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Seasonal food habits of the black bear in the Whitefish range of northwestern Montana

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SEASONAL FOOD HABITS OF THE BLACK BEAR IN THE WHITEFISH RANGE OF NORTHWESTERN MONTANA

by

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E. L. T.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

This study deals with the seasonal food habits of black bears (Ursus americanus) in the Whitefish Range of northwestern Montana. It comprised one phase of a long term ecological study being conducted by the Montana Department of Fish and Game. This phase was a cooperative effort between the Montana Cooperative Wildlife Research Unit and the Fish and Game Department. The major objectives of the study were:

1. To determine the seasonal foods of the black bear by frequency of occurrence of food items in fecal material;

2. To determine the relationship between availability of food items and selection by the feeding animal;

3. To determine the relationship of seasonal feeding activity to vegetation types present on the study area.

Field investigations were conducted during the following periods: June 12 to September 23, 1959; June 9 to September 18, 1960.

Black bear food habits have been studied in other parts of the United States and in Canada; however, most of the early reports are based upon a few field observations and include little or no quantitative material dealing with the subject. This is true of short accounts which relate findings in Texas (Bailey, 1905), the Athabaska-Mackenzie region (Preble, 1908), Ontario (Bigelow, 1922), northern California (Bailey, 1923), Oregon (Bailey, 1923), New Mexico (Bailey, 1931), Washington (Bailey, 1936; Schwartz and Mitchell, 1945), Anticosti Island (Newsom, 1937), Florida (Hamilton, 1941), New York (Shadle, 1941),

Alaska (Dufresne, 1946), and Michigan (Bradt, 1946; Shapton, 1956).

One of the earliest attempts to analyze black bear scats quantitatively was made by Murie (1937) in Jackson Hole, Wyoming. The early winter food habits of bears in West Virginia were determined by remains found in 25 stomach samples obtained from hunters between 1935 and 1938 (Cottam et al., 1939). Bennett et al.(1943) recorded the contents of 119 scats collected in Pennsylvania over a three year period. Seven stomach samples from Maine were included with the same analysis; however, these were grouped separately. Arner (1948) described the fall foods of Pennsylvania bears as indicated by food remains found in 26 droppings collected in November of two consecutive years. In another study (Chatelain, 1950) no attempt was made to differentiate between black and brown bear feces collected on the Kenai Peninsula, but general ecological relationships between the environment and feeding bears were considered. Some foods of Colorado black bears were described on the basis of items found in 20 scats and 5 stomach samples from the Uncompahgre National Forest (Gilbert, 1951). More intensive research relating to Maine bears was conducted by Spencer (1955) who analyzed 108 stomachs and 377 scats.

With the exception of the more extensive recent studies, investigations dealing with black bear food habits are relatively limited in scientific value. Several workers collected scats on a seasonal basis and correlated their findings with general seasonal changes in environment. Nevertheless, sparse bear populations, especially in the eastern United States, made it necessary for some investigators to gather scats over very large areas. Data derived from such fecal collections are

difficult to evaluate since they are an expression of the feeding behavior of bears occupying somewhat different habitats. In a number of instances droppings representing several successive years were analyzed as a unit, and therefore comparison between different years could not be made. Scat analysis techniques were not sufficiently described.

Other workers have attempted to relate food habits to the definite area of land occupied by animals. Craighead and Craighead (1956:355), who conducted an intensive study of raptor-prey relationships in Michigan, have shown that the relative abundance of prey species greatly influences the food habits of hawks. In addition, they found that the number of hawks present on any area of land is "governed by the density of major prey species." Weckwerth (1957), in a similar study, demonstrated that marten (Martes americana) food habits are regulated by the availability of food items.

PHYSIOGRAPHY OF THE STUDY AREA

Geography

The study area is situated in the Flathead National Forest about 15 miles north of Columbia Falls, Montana. It is bounded on the north by Coal Creek, on the west and southwest by the Whitefish Divide, on the south and southeast by the Smoky Range, and on the east by Lookout and Langford Creeks (Fig. 1). Approximately 116 square miles of terrain are included within the above boundaries. Most of this area is located in T32N R21W, T32N R22W, T33N R21W, and T33N R22W, Flathead County. Field investigations were conducted primarily in the Big Creek drainage which is about 80 square miles in area.

Topography

The study area is dominated by numerous ridges and small valleys leading down from the Whitefish and Smoky Divides. Streams, with the exception of those located north and northeast of Dead Horse Ridge, drain eventually into Big Creek, a tributary of the North Fork of the Flathead River. The area is drained on the north by Coal Creek. Elevations range from about 3,800 feet in the southeastern corner of the study area to 7,521 feet at the summit of Moose Peak near the northwestern boundary. Glacial activity has modified the topography.

Climate

Climatic conditions, especially precipitation, are determined by the Pacific (Northwest) storm track which lies in the region.

Moisture-laden air blowing inland from the Pacific Ocean produces high annual precipitation rates which apparently reach maximum levels in Canyon Creek just south of the study area. The coastal influence is evidenced by small stands of cedar and hemlock which occur in some of the river bottoms. Weather data recorded at West Glacier, 14 miles southeast of the area, are presented in Table I.

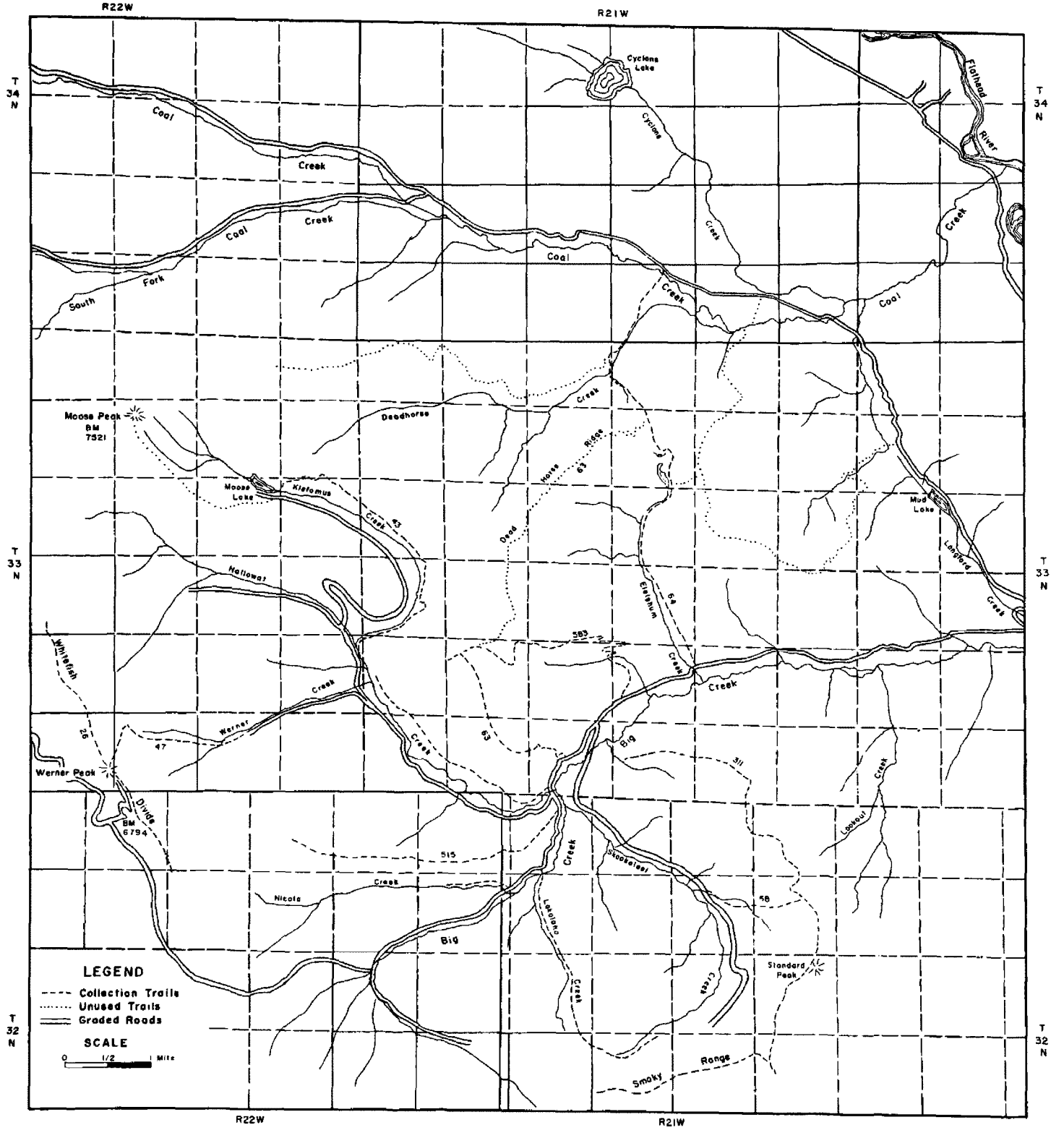

Figure 1. Map of the study area

Table I. Temperature and precipitation data from West Glacier, Montana

Month	Precipitation in Inches*			Average Temperature in °F.*				
	Long Term Mo. Av.	1959	1960	Long Term Mo. Av.	1959 Max.	1959 Min.	1960 Max.	1960 Min.
January	3.12	5.31	2.63	21.3	28.6	15.9	25.9	10.7
February	2.35	2.29	2.33	24.4	29.7	14.7	32.9	15.0
March	1.83	1.49	2.06	31.3	42.4	25.8	41.1	19.8
April	1.77	2.62	2.14	42.0	53.5	29.4	51.8	29.3
May	2.41	3.05	3.65	51.0	58.9	33.9	60.6	35.3
June	3.05	2.33	1.96	56.9	71.3	42.6	71.3	42.2
July	1.39	.05	.00	64.0	81.4	44.1	84.4	47.8
August	1.31	1.55	2.75	62.2	73.4	43.9	70.2	45.5
September	1.84	4.08	.59	53.4	59.8	41.0	67.8	38.0
October	2.68	2.69	1.70	43.3	49.3	32.3	53.1	32.4
November	2.87	7.52	4.52	31.3	32.5	15.7	35.4	25.0
December	3.33	1.15	1.49	25.5	32.9	18.9	27.3	18.5
Annual	27.95	34.13	26.17					
Maximum Temperature					91		93	
Minimum Temperature						-29		-30

Killing Frost Dates (28°F. or below)

Last in Spring:	June 1	May 9
First in Fall:	Oct. 1	Sept. 22

*From records of the United States Weather Bureau (Anon., 1959-1960)

DESCRIPTION OF THE VEGETATION ON THE STUDY AREA

The Big Creek study area is situated in the Picea engelmanni-Abies lasiocarpa zone (Daubenmire, 1952). Although the Pseudotsuga menziesii var. glauca union apparently forms climax stands on some exposures, the Douglas-fir zone with its related associations does not extend into the area. No well-defined alpine communities are present, but alpine species occur on several sites above an elevation of about 6,500 feet.

The spruce-fir zone forms the highest forest belt in the Whitefish Range. Picea engelmanni and Abies lasiocarpa are the climax dominants of this zone, and Pinus albicaulis plays a minor climax role on some habitat types, especially near timberline. Larix lyallii and Tsuga mertensiana were not observed by the investigator but are reported to occur on the study area.

Daubenmire (1952, 1953) describes four major climax associations for the Picea-Abies zone. These are the Picea-Abies/Pachistima myrsinites, Picea-Abies/Xerophyllum tenax, Picea-Abies/Menziesia glabella, and Picea-Abies/Vaccinium scoparium associations. The Vaccinium scoparium union is represented on the study area; however, climax stands with subordinate vegetation dominated by this union were not encountered. This shrub is common in open parks near timberline.

Various microclimatic conditions have brought about the development of a number of vegetation types not extensive enough to be considered by Daubenmire. Since these types with their characteristic flora

relate to the black bear diet, a qualitative description of each is included in the following discussion of vegetation. The scope of this food habit study did not permit quantitative evaluation of vegetation types. The main terminologies utilized in the discussion of vegetation types are defined by Daubenmire as follows:

> Each piece of vegetation that occupies a distinctive habitat, or has experienced a distinctive history of regeneration following a catastrophe, is a stand . . . . The plants which comprise a stand may be grouped according to their similarities in local environmental requirements, periodicity, and size, into groups called unions . . . . An association is defined here as a distinctive combination of unions that reappears over the landscape wherever ecologically equivalent habitats reappear (Daubenmire, 1953).
>
> The term association is applied only to climax communities . . . . That type of climax vegetation which is characteristic of undulating topography and loamy soils that are moderately drained, is called the climatic climax. Within a small region those climaxes which differ from the climatic climax because of stable but peculiar and ecologically important soil condition are called edaphic climaxes. On still other habitats where mature vegetation differs from the climatic climax because rough topography results in excessive exposure to, or protection from, direct solar radiation, or where wind manifestly modifies vegetation, such vegetation is considered topographic climaxes. Frequently soil peculiarities accompany strong topographic influence, and in such cases the term topoedaphic climax seems appropriate . . . . The collective area which one association occupies, or will occupy as succession advances, is called a habitat type . . . . The area occupied or potentially occupied by a closely related group of associations is called a zone (Daubenmire, 1952).

A list of the major vascular plants noted on the study area is included in Appendix A. Identification of most of these was accomplished by the use of Davis' (1952) Flora of Idaho. Phenological data relating the approximate dates of initial blooming and fruit maturation of several plant species are presented in Appendix D.

Picea-Abies/Pachistima Association

The Picea-Abies/Pachistima association represents the lowest climatic climax on the study area. This association potentially occupies

most exposures below about 5,000 feet and some exposures above this elevation; however, early fires have established seral stands over much of the Picea-Abies/Pachistima habitat type in the Whitefish Range. Vegetation representative of this association is approaching climax conditions in the Lakolaha Creek drainage. Here the Picea-Abies union exists as a stand of mature trees, some with a d. b. h. of 3 feet. Mature seral trees, notably Larix occidentalis and Pseudotsuga menziesii, are rare in the stand.

The Pachistima myrsinites union forms the subordinate vascular vegetation in this association. Species characteristic of this large union include: Actea arguta, Arnica cordifolia, Athyrium filix-foemina, Bromus vulgaris, Chimaphila umbellata, Clintonia uniflora, Disporum oreganum, Galium triflorum, Goodyera oblongifolia, Hieracium albiflorum, Linnaea borealis var. americana, Lonicera utahensis, Mitella stauropetala, Osmorhiza obtusa, Pyrola spp., Rosa gymnocarpa, Rubus parviflorus, Smilacina stellata, Taxus brevifolia, Tiarella unifoliata, and Trillium ovatum.

Daubenmire (1952) points out that three kinds of stands occur in the lower portions of the Picea-Abies zone. These are caused by the influx of species from the higher Menziesia glabella and Xerophyllum tenax unions. Rather than create three associations, Daubenmire recognizes only the Pachistima myrsinites union, allotting to it Xerophyllum and Menziesia facies where the strong representation of species from these two unions necessitates this.

Picea-Abies/Xerophyllum Association

The Picea-Abies/Xerophyllum association was observed most

frequently on south-facing slopes above 5,500 feet elevation. Daubenmire (1952) recognizes this forest as a topographic climax because it is confined to southerly exposures. Throughout the association Abies lasiocarpa is the dominant tree. Apparently Picea engelmanni does not tolerate the xeric conditions prevailing on the Picea-Abies/Xerophyllum habitat type.

Daubenmire (1952) has shown that over 95 per cent of the undergrowth in this association consists of Xerophyllum tenax and Vaccinium membranaceum. On the study area V. membranaceum becomes less abundant near the upper limits of the Picea-Abies/Xerophyllum habitat type. Other subdominants common above 6,000 feet include: Angelica dawsoni, Campanula rotundifolia, Castilleja rhexifolia, Erigeron peregrinus, Lupinus sericeus, Pedicularis bracteosa, Vaccinium scoparium, and Valeriana sitchensis.

Near timberline, small parks dominated by representatives of the Agropyron spicatum union form topoedaphic climaxes on certain sites within this habitat type.

Picea-Abies/Menziesia Association

On north-facing slopes and in shaded ravines on other exposures, between elevational extremes of about 5,000 and 6,500 feet, the Picea-Abies/Menziesia association forms the climatic climax. Daubenmire (1952) speaks of this association as being "impoverished" in terms of an herbaceous flora. This phenomenon is partially due to the fact that the subordinate vascular vegetation consists of dense shrubby cover provided by Menziesia glabella. Insolation beneath the Menziesia canopy is so reduced that few herbs can survive.

