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FOODS AND WEIGHTS OF THE ROCK PTARMIGAN ON AMCHITKA, ALEUTIAN ISLANDS, ALASKA

William B. Emison¹ and Clayton M. White²

ABSTRACT.—We examined the crop contents from 129 Rock Ptarmigan (*Lagopus mutus*) collected between 1967 and 1971 on Amchitka, Aleutian Islands, Alaska. On a yearly basis two plant species, *Empetrum nigrum* and *Equisetum arvense*, made up 87% of the diet. Only in July and August were they less than 90% of the diet, and in those months they constituted 65% of the diet. During the warmer months (May–October) when a variety of plant species were available, the Amchitka ptarmigan fed upon growth forms of plants high in nutritive value (particularly *Equisetum strobili*). Its main winter food was the vegetative portions of *Empetrum*, one of the few abundant evergreen vascular plants on the island.

The Rock Ptarmigan (*Lagopus mutus*), is one of the most abundant and widely distributed terrestrial vertebrate herbivores residing permanently in arctic and subarctic regions. Its circumpolar distribution covers most of the northern regions of Europe, Asia, and North America and extends southward as far as northern Japan and the Pyrenees Mountains of northern Spain. Throughout this extensive range, the Rock Ptarmigan is primarily a browser upon leaves, twigs, and buds of various plants (cf. Cramp and Simmons 1980). In many areas it is sympatric, at least for part of the year, with the Willow Ptarmigan (*Lagopus lagopus*) and may also share available food resources with other, primarily mammalian, browsing animals. However, neither Willow Ptarmigan nor terrestrial herbivorous mammals occur in the western Aleutian Islands.

In contrast to many other areas where Rock Ptarmigan occur, Amchitka Island in the western Aleutians (Fig. 1) consists of a small land area, in which the climate is maritime with little winter snow accumulation in the lower elevations and a somewhat depauperate flora (Hulten 1960). Many foods reportedly eaten by Rock Ptarmigan in other areas (Geltling 1937, Watson 1964, Weeden 1969, Gardarsson and Moss 1970, Cramp and Simmons 1980) are rare or absent. In particular, birch (*Betula*) and alder (*Alnus*), which make up 90% (dry weight) of the winter diet of central Alaskan birds (Weeden 1969), are not on

Amchitka; and willows (*Salix*), which are sometimes eaten by Rock Ptarmigan in other areas, are rare on the island. Other unusual features of Rock Ptarmigan on Amchitka include its moult (Jacobsen et al. 1983) and its breeding phenology (White et al. 1977). This paper describes the food and shows weights of the Rock Ptarmigan on Amchitka Island.

MATERIALS AND METHODS

Between August 1967 and October 1971, crop contents were removed from 129 Rock Ptarmigan collected on Amchitka (Table 1). In most cases a specimen was processed on the day of collection as follows: at the time of collection the date, location, time, general weather condition, general ground condition (dry, wet, snow covered, etc.), and flock size were recorded; the specimen was then taken to the field laboratory where the crop and its contents were removed and placed in a bottle containing 8% formalin. The bird was then weighed and gonad measurements made. About 75% of the collected birds were aged by the method of Weeden and Watson (1967).

The preserved crop contents were sorted into component food species, thoroughly dried at 80 C, and weighed to the nearest 0.001 gram. Samples of vegetation from one bird were used to determine nitrogen and phosphorus content. These samples were removed from the crop, sorted, and air-dried in the field laboratory before shipment (no

