

SHORT COMMUNICATIONS

FOOD OF NESTING BALD EAGLES ON SAN JUAN ISLAND, WASHINGTON

LASZLO RETFALVI

Canadian Wildlife Service
Edmonton, Alberta, Canada

Quantitative information on food of Bald Eagles (*Haliaeetus leucocephalus* L.) has been published for the Aleutian Islands (Murie 1940), for New Brunswick (Wright 1953), for southeastern Alaska, Kansas, Maryland and Virginia (Imler and Kalmbach 1955). Less comprehensive accounts are available for British Columbia (Brooks 1922; Munro 1938) and for Northwestern Illinois (Southern 1963, 1964). For other parts of the bird's range such data is lacking. This paper presents data on the diet of Bald Eagles in coastal Washington. The information contained herein resulted from a broader study of factors affecting the abundance of Bald Eagles on San Juan Island, Washington (Retfalvi 1965).

METHODS

San Juan Island, with an area of 35,448 acres, is the second largest among a group of islands of the same name situated at the southern tip of Vancouver Island in the Pacific Northwest.

Feeding habits of the eagles were studied by direct observations and by the analysis of debris collected from the base of nest trees.

Direct observations were carried out at two different locations. During the summer of 1962 the activities at a nest on Turn Island were observed. In 1963 the Turn Island pair failed to raise a brood, so information on food was gathered at an active nest in Rocky Bay. Both nests were built more than 100 ft above the ground on tall Douglas fir trees, the tallest trees of the surrounding stands. The nests were observed with the aid of a 30 \times -powered telescope from distances of 650 m (the Turn Island nest) and 550 m (the Rocky Bay nest) from vantage points somewhat lower than the nests. The nests were observed for a total of 463.5 hr between 2 May and 4 September 1962, and between 8 May and 29 August 1963, and on additional weekends during the winters of 1962 and 1963.

The accumulated debris at the base of the nest tree on Turn Island was collected for analysis in 1962. At the time of collection, groups of bones and remains lying in close proximity to one another were considered to originate from the same item and were collected into one container. During the analysis of the contents of each container, bones which could be assembled to form the partial skeleton of a species were regarded as one item, while bones and fragmental skeletons of other species were counted as additional items. Thus some containers, regardless of volume of remains, contained only one item, while others contained several food items. When bones from separate containers unmistakably belonged together, they were regarded as one food item.

The base of the Turn Island nest tree was visited again in 1963, but no new food remains were found. No food remains were found near the base of the Rocky Bay nest tree in 1962 or 1963.

RESULTS

Observations of food items brought to the nest during the nesting seasons of 1962 and 1963, combined with information on feeding activities gathered after the young had left the nest but were still associated with the parents, are presented in table 1. Occurrence percentages were calculated on the basis of volumetric amounts consumed. Since exact measurements could not be taken, the observed food items were assigned to size categories of small, medium, and large, and were multiplied by 1, 2, or 3, respectively, to compensate for differences in their size.

The analysis of food remains collected at the base of the Turn Island nest tree in 1962 is presented in table 2. Occurrence percentages reflect the numbers of different items represented in the diet.

Mammals. Direct observations indicate that the feral domestic rabbit of the San Juan Islands was the most common item in the diet. These animals are thought to have originated from the European rabbit (*Oryctolagus cuniculus* L.) and were introduced into the islands in their domestic form around the turn of the century (Couch 1929). They have increased rapidly in the wild. The rabbits are not considered game animals, but rather part of the domestic stock of the landowner; their hunting is therefore unrestricted by the State Game Department (Latham 1955).

Eagles were not observed to kill rabbits, but they picked them up as carrion from roadsides and fields. The abundance of carcasses was due to the rabbits' high mortality through collision with automobiles and to the strong hunting pressure exerted on the rabbit population throughout the year. Many rabbits were also killed by the hay-cutting machines in late May and early June when the hay fields were harvested.

Rabbit remains were also abundant in the collected debris. Several skulls, other parts of skeletons, and torn pieces of hide were present. Hides, however, were excluded from the count when their condition indicated that they had been picked up as remains of rabbits skinned by hunters.