In local situations, especially near the timberline type, Luzula glabrata forms low mats in small clearings within the Menziesia thickets. Arnica latifolia, Mitella pentandra, and Tiarella unifoliata are several less common species noted to survive in the shady environments of this association. Sorbus scopulina and S. sitchensis are present; however, these shrubs grow to a height of ten or more feet and thus protrude above the Menziesia canopy.

Clearings within this association, resulting apparently from mesic conditions, are vegetated in nearly all situations by various combinations of the following: Angelica dawsoni, Arnica latifolia, Castilleja rhexifolia, Elymus glaucus, Heracleum lanatum, Melica subulata, Pedicularis bracteosa, Senecio triangularis, and Veratrum viride.

It was noted that Phegopteris dryopteris and Luzula parviflora frequently grow beneath the Menziesia shrubs near 5,000 feet where the Picea-Abies/Menziesia habitat type merges with the Picea-Abies/Pachistima habitat type.

Seral vs. Climax Vegetation

Forest stands on the study area have burned in the past. Fires destroyed many acres of timber in the Picea-Abies/Pachistima and Picea-Abies/Xerophyllum habitat types in 1910 and 1919. Daubenmire (1952) mentions that forest fires are generally less common in the continually moist Picea-Abies/Menziesia habitat type.

The numerous seral stands occurring on the study area vary with age, exposure, elevation, and other factors. Table II presents a general summary of the ecological roles played by various tree species

Table II. Distribution and ecological roles of tree species and subordinate unions in relation to habitat types (after Daubenmire, 1952)

C-major climax role
c-minor climax role
S-major seral role
s-minor seral role
t-topographic role*
r-relic*

	Habitat Types		
	Picea-Abies/ Menziesia	Picea-Abies/ Xerophyllum	Picea-Abies/ Pachistima
Tree Species			
Larix lyallii	c	-	-
Abies lasiocarpa	C	C	C
Pinus albicaulis	S	S	-
Picea engelmanni	C	c	C
Tsuga heterophylla	-	-	r
Thuja plicata	-	-	r
Pinus monticola	S	s	S
Pinus contorta	-	S	S*
Larix occidentalis	s	s	S
Pseudotsuga menziesii	s	s	S (t)
Populus tremuloides	-	s	-
Pinus ponderosa	-	-	t or s*
Subordinate Unions			
Vaccinium scoparium	-	c*	-
Menziesia glabella	C	-	c
Xerophyllum tenax	C	C	c
Oplopanax horridum	-	-	r or c*
Calamagrostis rubescens	-	-	s
Corallorhiza-Pyrola	-	-	c
Symphoricarpos rivularis	-	-	s
Agropyron spicatum	-	t	t

*Categories modified or added by investigator

and subordinate unions with respect to habitat types. Daubenmire (1953) originated this classification system; however, some of his categories are not applicable to vegetation as it exists on the Big Creek study area. Therefore, several categories have been modified.

Each habitat type is characterized "by a relatively uniform successional sequence" (Daubenmire, 1953), and as succession proceeds the vegetation occupying a particular site becomes progressively more similar to the climax association of the habitat type on which the site is located.

Timberline or Pinus albicaulis Type

Above approximately 6,000 feet Pinus albicaulis is represented in the spruce-fir forests of the study area. On most sites at this elevation the trees are scattered or in small groups and show a high degree of wind-deformation.

Although the tree union is unique, Daubenmire has shown that the subordinate shrub-herb communities at 6,000 feet and above are a mixture of species drawn from lower forest associations and higher alpine areas. The understory of timberline stands located on north-facing slopes is comprised mainly of plants from the Menziesia union. On many sites Luzula glabrata grows in dense mats about 6 inches tall beneath an overstory of alpine fir and white-bark pine. Menziesia glabella is often permanently deformed by the weight of snowbanks which may persist until the end of June. Vaccinium membranaceum and V. scoparium are present; however, the fruit seldom matures because of the short growing season. Other plants observed growing on such timberline sites include: Arnica latifolia, Deschampsia atropurpurea, Erythronium

grandiflorum, Pedicularis bracteosa, P. racemosa, and Pyrola secunda.

On south and west-facing slopes and on ridgetops the Xerophyllum union is well represented. Most of the vegetative cover is Xerophyllum tenax, Vaccinium membranaceum, and V. scoparium, but the following species may also be present: Angelica dawsoni, Castilleja rhexifolia, Erigeron peregrinus, Erythronium grandiflorum, and Valeriana sitchensis. Patches of Elymus glaucus occur in depressions that retain soil moisture.

Small grassy parks, surrounded by the Xerophyllum union but vegetated by plants from the Agropyron spicatum union, were noted on some south-facing slopes. Bunchgrass meadows such as this were recorded on Werner Peak at 6,500 feet elevation.

Pseudotsuga menziesii Type

The ecological role of Pseudotsuga menziesii var. glauca on the study area is not clear. Daubenmire (1952, 1953) describes the seral role of Douglas-fir in the Picea-Abies/Pachistima habitat type. In most cases the presence of this tree in spruce-fir forests of the Whitefish Range is indicative of early fires. Pseudotsuga menziesii may form a topographic climax on some dry, rocky sites within the Picea-Abies zone.

Stands of Douglas-fir which appeared to be climax, as evidenced by the development of reproduction beneath mature trees, were observed on south-facing slopes along the lower 7 miles of Big Creek Road and on west-facing slopes adjacent to Trail 64 and Mud Lake. Spruce and fir reproduction is usually lacking on sites similar to those listed above. All of the stands placed in this category occur on talus slopes covered by very thin soil layers.

The Agropyron spicatum, Calamagrostis rubescens, and Symphoricarpos rivularis unions are expressed in the subordinate vegetation of this type. Shrubby species comprising the understory cover include: Acer glabrum, Amelanchier alnifolia, Holodiscus discolor, Juniperus communis, Prunus virginiana var. demissa, Spiraea betulifolia, and Symphoricarpos rivularis. The major grasses and forbs are: Agropyron spicatum, Antennaria racemosa, Calamagrostis rubescens, Castilleja hispida, Fragaria spp., Heuchera cylindrica var. glabella, Lomatium simplex, and Polemonium pulcherrimum. Pinus ponderosa was observed in this type.

Mountain Meadows

Two general meadow types occur on the study area. These were classified as dry and wet mountain meadows in accordance with the environmental conditions peculiar to each.

The dry mountain meadows may be considered topoedaphic climaxes. Usually they occur on steep southwest, south, and southeast-facing slopes between elevational extremes of approximately 4,400 and 6,500 feet. Edaphic conditions are characterized by the presence of shallow, rocky soil which is often well-aerated as a result of the burrowing activities of Citellus columbianus and Thomomys talpoides. All of the dry meadows examined possessed vegetation dominated by representatives of the Agropyron spicatum union (Daubenmire, 1952, 1953), namely A. spicatum, Festuca idahoensis, Achillea millefolium spp. lanulosa, Balsamorhiza sagittata, Carex geyeri, and Lupinus sericeus. Other plants encountered include: Agoseris aurantiaca, Allium cernuum, Calochortus apiculatus, Castilleja hispida, Crepis atribarba,

Delphinium sp., Eriogonum spp., Heuchera cylindrica var. glabella, Hieracium albertinum, Juniperus communis, Penstemon albertinus, Sedum stenopetalum, and Senecio integerrimus. Above 6,000 feet the preceding species are often accompanied by: Castilleja rhexifolia, Deschampsia atropurpurea, Elymus glaucus, Erigeron peregrinus, Juncus parryi, and Valeriana sitchensis.

Wet meadows form edaphic climaxes in the flat bottoms of some mountain valleys. Poor drainage is a possible explanation for the almost complete absence of trees in parks of this nature. In general, the wet meadows possess vegetation very different from that found on dry ones; however, a few plant species, those apparently limited more by insolation than edaphic factors, tolerate the ecological conditions of both meadow types. Calamagrostis canadensis is one of the most common grasses on wet meadows. At elevations below 5,500 feet this species forms dense stands up to 4 feet in height. Wet meadows situated above this elevation are usually occupied by additional plants: Agrostis thurberiana, Carex spp., Delphinium sp., Dodecatheon radicatum, Elymus glaucus, Equisetum arvense, Erigeron peregrinus, Juncus drummondii, J. mertensianus, Phleum alpinum, Poa alpina, Senecio triangularis, and Trollius laxus.

Snowslide Areas

Mass movement of snow down mountain slopes has created numerous snowslide areas in the Whitefish Range. The tree union is absent on these fan-shaped areas, and the shrubby cover that persists does not resemble the subordinate unions normally found beneath stands of spruce and fir. On southerly exposures the vegetation of snowslide areas is

stratified; however, the layered effect is not obvious on north-facing slides where representatives of the Menziesia glabella union usually dominate the vegetative cover.

Dense stands of shrubs and large forbs occupy the bottom portions of south and southwest-facing snowslide corridors. In general, the shrub-forb thickets in the lowest layer consist of several species common to all slides on these exposures. The actual dominance of the different plants was not determined; however, it was apparent that Alnus sinuata and Rhamnus alnifolia are the predominant species. Pteridium aquilinum also occurs in dense aggregations on some slide areas. Other species scattered through the Rhamnus-Alnus-Pteridium thickets of the bottom layer include: Angelica arguta, A. dawsoni, Bromus carinatus, Epilobium angustifolium, Heracleum lanatum, Lonicera spp., Osmorhiza occidentalis, Ribes inerme, Rubus idaeus var. strigosus, Salix spp., Symphoricarpos spp., Urtica lyallii, and Veratrum viride. Populus tremuloides was observed on one avalanche path.

The arrangement of additional layers varies. Some slide areas possess a belt of Salix spp. immediately above the first shrub-forb layer. Others possess an Alnus sinuata layer above a bottom layer dominated by Rhamnus alnifolia. One slide located along Coal Creek Road had three successive shrub-forb layers dominated respectively by Rhamnus alnifolia, Salix spp., and Alnus sinuata. Although certain associated forbs were common to each of the layers, the large shrub species dominating the physiognomy were arranged into three distinct belts, one above the other.

The narrow, upper portions of snowslide areas are usually more

steeply inclined than the lower portions which fan out in valley bottoms. The vegetative cover on these sites contains representatives of the Agropyron spicatum, Symphoricarpos sp., and Xerophyllum tenax unions.

Creek Bottoms

Creek bottom vegetation, as it occurs in the spruce-fir zone, varies considerably from one habitat type to another. In addition, stream size apparently has some influence on this type of vegetation. Small streams are often shaded by the forest canopy, and in this case the plant cover is comprised mainly of representatives of the subordinate union native to the adjacent habitat type. Wide streams create openings in the forest canopy and thus provide conditions in which additional sun-tolerant species survive.

The influence of stream width is clearly demonstrated in the Picea-Abies/Pachistima habitat type, especially where the forest is dense. Banks of small streams in this type are vegetated mainly by species belonging to the Pachistima union. Exceptions to this rule include those creek bottoms in which Oplopanax horridum and Alnus spp. comprise most of the cover. Wide streams, such as Big Creek and Coal Creek, are bordered by a number of shrub and tree species: Alnus tenuifolia, Cornus stolonifera, Populus trichocarpa, Rhamnus alnifolia, Ribes lacustre, and Salix spp. Commonly associated with these are: Aster spp., Elymus glaucus, Equisetum arvense, E. hyemale var. californicum, Heracleum lanatum, and some representatives of the Pachistima union; Cornus canadensis, Galium triflorum, Linnaea borealis var. americana, and Pachistima myrsinites.

Stream terraces in the Picea-Abies/Xerophyllum habitat type are not strongly shaded by trees. Thickets of Alnus spp. commonly extend along the banks of streams in this type. The herbaceous vegetation, which develops between the alder stands and the water's edge, usually consists of various combinations of the following species: Angelica arguta, A. dawsoni, Elymus glaucus, Heracleum lanatum, Mitella spp., Senecio triangularis, Veratrum viride, Mimulus guttatus, M. lewisii, Osmorhiza occidentalis, Parnassia fimbriata, and Epilobium spp.

Most of the streams in the Picea-Abies/Menziesia habitat type are narrow because they are situated close to their source. Thickets of Menziesia glabella comprise most of the bank cover. Additional species, if present, may grow in the actual stream bed; these include Angelica dawsoni, Arnica spp., Parnassia fimbriata, Senecio triangularis, Tiarella unifoliata, and Veratrum viride.

Roadsides

The construction of logging roads has resulted in the establishment of bare areas open to invasion by both native and exotic plants. Many of the native components have invaded from the vegetation types adjacent to the roads. Exotic species, such as Agropyron repens, Agrostis alba, Capsella bursa-pastoris, Cirsium spp., Phleum pratense, Poa pratensis, Plantago major, Taraxacum officinale, and Trifolium spp., are common on road shoulders in the Picea-Abies/Pachistima habitat type. Combined with these are native plants which apparently thrive where soil is disturbed: Agrostis scabra, Anaphalis margaritacea, Bromus carinatus, Deschampsia elongata, Epilobium spp., Equisetum spp., Fragaria spp., Rubus parviflorus, and Solidago spp.

Plantago major, Poa pratensis, Taraxacum officinale, and Trifolium repens tolerate highly-compacted soil and may grow in close proximity to the tire tracks of motor vehicles. Equisetum arvense occurs in dense patches on some road shoulders, especially on sites characterized by coarse-textured soil and high moisture availability.

The roadside flora in the higher habitat types consist mainly of native species. Arnica latifolia is a common roadside forb in the Picea-Abies/Menziesia habitat type. In the Picea-Abies/Xerophyllum type, Campanula rotundifolia, Epilobium angustifolium, and Lupinus sp. are among species that migrate onto road shoulders.

Logged Areas

Logging activities were initiated on the study area about 17 years prior to the beginning of this study. A policy of clear-cutting has resulted in the creation of numerous openings, nearly all of which occur in the Picea-Abies/Menziesia and Picea-Abies/Pachistima habitat types.

The clear-cut areas are occupied by various native and exotic species. Fireweed (Epilobium angustifolium) is very common on most of the logged sites. The burning of brush may be responsible for the abundance of this seral species. Other plants which apparently increase in abundance as a result of logging activities include: Anaphalis margaritacea, Carex spp., other species of Epilobium, Rubus idaeus var. strigosus, and Sambucus melanocarpa.

FOOD HABITS METHODS

Scat Collection

Since foolproof methods were unavailable, no attempt was made to differentiate between grizzly bear and black bear scats. Population data obtained by Charles Jonkel (pers. comm.) indicate that the ratio of black bears to grizzlies in the Big Creek drainage was approximately 104 to 4 (26:1) at the time of the food habits study. These population data, plus the fact that the recorded grizzlies may have been transient animals, suggest that very few, if any, grizzly bear scats are represented in the fecal collections.

Scat collection routes were selected during June and July, 1959. All of the maintained logging roads on the study area and most of the trails occurring in the Big Creek drainage were investigated, and permanent routes selected. It was necessary to discontinue the use of trails overgrown with brush, since the accurate dating of scats deposited on these was difficult. The permanent scat collection route consisted of about 70 miles of logging road and 50 miles of foot trail.

Early spring scats were gathered for the first time in May or June. The only scats noted to persist through the fall and winter months were those consisting largely of the seed coats of Pinus albicaulis and such feces could not be mistaken for ones deposited in the spring. Following the initial collection, trails and roads were cleared at approximately 2-week intervals. Estimated dates of deposition, based upon degree of scat desiccation, were made whenever possible. Scats occurring off collection routes were collected if

they appeared to have been recently deposited. Accurately dated feces were taken at trapsites. To avoid overemphasis of particular food items, the several defecations of a trapped animal were lumped into one fecal unit. If several bears occupied a trapsite, e. g., an adult female with cubs, an equivalent number of fecal units was created. Fresh scats were retained in muslin bags prior to drying or analysis. A total of 815 scats and 4 stomach samples was collected.

Preservation of Scats

It was noted that fresh bear droppings deteriorate rapidly. Scats containing fruit remains were often disturbed by birds and rodents prior to collection. In addition, live insects entered the fecal material and fed upon the digested and undigested food remnants. The insects commonly encountered include maggots (Diptera), hister beetles (Histeridae), and scavenger beetles (Silphidae). To preserve droppings it was necessary to dry them soon after collection. During clear weather this was accomplished by spreading the scats on boards in the sun. Feces were also dried indoors by placing them on a wire grate above a single-burner Coleman camp stove. Dry scats were stored in muslin, cheesecloth, and paper bags. During the summer of 1960, bear droppings were analyzed in a field laboratory within a few days after collection, and therefore no attempt was made to dry them.

Scat Analysis

Both dried and fresh scats were soaked in water prior to analysis. They were placed in containers, covered with water, and allowed to stand for a period of 1 to 12 hours, depending on the nature of the

food remains present. The soaking procedure was conducted to render the fecal material pliable. When facilities were available, the soaked scats were placed upon a fine-meshed strainer (No. 60 mesh) and washed in a stream of tap water. In the field laboratory, feces could not be washed as described. The water was merely drained from the soaking containers before analysis.