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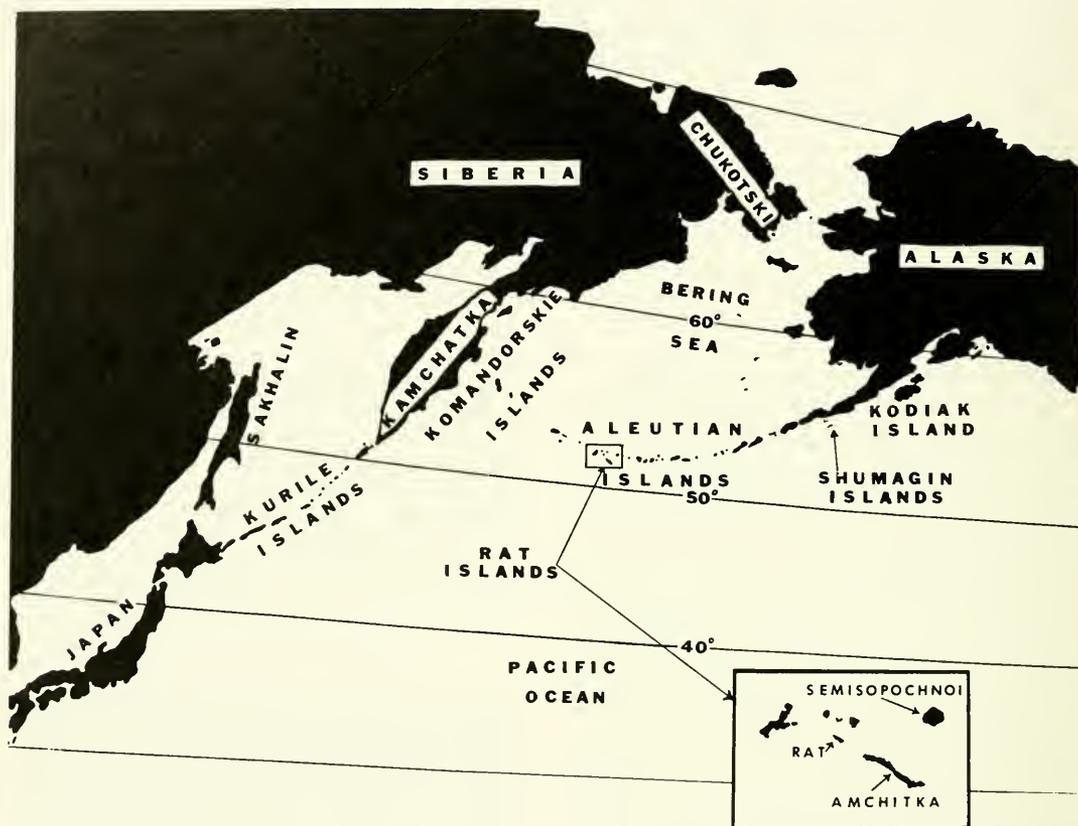


Fig. 1. Rat Islands and surrounding Bering Sea and north Pacific Ocean areas.

preservatives used). They were analyzed by Donald W. Fisher at the U.S. Geological Survey, Water Quality Laboratory, Washington, D.C.

RESULTS

Body weights

Weights in relation to collection dates of adult and juvenile females and of adult and juvenile males are shown in Figures 2 and 3.

Foods

Yearly foods: The year-round diet of Rock Ptarmigan on Amchitka was composed primarily of two plant species, *Empetrum nigrum* (crowberry) and *Equisetum arvense* (horsetail). Together these constituted 89% to 97% (dry weight) of the total diet in all months except July and August, when they formed

about 65% of their diet (Fig. 4). On a yearly basis these two plants formed 87% of the diet (Table 2).

Food plants and their growth patterns: In the following discussions, abundances of plants were based both on personal observations and on abundance and ground coverage studies by C. C. Amundsen (unpublished manuscript and 1977) of important plant species in various habitats on Amchitka.

Empetrum nigrum was an evergreen plant that occurred over the entire island and formed extensive mats several cm high. It probably had the greatest gross biomass of any of the island species (Amundsen 1971, 1977) and, at least visually, was the dominant vascular plant on Amchitka. Berries were produced in profusion in May and were mature in August. Ptarmigan ate most berries in August and tapered off through the autumn and early