Sheep ranching is common on San Juan Island, and eagles congregated around the fields during the lambing seasons in late February and early March. Most sheep ranchers did not believe that eagles killed newborn lambs. However, eagles fed readily on carcasses of lambs and on sheep placentas. No remains of sheep of any age were found underneath the nest trees, nor were sheep remains observed being brought to the nest by the eagles.

The carcass of a harbor seal (*Phoca vitulina* L.), washed ashore not far from the Turn Island nest in July 1962, was utilized by the parent birds and the flying young eagles until it was washed away by the sea.

TABLE 1. Diet of Bald Eagles on San Juan Island, based on observations of food brought to nest during 1962 and 1963.

Items	No. observations		Est. amount ^a		% occurrence	
	1962	1963	1962	1963	1962	1963
Mammals	23	22	42	43	53.4	58.1
Fish	19	20	34	27	43.0	36.5
Birds	1	2	1	4	1.2	5.4
Amphibians	1	—	1	—	1.2	—
Crustaceans	1	—	1	—	1.2	—
Total	45	44	79	74		

^a Based on size categories; see text.

Fish. Fish constituted a large portion of the eagles' diet. The birds were often observed to fish, although actual captures of fish were seldom seen. The live fish caught were small, varying between estimated weights of 1–4 lb. Floating dead fish were undoubtedly picked up by the eagles. Live and dead fish are treated together in table 1 because the condition of prey at the time of capture was not always known.

The most abundant items in the collected debris were the remains of rockfish (*Sebastes* sp.) and ling cod (*Ophiodon elongatus* Girard). Skulls of giant sculpin (*Scorpaenichtys marmoratus* Ayres), arrowtooth flounder (*Atherestes stomias* Jordan and Gilbert), and red Irish lord (*Hemilepidotus hemilepidotus* Tilesius) were also found.

Birds. Only three food items of avian origin were observed being brought into the nest: a Bufflehead (*Bucephala albeola*) in 1963 and two unidentified birds in 1962. In the debris, bird remains were represented to a larger extent. The remains included wings, legs, and skulls of gulls (*Larus* sp.), Surf Scoters (*Melanitta perspicillata*), and Common Murre (*Uria aalge*). Skeletal remains of several unidentified birds were also found. Although crows were the greatest

antagonists of eagles, their remains were not found in the collected material.

Others. Food items other than mammals, fish, and birds seldom occurred in the Bald Eagles' diet on San Juan Island. An adult of the Turn Island nest was seen to pick up a crab (*Carcinus* sp.) from the seashore and a frog or toad from the shore of a freshwater pond nearby.

Dried grass was brought to the nest early in the nesting seasons of 1962 and 1963 but the eagles were not observed to feed on it.

Change in diet. The monthly distribution of the amount and kind of food items brought to the nests during the summers of 1962 and 1963 combined are presented in table 3. The two main items, fish and rabbit, comprised more than 95 per cent of the diet. The relative quantities of these two items changed with the season. Fish predominated until about mid-May; thereafter rabbits were mainly utilized. The monthly change in the occurrence of these two items in the diet, from May to August 1962 and 1963 combined, has been statistically analysed (analysis of variance for randomized complete block design with two observations per experimental unit, see Steel and Torrie 1960). While neither monthly change nor type of food alone proved significant as a source of variation, the variance accounted for by the interaction of monthly change and the type of food ($F = 4.28$, with 3 and 8 df) is significantly greater ($P < 0.05$) than the variance accounted for by the sampling error. The hypothesis that there was a seasonal change in the relative proportions of fish and rabbit in the diet is therefore accepted. Figure 1 is the graphical representation of this change and is based on the data of table 3. A similar, less pronounced tendency can be seen in the data of Imler and Kalmbach (1955), which show a pronounced decrease in utilization of fish during the later stages of the nesting season and a corresponding increase in food other than fish.

