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THE ROLE OF BIRDS IN MATTER AND ENERGY FLOWIN THE ECOSYSTEM

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ABSTRACT. – This paper is an attempt to present the pattern of matter and energy flow in a most common species of bird, the House Sparrow (*Passer domesticus*). At the early stage of the bird produces a biomass with relatively well effectively whereas oxidize a strikingly significant ration of their food consumed afterwards. The rate of matter flow from the sparrows fed on millet and eggs can be compared to that of the grasshopper larvae or other small insects. In a similar study it was found that birds at any age utilized surplus materials for vital process but with a lower production compared to the epimorph insect model. Thus, this small study is all the more important to emphasize the role of birds in the energy budget in ecosystem may be unambiguous but are important by all means.

KEYWORDS. – Birds, energy, food, biomass environment protection.

INTRODUCTION

In accordance to the production biologists, ecosystems and the communities involved as continual varying open systems. The motive of this variation is the suns' energy harnessed by the green plants via their assimilation. Other organisms for life then utilize the matter and the energy accumulated in the plant tissues either directly or indirectly accordingly their own species-specific way. The transfer of matter and energy from one organism to another (say from one trophic level to another) is mediated through feeding. This results in a continual flow of matter and energy throughout the ecosystem and a trophic relationship among the units of the communities.

In ecology, several types of relationships are known among the various living organisms and between the living organisms and their lifeless environment. On part of these is contingent. The trophic relationship is however, implicit and lies in the principle of the system. It can be, therefore, considered to be the most important relationship. When discovering this relationship system and being familiar with the quality of the variations in matter and energy, we can see the operation of the community (or ecosystem). This approach enables at least quantitative estimates of matter and energy utilization needed for human processes without inducing fatal and irreversible changes in the system. All these of course, include only a part of the operating problems. Yet, production biological data would provide knowledge for necessary utilization of the natural resources and the solution of problems involved in nature and environment protection.

The food consumed by the animals are rearranged into three various matter and energy pathways. A part of it is built up their own organism and some of which is eliminated as faeces, urine and other wastes and a third part is utilized as energy for vita process in the course of metabolism or degradation. The decomposed matter could be returned to the food supply of the community only by the autotrops, where as the degraded energy is dissipated and is totally lost in the community. This provides the basic foodstuff for the units of the communities at appropriate trophic level (Gere, 1957; Balogh, 1958; Richman, 1958; Gere, 1983).

All the process involved in the matter and energy flow may be summed up as $C = P + FU + R$; where, C is absorbed energy or consumption, P: production, FU: faeces, urine or wastes and R the degraded energy or respiration (Petrusewicz & Macfadyen, 1970; Gere, 1978).

Like the majority of commonly kept companion birds, passerines are primarily seed eaters in captivity. However, a few scientific studies on their feeding ecology in the wild have been reported to confirm their natural diets. The daily allowance for individual nutrients for passerines has only recently been investigated (Caton, 1992); previous nutritional guidelines being based on extrapolations from data for other species, primarily poultry. Since poultry species belong to the orders Anseriformes and Galliformes and are thus biologically distinct from the Passeriformes, applying the results of studies conducted on poultry must be done with caution. Furthermore, the diets of poultry are very different from those of birds such as house sparrows, making it even less appropriate to compare the species.

The majority of Passeriformes are seed-eaters (granivores) although some also eat insects, fruit, berries and green foods. Generally, sparrows are considered to be easily maintained on an all-seed diet and, common with other seed-eating birds, they remove the husk and consume only the kernel (Caton, 1992). Seed husks are of poor nutritional value, containing low amounts of protein and fat and relatively high amounts of non-starch polysaccharides and ash. Seed husk contribution to the whole seed by weight is reported to depend upon seed species. Husks of seed species whose kernels contain high amounts of starch contribute between 15 and 22% of the whole seed by weight, whilst husks of seeds whose kernels have high fat contents contribute between 24 and 56% of the whole seed by weight (Kamphues et al., 1997). However, Taylor reports little variation of husk weight between seed species (Taylor, 1997).

In general, seed selection by birds is dictated by seed size and nutritive value, with more nutritive seeds being selected by smaller birds, independent of family. Seed size selection shows dependence on both body and bill size, although interfamilial differences exist; species with larger bills within a family tending to select the larger seeds. Based on these data, Diaz hypothesizes that "smaller birds are only capable of increasing their energy intake by selecting the more energy-rich seeds, since they can handle only small seeds. On the other hand, because larger birds are capable of eating larger seeds, their dependence on the energy contents of seeds decreases as their size increases" (Diaz, 1990).

Preferred seed type may additionally depend upon macronutrient composition; seeds having higher starch contents reported as being favoured over those with high fat contents. In this case, oats (*Avena sativa*), canary seed and millet (*Panicum milioceum*) were the most frequently selected, with some consumption of hemp (*Cannabis sativa*) and niger (*Guizotia abyssinica*) (Kamphues et al., 1993). These observations deviate somewhat with the hypothesis of Diaz (1990); seeds with high fat contents contain more energy in kJ/g than those with high starch contents.

Like all animals, birds eat to satisfy their energy requirements provided all other nutrients in the diet are balanced. Individual energy requirements are influenced by a variety of factors including energy density of the diet, environmental conditions, body size, physiological state and activity level. Of all the birds commonly kept as pets, the energy requirements of the budgerigar (*Melopsittacus undulatus*) have been most extensively studied (Drepper et al., 1988; Harper & Skinner, 1998). However, studies exist which provide indications as to the energy requirements of other bird species. (Davis, 1955; Cox, 1961; Bairlein, 1987).