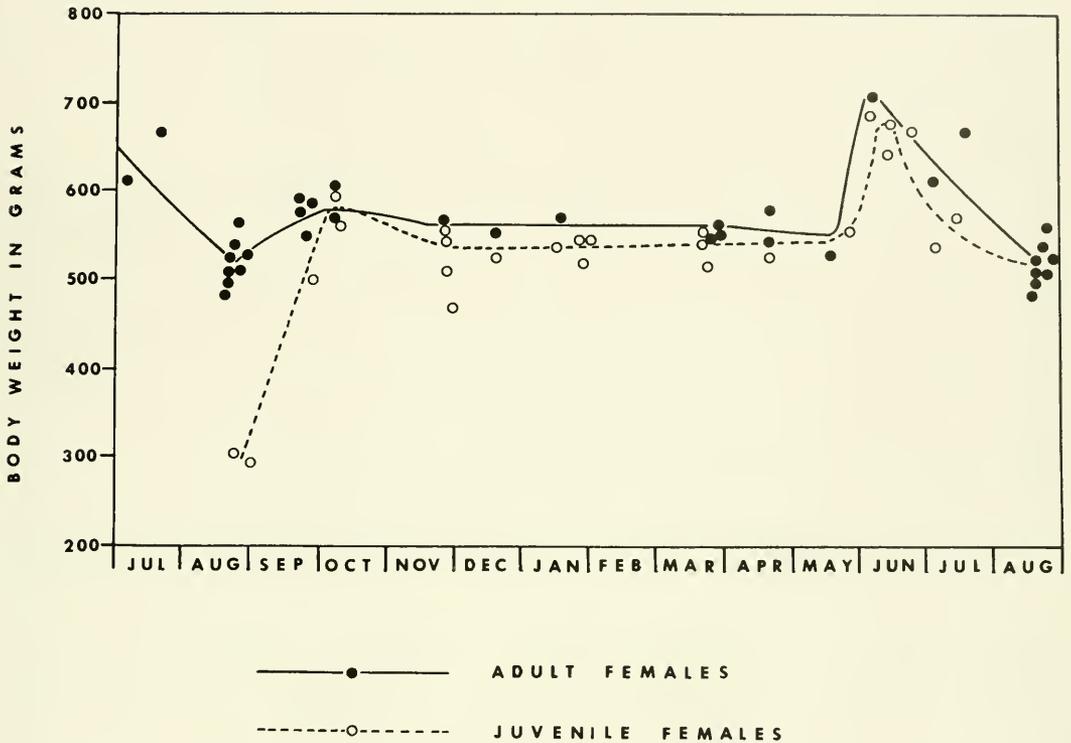


Fig. 2. Seasonal changes in body weight (less crop weight) of female Rock Ptarmigan on Amchitka Island, Alaska. Birds in their second August (and older) are classed as adults. Lines fitted by inspection.

TABLE 1. Number of Rock Ptarmigan collected from Amchitka Island for crop content analyses.

Sampling period	Number of Rock Ptarmigan collected					Total
	1967	1968	1969	1970	1971	
January–February		6		13		19
March–April				11	7	18
May		15	1			16
June			10	7	1	18
July				4	8	12
August	11		5			16
September–October	1		11		2	14
November–December			12	4		16
						129

winter months (Fig. 4) as berries become scarce. Leaves and twigs of *Empetrum*, available throughout the year, were mainly eaten in July and during winter (November–April). *Empetrum* usually protruded above the shallow winter snows. Although it was probably the most abundant vegetation even during warmer months (May–October), it was only eaten in quantity during June and July, when

new growth was occurring. During the rest of summer other plants or growth forms were eaten.

Equisetum arvense was locally common, but in most habitats its abundance did not approach that of *Empetrum*. It occurred mainly in lush riparian meadows, on sand dunes, and on disturbed gravel areas on the low plateaus. Its two distinct growth forms

