

FOOD REQUIREMENTS OF THE GOLDEN EAGLE

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IN the fall of 1954 a raptor feeding study was undertaken at the Montana Cooperative Wildlife Research Unit, Missoula, Montana. Objectives were to determine the average daily food intake of the Golden Eagle (*Aquila chrysaetos*), and to observe if the relation of body weight to food consumed by this large raptor varied with environmental temperature fluctuations.

Such information is necessary in the field of raptor predation, for use in estimating the number of prey species required to maintain the predator in its environment. Craighead and Craighead (1956: 318-320) have obtained such data for a number of the smaller raptors and applied these to express the number of prey individuals consumed by a raptor population. No work of this nature has previously been done with the Golden Eagle.

METHODS

Three Golden Eagles and one Goshawk (*Accipiter gentilis*) were kept from the fall of 1954 to the summer of 1955. One eagle was retained for the following year also. The birds were kept out-of-doors exposed to natural climatic conditions. They were handled, fed, weighed, and cared for using the techniques of Craighead and Craighead (1956: 312-313). Each bird was placed on a perch and secured with jesses and a leash. By "bating off" the perch (beating the wings continually) at intervals the birds received a considerable amount of daily exercise. It was not uncommon for the eagles to "bate off" and exercise their wings until fatigued.

By controlled feeding, each bird was initially brought to a body weight where it was "eager" for food, but not starving; then the daily ration was regulated to maintain the birds at these weights. It proved to be a more difficult task to hold the eagles at constant body weights than the smaller Goshawk. The data in Tables I through III show that the change in body weight of the experimental eagles from the beginning to end of a feeding experiment varied from a loss of 54 grams to an increase of 75. A change of this magnitude is relatively insignificant. For the purposes of these experiments we can consider that the body weight of the eagles remained relatively constant during the feeding periods, since by the inclusion of several final feedings or the exclusion of a similar number the initial and final body weights would have showed little or no change.

The diet consisted primarily of venison during the fall and winter

months, with a mixture of chopped venison and chicken heads being fed once a week to provide the necessary roughage and minerals. During the spring and summer months the staple diet was changed to horse meat, and the roughage requirements were obtained primarily from wild rodents.

Feeding took place once each day in the afternoon at a prescribed time. The birds were weighed at least once a week prior to the day's feeding.

Golden Eagle 2, which was retained from the summer of 1955 to the spring of 1956, was trained and exercised during a 24-day interval of warm summer weather and for a 29-day interval during cold winter weather. The eagle was flown from its perch to the gloved hand. After each flight it was rewarded with food. One long flight or several shorter flights constituted the daily flight exercise. These distances were paced off and recorded.

The Goshawk was fed under the same conditions, so data obtained could be compared with the work of Craighead and Craighead (1956: 412-413) and in turn used as a check and reference for any variation that might be found in the larger raptors. The maximum and minimum temperatures were recorded each day at the study site.

RESULTS

From the fall of 1954 to the spring of 1955, food consumption data were obtained from all four birds. During this time they were not flown, but did obtain exercise by "bating off" the perches. The per cent of body weight eaten by the eagles (Table I) ranged from 5.7 per cent for the larger female (No. 3) to 6.6 and 6.5 per cent for the smaller males (Nos. 1 and 2). During this same period the Goshawk consumed daily an amount of food equal to 14.1 per cent of its body weight. This figure for the Goshawk agrees quite closely with the data compiled by Craighead and Craighead (1956: 412-420) for raptors of a similar size. The Craigheads (1956: 314, 413, 420) also related the food consumed by large and small raptor species to their respective body weights. They showed that the large raptor species daily consumed less food in relation to body weight than did the smaller raptors. The percentage of food eaten by the eagles in this experiment shows this same general trend (Table I). This is also evident when the data for the large female (No. 3) is compared with that for the two smaller male eagles (Nos. 1 and 2). This may well be a manifestation of a lower basal metabolic rate in the larger raptor species and possibly also reflects a difference in basal metabolic rate between male and female of the same species.

TABLE I
FALL AND WINTER FOOD REQUIREMENTS

Feeding Dates	Raptor Species	Sex and Age	Max. Daily Ration, grams	Ave. Wt. of Food Eaten per Day, gms.	Ave. Wt. of Raptor, grams	% Ave. Body Wt. Eaten per Day	Ave. Temp. °F.	No. Days Fed	Change in Body Wt. gms.
11/7/54 to 3/30/55	Golden Eagle 1	Ju.M.	524	266	4026	6.61	27.8	143	+1
11/7/54 to 3/8/55	Golden Eagle 2	Ju.M.	388	262	4059	6.47	27.7	121	+30
	Golden Eagle 3	Ad.F.	562	308	5436	5.67	27.7	121	+48
	Goshawk 4	Ad.M.	267	124	880	14.1	27.7	121	-36

TABLE II
COMPARISON OF FOOD REQUIREMENTS DURING WARM WEATHER PERIOD WITH AND WITHOUT EXERCISE

Feeding Dates	Raptor Species	Sex and Age	Max. Daily Ration, grams	Ave. Wt. of Food Eaten per Day, gms.	Ave. Wt. of Raptor, grams	% Ave. Body Wt. Eaten per Day	Ave. Temp. °F.	No. Days Fed	Change in Body Wt. gms.
6/28/55 to 7/31/55	Golden Eagle 2 without exercise	Ju.M.	290	188	3572	5.26	64.8	33	-54
8/17/55 to 9/10/55	Golden Eagle 2 with exercise	Ju.M.	361	231	3324	6.94	65.3	24	-3