DISCUSSION

Since the data presented in table 1 were collected during the breeding season, the figures show the birds' diet only during the spring and summer; in particular they show the kind of food that was fed to the young. The data of table 2 show the eagles' year round feeding habits since the debris collected at the base of the Turn Island nest tree in 1962 was an accumulation of several years' food remains. This was indicated by the absence of food debris at this nest in the following year and by the absence of remains at the base of the Rocky Bay nest, a small nest, in both 1962 and 1963.

The tendency of the eagles to tear their larger prey and take only parts into the nest was further respon-

TABLE 2. Diet of Bald Eagles on San Juan Island, based on analysis of debris collected at base of Turn Island nest tree, 1962.

Food items	Occurrence	
	No.	%
Fish		
rock fish sp.	17	
ling cod	8	
giant sculpin	3	
arrowtooth flounder	2	
red Irish lord	1	
Total	31	50.8
Birds		
gull sp.	2	
Surf Scoter	2	
Common Murre	2	
unidentified	11	
Total	17	27.9
Mammals		
rabbit	13	21.3
Totals	61	100.00

TABLE 3. Change in composition of diet of Bald Eagles on San Juan Island, based on observations of food items brought to the nest (data for 1962 and 1963 combined).

Items	May			June			July			August		
	No. observ.	Est. amt. food	% occur.	No. observ.	Est. amt. food	% occur.	No. observ.	Est. amt. food	% occur.	No. observ.	Est. amt. food	% occur.
Fish	24	38	74.5	7	15	36.6	3	3	6.4	5	5	45.5
Rabbit	5	9	17.5	14	25	61.0	20	40	85.0	2	5	45.5
Seal	—	—	—	—	—	—	3	4	8.6	—	—	—
Birds	2	4	6.0	1	1	2.4	—	—	—	—	—	—
Frog	—	—	—	—	—	—	—	—	—	1	1	9.0
Crab	1	1	2.0	—	—	—	—	—	—	—	—	—
Totals	32	52		22	41		26	47		8	11	

sible for the differences in the data of tables 1 and 2. Fish caught in the water were always taken whole and torn to pieces in the nest, leaving all remains in the vicinity, and thus exaggerating the proportions of fish in the diet.

The alteration of feeding habits during the breeding season cannot be explained by seasonal change in food availability. Rabbit carrion was most abundant during the summer, but such carrion was also available in the spring and was never fully utilized. A decrease in fish availability was unlikely. On the contrary, the drop in fish consumption nearly coincided with the start of commercial salmon fishing operations. With the available information this phenomenon cannot be further evaluated.

Outside the breeding season the adult birds were likely to have a diet that resembled the data in table 2, while the young of the year fed largely on rabbit carrion. This was the food item that the young were most likely to encounter once the parent-offspring relationship ceased. The stomach contents of one juvenile Bald Eagle, killed accidentally in 1963, contained a great amount of rabbit hair, a few rabbit claws, and some grass. The contents of this stomach, together with the numerous observations by local residents of young eagles feeding on dead rabbits in the fall, suggest that the young eagles, after breaking relationship with the parents, fed almost entirely on carrion.

The flying ability of these young birds was still limited. Feeding on rabbit carrion required no great

ability, but the task of securing a fish out of the water may have presented too difficult a problem for them. A definite preference for fish was thought to exist. During the early part of the nesting season, rabbits being fed to the young were abandoned when the other adult brought fish into the nest. Similar preference was observed later in the season when the young were able to feed themselves.

The ability of a primarily fish-eating bird to feed on a less preferred, but more abundant, food item shows the beneficial role that predators and scavengers play in the reduction of carrion and the adaptability of the predator to the most abundant food supply. Murie (1940) found that eagles on the Aleutian Islands, Alaska, fed mainly on seabirds, the most abundant members of the fauna. On San Juan Island the most abundant food item was carrion, which was also the most abundant item in the diet of Bald Eagles. This source of food was never fully utilized, and it is therefore concluded that food did not limit the abundance of Bald Eagles on San Juan Island.