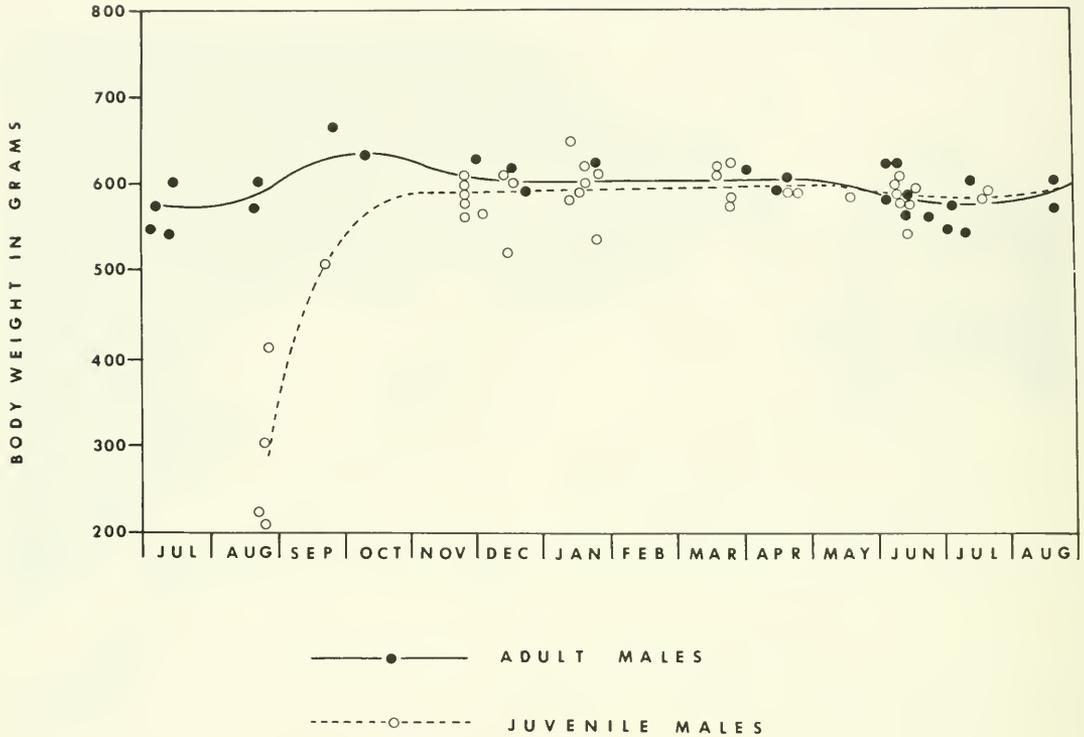


Fig. 3. Seasonal changes in body weight (less crop weight) of male Rock Ptarmigan on Amchitka Island, Alaska. Birds in their second August (and older) are classed as adults. Lines fitted by inspection.

TABLE 2. Percent composition of Rock Ptarmigan crop contents (dry weight) on a yearly basis (all months weighted equally).

Food plants	Percent of diet
<i>Empetrum nigrum</i>	62
<i>Equisetum arvense</i>	25
Ferns	2
<i>Lupinus nootkatensis</i>	2
<i>Carex</i> spp.	2
<i>Sibbaldia procumbens</i>	1
<i>Ranunculus occidentalis</i>	1
<i>Cerastium</i> spp.	1
Miscellaneous* and unidentified	4

*Includes parts of plants of the genera *Anemone*, *Cassiope*, *Cornus*, *Polygonum*, *Potentilla*, *Rubus*, *Salix*, and *Vaccinium*.

consisted of a fertile, erect stem with a single fruiting cone (strobilus) at the apex, and a sterile stem with many branches and tiny appressed leaves.

The sporangia of the fertile plant matured in early June (Shacklette 1969), and soon thereafter the stems and strobili appeared quite withered. Although timing of the ap-

pearance above ground of new strobili did not conform to that of *E. arvense* in other areas, it was the only species of *Equisetum* present (Hulten 1968, Shacklette 1969). In the typical life cycle of *E. arvense* the strobili, although fully formed, overwinter under the soil. However, on Amchitka some new strobili emerged to just above the soil in dense grasses (particularly in the riparian meadows) in September, and thus overwintered until the following spring when stems elongated and sporangia begin maturing (Amundsen, personal communication). Even though *Equisetum* strobili were relatively difficult to obtain during autumn and winter, ptarmigan fed extensively upon them in September–October and continued to eat substantial quantities throughout the winter (Fig. 4). In May and June, when the stems elongated and sporangia began maturing, the strobili were conspicuous and abundant in some habitats and were correspondingly abundant in ptarmigan crops. After the sporangia matured in June, the