However, in ornithology, the daily energy consumed is referred to as great energy". The energy utilization by birds is more varied than that of the majority of the vertebrates. This is mainly because of its high mobility and thus follows the second thermodynamic law (Kendeigh, 1970). Therefore, in this paper, 'Productivity' as a general term being used for production-biological achievements of the species in study. The present research aims to account productivity in terms of energy gained and the expected results could be used to extrapolate the other seed depredator specially in the agricultural ecosystem.

MATERIAL AND METHODS

The birds selected for this study, particularly for rearing the nestlings, represent those species, which are most tolerant for enclosure husbandry and thereby exhibiting most realistically their productivity, regardless of their significance in any ecosystems. The results would be extrapolated for other birds being of importance in the latter sense. To prefer with the seedeater, House Sparrow (*Passer domesticus*) was selected as a model bird species. In a similar kind of a study, Finches were objected for experiment (Eisner, 1960; Caton, 1992).

The study was conducted in premises of the Gujarat Agricultural University using ten nest boxes (ten breeding pairs) having 26 nestlings were monitored from 3rd October – 15th of November 2005. The data was collected from the day of nestling till they fly out (approximately 30 days).The productivity of the growing the sparrows nestling was evaluated as follows. The breeding pairs were housed into cages of 45 X 25 cm floor. Wooden boxes with a wide opening and an open able cover which served as a nest was

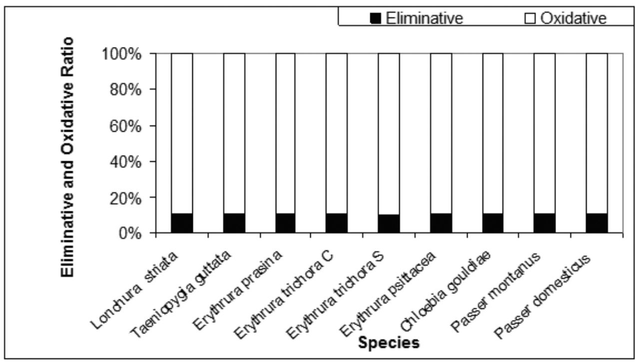

Fig. 1. The ratio of matter flow in the adults of the various avian species with similar matter flow, using millet as diet (Gere,1983). NB: Only data for *Passer domesticus* is incorporated from the present study.

Table 1. Matter flow in the house sparrows *Passer domesticus*.

Age (Days)	Mean live weight per nestling (g)		Consumption	Share in consumption		Production (g) P x 100 C	Faeces and urine FU x 100 C	Respiration R x 100 C
	Onset	Terminal		Millet (%)	Egg (%)			
0-12	**0.75**	**10.52**	**12.7**	**66.9**	**33.1**	**2.8** **22.04%**	**3.9** **30.70%**	**6.0** **47.24%**
13-22	**10.52**	**13.60**	**23.5**	**72.4**	**27.6**	**1.3** **5.5%**	**4.7** **20%**	**17.5** **74.5%**
23- 30 (fly out)	**13.71**	**14.91**	**17.45**	**92.6**	**7.4**	**0.85** **4.8%**	**2.7** **15.4%**	**13.9** **79.65%**

taken for the study. As the nestlings of the most seed eating birds require animal protein, a test diet composed of millet and boiled hen eggs was twice provided daily. Food consumption, faecal production and body weight of the nestlings were measured daily at an analytical accuracy and corrected for dry weight.

The rate of matter flow through the nestlings was quantified by subtracting the values for the parents, calculated from control experiments, from the daily total food consumption and total faecal production. This enabled the detection of the productivity of the sparrow over its growing period. Similar tests on other seed eating species have been reported by (Dolink, 1975; Myrcha et al., 1970).

RESULTS AND DISCUSSION

The results obtained from ten nests comprising 26 nestlings are represented in Table 1 and Fig. 1. (Please note that the Fig. 1 is a comparison of data from Gere, 1983 and our results for House Sparrow). The first phase includes the initial life span inside the nest, second represent the fledgling stage and the third is post flying or at flying stage. Here the weight at the third stage remained almost constant. The production for the nestlings with respect to its food consumption was significantly higher in the initial period. In spite of this tendency, the food uptake by the birds proved less effective at early stage compared to the fledgling stage, especially when the when there was a decreasing ratio of FU to an increasing R. Thus it implies that the nestlings gain a biomass during the initial period and then the process of gaining weight becomes moderate and further slows down to a constant. The characteristic period was the intense oxidation of the majority of food. The energy budget/ balance up to the onset of flying out was as follows.

Energy consumption in millet was 485.7 x 10 3 J and that obtained from eggs was 288.1 x 10 3 J resulting a total of 773.8 x 10 3 J of consumed energy while 79.5 x 10 3 J are energy accumulated into the young. Thus the ratio of energy production to the energy source of the food was 10 .3%. All the calculation is based on (Gere, 1972). Our results are in line with previous findings of other seed eaters (Fig. 1).

A realistic estimate in the wild could be done if we approached by comparison with the role of other animal. For the same insects seems to be the most convenient as they are usually dominant in the ecosystems. Another presumption for a reliable comparison is the similar character of the food to be ingested. Therefore, the rate of matter flow from the sparrows fed on millet and eggs can be compared to that of the grasshopper larvae or other small insects. In a similar study it was found that birds at any age utilized surplus materials for vital process but with a lower production compared to the epimorph insect model.

It was also interesting to note that the intensity of food consumption is frequently related to the surface area, instead of the body mass, as it being mainly proportional to the variations in surface area over individual growing and or to the size of the various animals belonging to the identical types. Our present findings on comparative food consumption with body mass are well supported in accordance to Gere (1978). This small study is all the more important to emphasize the role of birds in the energy budget of the ecosystem is unambiguous but are important by all means.

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