The saturated scats were placed on a dissecting board covered with sheets of paper toweling. A Petri dish of water was used for floating herbaceous remains. Macroscopic examination of the fecal contents was accomplished by spreading the material to a depth of about one-quarter inch. Items such as berries, seeds, and insects could usually be identified without the use of a microscope. Herbaceous and floral remains were placed on the glass platform of a binocular dissecting microscope and carefully separated and unfolded with two BB forceps. Microscopic examination of small samples of fecal material was continued until it was felt that all food items present had been identified. About one hour was required to analyze each scat.

Actual volumetric contents were not calculated. Five estimate of volume categories were chosen: 100 to 75 per cent, 75 to 50 per cent, 50 to 25 per cent, 25 to 5 per cent, and 5 per cent to trace. Occurrences of food item remains in scats were rated in terms of these. This method was utilized by Clark (1957) for analysis of Kodiak bear scats. An ocular estimate of volume was conducted for the following reasons: 1. Bird and rodent feeding had altered the volumetric contents of scats prior to collection; 2. Feces scattered over the ground could not be collected in entirety; 3. Volumetric analysis by more

precise means would have been extremely time consuming; 4. The relative amounts of digested food material in a scat are not indicative of the amounts of food initially consumed by the animal. Occurrences and volumetric estimates were entered on Unisort Analysis cards.

Reference collections of plants, seeds, and small mammals were compiled. These were used for comparative purposes during scat analysis. Unknown items taken from bear scats were bottled in formalin solution, and additional occurrences of each were recorded. During the second summer of field work most of the unknowns were identified.

Genera represented by more than one species presented a problem. The seeds of Ribes were not readily classified; however, each Ribes species possessed diagnostic exocarp and inflorescence characteristics that were utilized for identification purposes. It was necessary to magnify the seeds of Lonicera for species recognition. Seeds of Disporum, Prunus, Rosa, Smilacina, Sorbus, Symphoricarpos, and Vaccinium were usually identified only to genus level.

Nearly all herbaceous remains were examined with the dissecting scope. Leaf venation pattern and the presence of characteristic trichomes made possible the identification of Angelica arguta, A. dawsoni, Heracleum lanatum, Hieracium spp., Hydrophyllum capitatum, and Osmorhiza spp. The stems of Equisetum with nodal joints and whorls of scale-like leaves were easily distinguished. Leaves of Trifolium passed through the black bear digestive tract with little physical alteration. The presence of stipules and tendrils made possible the initial identification of Vicia americana remains. Grasses, sedges, and rushes were separated on the basis of culm, leaf and floral differences. Fern

(Polypodiaceae) occurrences varied seasonally. Spring remains were characterized by the presence of small brown scales that are prominent on fern stipes in early stages of sporophyte development. Later, in the summer, fall, and late fall periods, pinnule, rachis and rachilla fragments were found in scats.

The blossoms of Menziesia glabella and Vaccinium spp. were distinct when magnified. Dandelion heads (Taraxacum officinale) were often intact and recognizable. If not, examination of the pappus and rough achenes of this species aided in identification. No remains of Agoseris spp. were identified in scats. The blossoms of Hydrophyllum capitatum were occasionally found among the vegetative remains of that plant.

Mammal hairs were retained and identified using a key to the dorsal guard hairs of California mammals (Mayer, 1952) and mammal hairs mounted on microscope slides. Known and unknown hairs were compared on a binocular dissecting microscope.

Presentation of Findings

The period of black bear feeding activity was divided into four temporal units: spring (emergence from hibernation through June 30), summer (July 1 through August 15), fall (August 16 through September 25), and late fall (September 26 to approximately the beginning of hibernation). These units were chosen on the basis of seasonal changes in feeding behavior. Actually, the dates delimiting the beginning and end of hibernation are not well-defined. Scats deposited after spring emergence were found when trails were initially cleared in June. Those representing the period immediately prior to the beginning of hibernation are lacking in the analysis since snowfall terminated scat

collection before bear activity ceased in the autumn.

Analysis of the scats collected during each of the periods in 1959 and 1960 is presented in tabular form. Frequency of occurrence or frequency index is calculated for the food items. In addition, the number of occurrences of each item in the five volumetric categories is presented. Plant foods are grouped according to the manner in which they usually appeared in fecal material.

SEASONAL FOOD HABITS

Spring Food Habits

The analysis of spring scats is presented in Tables III and IV. Vegetative material formed the bulk of spring food remains. Grasses (Gramineae) led the list both years, occurring with a frequency of 76.3 per cent in 1959 and 69.8 per cent in 1960. Angelica dawsoni dropped from a frequency index of 48.1 in 1959 to 30.2 in 1960; however, volumetric estimates indicate that this forb comprised considerable bulk of both years' collections. Though Osmorhiza spp. appeared frequently in 1959 as well as 1960, most occurrences were at the trace level. Equisetum spp. was represented in 37.8 per cent of the spring scats in 1959 and in 43.0 per cent in 1960. Heracleum lanatum appeared more frequently and in larger volumetric amounts in 1960. Collection of feces in the southeastern corner of the study area was accompanied by increased occurrence of Lomatium simplex and Vicia americana during the second year of the study. Clover (Trifolium spp.) and dandelions (Taraxacum officinale) occurred frequently both years, demonstrating the influence of roadside vegetation on the spring food habits of black bears.

In terms of volume of blossoms consumed, Indian paintbrush (Castilleja spp.) ranked second to dandelions in 1959 and 1960.

Trace occurrences of the seeds of Amelanchier alnifolia, Arctostaphylos uva-ursi, and Lonicera involucrata indicate the consumption of green fruit in early spring and the consumption of fruit that

Table III. Food remains identified in 156 black bear scats deposited in the Whitefish Range, spring*, 1959

Items Identified	Occurrences/Volumetric Category					Frequency Index
	100-75	75-50	50-25	25-5	5-Tr.	
Plant Remains						
Mainly stems & leaves						
Gramineae	21	9	16	19	54	76.3
Angelica dawsoni	6	3	11	18	37	48.1
Osmorhiza spp.	1	1	10	17	42	45.5
Equisetum spp.	14	4	5	14	22	37.8
Trifolium spp.	5	3	5	8	29	32.1
Heracleum lanatum	5	5	8	14	15	30.1
Cyperaceae	4	1	5	5	22	23.7
Polypodiaceae	5	1	4	3	5	11.5
Angelica arguta	-	1	4	1	11	10.9
Hieracium spp.	3	-	2	1	7	8.3
Unidentified forbs	-	-	-	2	7	5.8
Unidentified monocots	1	-	-	3	1	3.2
Rubus parviflorus	2	-	1	-	1	2.6
Hydrophyllum capitatum	-	-	-	1	2	1.9
Lomatium simplex	-	-	1	1	-	1.3
Juncaceae	-	1	-	-	-	0.6
Mainly blossoms						
Taraxacum officinale	7	3	5	9	23	30.1
Vaccinium spp.	-	-	-	2	12	9.0
Castilleja spp.	8	-	-	-	2	6.4
Menziesia glabella	-	-	-	-	2	1.3
Unidentified blossoms	-	-	-	-	1	0.6
Animal Remains						
Formicidae	-	-	-	2	55	36.5
Cervidae	1	-	-	1	6	5.2
Citellus columbianus	-	-	-	-	1	0.6
Coleoptera	-	-	-	-	1	0.6
Dermacentor andersoni	-	-	-	-	1	0.6
Unidentified bone	-	-	-	-	1	0.6
Miscellaneous Remains						
Debris	-	-	1	5	120	80.8
Garbage	-	-	-	3	2	3.2
Conifer cambium (Abies)	-	-	-	1	1	1.3
Abies lasiocarpa (buds)	1	-	-	-	-	0.6
Lonicera involucrata (seed)	-	-	-	-	1	0.6

*Emergence from hibernation through June 30

Table IV. Food remains identified in 149 black bear scats deposited in the Whitefish Range, spring, 1960

Items Identified	Occurrences/Volumetric Category					Frequency Index
	100-75	75-50	50-25	25-5	5-Tr.	
Plant Remains						
Mainly stems & leaves						
Gramineae	22	10	13	14	45	69.8
Osmorhiza spp.	3	1	3	16	61	56.4
Heracleum lanatum	11	7	4	15	32	46.3
Equisetum spp.	8	5	7	9	35	43.0
Angelica dawsoni	10	2	6	10	17	30.2
Cyperaceae	-	1	3	1	37	28.2
Hieracium spp.	2	1	2	9	27	27.5
Angelica arguta	2	1	3	6	26	25.5
Trifolium spp.	4	2	3	5	12	17.4
Lomatium simplex	1	1	3	6	14	16.8
Unidentified forbs	1	-	1	4	13	12.8
Vicia americana	1	-	2	3	4	6.7
Polypodiaceae	1	-	2	-	6	6.0
Hydrophyllum capitatum	-	-	-	1	8	6.0
Unidentified monocots	-	-	-	-	6	4.0
Juncaceae	1	-	1	-	-	1.3
Lomatium montanum	-	-	-	-	1	0.7
Mainly blossoms						
Taraxacum officinale	8	3	3	6	36	37.6
Castilleja spp.	9	4	4	3	11	20.8
Vaccinium spp.	-	-	1	3	16	13.4
Unidentified blossoms	-	-	-	-	2	1.3
Mainly fruit & seeds						
Amelanchier alnifolia	-	-	-	-	1	0.7
Arctostaphylos uva-ursi	-	-	-	-	1	0.7
Lonicera involucrata	-	-	-	-	1	0.7
Animal Remains						
Formicidae	-	-	-	1	68	46.3
Cervidae	1	-	-	1	7	6.0
Unidentified bone	-	-	-	-	8	5.4
Ursus americanus (cub)*	-	1	-	-	-	0.7
Ursus americanus (preenings?)	-	-	-	1	2	2.0
Coleoptera	-	-	-	-	1	0.7
Miscellaneous Remains						
Debris	-	-	1	1	106	72.5
Garbage	-	1	-	-	3	2.7

*Claws, hair, and bone remains comprised this occurrence.

had persisted through the winter months.

Members of the family Formicidae led the list of animal remains, occurring with a frequency of 36.5 per cent in 1959 and 46.3 per cent in 1960. Cervid remains ranked second both years. Most cervid occurrences were at the trace level and probably did not represent predation. In general, mammal occurrences other than the Cervidae were rare. Remains of a black bear cub were identified in the spring of 1960.

Early in the spring periods (April and May) much of the study area was snow-covered. Black bear food items, mainly forbs, grasses, and sedges, were first available in dry mountain meadows and in the Picea-Abies/Pachistima habitat type between elevations of about 3,800 and 4,500 feet. Roadsides in this habitat type were frequented by feeding bears in the spring. Many of the large forbs were available on stream banks at this elevation. Likewise, spring feeding sites were observed in creek bottoms located in the Picea-Abies/Xerophyllum habitat type. Evidence of feeding activity was noted in south-facing snowslide areas. Castilleja hispida blossoms and several herbaceous foods, including Agropyron spicatum, were taken in the Pseudotsuga menziesii type.

Summer Food Habits

There was no sharp transition between the spring and summer food habits. Until mid-July, when the various fruits began to mature, bears continued to feed on the major spring forbs (Tables V and VI). Heracleum lanatum ranked first in the forb category, occurring with a frequency of 54.6 per cent in 1959 and 49.6 per cent in 1960. Equisetum spp. ranked second both years, occurring in 36.8 per cent of the scats in 1959 and in 44.4 per cent in 1960. Gramineae appeared frequently; however, most

TABLE V. FOOD REMAINS IDENTIFIED IN 163 BLACK BEAR SCATS DEPOSITED IN THE WHITEFISH RANGE, SUMMER*, 1959

ITEMS IDENTIFIED	OCCURRENCES/VOLUMETRIC CATEGORY					FREQUENCY INDEX
	100-75	75-50	50-25	25-5	5-TR.	
PLANT REMAINS						
MAINLY STEMS & LEAVES						
HERACLEUM LANATUM	36	7	7	22	17	54.6
EQUISETUM SPP.	9	5	4	9	33	36.8
GRAMINEAE	7	1	3	11	33	33.7
ANGELICA DAWSONI	7	5	3	11	27	32.5
OSMORHIZA SPP.	1	-	3	7	26	22.7
ANGELICA ARGUTA	2	-	-	6	15	14.1
TRIFOLIUM SPP.	1	-	6	3	11	12.9
UNIDENTIFIED FORBS	-	-	-	3	18	12.9
POLYPODIACEAE	1	-	1	2	10	8.6
CYPERACEAE	-	-	-	3	8	6.7
HIERACIUM SPP.	-	1	-	-	3	2.5
JUNCACEAE	-	-	-	1	2	1.8
UNIDENTIFIED MONOCOTS	-	-	-	1	2	1.8
HYDROPHYLLUM CAPITATUM	-	-	-	-	2	1.2
RUBUS PARVIFLORUS	-	-	1	-	-	0.6
MAINLY BLOSSOMS						
TARAXACUM OFFICINALE	-	-	1	3	13	10.4
MENZIESIA GLABELLA	3	2	-	2	3	6.1
CASTILLEJA SPP.	2	1	1	1	2	4.3
VACCINIUM SPP.	2	-	-	-	5	4.3
MAINLY FRUIT & SEEDS						
VACCINIUM SPP.	31	1	-	10	22	39.3
LONICERA INVOLUCRATA	2	-	-	9	25	22.1
AMELANCHIER ALNIFOLIA	-	-	-	1	8	5.5
ELAEAGNUS CANADENSIS	-	-	-	-	5	3.1
LONICERA UTAHENSIS	-	-	-	-	5	3.1
ARCTOSTAPHYLOS UVA-URSI	-	-	-	-	4	2.5
CORNUS STOLONIFERA	-	-	-	-	3	1.8
UNIDENTIFIED SEEDS	-	-	-	-	3	1.8
OPLOPANAX HORRIDUM	-	-	-	-	2	1.2
RUBUS SPP.	-	-	-	-	2	1.2
STREPTOPUS AMPLEXIFOLIUS	-	-	-	-	1	0.6
ANIMAL REMAINS						
FORMICIDAE	-	-	-	9	97	65.0
BOMBIDAE	-	-	-	1	15	9.8
VESPIDAE	-	-	-	-	10	6.1
COLEOPTERA	-	-	-	-	4	2.5
CERVIDAE	-	1	-	-	2	1.8
DIPTERA	-	-	1**	-	1	1.2
BIRD (PASSERINE)	-	-	1	-	-	0.6
UNIDENTIFIED BONE	-	-	-	-	1	0.6
UNIDENTIFIED MAMMAL	-	-	-	-	1	0.6
MISCELLANEOUS REMAINS						
DEBRIS	3	1	6	13	109	81.0
GARBAGE	-	1	-	2	5	4.9
CONIFER CAMBIUM (ABIES)	1	1	-	1	-	1.8

*JULY 1 THROUGH AUGUST 15
**MAGGOTS CONSUMED WITH CARRION

Table VI. Food remains identified in 134 black bear scats (and one stomach sample) deposited in the Whitefish Range, summer, 1960

Items Identified	Occurrences/Volumetric Category					Frequency Index
	100-75	75-50	50-25	25-5	5-Tr.	
Plant Remains						
Mainly stems & leaves						
Heracleum lanatum	17	14	9	12	15	49.6
Equisetum spp.	7	4	7	9	33	44.4
Osmorhiza spp.	3	2	2	4	43	40.0
Angelica dawsoni	9	4	5	14	20	38.5
Gramineae	-	-	6	4	39	36.3
Angelica arguta	1	1	4	11	22	28.8
Polypodiaceae	-	1	-	1	14	11.9
Trifolium spp.	-	-	1	1	11	9.6
Unidentified forbs	-	-	-	1	11	8.8
Hieracium spp.	-	1	-	-	8	6.6
Unidentified monocots	-	-	-	-	6	4.4
Juncaceae	-	1	-	-	4	3.7
Cyperaceae	-	-	-	-	4	3.0
Hydrophyllum capitatum	1	-	-	-	1	1.5
Vicia americana	-	-	-	1	-	0.7
Mainly blossoms						
Taraxacum officinale	-	1	2	-	13	11.9
Castilleja spp.	2	-	-	1	5	5.9
Vaccinium spp.	-	-	-	-	3	2.2
Menziesia glabella	-	-	1	-	-	0.7
Mainly fruit & seeds						
Vaccinium spp.	24	5	4	5	22	44.4
Lonicera involucrata	1	1	2	4	24	23.7
Amelanchier alnifolia	10	-	1	5	13	21.5
Elaeagnus canadensis	2	-	1	-	12	11.1
Cornus stolonifera	-	-	-	-	2	1.5
Fragaria spp.	-	-	-	-	2	1.5
Lonicera utahensis	-	-	-	-	2	1.5
Ribes inerme	-	-	-	-	2	1.5
Ribes lacustre	-	-	-	-	2	1.5
Unidentified seeds	-	-	-	-	2	1.5
Pinus albicaulis	-	-	-	-	1	0.7
Animal Remains						
Formicidae	-	1	-	5	67	54.1
Cervidae	-	-	-	3	3	4.4
Bombidae	-	-	-	-	4	3.0
Vespidae	-	-	-	-	2	1.5
Coleoptera	-	-	-	-	1	0.7
Egg shells (bird)	-	-	-	-	1	0.7
Unidentified mammal	-	-	-	-	1	0.7
Miscellaneous Remains						
Debris	-	1	4	9	79	68.9
Garbage	-	-	-	-	4	3.0
Conifer cambium (Abies)	1	-	-	-	-	0.7

grass occurrences were at the trace level. This was true of Osmorhiza spp. which rose from a frequency index of 22.7 in 1959 to 40.0 in 1960. Angelica dawsoni remains occurred respectively in 32.5 per cent and 38.5 per cent of the scats in 1959 and 1960. The top five positions in the stem and leaf category were held by the same species both years.