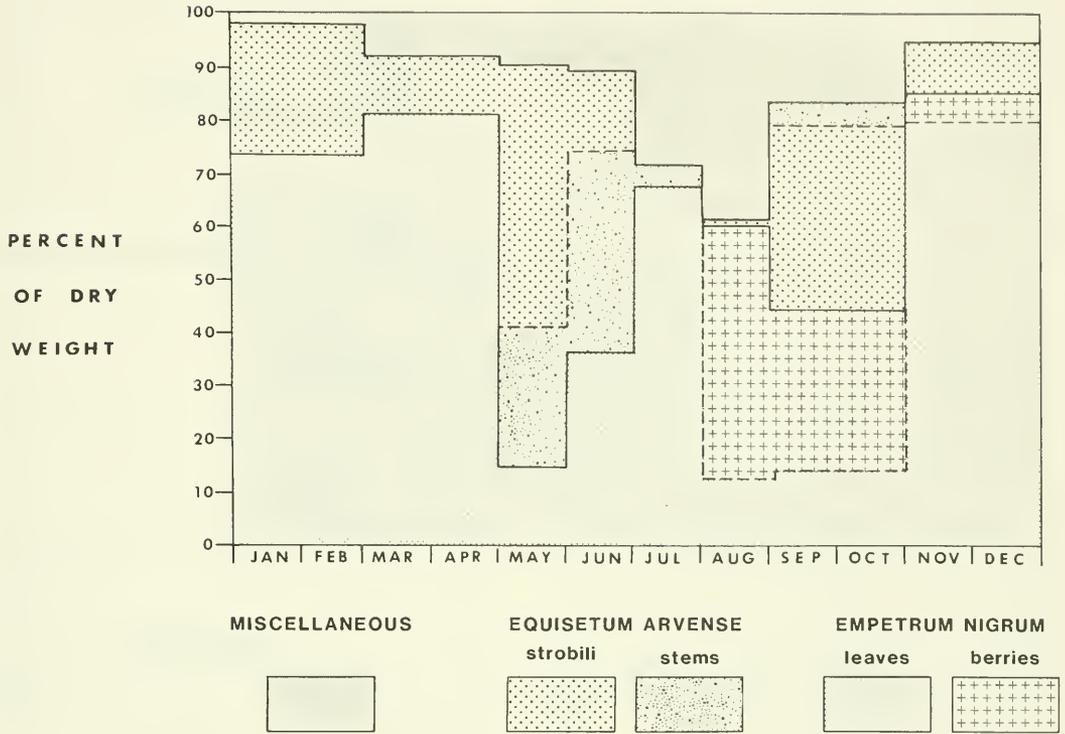


Fig. 4. Percentages of major food plants in the crop contents of Rock Ptarmigan on Amchitka Island, Alaska. The results are expressed in two-month periods for Jan–Feb, Mar–Apr, Sep–Oct, and Nov–Dec; and in one-month periods for May, Jun, Jul, and Aug.

plants withered, and strobili were not eaten between late June and the emergence of some new cones in September.

The new sterile plants of *Equisetum* emerged in late April, and ptarmigan fed heavily on the tips of the new growth (apical meristems) during May and early June (Fig. 4). After the plants branched out in late June they were rarely eaten, but a few newly grown tips appeared in crops of ptarmigan in September–October. Sterile plants withered in the autumn and were not a food source until the following spring when new plants again emerged.

Analyses of plant remains taken from the crop of a female collected on Amchitka in late April showed that *Equisetum strobili* contained 2.54% nitrogen and 0.42% phosphorus, while *Empetrum* vegetation had only 1.25% nitrogen and 0.14% phosphorus.

Plants other than *Empetrum* and *Equisetum* were seldom eaten by ptarmigan except during July and August (Fig. 5). New leaves of

Lupinus nootkatensis (common in disturbed gravel areas) were fed upon mainly in June (trace) and July, and older leaves were less commonly taken in August–October. The flowers of *Carex macrochaeta* (one of the most abundant sedges) were eaten in June and July, and *Carex achenes* occasionally occurred in crops from August through December. Leaflets of ferns, which were probably either *Athyrium felix-femina* or *Dryopteris dilatata* (common in riparian meadows), were eaten in July–August. Achenes and a few leaves of the locally common buttercup (*Ranunculus occidentalis*) were eaten in August, and a few crops also contained some flowers in July. *Cerastium* (common in disturbed areas) capsules filled with seeds were eaten in limited quantities in September–October. The evergreen leaves of *Sibbaldia procumbens* (uncommon in disturbed areas such as old roadbeds) were eaten in small amounts from November through May. *Salix* and *Polygo-*

