A note on the energy demands of the breeding bird community of Hutcheson Memorial Forest

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Abstract. The energy requirements of the avian community are calculated for each feeding-niche group from previously published population estimates. The total energy demand (23, 565 kcal/day) for Hutcheson Forest yields an average 982 kcal/ha/day—comparable with other recent estimates of avian bioenergetics in temperate woodlands.

Weins and Innis (1974) clearly outlined a procedure for the calculation of avian energy demands (kcal/m²/day) with two important additions to the methods of most previously published estimates—they included a factor for digestive efficiency (Kale, 1965) and a factor for the increased activity (beyond existence energy) of breeding birds (Schartz and Zimmerman, 1971).

The data needed for the calculation of the energy demands are population estimates and avian species weights. For Hutcheson Forest we have good estimates of the breeding populations and species weights from the literature (both in Leck, 1975). This note presents an estimation of the energy demands of the Hutcheson Forest birds by ecological units (feeding niches).

The *existence energies* as defined by physiologists must first be calculated. Equations for existence energy at 0°C and 30°C, for passerines and for non-passerines, were derived by Kendeigh (1970). Linear interpolations between the Kendeigh equations give equations at 23°C, an average temperature for the forest from June 1-August 1. For bird of weight W (in g), the existence energy requirements, M (kcal/day), at 23°C are:

Passerines: $\text{Log } M = .2993 + .5997 \log W$

Non-passerines: $\text{Log } M = -.0559 + .7021 \log W$

The existence energy values for each species were subsequently multiplied by 1.4 and 1.43 to incorporate the 40% increase in activity during the breeding season and an assumed 70% limit of metabolic availability of consumed food (Weins & Innis, 1974). (The natural energy demands at the breeding season are thus about twice the caloric estimates of the existence energy.) The individual energy demands calculated above for each species are multiplied by the appropriate species population estimates (Leck, 1975) to provide a total community value. Table 1 gives the total energy demands of eight feeding-niche groups, inclusive of all birds in the breeding community at the 24-hectare forest. (Names are from the A.O.U. 1957 Checklist of North American Birds). Details of the original population estimates and discussion of the ecological groups can be found in my earlier report (Leck 1975).

Table 1. Energy demands of the breeding bird (adults only) community at Hutcheson forest. The caloric requirements for each feeding-niche group are for the entire 24-ha forest, and for a hectare (in parenthesis).

I. Insects from air: 432 kcal/day (18 kcal/ha/day); ***Myiarchus crinitus, Contopus virens, Polioptila caerulea.***

II. Insects from vetetation: 5599 kcal/day (233 kcal/ha/day); ***Coccyzus americanus, Pipilo erythropthalmus, Troglodytes aedon, Vireo olivaceus, Mniotilta varia, Dendroica pensylvanica, Seiurus aurocapillus, Icterus galbula, Piranga olivacea.***

III. Insects from bark: 1576 kcal/day (66 kcal/ha/day) ***Centurus carolinus, Dendrocopus villosus, D. pubescens, Parus atricapillus, P. bicolor, Sitta canadensis.***

IV. Insects and other invertebrates from ground: 8416 kcal/day (351 kcal/ha/day) ***Philohela minor, Colaptes auratus, Toxostoma rufum, Turdus migratorius, Hylocichla mustelina, Sturnus vulgaris, Pipilo erythrophthalmus.***

V. Widespread omnivores: 4461 kcal/day (186 kcal/ha/day) ***Cyanocitta cristata, Corvus brachyrhynchos.***

VI. Omnivores from vegetation: 2283 kcal/day (95 kcal/ha/day) ***Richmondena cardinalis, Pheucticus ludovicianus, Passerina cyanea.***

VII. Seeds from ground: 226 kcal/day (11 kcal/ha/day) ***Zenaidura macroura.***

VIII. Large prey from ground: 532 kcal/day (22 kcal/ha/day) ***Otus asio, Bubo virginianus.***

TOTAL ENERGY DEMAND 23,565 kcal/day (982 kcal/ha/day)

Of course the values present only the energy requirements of the *adult* birds during the breeding season. Young birds (nestlings, fledgings, and juveniles) would roughly double the total energy demand (Weins and Innis, 1974), but I have elected not to make such an extrapolation until we have full knowledge of nesting success at the forest.

A bio-energetic comparison of the Hutcheson community can be made with a recently evaluated Illinois forest avifauna (Karr, 1971). Karr's forest, known as Trelease Woods, is an upland maple-oak climax with an obvious death of elms (*Ulmus*) from the Dutch elm disease (Boggess, 1964). As shown in Table 2, the two breeding-bird communities are remarkably similar in biomass and energetics. Both of these temperate deciduous-forest estimates should be useful for global comparisons with current avian energetics studies in other forest biomes (e.g. Karr, 1975). For example, a comparison of HMF with a coniferous forest community (Weins and Nussbaum, 1975) shows HMF's greater total density

Table II. Comparison of breeding bird communities at two temperate deciduous forests. (Illinois data from Karr, 1975).

	Hutcheson Forest	Illinois Forest
Breeding Birds (No. of species)	34	32
Standing Crop (g/ha)	1304	1210
Consuming Biomass (g/ha)	247	247
Existence Energy	491	411

(individuals/km²), 2,508 versus 1,967, and greater standing crop biomass (g/ha), 1,304 versus 346. Most recently published studies will allow such direct comparisons with a minimum of conversions or calculations (for unit differences, or biomass versus energy requirements).

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