Blossom consumption was low during the summer period. Taraxacum officinale occurrences were nearly identical both years, but Menziesia glabella dropped from a frequency index of 6.1 in 1959 to 0.7 in 1960.

In the fruit and seed category Vaccinium spp. ranked first each year. This genus occurred with a frequency of 39.3 per cent in 1959 and 44.4 per cent in 1960. Lonicera involucrata was next in order, occurring respectively in 22.1 and 23.7 per cent of the summer feces. Amelanchier alnifolia rose from 5.5 per cent occurrence in 1959 to 21.5 per cent in 1960. This increase in frequency was also accompanied by increased volumetric occurrence. Elaeagnus canadensis appeared more frequently in the second year.

Insect remains were represented in over half of the summer droppings. Formicidae occurred in 65.0 per cent of the 1959 scats and 54.1 per cent of the 1960 scats. Both Bombidae and Vespidae declined in occurrence in 1960.

Remains of a juvenile cervid in 1960 were among the few mammal remains identified.

Conifer cambium belonging to the genus Abies appeared three times in 1959 and once in 1960. Cambium consumption apparently terminated in late July or early August.

Summer feeding activity continued on several vegetation types

frequented by bears in the spring; however, the disappearance of snow permitted feeding at all altitudes. Moist sites at low elevation provided a source of herbaceous foods during the summer. As the plants found on dry mountain meadows began to wither during the first two weeks of July, there was subsequent decline in the occurrence of these in bear scats. Palatable Castilleja hispida was available on dry mountain meadows and in the Pseudotsuga menziesii type until about the middle of July, but consumption of this species had nearly terminated by the end of June. Creek bottoms in the Picea-Abies/Pachistima and Picea-Abies/Xerophyllum habitat types provided a source of the large umbellifers that occurred frequently in summer scats. Several of the same species were also available in the lower shrub-herb communities of south-facing snowslide areas and in wet mountain meadows. Minor feeding activities continued on roadsides. Remains of Angelica dawsoni comprised the bulk of early summer scats collected in the timberline type, suggesting that this was the main forb taken at high elevations during the month of July. This species may have been taken in clearings in the Picea-Abies/Menziesia association. Most of the berries eaten by bears during the summer period were in seral and climax forest stands located in the Picea-Abies/Pachistima habitat type.

Fall Food Habits

Results of the analysis of fall scats are presented in Tables VII and VIII. The fall diet consisted mainly of berries and pine-nuts; however, several herbaceous foods occurred frequently, especially in scats collected in and near the timberline type.

In the fruit and seed category Vaccinium spp. led the list both

Table VII. Food remains identified in 69 black bear scats (and one stomach sample) deposited in the Whitefish Range, fall*, 1959

Items Identified	Occurrences/Volumetric Category					Frequency Index
	100-75	75-50	50-25	25-5	5-Tr.	
Plant Remains						
Mainly fruit & seeds						
Vaccinium spp.	31	3	3	5	24	94.3
Pinus albicaulis	4	-	1	8	9	31.4
Ribes lacustre	2	-	-	1	12	21.4
Amelanchier alnifolia	1	-	-	-	13	20.0
Lonicera involucrata	-	-	-	-	11	15.7
Cornus stolonifera	1	-	1	2	4	11.4
Oplopanax horridum	-	-	-	2	6	11.4
Streptopus amplexifolius	-	-	-	-	6	8.6
Lonicera utahensis	-	-	-	-	4	5.7
Sorbus spp.	1	-	-	1	1	4.3
Rubus parviflorus	-	-	-	-	3	4.3
Sambucus melanocarpa	-	-	-	-	2	2.9
Crataegus douglasii	1	-	-	-	-	1.4
Rhamnus alnifolia	-	-	-	-	1	1.4
Mainly stems & leaves						
Angelica dawsoni	7	2	-	3	8	28.6
Gramineae	-	-	-	1	9	14.3
Equisetum spp.	2	-	-	1	6	12.9
Juncaceae	3	-	-	1	4	11.4
Unidentified forbs	-	-	1	-	5	8.6
Angelica arguta	-	-	-	5	-	7.1
Heracleum lanatum	2	1	-	-	1	5.7
Polypodiaceae	-	1	-	-	2	4.3
Cyperaceae	-	-	-	-	1	1.4
Osmorhiza spp.	-	-	-	-	1	1.4
Animal Remains						
Formicidae	-	-	-	4	30	48.6
Vespidae	-	-	-	-	7	10.0
Coleoptera	-	-	-	-	2	2.9
Bird (Passerine)	-	-	-	1	-	1.4
Bombidae	-	-	-	-	1	1.4
Cricetidae	-	-	-	-	1	1.4
Miscellaneous Remains						
Debris	3	2	1	4	51	87.1

*August 16 through September 25

TABLE VIII. FOOD REMAINS IDENTIFIED IN 85 BLACK BEAR SCATS (AND ONE STOMACH SAMPLE) DEPOSITED IN THE WHITEFISH RANGE, FALL, 1960

ITEMS IDENTIFIED	OCCURRENCES/VOLUMETRIC CATEGORY					FREQUENCY INDEX
	100-75	75-50	50-25	25-5	5-TR.	
PLANT REMAINS						
MAINLY FRUIT & SEEDS						
VACCINIUM SPP.	14	5	3	3	31	65.1
AMELANCHIER ALNIFOLIA	3	2	1	1	28	40.7
CORNUS STOLONIFERA	15	3	3	4	8	38.4
RIBES LACUSTRE	-	-	-	3	25	32.6
SORBUS SPP.	1	2	3	2	19	31.4
PINUS ALBICAULIS	6	1	4	3	11	29.1
RHAMNUS ALNIFOLIA	3	-	1	-	13	19.8
STREPTOPUS AMPLEXIFOLIUS	-	-	-	-	11	12.8
OPLOPANAX HORRIDUM	-	-	-	1	8	10.5
SMILACINA SPP.	1	-	-	-	3	4.7
LONICERA INVOLUCRATA	-	-	-	-	4	4.7
UNIDENTIFIED SEEDS	-	-	-	-	4	4.7
ROSA SPP.	-	-	-	-	3	3.5
RUBUS PARVIFLORUS	-	-	-	-	2	2.3
SYMPHORICARPOS SPP.	-	-	-	-	2	2.3
ARALIA NUDICAULIS	-	-	-	-	1	1.2
ARCTOSTAPHYLOS UVA-URSI	-	-	-	-	1	1.2
BERBERIS REPENS	-	-	-	-	1	1.2
CRATAEGUS DOUGLASII	-	-	-	-	1	1.2
PRUNUS SPP.	-	-	-	-	1	1.2
MAINLY STEMS & LEAVES						
ANGELICA DAWSONI	6	2	2	5	27	48.8
POLYPODIACEAE	1	1	1	7	14	27.9
GRAMINEAE	-	-	-	1	21	25.6
JUNCACEAE	5	1	4	1	8	22.1
HERACLEUM LANATUM	-	-	1	1	16	20.9
OSMORHIZA SPP.	-	-	-	2	16	20.9
EQUISETUM SPP.	1	1	-	1	14	19.8
ANGELICA ARGUTA	-	-	2	3	6	12.8
TRIFOLIUM SPP.	-	-	-	-	8	9.3
UNIDENTIFIED FORBS	-	-	1	-	6	8.1
CYPERACEAE	-	-	-	1	1	2.3
UNIDENTIFIED MONOCOTS	-	-	-	1	1	2.3
TARAXACUM OFFICINALE	-	-	-	1	-	1.2
VICIA AMERICANA	-	-	-	1	-	1.2
HIERACIUM SPP.	-	-	-	-	1	1.2
LATHYRUS OCHROLEUCUS	-	-	-	-	1	1.2
ANIMAL REMAINS						
FORMICIDAE	-	-	-	-	23	26.7
CERVIDAE	-	-	-	1	1	2.3
BIRD (UNIDENTIFIED)	-	-	-	-	1	1.2
CITELLUS LATERALIS	-	-	-	-	1	1.2
EUTAMIAS RUFICAUDUS	-	-	-	-	1	1.2
MISCELLANEOUS REMAINS						
DEBRIS	-	-	-	-	33	38.4
GARBAGE	-	-	-	-	1	1.2
TARAXACUM (BLOSSOMS)	-	-	-	-	1	1.2

years, occurring with a frequency of 94.3 per cent in 1959 and 65.1 per cent in 1960. Pinus albicaulis nuts were represented in 31.4 per cent of the 1959 fall scats and 29.1 per cent of those from 1960. Ribes lacustre appeared frequently both years, but most occurrences of this species were at the trace level. Amelanchier alnifolia rose from a frequency index of 20.0 in 1959 to 40.7 in 1960. The increased occurrences of Cornus stolonifera, Sorbus spp., and Rhamnus alnifolia in 1960 were also notable. C. stolonifera occurred with a frequency of 11.4 per cent in 1959 and 38.4 per cent in 1960. Likewise, Sorbus spp. increased from 4.3 to 31.4 per cent in the respective years and R. alnifolia from a frequency index of 1.4 in 1959 to 19.8 in 1960.

In the stem and leaf category Angelica dawsoni ranked first. This forb occurred with a frequency of 28.6 per cent in 1959 and 48.8 per cent in 1960. Polypodiaceae was represented respectively in 4.3 and 27.9 per cent of the scats. An increased occurrence of Gramineae was noted in 1960, but this was mainly in the low volumetric categories and is probably insignificant. Juncaceae, primarily Luzula glabrata, ranked fourth in this section each year, occurring in 11.4 per cent of the 1959 scats and 22.1 per cent of those from 1960. A number of additional herbaceous foods eaten in the spring and summer appeared in scats from the fall periods.

Insects occurred less frequently in the fall than in the summer. The cool, humid weather conditions which began about August 20 may have reduced insect availability. Formicidae continued to hold first place in the animal category, occurring with a frequency of 48.6 per cent in 1959 and 26.7 per cent in 1960. Vespidae and Bombidae were identified

in scats from 1959; however, neither of these occurred in 1960. There were minor bird and mammal occurrences during the fall periods.

Black bears fed over most of the study area in the fall. Pinus albicaulis, Angelica dawsoni, Luzula glabrata, and Ribes lacustre were taken mainly above 6,000 feet in or near the timberline type. Forbs, grasses, and possibly ripe huckleberries were available in the Picea-Abies/Menziesia association; however, there was little evidence of bear feeding activity in this vegetation type. Huckleberries were apparently most abundant in the Picea-Abies/Pachistima and Picea-Abies/Xerophyllum habitat types during the fall period. The fruits of Cornus stolonifera and Rhamnus alnifolia were available on the banks of wide streams located in the Picea-Abies/Pachistima habitat type. Snowslide areas provided a source of Rhamnus alnifolia, Symphoricarpos spp., and several forbs. Amelanchier alnifolia and most of the minor fruits, forbs, and grasses were found in seral and climax forests in the Picea-Abies/Pachistima habitat type.

Late Fall Food Habits

The late fall of 1959 was represented by only five scats (Table IX). Three of these were deposited by an adult female and two cubs that were observed feeding on moose carrion during the first week of October. The need for recognizing a late fall period became more evident in 1960. During this year mild weather prevailed through October, and bears apparently hibernated later. Because of the change in food habits after September 25, the late fall scats were grouped separately. This permitted a more equivalent comparison between the fall periods of 1959 and 1960.

Table IX. Food remains identified in five black bear scats deposited in the Whitefish Range, late fall*, 1959

Items Identified	Occurrences/Volumetric Category					Frequency Index
	100-75	75-50	50-25	25-5	5-Tr.	
Plant Remains						
Mainly fruit & seeds						
Sorbus spp.	1	-	-	-	3	80.0
Vaccinium spp.	1	-	-	-	1	40.0
Amelanchier alnifolia	-	-	-	-	1	20.0
Cornus stolonifera	-	-	-	-	1	20.0
Mainly stems & leaves						
Equisetum spp.	-	-	-	-	1	20.0
Animal Remains						
Cervidae (moose carrion)**	-	2	-	1	-	60.0
Miscellaneous Remains						
Debris	-	-	3	-	-	60.0
Unidentified material	-	-	-	1	-	20.0

* September 26 to approximately the beginning of hibernation
**Remains from hunter kill

In 1960 Sorbus spp. berries occurred in 92.7 per cent of the late fall droppings (Table X). Remains of this fruit comprised 75 to 100 per cent of the volume of 31 of the 54 scats and one stomach sample representing the period. Amelanchier alnifolia ranked second in the fruit and seed category, occurring with a frequency of 27.3 per cent. All service berry occurrences were at the trace level. Symphoricarpos spp. was next in order, occurring in 20.0 per cent of the scats. Smilacina spp. berries were found in 12.7 per cent of the feces. In terms of volume, Smilacina spp. ranked above the preceding two genera. Rhamnus alnifolia and Vaccinium spp. placed fifth and sixth with frequencies of 10.0 and 9.1 per cent.

In the stem and leaf category Gramineae ranked first, occurring in 54.5 per cent of the scats. Although Angelica dawsoni occurred with

Table X. Food remains identified in 54 black bear scats (and one stomach sample) deposited in the Whitefish Range, late fall, 1960

Items Identified	Occurrences/Volumetric Category 100-75	75-50	50-25	25-5	5-Tr.	Frequency Index
Plant Remains						
Mainly fruit & seeds						
Sorbus spp.	31	2	8	3	7	92.7
Amelanchier alnifolia	-	-	-	-	15	27.3
Symphoricarpos spp.	-	-	-	1	10	20.0
Smilacina spp.	3	-	-	-	4	12.7
Rhamnus alnifolia	-	-	-	1	5	10.9
Vaccinium spp.	1	-	-	-	4	9.1
Prunus spp.	-	-	-	1	2	5.5
Oplopanax horridum	-	-	-	-	3	5.5
Unidentified seeds	-	-	-	-	3	5.5
Pinus albicaulis	-	-	-	-	2	3.6
Rosa spp.	-	-	-	-	2	3.6
Arctostaphylos uva-ursi	-	-	-	-	1	1.8
Disporum spp.	-	-	-	-	1	1.8
Lonicera involucrata	-	-	-	-	1	1.8
Rubus parviflorus	-	-	-	-	1	1.8
Mainly stems & leaves						
Gramineae	1	-	1	5	23	54.5
Angelica dawsoni	1	3	5	3	10	40.0
Heracleum lanatum	-	1	-	2	5	14.5
Polypodiaceae	-	-	1	2	5	14.5
Unidentified forbs	2	1	-	-	4	12.7
Osmorhiza spp.	-	1	-	1	4	10.9
Trifolium spp.	-	-	-	1	4	9.1
Angelica arguta	-	-	-	-	5	9.1
Equisetum spp.	-	-	-	-	4	7.3
Juncaceae	1	-	-	-	1	3.6
Animal Remains						
Formicidae	-	-	-	-	2	3.6
Cucujidae (larvae)	-	-	-	-	1	1.8
Miscellaneous Remains						
Debris	-	-	-	-	4	7.3
Unidentified material*	-	-	1	-	-	1.8
Garbage	-	-	-	-	1	1.8

*Possibly mushroom remains

a frequency of only 40.0 per cent, remains of this species comprised a greater bulk of the fecal material than did grass remains. Heracleum lanatum and Polypodiaceae remains appeared in 14.5 per cent of the scats. An unidentified forb occurred in about 10 per cent of the droppings, particularly those collected on Coal Creek Road.