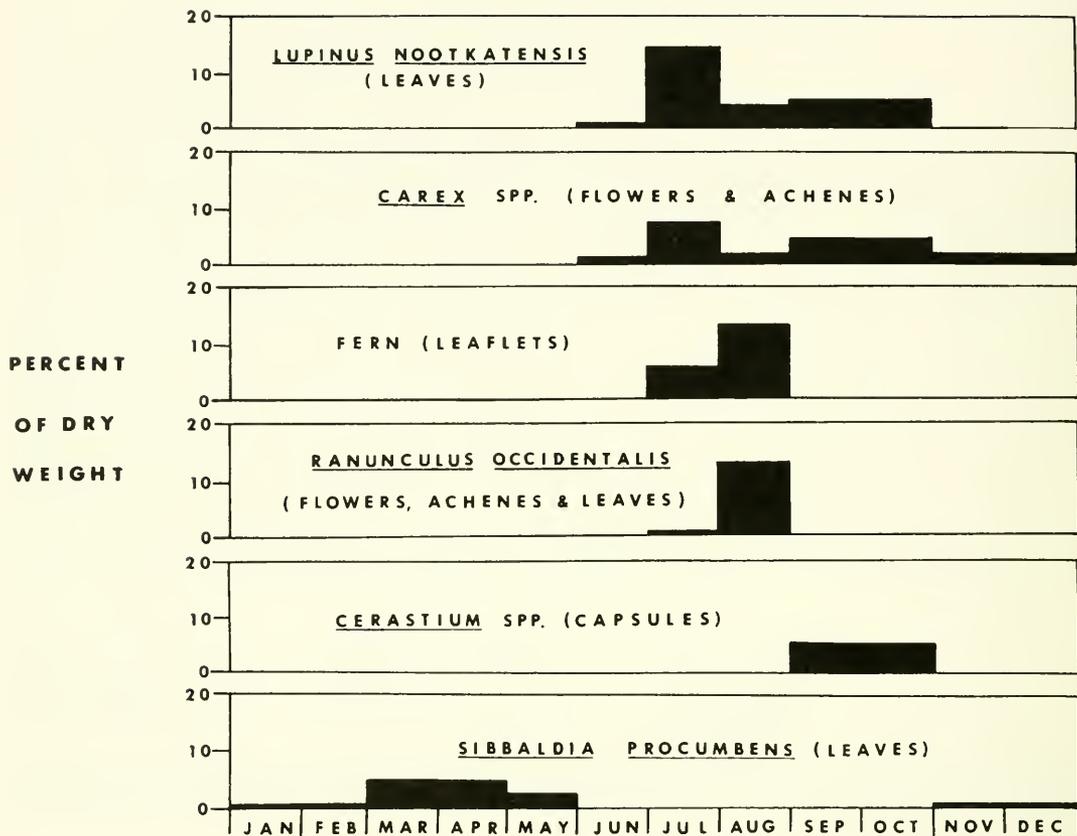


Fig. 5. Percentages of miscellaneous plants in the crop contents of Rock Ptarmigan on Amchitka Island, Alaska. The results are expressed in two-month periods for Jan–Feb, Mar–Apr, Sep–Oct, and Nov–Dec; and in one-month periods for May, Jun, Jul, and Aug.

num rarely occurred in crops, probably because they were rare on the island.

DISCUSSION

The diet of the Rock Ptarmigan on Amchitka Island was very simple, consisting of only two main foods, *Empetrum nigrum* and *Equisetum arvense*. During winter (November through April) its main food was the vegetative portions of *Empetrum*, one of the few abundant evergreen vascular plants on the island. The less abundant and more difficult to obtain *Equisetum* strobili also were taken throughout these months, but in smaller quantities than *Empetrum*. This pattern of winter feeding was similar to that of Rock Ptarmigan populations studied in other widely separated areas, such as central Alaska

(Weeden 1969, Moss 1973, 1974), Greenland (Gelting 1937), Iceland (Gardarsson and Moss 1970), and Scotland (Watson 1964). All of these studies showed that winter foods consisted of one to three plants occurring abundantly in the winter habitat.

