO VARIATIONS IN ABUNDANCE OF THE BUDWORM, *CHORISTONEURA PINUS* (LEPIDOPTERA: TORTRICIDAE)

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Recent studies have emphasized that to evaluate the potential importance of any predators in prey regulation it is necessary to consider their functional (feeding) and numerical responses to variations in prey abundance (Holling 1959, Buckner 1966, 1967). For example, preliminary data from a study of bird predation on the jack pine budworm (*Choristoneura pinus* Freeman) in Michigan indicated that budworm consumption by the common resident birds in jack pine (*Pinus banksiana* Lambert) forests was only weakly related to observed budworm abundance (Mattson *et al.* 1968). This note reports further evidence to substantiate the preliminary data.

During the summers of 1965 through 1968, four to eight specimens of each of the three most common resident birds–black-capped chickadee, *Parus atricapillus* L.; brown-headed cowbird, *Molothrus ater* (Boddaert); and chipping sparrow, *Spizella passerina* (Bechstein)–were collected from the Panola jack pine plains in Iron County of Upper Michigan. In addition, during 1965 and 1966, similar numbers of specimens were collected from jack pine forests in Crawford County of Lower Michigan. Collecting was done on clear days between the hours of 8 AM and 6 PM while budworm populations were in the late-larval and pupal stages–usually the last week of June and first week of July. Bird gizzards were preserved in formalin until dissection to obtain counts of larval mandibles and pupal cremasters. Concurrently, budworm populations were measured by scientists from the University of Michigan (Foltz *et al.* 1968, Foltz *et al.* 1972).

RESULTS AND DISCUSSION

The gut contents of birds, were used as point measures of their rate of feeding on specific foods. For example, Mook and Marshall (1965) concluded that pupal cremasters found in gizzards of the olive-backed thrush (*Hylochichla ustulata* (Tschudi)) represented about 75% of the birds' actual consumption in the 2 hours before death. Gage *et al.* (1970) concluded that counts of larval mandibles and pupal cremasters found in the digestive tracts of three bird species (two warblers and one sparrow) represented approximately 35% of their actual consumption in the 2-1/2 hours before death.

In this study, budworm populations varied from incipient to moderate outbreak levels (i.e., 4 to 33 late-stage larvae and pupae per 100 branch tips, or about 94,000 to 802,000 per acre). Four insects per 100 tips caused negligible defoliation whereas 33 caused light to moderate defoliation which resulted in conspicuous browning of tree crowns.

Consumption of late-stage larvae and pupae by chipping sparrows and chickadees showed little or no change over the wide range of budworm intensities (Table 1). In other words, these birds probably consumed as many budworms at the lowest level of insect abundance as they did at the highest. Data derived by Holling (1965) and Buckner (1967) on vertebrate feeding responses to increasing concentration of prey typically produced S-shaped functional response curves which eventually plateaued. Therefore, these data suggest that the birds had already reached such a consumption plateau for budworms at the lowest observed abundance (4 per 100 tips).

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Table 1. Mean numbers* of budworms per gizzard for three bird species at different budworm population intensities.

Bird Species	Budworm Population Intensity (Number Per 100 Tips)					
	4	5	12†	26†	28	33
	1966	1965	1966	1965	1968	1967
Chipping sparrow	7.4 ± 1.7	8.6 ± 2.1	4.6 ± 0.5	8.9 ± 2.7	10.2 ± 1.5	13.3 ± 6.4
B. C. chickadee	8.4 ± 2.0	5.3 ± 1.4	3.8 ± 0.2	—	7.8 ± 1.2	6.3 ± 1.6
B. H. cowbird	37.6 ± 8.5	19.3 ± 5.8	11.4 ± 1.3	—	34.4 ± 3.0	27.2 ± 3.2

*Means ± 1 standard error where sample size ranged from 4 to 8.
†Data from Crawford County, Lower Michigan. Other data from Iron County, Upper Michigan.

Consumption of budworms by cowbirds is more difficult to interpret because of variations in their behavior between areas and years. For example, at Panola in 1965 and 1968, as well as in Lower Michigan in 1966, the cowbirds fed individually or in small groups rather than with nonresident blackbirds in large flocks, which occurred in 1966 and 1967 at Panola. When the birds fed more individually (at budworm intensities 5, 12, and 28), there was probably a two- to threefold increase in consumption with a two- to fivefold increase in budworm abundance. When cowbirds fed in large flocks of blackbirds (at budworm intensities 4 and 33), consumption rates did not differ even though budworm populations varied eightfold. This suggests that flocking stimulated the birds to feed at their maximal rate at the lowest budworm intensity.

These data also imply that unless the resident birds could have responded numerically their impact would certainly have decreased as budworm numbers increased above 4 per 100 tips. Mattson *et al.* (1968) concluded that it was unlikely that birds could make a sufficient numerical response (barring large immigrations of nonresident birds) during brief outbreaks when the insect can increase tenfold or more between years, as occurred at Panola during 1966-1967. Therefore, it appears that the ability of resident birds to function as cybernetic regulators of budworm numbers is probably greatest when budworms are at endemic levels—somewhere below 4 per 100 tips in this case. Morris (1963) made a similar conclusion in a study of the spruce budworm (*C. fumiferana* (Clem.)). However, even at these levels the impact of bird predation can be variable and possibly insignificant because of fluctuations in the relative abundance of alternative, desirable foods.

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