Animal remains were restricted to insects. There were two occurrences of Formicidae and one of Cucujidae larvae (flat bark beetles).

Unidentified material, possibly the remains of mushrooms, comprised 25 to 50 per cent of the volume of one scat.

The two species of Sorbus found on the study area are not restricted to a particular vegetation type. Sorbus spp. appeared to be most available in the Picea-Abies/Menziesia and Picea-Abies/Pachistima habitats. In general, the occurrences of minor food items imply that feeding activity in 1960 was concentrated in creek bottoms and seral and climax forest stands in the Picea-Abies/Pachistima habitat type. The supply of pine-nuts was nearly consumed by bears and other animals by September 15, so these were insignificant in the late fall diet. Likewise, the freezing of huckleberries at high elevation probably reduced feeding activity in the timberline type. The few clover occurrences were a possible indication of roadside feeding in the Picea-Abies/Pachistima habitat type. Snowslide areas and the Pseudotsuga menziesii type provided a source of Symphoricarpos spp. and Amelanchier alnifolia berries.

General Food Habits

A summary of the various classes of food identified in the black bear scats is presented in Table XI. Frequency of occurrence in the four periods of the year and in the total of 819 scats (including four stomach

Table XI. Frequency of occurrence of foods identified in 819* black bear scats collected in the Whitefish Range in 1959 and 1960

Items Identified	Spring 1959 (156)	Spring 1960 (149)	Summer 1959 (163)	Summer 1960 (135)	Fall 1959 (70)	Fall 1960 (86)	Late Fall 1959 (5)	Late Fall 1960 (55)	Totals (819)
Plant Remains									
Stems and leaves	98.7	99.3	86.5	87.4	55.7	77.9	20.0	80.0	86.9
Blossoms	35.9	47.0	18.4	14.1	0.0	1.2	0.0	0.0	21.5
Fruit and seeds	1.2	2.0	46.0	53.3	97.1	97.7	100.0	100.0	44.4
Total plants	100.0	100.0	99.4	100.0	100.0	100.0	100.0	100.0	99.9
Animal Remains									
Insects	36.5	46.3	66.3	55.5	51.4	26.7	0.0	5.5	45.3
Mammals	5.8	8.7	2.5	5.2	1.4	4.4	60.0	0.0	5.0
Birds	0.0	0.0	0.6	0.0	1.4	1.2	0.0	0.0	0.4
Other (garbage etc.)	1.3	4.7	3.7	1.5	0.0	0.0	0.0	0.0	2.1

*Four stomach samples included
Numbers in parentheses indicate the number of scats analyzed

samples) is included for each class.

A generalized breakdown of the food items shows that plant material occurred in 99.9 per cent of the scats, insects in 45.3 per cent, mammals in 5.0 per cent, and birds in 0.4 per cent.

The plant remains section is divided into three categories: stems and leaves, blossoms, and fruit and seeds. These categories comprised major subdivisions in the tables relating specific seasonal foods. Remains included under the stems and leaves heading occurred in 86.9 per cent of the 819 scats. The frequency of occurrence of these was highest in the spring and dropped gradually through the late fall period. Stem and leaf remains occurred slightly more frequently in the late fall of 1960 than they did in the fall of that year. Blossom remains also declined in occurrence after the spring period. These appeared in 35.9 per cent (1959) and 47.0 per cent (1960) of the spring scats but in none of the late fall droppings. Fruit and seed remains increased in occurrence after the spring period. This is due mainly to availability and also to the fact that fruit is probably more palatable and nutritious than herbaceous material, especially late in the growing season.

Insect occurrences reached a peak during the summer period. Remains of insects were present in 66.3 per cent of the summer scats of 1959 and 55.5 per cent of those from 1960. Occurrence of insects was also high in the spring and fall periods, but negligible in the late fall.

Mammal remains appeared with highest frequency in the spring period and early in the summer. This may have been the result of high availability of carrion and also animals in poor nutritional condition following the winter. Likewise, juvenile animals are probably vulnerable

during the months of May and June. Occurrence of bird remains was very low throughout the year.

SPECIFIC FOOD ITEMS

Amelanchier alnifolia. Service Berry

Black bears are reported to feed on the fruit of Amelanchier spp. in West Virginia (Cottam et al., 1939), New York (Shadle, 1941), Pennsylvania (Bennett et al., 1943), and Michigan (Shapton, 1956). Remains of the fruit of A. bakeri comprised 24.1 per cent of the volume of summer scats and stomach samples from Colorado (Gilbert, 1951).

The fruit of A. alnifolia was an important summer and fall food of bears on the study area. Early summer occurrences of the green fruit of this species were generally accompanied by an abundance of stem and leaf fragments. In 1959 consumption of ripe service berries was heaviest during the last two weeks of August. In 1960 ripe fruit remains appeared initially in a scat deposited on July 20, and occurrence was highest in feces deposited between about July 25 and September 15.

Angelica spp. Angelica

Clark (1957) found remains of Angelica spp. in 34.3 per cent of 140 summer and fall Kodiak bear scats examined July 1 to October 29, 1955. Kare Elgmork, a zoologist from the University of Oslo, who visited the study area in June, 1960, stated that the European brown bear feeds on angelicas found in Norway. He also mentioned that the early Vikings ate the roots of these plants, considering them a source of the strength possessed by bears. It is probable that black bears feed on representatives of this genus in other sections of western North America; however, no mention of this was found in the literature.

Two species of Angelica occur on the study area. When feeding on these, bears ate mainly stems and leaves, but floral remains were occasionally found in scats. Of the two, A. dawsoni appeared most frequently in feces. In the stem and leaf category this species ranked above fifth place throughout the study. In 1959 there was heavy use of A. dawsoni between June 15 and July 15. Frequency of occurrence declined when huckleberries ripened; however, it rose again in the middle of August when bears moved into the timberline type to feed on pine-nuts and Luzula glabrata. In 1960 spring and summer use was highest between June 20 and July 20. The period of intense fall consumption began about August 20 and prevailed through the late fall period.

A. arguta is a larger plant; however, it is less widely distributed through the various vegetation types than the above species. In 1959 consumption of this forb was highest in June and July. During the second year occurrence was highest in scats deposited between about June 20 and July 30.

Birds

Birds apparently comprise a very minor portion of the black bear diet. Cahalane (1947:140) and Murie (1954) state that bears will occasionally eat the young of low-nesting birds. Three of 25 stomachs collected in West Virginia during the late fall contained bird remains (Cottam et al., 1939). In Maine, birds occurred in scats and stomach samples with a frequency of 3.3 per cent in the spring and 0.5 per cent in the summer (Spencer, 1955). The eggs of birds may also be taken (Cahalane, 1947:140). Rowan (1928) found evidence of predation on duck eggs in northern Alberta, and Taverner (1928) reports that bears may

remove eggs from the nests of certain raptors in the Peace River region.

Bird remains occurred three times in scats collected on the study area (Appendix B). Two of the occurrences were identified to the order Passeriformes. Egg shells appeared 13 times; however, 12 of the occurrences were apparently associated with garbage consumption.

Castilleja spp. Indian Paintbrush

Gilbert (1951) included Castilleja in a list of black bear food items, but he did not describe the conditions under which this genus was consumed.

At least three species of Indian paintbrush grow on the study area (Appendix A). Field observations, the ecology of the plants involved, and digested remains in scats suggest that C. hispida is the major, if not the only species consumed by bears in this region. The bracts and blossoms of this plant are apparently very palatable. In 1959 the occurrences of Castilleja spp. were poorly dated; however, heaviest use occurred in the spring prior to June 25. In 1960 paintbrush remains occurred most frequently in scats deposited between May 20 and June 20.

Browsed paintbrush plants (C. hispida) were noted on July 14 and 24, 1959, and June 13, 30, and July 3, 1960. Feeding sites of this nature were very abundant along Trail 583 in seral stands situated on a Xerophyllum facies of the Picea-Abies/Pachistima habitat type.

Cornus stolonifera. Red Osier Dogwood

Preble (1908) reports that the fruit of C. stolonifera is a summer food of black bears in the Athabaska-Mackenzie region. Remains of other dogwood species have occurred in small amounts in scats and

stomachs from West Virginia (Cottam et al., 1939), Pennsylvania (Bennett et al., 1943), Colorado (Gilbert, 1951), and Maine (Spencer, 1955).

Remnants of the fruit of C. stolonifera were most abundant in fall scats collected on the study area. This species occurred with highest frequency in bear feces deposited between August 15 and September 5, 1959, and August 18 and September 15, 1960. The fruit of red osier dogwood was apparently taken close to the banks of large streams situated in the Picea-Abies/Pachistima habitat type. Bears trapped near such sites on August 26 and September 5, 1959, and September 9, 1960, deposited scats containing this food. Feeding sites characterized by broken buckthorn (Rhamnus alnifolia) and dogwood shrubs were noted along the banks of Coal Creek on September 2, 1960. Similar evidence was found near the junction of Big Creek and Skookoleel Road on September 11, 1960.

Cyperaceae. Sedge Family

Heaviest consumption of sedges (Carex spp.) apparently occurred in dry mountain meadows during the spring period. In 1959 sedge remains appeared most frequently in scats deposited in June. Occurrence had nearly terminated by July 10 of that year. In 1960 consumption was highest between about May 20 and June 20.

C. geyeri is the only sedge that was positively identified in fecal material. Remains of this species were present in at least 44 per cent of the spring and summer sedge occurrences in 1959 and 67 per cent in 1960.

Debris

The fact that bears consume considerable amounts of non-food material has been pointed out by a number of observers (Cahalane, 1947; Chatelain, 1950; Gilbert, 1951; Spencer, 1955). Remains classified as debris occurred in 68 per cent of the scats collected in the Whitefish Range. Material in this category included rotten wood, stones, soil, conifer needles, and leaf fragments of Pachistima myrsinites and Xerophyllum tenax.

Wood particles commonly accompanied the remains of ants, especially those of the genus Camponotus which dwell in logs and stumps. Likewise, occurrences of soil and stones could usually be correlated with consumption of ants. Conifer needles occurred in 526 scats; however, with the exception of one case, they did not appear to have been deliberately taken. Alpine fir buds comprised over 90 per cent of the volume of a scat deposited near the top of Werner Peak in the spring of 1959. Trace amounts of P. myrsinites leaves occurred 20 times.

Fragments of X. tenax blades were identified in 76 droppings. Bailey (1936) reports that bears occupying the Olympic Peninsula eat beargrass floral stalks during the summer months. Although cervids commonly fed on the inflorescence of X. tenax, no evidence was found to indicate that black bears on the study area were consuming any parts of this plant as a food.

Equisetum spp. Horsetail

Equisetum spp. has been identified in black bear scats and stomachs collected in the Athabaska-Mackenzie region (Preble, 1908), on

the Kenai Peninsula (Chatelain, 1950), and in Colorado (Gilbert, 1951). Horsetails occurred in 4.0 per cent of the scats from Colorado. Clark (1957) found remains of E. arvense in 24.3 per cent of 140 Kodiak bear scats.

E. arvense occurred very frequently in spring and early summer scats collected on the study area. Remains of this dimorphic species comprised at least 93 per cent of the horsetail occurrences in 1959 and 94 per cent of those from 1960. Fertile shoots were identified 13 and 11 times in the respective years. There was one identification of E. variegatum in a scat deposited on May 20, 1960.

In 1959 consumption of fertile shoots terminated about June 20, while heaviest use of sterile stems prevailed through July 15. In 1960 fertile and sterile stems occurred initially in a scat deposited prior to May 10. Remains of fertile shoots were not identified in scats deposited after about June 10, and occurrence of sterile stems declined sharply after July 25.

Garbage

Black bears will apparently consume garbage whenever it is available (Thorton, 1947; Grove, 1957). Individuals may become habitual dump feeders. This is evidenced by the fact that a particular female bear frequented garbage pits located near the field camp during much of the spring and summer of 1959.

Garbage remains occurred in only 23 of the 815 scats and 4 stomachs. The items identified included paper, egg shells, tinfoil, bacon rinds, grapefruit seeds, apple seeds, melon seeds, potato peelings, and prune seeds.

Gramineae. Grass Family

Reports from a number of areas relate the consumption of grass by black bears. Bailey (1931) lists grass as a food item of New Mexico bears. Small amounts of grass occurred in summer scats from Jackson Hole, Wyoming (Murie, 1937) and fall scats from Pennsylvania (Arner, 1948). On the Kenai Peninsula, 90 per cent of black and brown bear feces deposited between May 24 and the middle of July contained remains of grass and grass-like plants (Chatelain, 1950). Similar high occurrence was noted on the Olympic Peninsula where 37 of 44 stomachs collected between April and August contained grass (Resner, 1953). In Maine, grass occurred most frequently in spring scats (Spencer, 1955).

Grass was a very abundant item in spring scats from the study area. In 1959 and 1960 grass remains appeared with highest frequency in scats deposited prior to June 30. Occurrences, mainly at the trace level, were common through July 20 of both years; however, use of grass nearly terminated when berries ripened.

Occasionally it was possible to identify grass remains to genus or species. There were 19 identifications of Elymus glaucus, 8 of Agropyron spicatum, 5 of Deschampsia atropurpurea, 4 of Poa spp., 2 of Cinna latifolia, and 1 of Agrostis sp. Occurrences of E. glaucus were in scats representing the spring, summer, and fall periods. This may be the main grass taken by bears on the study area. Remains of A. spicatum were noted only in spring scats and probably resulted from feeding activity in dry mountain meadows and the Pseudotsuga menziesii type. D. atropurpurea occurred in fall scats collected in or near the timberline type.

Heracleum lanatum. Cow Parsnip

Bailey (1936) found that H. lanatum is consumed by bears on the Olympic Peninsula. Remains of this plant occurred in about 3 per cent of black and brown bear scats collected on the Kenai Peninsula in May and June (Chatelain, 1950). Cow parsnip also comprised 12.4 per cent of the bulk of scats from Colorado (Gilbert, 1951). Clark (1957) pointed out that the Kodiak bear feeds on this plant.

Black bears on the study area ate H. lanatum from spring through late fall. Leaf remains generally comprised most of the spring occurrences of this species. In 1959 bears began to consume the stems and petioles of Heracleum during the last week in June, and from this date through July 30 cow parsnip was the most heavily utilized forb. In 1960 use of large stems began between June 20 and July 1. Occurrence was highest from this period through about July 30.

Hieracium spp. Hawkweed

Cottam et al. (1939) identified hawkweed seeds in a bear stomach collected in West Virginia; however, these were probably unrelated to the consumption of the vegetative parts of Hieracium. Occurrences of these plants in scats collected on the study area were comprised of stem and leaf remains. In 1959 consumption of hawkweed was highest during the month of June. In 1960 remains occurred most frequently in scats deposited between about May 22 and June 30.

Hydrophyllum capitatum. Water-leaf

Occurrences of water-leaf were poorly dated in 1959; however, none were recorded in scats deposited later than July 10. In 1960 the

earliest occurrence was dated between May 25 and June 4. Heaviest use prevailed from this date through about June 10.

Insects

The insects taken most often by bears are those that live in colonies (Bradt, 1946). To expose ants, wasps, bees, hornets, and grubs, bears usually turn over rocks, claw bark from trees, or break open logs and stumps (Bailey, 1905, 1931; Scott, 1947; Shapton, 1956). Rush (1947) and Murie (1954) state that bears will also tear into ant hills and lick up the swarming ants, including those that run up their paws. The paper nests of yellow jackets and hornets are occasionally opened and larvae as well as adults are consumed (Bigelow, 1922).

Remains of ants (Formicidae) occurred in scats from Maine with a frequency of 11.6 per cent in the spring, 11.6 per cent in the summer, and 9.5 per cent in the fall (Spencer, 1955). Ants and ant eggs comprised 13.4 per cent of the volume of fecal material from Colorado (Gilbert, 1951). Bees (probably Apis spp.) were recorded in scats from the Eastern United States. In Pennsylvania, bees and wax comprised 11.5 per cent of the volume of summer scats (Bennett et al., 1943). Spencer (1955) found bees in spring, summer, and fall scats from Maine. Hornets (Vespidae) occurred in 32 per cent of scats and stomachs from Colorado (Gilbert, 1951). Black bears are also reported to consume Orthoptera (Murie, 1937) and Coleoptera (Bennett et al., 1943; Murie, 1954; Spencer, 1955).