Summer foods, although more varied, were generally composed of either reproductive structures or parts of plants undergoing growth. Examinations of the crop contents of Amchitka Rock Ptarmigan taken between early May and mid-October revealed that developing strobili and apical meristems of *Equisetum* were being eaten. This resulted in two peaks of *Equisetum* consumption, one in May and June before the plants matured and the other in September–October when new strobili began appearing. Between these two peaks (in July and August) only mature growth

forms of *Equisetum* were available, and these were rarely eaten. At this time *Equisetum* was replaced in the diet by new *Empetrum* vegetation, *Empetrum* berries, and various other plants, most of which were exhibiting either new growth or mature fruits. Such selective feeding during the growing season is well documented for ptarmigan populations in other areas and has been shown to be related to the high nutritive values of plants undergoing growth and development (Gelting 1937, Moss 1968, Gardarsson and Moss 1970). In Iceland, where *Equisetum arvense* and *Empetrum nigrum* both occur, detailed chemical analyses by Gardarsson and Moss (1970) revealed that during May *E. arvense* strobili were considerably more nutritious and digestible than were leaves and shoots of *E. nigrum*. Considered to be of importance were the high percentages of nitrogen and phosphorus. Samples of *Equisetum* strobili and *Empetrum* vegetation taken from the crop of a female collected on Amchitka in late April were analyzed for both nitrogen and phosphorus and the results were similar to those of Gardarsson and Moss (1970). Thus, during the warmer months (May–October) when a variety of plant species were available, the Amchitka ptarmigan fed upon growth forms of plants high in nutritive value.

The body weights of all ages and sexes of ptarmigan collected on Amchitka increased during September and October. Another period of rapid weight increase occurred in females during June when they were forming and laying eggs; during June and July females weighed more than males. Other than during these two periods the average adult body weights remained either unchanged or declined. Both periods of weight increases coincided with the two periods of maximum intake of nutritious *Equisetum* strobili. This pattern of body weight changes was similar to that of the Svalbard Rock Ptarmigan in the high latitudes (77–81°N) north of Norway (Steen and Unander 1985). However, the increase in the September–October weights was much greater in the Svalbard Rock Ptarmigan, presumably because they lay down heavy deposits of fat prior to periods of continuous darkness during winter (Mortensen and Blix 1985).

When major food plants eaten in each of five different geographic areas (Amchitka

Island, Scotland, Iceland, Greenland, and central Alaska) were compared, it was apparent that the Rock Ptarmigan was a flexible species capable of exploiting a variety of plant species, although within any one area it was considerably more selective. There appeared to be three major factors involved in winter food selection. (1) The abundance and availability of a suitable winter food. Generally, important winter foods were also some of the most important plants, in terms of abundance, in the winter habitat. (2) The nutritive value of winter plants. In some areas where more than one suitable food plant occurred abundantly, the more nutritious species predominated in the diet. This was shown to be the case in Iceland where *Salix*, *Betula*, *Empetrum*, and *Calluna* all occurred commonly, but the birds fed mainly on *Salix*, which was the highest quality food. (3) The presence of a closely related competitor within the winter habitat of the Rock Ptarmigan. In Iceland and Greenland where the Rock Ptarmigan was the only species of *Lagopus* present, the major winter food was *Salix*. However, in central Alaska where the Willow Ptarmigan was also present, the Rock Ptarmigan subsisted on *Betula*, while the Willow Ptarmigan fed on *Salix*.

Based upon examination of the foods eaten between April and November by Rock Ptarmigan in these studies, it appeared that plant abundance and nutritive values continued to be important factors influencing food selection, but that competition was of little importance because of nesting habitat separation between the two ptarmigan species (Weeden 1969). While a variety of plants and plant parts were eaten during these months, it was significant that parts of plants high in digestibility and nutritive value were selected; this was particularly evident at times when growth and development of young birds was occurring and when females were forming and laying eggs. In Iceland, Greenland, and central Alaska selection was primarily for *Polygonum* bulbils, but on Amchitka where this plant was rare, selection was for *Equisetum* strobili. However, in Scotland, plants high in digestibility and nutritive value were not available, but despite this, the Rock Ptarmigan was capable of maintaining breeding populations (Moss 1968). Thus, the Rock Ptarmigan was an adaptable species in terms

of food requirements and was successful in areas where the nutritive values of winter foods were low (as on Amchitka), where winter food competition with Willow Ptarmigan occurred (as in central Alaska), or where the year-round foods were relatively low quality (as in Scotland).

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