SUMMARY

Information on feeding habits of Bald Eagles on San Juan Island, Washington, was obtained by direct observation of food items taken to the nest, and by the analysis of debris collected at the base of nest trees. The diet based on direct observation was found to differ from the diet calculated by means of debris analysis. Rabbits were mainly obtained as carrion from roads and fields where many were killed by cars and farming equipment. Although local residents reported eagles feeding on carcasses of lambs, no evidence of sheep remains were found in the collected nest debris. Eagles were observed to catch small fish. Remains of large fish found in the debris were possibly picked up as carrion. Birds constituted a small percentage in the diet. The diet of the young changed from predominantly fish during the early stages of their nest life to predominantly mammals during the later stage. Food supply did not limit the abundance of eagles on San Juan Island.

ACKNOWLEDGMENTS

I wish to thank members of the Department of Zoology and the Faculty of Forestry at the University of British Columbia, Vancouver, for advice and helpful criticism, and M. D. F. Udvardy for providing guidance and the facilities needed. D. R. Flock of the Canadian Wildlife Service critically read the manuscript. The study was financed by the National Research Council and the Canadian Audubon Society. Time provided by the Canadian Wildlife Service for the preparation of the manuscript is acknowledged.

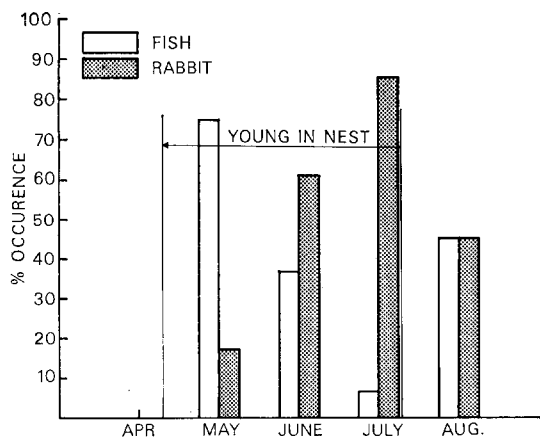


FIGURE 1. The monthly change in fish and rabbit occurrence in the diet of Bald Eagles on San Juan Island, Washington.

LITERATURE CITED

- BROOKS, A. 1922. Notes on the abundance and habits of the Bald Eagle in British Columbia. Auk 39:556-559.
- COUCH, L. K. 1929. Introduced European rabbits in the San Juan Islands, Washington. J. Mammal. 10:334-336.
- IMLER, R. H., AND E. R. KALMBACH. 1955. The Bald Eagle and its economic status. U.S. Fish Wildl. Serv. Circ. 30.
- LATHAM, R. M. 1955. The controversial San Juan rabbit. Trans. N. Amer. Wildl. Conf. 20:406-414.
- MUNRO, J. A. 1938. The northern Bald Eagle in British Columbia. Wilson Bull. 50:28-35.
- MURIE, O. J. 1940. Food habits of the northern Bald Eagle in the Aleutian Islands, Alaska. Condor 42:198-202.
- RETFALVI, L. I. 1965. Breeding behavior and feeding habits of the Bald Eagle (*Haliaeetus leucocephalus* L.) on San Juan Island, Washington. MF Thesis, Univ. Brit. Columbia, Vancouver.
- SOUTHERN, W. E. 1963. Winter populations, behavior, and seasonal dispersal of Bald Eagles in northwestern Illinois. Wilson Bull. 75:42-55.
- SOUTHERN, W. E. 1964. Additional observations on winter Bald Eagle populations: including remarks on bio-telemetry techniques and immature plumages. Wilson Bull. 76:121-137.
- STEEL, R. G. D., AND J. H. TORRIE. 1960. Principles and procedures of statistics. McGraw-Hill, Toronto.
- WRIGHT, B. S. 1953. The relation of Bald Eagles to breeding ducks in New Brunswick. J. Wildl. Mgmt. 17:55-62.

Accepted for publication 25 August 1969.