Ants were the major insect food of black bears on the study area. The relative occurrence pattern of Formicidae is described in the section on seasonal food habits. Larvae and eggs accompanied adult ants 13 times in 1959 and 6 times in 1960. Occurrence of these juvenile forms

was highest between July 28 and August 15, and July 8 and August 24 of the respective years. Hornets and yellow jackets occurred most frequently in scats deposited during the warm, dry part of the summer period. In 1959 consumption of Vespidae was highest between about July 26 and August 15. Hornets occurred twice in 1960 (Appendix B). Bumblebees (Bombidae) occurred primarily in scats deposited between July 10 and August 10, 1959, and July 8 and August 24, 1960.

The high frequency of occurrence of insects is offset by the low volumetric occurrence of these forms. Nevertheless, the fact that insect remains were identified in 45.3 per cent of the scats indicates that some factor, possibly palatability, induces bears to seek out insects, even when they are available in only small amounts. Bears apparently relish acrid-flavored foods such as Taraxacum officinale and Hieracium spp. If this is actually true, they may consume ants because of their formic acid content.

Juncaceae. Rush Family

Woodrushes (Luzula spp.) were the only representatives of this family identified in bear fecal material. In 1959 consumption of Luzula spp. was highest in the fall between about August 19 and September 2. In 1960 this genus occurred most frequently in scats deposited between August 20 and September 15.

Remains of L. glabrata were present in at least 75 per cent of the Luzula occurrences in 1959 and 50 per cent of those in 1960. L. parviflora comprised 25 to 50 per cent of the volume of a scat deposited about June 25, 1960.

Lomatium spp. Desert Parsley

Four species of Lomatium were found growing on the study area (Appendix A). Of these, L. simplex occurred most often in scats. In 1959 remains of this species were identified twice in feces dated about June 25. In 1960 occurrence was highest in scats deposited between May 17 and June 7. Black bears fed to a small extent on L. dissectum (Appendix C) and L. montanum (Appendix B).

Lonicera spp. Honeysuckle

In terms of frequency of occurrence the berries of L. involucrata (bear berries) ranked second in the fruit and seed category both summers. In 1959 consumption of this species was highest between July 10 and August 20. In 1960 remains of green bear berries occurred initially on June 28; however, ripe fruit did not appear in scats till July 20. Use was highest from this date through about August 5.

Remains of the fruit of L. utahensis (red twin-berry) occurred in small volumetric amounts during the summer and fall periods. The nine occurrences in 1959 were in scats deposited between July 10 and September 4. Red twin-berries were identified twice in 1960 scats (Appendix B).

Mammals

The black bear is definitely an omnivore (Seton, 1909:1080; Shapton, 1956; Grove, 1957). Moreover, since this animal is an opportunist, a list of its "staples is not a list of what it likes, but of what it can get" (Seton, 1953:154). Bradt (1946) feels that black bears subsist mainly on vegetable food because they are physically incapable of getting enough meat. Black bears on the Kenai Peninsula eat unusually large amounts of meat, especially when berries and mast are scarce

(Chatelain, 1950).

The literature indicates that cervid remains in bear scats are derived primarily from the consumption of carrion and juvenile animals. Chatelain (1950) doubts that a black bear could kill an adult moose, but he frequently identified moose calf remains in scats: "Calf remains were located in increasing amounts from 1.5 per cent in May, 16.2 per cent in June, to 26.3 per cent in July and early August." Cooney (1943) considers the black bear a common moose predator in Montana. The black bear is also reported to take elk calves and deer fawns in many parts of Alaska (Dufresne, 1942, 1946) and the Olympic Peninsula (Schwartz and Mitchell, 1945; Resner, 1953; Levin, 1954). Arner (1948) and Gilbert (1951) identified deer remains in scats from Pennsylvania and Colorado.

In the rodent category, the black bear is reported to consume mice, voles, chipmunks, ground squirrels, pocket gophers, and marmots (Bradt, 1946; Cahalane, 1947:140; Scott, 1947). Woodchuck remains comprised 5.7 per cent of the volume of summer scats from Pennsylvania (Bennett et al., 1943). Spring and summer scats collected in Maine contained red squirrel, porcupine, and woodchuck remains at the trace level (Spencer, 1955). Chatelain (1950) feels that bears on the Kenai Peninsula make no particular effort to hunt rodents unless they are readily available. In that area rodent remains occurred in scats with a frequency of 11.9 per cent in May and early June, 2.9 per cent in June, and 12.3 per cent in July and August.

Cervid remains in scats collected on the study area occurred with highest frequency during the spring period. In 1959 all of the spring occurrences were in scats deposited prior to June 16. There was one

occurrence in July and two in August. In 1960 eight of the nine spring cervid occurrences were dated prior to June 20. The six summer identifications were from the month of July.

Rodent remains were identified four times (Appendix B). These occurrences included one Citellus columbianus, one C. lateralis, one Eutamias ruficaudus, and one unidentified cricetid.

The black bear cub remains were in a scat deposited prior to June 12, 1960. Minor incidents of cannibalism have been reported. Seton (1953: 165) describes two incidents which involved the consumption of adult or sub-adult bears. Cahalane (1947:142) states that adult male bears will occasionally kill cubs.

Menziesia glabella. Menziesia

Cottam et al. (1939) found remains of the fruiting capsules of M. pilosa in an early winter stomach sample from West Virginia. This occurrence does not closely compare with the blossom occurrences noted in spring and early summer scats collected on the study area. Bears in the Whitefish Range apparently consume the blossoms of M. glabella because of their high nectar content; however, July occurrences of this species contained remains of fruiting capsules.

In 1959 M. glabella occurred most frequently in scats deposited between about June 25 and July 15. There was a single identification in 1960 (Appendix B). Vaccinium spp. blossoms accompanied six of the 13 menziesia occurrences. Menziesia shrubs from which blossoms had been eaten were noted on July 10 and 20, 1959; however, whether these feeding sites resulted from foraging activities of bears was not determined.

Osmorhiza spp. Sweet Cicely

Two species of sweet cicely were collected on the study area (Appendix A). Both possess the flavor and odor of anise, a characteristic which probably has some influence on palatability. When feeding on these plants, bears consumed mainly stems and leaves. In 1959 remains of Osmorhiza spp. occurred most frequently in scats deposited during the month of June and the first 10 days of July. In 1960 occurrences were noted as early as May 20, and heaviest use prevailed through about July 20. As was true of all of the major spring and summer forbs, consumption of sweet cicely declined when berries matured. Browsed plants of the species O. occidentalis were noted in a south-facing snowslide area on June 16, 1960.

Pinus albicaulis. White-bark Pine

Nelson (1916), Murie (1954), and Cahalane (1947:141) relate the consumption of pine-nuts in general discussions on black bear food habits. Pine-nuts are apparently an important food of bears in the mountainous regions of New Mexico (Bailey, 1931).

The nuts of P. albicaulis were a major fall food of bears on the study area. In 1959 and 1960 remains of these occurred most frequently in scats deposited between about August 20 and September 10. By about September 15 of both years the feeding activities of red squirrels, Clark's nutcrackers, Steller's jays, and chipmunks had depleted most of the pine-nut crop. Moreover, the cones of P. albicaulis disintegrate during the fall months, and this factor may produce a subsequent decline in pine-nut availability in mid-September.

Pine-nut occurrences were relatively free of the remains of cone bracts. This may be due to the fact that bears consume nuts that are stored in the caches of smaller mammals and birds. Nevertheless, it is apparent that some black bears climb into trees to collect cones. Four bears trapped on September 9, 12, and 13, 1960, possessed white-bark pine pitch in various arrangements on the backs of their paws, on their fore-limbs, on their chests, and around their mouths. Pine-nuts were still imbedded in the pitch on one bear. Since two of these animals were trapped near the 4,000 feet level, it is evident that black bears migrate back and forth between the timberline type and the lower habitat types, possibly to obtain water. The same two bears deposited scats containing remains of foods native to the Picea-Abies/Pachistima habitat type. Pine-nut remains were present in fecal material from the other two animals, indicating that pine-nut consumption had not terminated by these dates.

Polypodiaceae. Fern Family

No mention of ferns was found in literature pertaining to black bear food habits; however, Clark (1957) lists Polypodiaceae among the items eaten by Kodiak bears. Because of the difficulties involved in identifying fern remains, it is possible that early investigators failed to recognize these in black bear scats from other localities.

Representatives of this family occurred in scats from all four seasonal periods. Spring occurrences were comprised mainly of the stipes of unfolded leaves, while scats from later periods contained remains of the various leaf subdivisions, some of which were identified to species. Sixty-five fern occurrences from the summer, fall, and late fall periods

of the two years included 37 identifications of Dryopteris filix-mas and 17 of Athyrium filix-foemina. Although these are the only ferns that were found in scats, morphological similarities of the two species usually limited identification to family level.

Stipe occurrences were poorly dated in 1959. Rachis and pinnule remains began to occur regularly about July 20 of that year. In 1960 nearly all stipe remains occurred in scats deposited between May 20 and June 10. Consumption of distal leaf portions began about the first week in July and prevailed through October 21, on which date scat collection terminated.

Rhamnus alnifolia. Dwarf Buckthorn

Black bears are reported to feed on the fruit of cascara (R. purshiana) in Texas, California, and Oregon (Bailey, 1905, 1923, 1936). R. alnifolia is the closest relative of cascara known to occur on the study area. Consumption of the fruit of this species was confined mainly to the fall period. In 1959 there was a single occurrence (Appendix B). Remains of buckthorn fruit occurred with highest frequency in scats deposited between August 18 and September 15, 1960. Scats containing R. alnifolia and Cornus stolonifera were deposited in large numbers along Coal Creek Road during the above period. This suggests that intensive feeding occurred along the banks of large streams in the Picea-Abies/Pachistima habitat during the same period in which pine-nuts were being consumed in the timberline type.

Ribes spp. Currant, Gooseberry

Three species of Ribes were noted on the study area. The fruit

of R. lacustre (swamp currant) was taken most often by bears. In 1959 and 1960 remains of this species occurred with highest frequency in scats deposited between about August 20 and September 15. Occurrences of swamp currant usually ranked in the lowest volumetric category.

Remains of the fruit of R. inerme (white-stemmed gooseberry) occurred twice in 1960 (Appendix B). No evidence was found to indicate the consumption of R. viscosissimum berries. The low productivity of this species may have been responsible for its apparent absence in the collected scats.

Smilacina spp. False Solomon's Seal

Occurrences listed under this genus were evidently derived from the consumption of S. racemosa, since all of the remains contained red particles resembling the exocarp of this species. There were 11 occurrences in scats deposited between about September 1 and October 21, 1960. All of these were accompanied by the remains of foods native to the Picea-Abies/Pachistima habitat type.

Sorbus spp. Mountain Ash

Newsom (1937) observed black bears eating mountain ash berries on Anticosti Island, in the Gulf of St. Lawrence. Bears on the study area ate large amounts of this fruit after September 10; however, they apparently avoided feeding on Sorbus spp. until the availability of more palatable foods was lowered by fall frosts. Cold weather may increase the palatability of Sorbus spp. In 1959 most of the occurrences were in scats deposited between September 5 and October 7. Highest consumption in 1960 occurred between September 10 and the end of the late fall

period. Ripe mountain ash fruit was very abundant as early as August 24 of the second year.

A bear seen eating mountain ash berries (Appendix C) used its front limbs to bend the tall shrubs (Jonkel, pers. comm.).

Taraxacum officinale. Common Dandelion

Cottam et al. (1939) found a trace of the fruit of Taraxacum sp. in a late fall stomach sample from West Virginia. Gilbert (1951) identified remains of dandelion leaves and blossoms in 8 per cent of the scats and stomach samples collected in Colorado. Occurrences of T. officinale in scats collected on the study area were also comprised of vegetative and floral parts. Remains of the floral heads were present in at least 70 per cent of the dandelion occurrences in 1959 and 47 per cent of those in 1960. In 1959 as well as 1960 the occurrence of T. officinale was highest in scats deposited during the month of June.

Dandelion consumption followed a definite pattern. Field observations made in 1959 revealed that in early spring (about June 11) bears fed primarily on newly-opened dandelion heads. Dandelion plants from which the heads had been eaten were abundant on roadsides in the Picea-Abies/Pachistima habitat type on the above date. Mature blossoms were seldom taken; however, by June 24 it became evident that there was progressively increased use of vegetative portions of the plants. By July 2 dandelion blossoms were rare along Big Creek Road. Plants browsed back to the root crown were observed on this date. No evidence was found to indicate that bears fed on dandelion roots. In 1960 Jonkel (pers. comm.) noted that dandelion consumption was also common during the last 10 days of May.

Trifolium spp. Clover

Remains of clover occurred in 1.7 and 0.7 per cent of spring and summer bear scats from Maine (Spencer, 1955). Clover appearances in scats from the study area were confined mainly to the spring and summer periods. In 1959 and 1960 occurrence was highest in scats deposited during the month of June. The ripening of berries and dusty road conditions were accompanied by an abrupt decline in the occurrence of clover on approximately July 15. The occurrence patterns of dandelions and clover coincided very closely, probably because both of these items were simultaneously consumed by bears feeding along roads.

Vaccinium spp. Huckleberry, Blueberry

The fruit of this genus is consumed by bears in many areas (Nelson, 1916; Cahalane, 1947:141). Members of the genus Vaccinium that possess clustered fruits are commonly referred to as blueberries, the name huckleberry being applied to those species with solitary inflorescences. Blueberries are the predominant forms found in eastern portions of the United States and restricted areas on the West Coast. Bears consume blueberries in the Athabaska-Mackenzie region (Preble, 1908) and Oregon (Bailey, 1936). Blueberry remains comprised 17.4 per cent of the total foods that occurred in stomachs collected in West Virginia during the late fall months (Cottam et al., 1939). Chatelain (1950) identified the fruit of V. uliginosum, a blueberry, in summer and fall scats from the Kenai Peninsula. Ten per cent of the summer scats and stomach samples from Maine contained Vaccinium (Spencer, 1955).

Black bears on the study area fed on various parts of huckleberry

plants from spring through late fall. Prior to the maturation of berries, bears ate Vaccinium blossoms. In 1959 blossom consumption terminated about July 1, at which time the remains of green huckleberries began to occur in scats. Ripe fruit occurred initially in a feces deposited between July 10 and 24. Use was highest between this period and about September 20. In 1960 consumption of flowers began as early as May 6 and prevailed through the first week in July. Remains of ripe berries occurred most frequently in scats deposited between about July 19 and September 20.

Three species of Vaccinium were noted on the area (Appendix A). Remains of V. membranaceum were present in at least 92 per cent of the fruit occurrences in 1959 and 81 per cent of those in 1960. The leaves and stems which accompanied berry remains facilitated specific identification. Apparently these were consumed accidentally by bears feeding on fruit; however, they also occurred in spring scats, at which time they were usually associated with blossom remains. I observed only one bear feeding on huckleberries (V. membranaceum). This animal used a front paw to pull the plants toward its mouth and then removed the berries with its lips and teeth.

Vicia americana. Vetch

Vetch is apparently confined to elevations of about 4,000 feet in the southeastern corner of the study area. Remains of this plant were not discovered in bear fecal material until scats were collected in the vicinity of Langford Creek in the spring of 1960. Consumption of V. americana was highest from about June 1 to 28.

Lathyrus ochroleucus (pea vine), a similar legume, occurred once

in 1960 (Appendix B). Consumption of this genus by black bears has been noted in Oregon (Bailey, 1936) and Colorado (Gilbert, 1951).

COMPARISON OF HUCKLEBERRY AND PINE-NUT ABUNDANCE WITH THE OCCURRENCE OF THESE ITEMS IN BEAR SCATS

Huckleberry Count Methods

An effort was made to correlate huckleberry abundance with frequency of occurrence of huckleberry remains in black bear scats. Six plots were set up, three at about 4,400 feet elevation on north, east, and west-facing slopes, and the remaining three on south exposures at elevations of 4,500, 5,800, and 6,600 feet. Two huckleberry species, Vaccinium membranaceum and V. scoparium, were involved in the counts. Line transects 50 feet in length were taken on each of the six plot sites. This was accomplished by stretching twine between two wooden stakes and marking all huckleberry plants that touched the twine. The markers consisted of aluminum tags which were wired to plants and then etched with identification numbers. A plant was considered to include all of the stems rising from a single root crown. Fruit production was evaluated in terms of the number and size of the berries occurring on a plant. Ten or less ripe berries were measured per plant, depending on the number of mature fruits present.