TABLE III
COMPARISON OF FOOD REQUIREMENTS DURING COLD WEATHER PERIOD
WITH AND WITHOUT EXERCISE

Feeding Dates	Raptor Species	Sex and Age	Max. Daily Ration, grams	Ave. Wt. of Food Eaten per Day, gms.	Ave. Wt. of Raptor, grams	Ave. Body Wt. Eaten per Day	Ave. Temp. °F.	No. Days Fed	Change in Body Wt. gms.
8/17/55 to 9/10/55	Golden Eagle 2	Ju.M.	388	262	4059	6.47	27.7	121	+30
11/15/55 to 12/14/55	Golden Eagle 2 without exercise	Ju.M.	294	253	3864	6.55	23.3	29	+75
	Golden Eagle 2 with exercise								

TABLE IV

DATA ON EXERCISE OF GOLDEN EAGLE

Ave. Distance per Study Day, yds.	Ave. Distance per Day Exercised, yds.	% Study Days Exercised
250 (app.)	275 (app.)	91.7
647 (app.)	816 (app.)	79.3

Feeding Dates
8/17/55 to 9/10/55
11/15/55 to 12/14/55

TABLE V

RELATION OF FOOD CONSUMPTION TO TEMPERATURE

Feeding Dates	Raptor Species	Sex and Age	Max. Daily Ration, grams	Ave. Wt. of Food Eaten per Day, gms.	Ave. Wt. of Raptor, grams	Ave. Body Wt. Eaten per Day	Ave. Temp. °F.	No. Days Fed	Change in Body Wt. gms.
10/28/54 to 12/17/54	Goshawk 4	Ad.M.	186	120	906	13.2	36.0	41	-43
11/14/54 to 11/21/54	Goshawk 4	Ad.M.	164	103	917	11.2	42.6	8	+34
11/7/54 to 3/8/55	Goshawk 4	Ad.M.	267	124	880	14.0	27.7	121	+36
12/5/54 to 2/2/55	Goshawk 4	Ad.M.	162	126	879	14.3	25.4	59	-6
12/8/54 to 1/8/55	Goshawk 4	Ad.M.	162	129	879	14.6	24.5	32	+7
11/7/54 to 3/8/55	Golden Eagle 2	Ju.M.	388	262	4059	6.47	27.7	121	+30
6/28/55 to 7/31/55	Golden Eagle 2	Ju.M.	290	188	3,572	5.26	64.8	33	-54

Data for eagle No. 2 during the warm weather period without exercise (6/28 to 7/31, Table II) when compared with data from the cold weather period without exercise (11/7 to 3/8, Table III), show that the per cent of body weight consumed decreases with an increase in the average daily temperature. This also is in agreement with the work by the Craighheads (1956: 412-413). However, upon comparing the per cent of average body weight eaten per day in warm weather with no exercise, against the per cent during a comparable warm weather period while the bird was being flown to the hand (Table II), it appears that this relatively small amount of exercise had a marked effect on the food consumption. On the other hand, comparison of the cold period data with and without exercise (Table III) does not illustrate a similar increase in food consumption due to exercise. This is even more striking since the amount of exercise per day during the cold period was almost three times that of the warm period, if distance of flight is assumed proportional to amount of exercise (Table IV).

The Golden Eagle was moulting during the summer months. Falconers have long suspected that food consumption of raptors increases due to nutritional demands of the moult. Although there appears to be no quantitative data in the literature to support this, we have much evidence that this is true. We suspect that the additional food required to grow new feathers masked any response to exercise and that what appears as a marked response to exercise is largely a response to the peak of the moult.

The smaller Goshawk also followed the pattern of the inverse relationship between temperature and food consumed, although a smaller fluctuation in temperature produced a much stronger response in the bird's food consumption (Table V).

This response in both the Golden Eagle and the Goshawk can be compared in Table V. These data can also be compared directly to similar data computed for other raptors by Craighead and Craighead (1956: 413).

APPLICATION

The data presented in Table I can be used in calculating the number of prey species required to maintain a pair of Golden Eagles or a known population of them.

In order to do this with some degree of accuracy it is necessary to have the following information: 1. The number of eagles and the length of time they are present on a given area of land. This can then be expressed as raptor-days. 2. An adequate sample of the eagles' food in the wild. 3. The average weights of major prey species available to the eagles. 4. The quantitative food requirements of Golden Eagles.

The procedure to be followed in making a calculation of this nature is presented in detail by Craighead and Craighead (1956: 311-326). All the information needed to do this for the Golden Eagle is not at present available, but the authors hope the data on food requirements here presented will inspire other workers to obtain the needed information and make the calculations. Such information appears essential if we are to understand better the role of the Golden Eagle and other raptors in regulating numbers of prey animals.

CONCLUSIONS

The ratio of the weight of food consumed by the Golden Eagle, expressed in per cent of its average body weight, varies inversely with respect to both the body weight of the individual bird and the environmental temperature. An adult female required an average daily ration during the fall and winter of 308 grams and two juvenile males required 262 and 266 grams respectively during the same seasons.

The per cent of average body weight eaten per day by the Golden Eagles lay between 5.5 and 6.6. The smaller Goshawk consumed 14 per cent of its average body weight during the cold weather period. Although the effect of exercise cannot be conclusively shown by this work, it is supposed that food consumption would increase slightly with exercise.

The data presented, when related to other vital statistics of diet, raptor-days, and average prey weights, can be used to estimate the number of prey animals of various species required to maintain these raptors in their environments.

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LITERATURE CITED

- CRAIGHEAD, J. J. and F. C. CRAIGHEAD. 1956. Hawks, owls and wildlife. The Stackpole Co., Harrisburg, Pa., and The Wildlife Management Institute, Washington, D. C. 443 pp.

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