BIRD OBSERVATIONS FROM TIERRA DEL FUEGO

ALLAN R. KEITH

Blue Mill Road
New Vernon, New Jersey 07976

The following observations were made by me as a member of a tour called "Antarctic Expedition 1967" which, as part of its itinerary, spent a total of eight days on or near Tierra del Fuego. Ninety species were recorded from the island or adjacent waters while aboard the ARA *Lapataia*. Notes on the 24 of greatest interest are presented here. Information on the other species is contained in an unpublished manuscript deposited in the libraries of the Division of Birds, Smithsonian Institution, Washington, D.C., and the Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina.

Specifically, the time spent in Tierra del Fuego was as follows. The *Lapataia* arrived at Ushuaia at 08:30, 13 January, and remained there until 07:05, on 14 January. On 13 January I explored the hills directly behind the town of Ushuaia and visited Parque Nacional Tierra del Fuego. On 14 January the ship left for the Antarctic and returned to Ushuaia at 21:45, 27 January. On 28 January Dr. Ira N. Gabrielson and I drove from Ushuaia to Lake Escondido and back. On 29 January the entire party drove from Ushuaia to Río Grande, with a stop at the east end of Lake Fagnano at noon-time. On 30 January, Dr. Gabrielson and I drove from Río Grande back toward Ushuaia, a total distance of about 70 miles over the road, and returned. On 31 January the entire party was driven from Río Grande to the Argentine and Chilean border patrol stations near San Sebastián Bay. After crossing the border we continued north through Cullen to Cerro Sombrero where we boarded a plane for Punta Arenas, thus leaving Tierra del Fuego. The map in figure 1 shows the route followed on the island.

I wish to express my thanks to Dr. Philip S. Humphrey, now of the Museum of Natural History, University of Kansas, for suggesting that these notes be published, and to David Bridge of the Smithsonian Institution for invaluable help on the content of the manuscript. The scientific and vernacular names of de Schauensee (The species of birds of South America and their distribution. Livingston Publ. Co., Narberth, Pennsylvania. 1966) are used in the following annotated list.

Silvery Grebe. *Podiceps occipitalis*. At least two were seen in Ushuaia harbor by Gabrielson on 12 January. Three were there on 13 January, and two were still there on 29 January. These appear to be the southernmost records for this species and are of further interest because the birds were on salt water.

Black-bellied Storm-Petrel. *Fregetta tropica*. Of interest is one bird seen at approximately 56°00' S, 65°30' W on 27 January. This bird is rarely recorded so far north of the Antarctic in the austral summer.

Black-necked Swan. *Cygnus melancoryphus*. Sixteen were seen in one of two lakes about 70 mi. over the road S of Río Grande on 30 January. Though at some distance, several swans the size of adults, but grayish in color and without the black heads and necks of adults, could be distinguished through a 30× telescope; they appear to have been immatures. Our guide told us that the swans nest in this lake. This appears to be the southernmost record to date for this species and, if correct, the southernmost breeding locality.

Spectacled Duck. *Anas specularis*. Two birds at Lake Roca west of Ushuaia in Parque Nacional Tierra del Fuego were seen on 13 January. This locality is extremely far south for this species.

Speckled Teal. *Anas flavirostris*. This species was common in all the areas where it was observed. Two broods of downy young were seen on 28 January where the Milna River flows out of the northern end of Lake Escondido. One brood consisted of only two young about 10 cm long, and the other contained five young about 7 cm long. On 31 January at the Chilean San Sebastián border patrol station, a pair with one downy young was found in a small stream in open grassland. When surprised by me, the young bird hid beneath an undercut bank, the female flew off, and the male began a "broken-wing" act. The male fluttered along the stream and in the pasture until it had "led" the author nearly 150 m from where the young bird hid.

Southern Wigeon. *Anas sibilatrix*. One male seen at Lake Roca on 13 January was especially far south for this species, being well south of the cordillera.

Red Shoveler. *Anas platalea*. Since there are few reports of this species in Tierra del Fuego, it is of interest to record a flock of 10 birds, of mixed sex, in a small freshwater pond, together with the following species, about 25 mi. over the road S of Río Grande on 30 January. The birds were observed at a distance of about 15 m by both Gabrielson and myself for 10