A descriptive summary of the six plots is presented in Table XII. Plots I and II were located in seral stands on Xerophyllum facies of the Picea-Abies/Pachistima habitat type. The vegetation on both of these sites burned about 1919. Repeated burning in the vicinity of plot III, also in the Picea-Abies/Pachistima habitat type, was probably responsible for a Douglas-fir overstory and a subordinate vegetation in which the Calamagrostis rubescens union was represented. Plot IV was set up on a

Table XII. Description of six plots utilized in the determination of huckleberry production indices

Plot No.	Exposure	Approximate Elevation	Overstory	Major Understory Species
I	South	4,500 ft.	Pinus contorta, Pseudotsuga menziesii, Larix occidentalis	Xerophyllum tenax, Pachistima myrsinites, Chimaphila umbellata
II	East	4,400 ft.	Pinus contorta	Spiraea betulifolia, Ceanothus velutinus, Rubus parviflorus, Pachistima myrsinites, Rosa sp., Calamagrostis rubescens, Xerophyllum tenax
III	West	4,400 ft.	Pseudotsuga menziesii	Calamagrostis rubescens, Spiraea betulifolia, Xerophyllum tenax, Antennaria racemosa, Pachistima myrsinites, Lonicera utahensis
IV	North	4,400 ft.	Pseudotsuga menziesii, Abies lasiocarpa, Picea engelmanni	Goodyera oblongifolia, Galium triflorum, Menziesia glabella, Actea arguta, Acer glabrum, Pachistima myrsinites
V	South	5,800 ft.	Pinus albicaulis	Xerophyllum tenax, Lonicera utahensis, Sorbus sitchensis
VI	South	6,600 ft.	P. albicaulis, Abies lasiocarpa	Xerophyllum tenax, Lupinus sp., Arnica latifolia

Menziesia facies of the Picea-Abies/Pachistima habitat type. Evidence of fire was present on this site; however, the vegetation was in a very late successional stage. Plot V was located in a seral stand on the Picea-Abies/Xerophyllum habitat type. Plot VI was in the timberline type on a site in which the Xerophyllum union was strongly represented in the understory. Fire and high elevation were responsible for the presence of Pinus albicaulis in the last two plots.

Results of the Huckleberry Count

Results of the huckleberry count are presented in Table XIII. Although two species were included in the counts, the fruit production of Vaccinium membranaceum was most significant in terms of black bear food habits. V. scoparium berries rarely appeared in scats, and the few occurrences that were recorded ranked in the lowest volumetric category. In more productive years the fruits of V. scoparium may be taken in larger amounts by bears; however, in 1959 and 1960 there was no apparent evidence that this was an important bear food.

On plot I the mean number of V. membranaceum berries per plant was 3.8 in 1959 and 3.0 in 1960. The plants on plot II averaged 5.2 and 1.9 berries each in the respective years. This latter difference in mean number of berries per plant is significant at the 5 per cent level as indicated by a test for paired variables (t=2.262, DF=27; Snedecore, 1940:67-78). On plot III the mean number was 9.5 per plant in 1959 and 10.4 in 1960. Animals, including bears, had apparently consumed berries on plot III prior to both of the counts, and this may have influenced the values obtained. Average berry production on plot IV was 2.3 per plant in 1959 and 4.0 in 1960. On plot V the mean number of berries

Table XIII. Results of huckleberry counts conducted on six plots in 1959 and 1960

Plot No.	Examination Date	Huckleberry Species	No. Plants Examined		Mean No. Berries/Plant		Mean Size (mm.) Ripe Berries	
			1959	1960	1959	1960	1959	1960
I	July 23, 1959	V. membranaceum	24	24	3.8	3.0	8.8	7.1
	July 23, 1960	V. scoparium	21	18*	0.9	3.7	3.7	3.0
II	July 24, 1959	V. membranaceum	28	28	5.2	1.9	8.7	8.2
	July 24, 1960							
III	July 29, 1959	V. membranaceum	38	38	9.5	10.4	8.4	7.5
	July 29, 1960							
IV	Aug. 6, 1959	V. membranaceum	39	39	2.3	4.0	7.1	8.2
	Aug. 6, 1960							
V	Aug. 7, 1959	V. membranaceum	39	39	7.2	4.7	6.2	6.9
	Aug. 7, 1960	V. scoparium	15	15	1.3	0.3	2.7	2.5
VI	Aug. 15, 1959	V. membranaceum	62	62	10.3	5.2	-**	8.4
	Aug. 15, 1960	V. scoparium	8	8	7.1	4.3	3.6	3.2

* Reduction in number of plants due to loss of plant markers
**No ripe V. membranaceum berries were present on the plot on this date

dropped from 7.2 in 1959 to 4.7 in 1960 ($P<.05$, $t=2.525$, $DF=38$). Average number of berries per plant went from 10.3 to 5.2 on plot VI ($P<.01$, $t=4.419$, $DF=61$).

Because huckleberries are perishable and also because animal feeding activity may greatly alter the results of berry counts, the use of biometrics in comparison of annual production indices is open to question. Likewise, the samples taken may not have been large enough to justify the use of such analysis methods.

Bear Food Habits Correlated with Huckleberry Availability

The above data, plus constant ocular estimate during the summer months, imply that berry production was lower in 1960. Since consumption of huckleberries by black bears was confined mainly to the summer and fall, any sizable changes in the availability of huckleberries should be reflected in the food habits of these periods. Vaccinium spp. occurred in summer scats with a frequency of 39.3 per cent in 1959 and 44.4 per cent in 1960. These frequencies apparently did not reflect the abundance of this food in the respective years. Huckleberry occurrence in fall scats was considerably lower in the second year. In 1959 Vaccinium spp. occurred with a frequency of 94.3 per cent, whereas in 1960 occurrence was at the 65.1 per cent level. Thirty-one of the 70 scats representing 1959 contained huckleberry occurrences that ranked in the largest volumetric category (75 to 100 per cent). In 1960 only 14 of the 86 fall scats contained occurrences that placed in this category. This may be positive evidence of a correlation between Vaccinium abundance and the occurrence of huckleberries in scats. Since factors other than the density of a single item determine bear food habits, this type of data

should be evaluated with caution. Nevertheless, there did appear to be some correlation between food availability and intake in the fall periods.

Pine Cone Count Methods

Pine-nut abundance indices were determined by counting the mature cones on white-bark pine trees. Pinus albicaulis is usually confined to high ridge tops on the study area; however, on Werner Peak this species is distributed through much of the Picea-Abies/Menziesia habitat type. This distribution pattern made it possible to count cones that occurred on trees situated along a 4-mile section of road that extended into Big Creek drainage from the top of the peak.

Two methods were utilized in the determination of pine cone production. The first method involved the counting of cones on trees located at about 100 pace intervals along the road described earlier. During both years the initial tally point was at a tree that grew approximately 150 feet below the summit of Werner Peak (6794 feet elevation). Intervals were paced off from this point, and at each stop counts were conducted on the nearest tree situated on the downhill side of the road. A binocular and spotting scope were utilized in the counts. The second census method involved determination of the cone production of 10 marked trees in 1959 and 1960. The marked trees were located at about .3-mile intervals along the lower two-thirds of the transect on which the unmarked trees occurred.

Results of the Pine Cone Count

Results of the pine cone census are presented in Tables XIV and

Table XIV. Results of white-bark pine cone count conducted on 100 systematically selected, unmarked trees occurring along a 4-mile road transect

Stop Number	Mean Number of Cones per Tree 1959*	1960*
1-10	2.8	16.3
11-20	1.3	6.1
21-30	1.7	9.8
31-40	7.7	4.6
41-50	4.6	5.9
51-60	1.2	8.7
61-70	5.0	25.3
71-80	12.6	27.2
81-90	11.1	29.9
91-100	18.2	6.5
1-100	6.2	14.0

*Counts conducted on August 16, 17, and 23, 1959; August 16 and 17, 1960

Table XV. Cone production of 10 marked white-bark pines in 1959 and 1960

Tree Marker Number	Number of Cones 1959*	1960*
1	1	0
2	0	7
3	0	6
4	17	35
5	0	12
6	1	34
7	23	37
8	4	6
9	3	27
10	0	1
Mean No. Cones/Tree	4.9	16.5

*Counts conducted on August 28, 1959, and August 27, 1960

and XV. The average number of cones per unmarked tree was 6.2 in 1959 and 14.0 in 1960. This increase in mean number of cones per tree in 1960 is very significant ($P<.01$, $t=3.689$, $DF=99$). In Table XIV the 100 stops are listed in groups of 10, and the mean cone production per tree is given for each group. The lower numbers of cones on approximately the first 60 trees is the result of at least two possible factors. In general, the white-bark pines occurring along the upper half of the road transect were smaller than those situated along the lower half. Also, the small trees were located mainly in the Picea-Abies/Xerophyllum habitat type, while the larger ones were in the Picea-Abies/Menziesia habitat type. Mean number of cones per marked tree increased from 4.9 in 1959 to 16.5 in 1960 ($P<.01$, $t=3.342$, $DF=9$).

Bear Food Habits Correlated with Pine-nut Availability

Although the cone counts indicate that there was a greater abundance of pine-nuts in 1960, there was no positive correlation between the availability of pine-nuts and the occurrence of these in bear scats. Pine-nuts occurred in fall scats with a frequency of 31.4 per cent in 1959 and 29.1 per cent in 1960. Volumetric occurrence was relatively similar each year.

As was pointed out in the correlation between huckleberry abundance and intake, data of this nature should be critically evaluated, especially since the relative abundance of all foods affects the utilization of any one (Craighead and Craighead, 1956). The high occurrences of Amelanchier alnifolia, Cornus stolonifera, Rhamnus alnifolia, and Sorbus spp. in the fall of 1960 suggest that these items were more abundant in the second year. If this was the case, the fall pattern of

feeding activity may have been altered in 1960. This may possibly account for the lower occurrence of Vaccinium spp. during the same period.

Remains of pine-nuts are more readily identified in scats, and care must be taken not to over-emphasize the importance of these in the bear diet.

CAMBIUM FEEDING

Review of Literature

Recently the lumber industry has become concerned with the cambium feeding activities of black bears. Thousands of commercial trees have been killed in the Pacific Northwest and in other areas where black bears are found.

Damage is reported to have occurred in stands of redwood (Fritz, 1951; Glover 1955), Douglas-fir (Levin, 1954; Childs and Worthington, 1955), balsam fir (Ray, 1941; Zeedyk, 1957), white spruce (Lutz, 1951), aspen (Lutz, 1951), and cedar (Zeedyk, 1957).

The expression "cambium feeding" has been applied to a form of feeding activity in which black bears remove bark from trees and lick or chew the exposed cambium. Apparently bears use their claws to strip bark from the lower part of the tree trunk (Fritz, 1951; Lutz, 1951; Levin, 1954). On some trees it is broken loose near ground level and stripped upwards. Pieces of bark may be left hanging near the top of the wound, while those torn away completely are found at the base of the tree. "Prominent vertical engravings on the cambium of stripped trees correspond in size and arrangement with the upper incisors of the black bear" (Glover, 1955).

Removed strips of bark are usually 4 to 6 inches wide. The wounds themselves vary in size. Most stripping extends to a point 2 to 3 feet above the ground; however, wounds 8 to 10 feet long are not uncommon. Trees have been found stripped to a height of 80 feet (Fritz,

1951; Lutz, 1951; Glover, 1955). Individual trees may be attacked as many as two to five times (Childs and Worthington, 1955). Glover (1955) reports that 48 per cent of 234 freshly barked redwoods examined in California had been previously damaged by black bears.

In general, damage is heaviest in areas of second growth (Lutz, 1951; Lauckhart, 1955). Ray (1941) found that there was increased evidence of cambium feeding in stands of balsam fir in which tree growth had been stimulated by thinning. In Alaska, "sappy" spruce trees, those with thin smooth bark, are reported to be frequently struck (Lutz, 1951). Douglas-fir trees 20 to 45 years of age and ranging from 10 to 18 inches in d. b. h. are heavily damaged in the Pacific Northwest (Childs and Worthington, 1955; Levin, 1954). Redwood reproduction 10 to 25 years of age is preferred by black bears (Fritz, 1951; Glover, 1955). In addition to tree age and size, degree of stocking may be influential. Glover (1955) reports that 70 per cent of the injured redwoods he examined were less than 6 feet from another tree. Trees with limby trunks were struck more often than trees with clear boles.

Cambium feeding occurs mainly in the spring and early summer, before the cells of the cambial layer are grown and lignified (Fritz, 1951). Damage to redwoods takes place during a 75 to 120 day period beginning in April or May and ending in July or possibly August, depending on the weather (Glover, 1955). Resner (1953) and Levin (1954) feel that spring food shortage may cause bears to turn to cambium. Lutz (1951) mentions that cambium feeding may be an acquired trait: "Although bears, notably omnivores, are plentiful throughout the Douglas-fir region, damage is localized in spite of the existence of vast areas of second growth."

Childs and Worthington (1955) state that cambium feeding has occurred in some parts of the Pacific Northwest since at least 1854. On the Olympic Peninsula, however, damage was hardly noticeable till about 1945 and did not reach a peak till 1951 (Resner, 1953; Levin, 1954). In the Little River basin of California, cambium wounds were first noted in 1946 and damage was heaviest in 1950 (Fritz, 1951; Glover, 1955).

It is believed that an average of 20 trees and a maximum of 40 might be attacked by a bear in 24 hours. A seasonal damage rate of 1,200 trees per bear is speculated (Glover and Hansen, 1954; Glover, 1955). On a cut-over area in the Little River basin 10,000 redwoods were killed between 1946 and 1949 (Fritz, 1951). The Hammond Lumber Company, located in the same area, has calculated a 40 year loss of 400,000,000 board feet of lumber, if cambium feeding continues at its present rate (Merrill, 1953).

Methods

A general analysis of cambium feeding was conducted to determine the significance of cambium in the diet of bears on the study area. Tree species damaged and the vegetation types in which damage was prevalent were noted. An attempt was made to determine the size and age class of stripped trees. Fresh wounds were dated whenever possible, and the periods of occurrence of cambium remains in bear fecal material were noted.

A sample of 201 cambium wounds was examined in a seral stand comprised mainly of Pinus contorta and Larix occidentalis in September, 1959. The study site was situated in a transition between the Picea-Abies/Pachistima and Picea-Abies/Xerophyllum habitat types. A transect was run parallel and coincident with the lower two miles of Trail 515

(S5 and S6 of T32N R21W). All of the trees located about 20 feet (7 paces) to either side of this stretch of trail were examined for cambium wounds. The length and circumferal extent of the wounds were measured, and aging was accomplished by cutting a notch with a hatchet at the edge of each wound and counting the number of annual growth rings deposited since the stripping of bark occurred. The d. b. h. of scarred trees was also recorded.

Results

Extensive damage to alpine fir (Abies lasiocarpa) was noted in climax and seral stands, mainly on the Picea-Abies/Menziesia habitat type. Size class may not be a limiting factor in the use of this species, since trees with a d. b. h. of as much as 30 inches were attacked by bears. In the timberline type, white-bark pines (Pinus albicaulis) 5 to 8 inches in d. b. h. were frequently struck. Damage to other species (Table XVI) was most abundant in seral stands on the Picea-Abies/Pachistima and Picea-Abies/Xerophyllum habitat types. Evidence of cambium feeding on Picea engelmanni was rarely observed.

Cambium feeding occurred mainly in June and July. Several periods of wound occurrence are listed in Table XVI. Remains of Abies sp. cambium appeared in scats deposited during the following periods: on June 29, on June 30, on July 10, June 24 to July 9, and July 2 to 22, 1959; July 1 to 15, 1960. Cambium feeding may relate to general food shortage in the spring; however, in June and July herbaceous foods are abundant over most of the study area. It is possible that conifer cambium is a minor food item taken whether alternate foods are scarce or abundant.

Results of the cambium wound analysis are presented in Table XVII.

Table XVI. Characteristics of 19 cambium wounds inflicted on conifers by black bears in 1959 and 1960

Tree Species Involved	Approximate Dimensions: Tree d.b.h. (inches)	Wound Length (feet)	Circumferal Extent (percentage)	Period of Occurrence*
1959				
Abies lasiocarpa	12	4.5	100	June 22-July 7
Abies lasiocarpa	-	6.5	-	Prior to July 7
Abies lasiocarpa	-	6.5	-	Prior to July 7
Pinus contorta	7	-	-	July 7-July 20
Pinus contorta	5	5.5	60	Prior to July 24
Pinus contorta	7	3.0	50	Prior to July 24
Pinus contorta	8	4.0	50	Prior to July 24
1960				
Abies lasiocarpa	30	-	-	Prior to June 27
Larix occidentalis	7	7.0	100	June 19-July 3
Abies lasiocarpa	10	5.0	40	July 4-July 19
Pseudotsuga**	10	3.5	25	July 4-July 19
Abies lasiocarpa	10	2.5	30	July 10-July 26
Larix occidentalis	6	4.5	100	July 17-July 31
Abies lasiocarpa	12	6.0	80	Prior to Aug. 11
Abies lasiocarpa	18	6.0	50	Prior to Aug. 11
Pinus albicaulis	5	2.5	40	Prior to Aug. 20
Pinus albicaulus	5	1.0	10	Prior to Aug. 20
Pinus albicaulus	6	2.0	40	Prior to Aug. 20
Pinus albicaulis	5	2.0	50	Prior to Aug. 20

* Wounds inflicted during these periods
**Pseudotsuga menziesii

Table XVII. Characteristics of 201 cambium wounds inflicted by bears

Tree Species Involved	Number of Wounds	Av. Tree d.b.h. (inches)	Av. Wound Length (inches)	Av. Circumferal Extent (percentage)
Pinus contorta	198	6.3	41	33
Abies lasiocarpa	2	8.5	47	55
Larix occidentalis	1	4.0	24	100
Totals	201	-	41	34

The length of the wounds ranged from about 10 inches to 30 feet and averaged 41 inches, while circumferal extent ranged from 7 to 100 per cent and averaged 34 per cent. Nearly all of the wounds (98.5 per cent) occurred on lodge-pole pines. Since 35 lodge-pole pines possessed two wounds, only 166 damaged trees were involved in the total analysis. At the time of examination, eight of the trees were dead and one was dying as a result of extensive girdling. All nine possessed single wounds. The wounds on the dead trees were not aged.

Age distribution of 191 cambium wounds is presented in Figure 2. The oldest wound was inflicted 21 years prior to the analysis date, and the most recent damage was less than one year old. Of possible significance is the fact that 87 per cent of the wounds on living lodge-pole pines were inflicted prior to 1949, while none dated earlier than 1938. Since fire destroyed most of the arboreal vegetation on the site in 1919, the damaged trees were probably less than 40 years old in 1959. If tree seedlings germinated within a few years after the fire, heaviest cambium

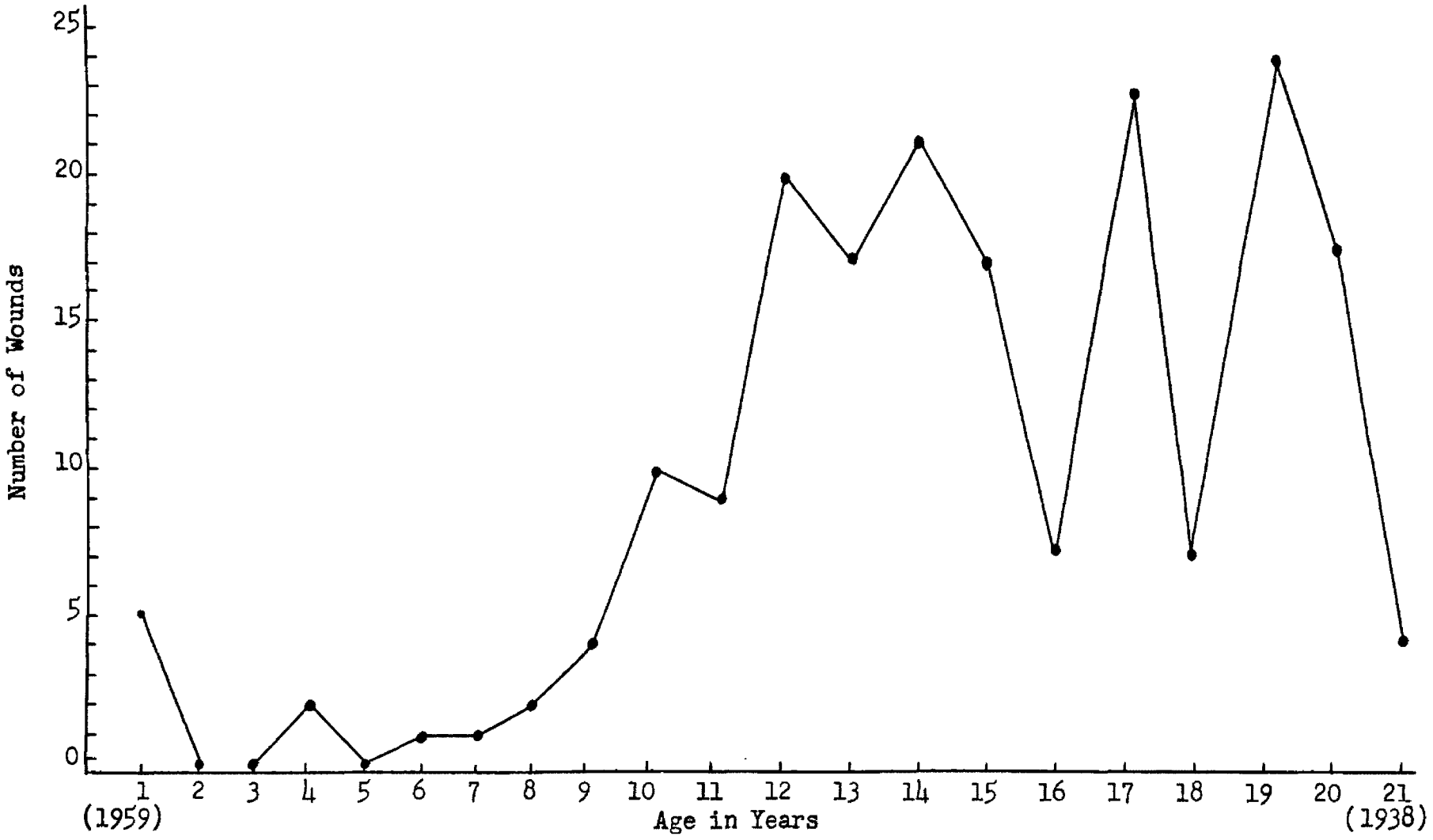

Figure 2. Age distribution of 191 cambium wounds on lodge-pole pines situated in a seral stand resulting from a 1919 forest fire

feeding occurred when the trees were approximately 18 to 28 years of age. In addition to the correlation between age class and intensity of cambium feeding, it would have been beneficial to show a similar relationship with respect to tree size. Tree d. b. h. at the time of wound infliction could have been determined by use of an increment bore or by sawing the trees down; however, these procedures were not conducted. The d. b. h. values presented in Table XVII relate to tree size in 1959. In several instances, where tree girdling was very extensive, it was possible to measure d. b. h. as it existed at the time damage occurred. Eleven lodge-pole pines that averaged 6.3 inches in d. b. h. in 1959, averaged 3.7 inches when initially struck by bears.

Throughout the study area, seral species such as lodge-pole pine, Douglas-fir, western larch, and white-bark pine were apparently struck most often when eight or less inches in d. b. h. For this reason, future studies in the spruce-fir zone may prove that damage to conifers, with the exception of alpine fir, is most extensive in young seral stands (20 to 30 years old) resulting from fire or logging activity.

RECOMMENDATIONS

Being of a preliminary nature, this study failed to provide an adequate evaluation of some phases of black bear food habits in the Picea-Abies zone. Future investigations should continue or modify the methods utilized in 1959 and 1960 to provide a more complete picture with respect to some of the following aspects:

1. More intensive study of the plant ecology of the zone should be conducted, and this should include the determination of suitable methods for quantitative analysis of vegetation types. The "constancy index" approach described by Daubenmire (1952) might be used in future work of this nature. The concept of habitat type should form the basis of vegetation description.

2. In addition to the huckleberry and pine cone counts, fruit production indices should be determined for Amelanchier alnifolia, Cornus stolonifera, Lonicera involucrata, Rhamnus alnifolia, and Sorbus spp. Since remains of the fruit of these species are readily identified, future investigators could calculate the relative use of each by gross examination of scats in the field. Determination of the abundance of native herbaceous foods would probably be of little practical value in terms of general black bear management.

3. Black bear cambium feeding activities require further investigation. If possible, damage intensity should be related to habitat type, tree age and size class, and stand density and successional status. The effect of cambium feeding on timber management should be included in such

an evaluation.

4. The influence of logging activity on black bear food habits should be considered. In addition to the fact that clear-cut areas produce very little bear food, the presence of forest reproduction on these sites in future years may be accompanied by increased cambium feeding and a subsequent need for the reduction of bear population, as has been necessary elsewhere (Lauckhart, 1950; Resner, 1953; Levin, 1954). Lauckhart pointed out that bear population levels tend to rise in forests recovering from logging and that resulting food shortages may cause bears to turn to cambium.

5. Major fluctuations in bear population, if they occur, might be correlated with fluctuation in food abundance.

6. Investigation of the food habits of animals of different age classes may reveal that black bear feeding activity is modified by a learned behavior.

SUMMARY

1. A study of the food habits of the black bear (Ursus americanus) in the Whitefish Range of northwestern Montana was conducted from June 1959, to November, 1960. The primary objectives were: to determine the seasonal foods of bears on a definite area of land; to correlate food availability with food intake; and to determine the relationship of seasonal feeding activity to vegetation types.

2. The 116 square mile study area lies in the Picea-Abies zone. Description of vegetation types was based on standards outlined by Daubenmire (1952, 1953).

3. A permanent collection route, consisting of about 70 miles of logging road and 50 miles of foot trail, was cleared of bear scats at approximately 2-week intervals. Four stomach samples and 815 scats were collected for analysis.

4. Frequency of occurrence and an ocular estimate of volumetric occurrence were determined for food item remains in scats.

5. Scats were grouped to represent four periods: spring (emergence from hibernation through June 30), summer (July 1 through August 15), fall (August 16 through September 25), and late fall (September 26 to approximately the beginning of hibernation).

6. Vegetative material formed the bulk of spring food remains. Grasses, umbellifers, and horsetails were important. The eight major items in 1959 in order of frequency of occurrence were: Gramineae, Angelica dawsoni, Osmorhiza spp., Equisetum spp., Formicidae, Trifolium

spp., Heracleum lanatum, and Taraxacum officinale. In 1960 the equivalent foods included: Gramineae, Osmorhiza spp., Heracleum lanatum, Formicidae, Equisetum spp., Taraxacum officinale, Angelica dawsoni, and Cyperaceae.

7. Summer scats consisted mainly of herbaceous remains until the various fruits matured in the middle of July. Heracleum lanatum and Vaccinium spp. were the predominant items taken. The top six foods in 1959 in order of frequency of occurrence were: Formicidae, Heracleum lanatum, Vaccinium spp., Equisetum spp., Gramineae, and Angelica dawsoni. In 1960 these positions were held by: Formicidae, Heracleum lanatum, Vaccinium spp., Equisetum spp., Osmorhiza spp., and Angelica dawsoni.

8. Berries and pine-nuts comprised most of the fall diet; however, Angelica dawsoni and Luzula glabrata ranked high in the stem and leaf category. The analyses show that the major foods in 1959 included: Vaccinium spp., Formicidae, Pinus albicaulis, Angelica dawsoni, Ribes lacustre, and Amelanchier alnifolia. In the second year these were: Vaccinium spp., Angelica dawsoni, Amelanchier alnifolia, Cornus stolonifera, Ribes lacustre, and Sorbus spp.

9. Mild weather in the autumn of 1960 was accompanied by extended bear feeding activity. Sorbus spp. occurred in 93 per cent of the late fall scats of that year. Other major items were: Gramineae, Angelica dawsoni, Amelanchier alnifolia, Symphoricarpos spp., and Heracleum lanatum.

10. Plant material occurred in 99.9 per cent of the 819 samples, insects in 45.3 per cent, mammals in 5.0 per cent, and birds in 0.4 per cent. In terms of volume, animal material formed a very minor portion of the fecal remains.

11. Six plots were set up to obtain indices of huckleberry production. Mean number of berries per plant was significantly lower on three plots in 1960. There appeared to be some correlation between huckleberry availability and intake in the fall periods.

12. Pine-nut (Pinus albicaulis) abundance indices were determined both years by counting cones on 10 marked and 100 unmarked trees located along a road transect. The counts indicated a higher cone production in 1960; however, there was no positive correlation between pine-nut availability and the occurrence of these in scats.

13. Of 19 cambium wounds inflicted in 1959 and 1960, eight occurred on Abies lasiocarpa, four on Pinus albicaulis, and four on Pinus contorta. Seven dated wounds were inflicted between June 19 and July 31. Abies sp. cambium occurred six times in scats deposited between June 29 and July 15.

14. Since bears were seldom observed feeding, it was not possible to accurately relate feeding activity to vegetation types. General relationships were based on the observation of feeding sites and the ecology of the food items involved.

15. This study supports what others have found concerning black bear food habits, namely that the black bear is an omnivore, feeding largely on herbaceous foods, Vaccinium spp., and insects. In addition to generally recognized items, it was discovered that bears consumed large amounts of representatives of the family Umbelliferae, particularly Angelica spp., Heracleum lanatum, and Osmorhiza spp. Horsetails (Equisetum spp.) and dandelions were other unusual foods consumed frequently.

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APPENDICES

LIST OF APPENDICES

Appendix A. Major vascular plants noted on the Big Creek study area

Forbs

Apocynaceae
Apocynum androsaemifolium var. glabrum
Araliaceae
Aralia nudicaulis
Boraginaceae
Hackelia diffusa
H. floribunda
Mertensia longiflora
Campanulaceae
Campanula rotundifolia
Caprifoliaceae
Linnaea borealis var. americana
Caryophyllaceae
Arenaria congesta var. expansa
Cerastium beeringianum
Silene alba
Cornaceae
Cornus canadensis
Crassulaceae
Sedum stenopetalum
Cruciferae
Arabis holboellii
A. lignifera
Capsella bursa-pastoris
Draba nemorosa
Compositae
Achillea millefolium ssp. lanulosa
Adenocaulon bicolor
Agoseris aurantiaca
Anaphalis margaritacea
Antennaria luzuloides
A. neglecta
A. racemosa
A. rosea
Arnica cordifolia
A. diversifolia
A. latifolia
Artemisia absinthium
A. michauxiana
Aster spp.
Balsamorhiza sagittata
Cirsium arvense
C. vulgare
Crepis atribarba
Erigeron compositus
E. peregrinus
E. speciosus
Hieracium albertinum
H. albiflorum
H. canadense
Senecio hydrophiloides
S. integerrimus
S. megacephalus
S. pseudaureus
S. triangularis
Solidago spp.
Taraxacum officinale
Tragopogon dubius
Ericaceae
Gaultheria humifusa
Geraniaceae
Geranium bicknellii
Hydrophyllaceae
Hydrophyllum capitatum
Phacelia leucophylla
P. sericea
Hypericaceae
Hypericum anagalloides
Labiatae
Prunella vulgaris
Liliaceae
Allium cernuum
Calochortus apiculatus
Clintonia uniflora
Disporum oreganum
D. trachycarpum
Erythronium grandiflorum
Smilacina racemosa
S. stellata
Stenanthium occidentale
Streptopus amplexifolius
Trillium ovatum
Veratrum viride
Xerophyllum tenax

Appendix A. (Continued)

Zigadenus venenosus
Leguminosae
Astragalus bourgovii
Hedysarum sulphurescens
Lupinus sericeus
Medicago lupulina
Melilotus officinalis
Trifolium hybridum
T. pratense
T. repens
Onagraceae
Epilobium adenocaulon
E. angustifolium
E. latifolium
E. spp.
Orchidaceae
Calypso bulbosa
Corallorhiza maculata
Goodyera oblongifolia
Habenaria dilatata
var. leucostachys
H. saccata
H. unalascensis
Listera caurina
L. convallaroides
L. cordata
Orobanchaceae
Orobanche uniflora
var. sedi
Polemoniaceae
Collomia linearis
C. tinctoria
Polemonium pulcherrimum
Polygonaceae
Eriogonum flavum
var. piperi
E. heracleoides
var. subalpinum
Oxyria digyna
Rumex acetosella
R. crispus
R. paucifolius
Polypodiaceae
Athyrium filix-foemina
Cryptogramma acrostichoides
Dryopteris filix-mas
Phegopteris dryopteris
Polystichum lonchitus
Pteridium aquilinum
var. languinosum
Woodsia oregana
Portulacaceae
Claytonia cordifolia
C. lanceolata
Primulaceae
Dodecatheon conjugens
var. viscidum*
D. radicatum*
Pyrolaceae
Chimaphila umbellata
var. occidentalis
Pyrola asarifolia
P. bracteata
P. secunda
P. uniflora
Ranunculaceae
Actea arguta
Anemone globosa
Aquilegia formosa
var. flavescens
Delphinium bicolor?
Ranunculus eschscholtzii
R. uncinatus
Thalictrum occidentale
Trollius laxus
Rosaceae
Fragaria vesca
var. bracteata
F. virginiana
var. glauca
Geum macrophyllum
var. perincisum
G. triflorum
Potentilla glandulosa
Rubiaceae
Galium boreale
G. triflorum
Saxifragaceae
Hemieva ranunculifolia
Heuchera cylindrica
var. glabella
Leptarrhena pyrolifolia
Lithophragma parviflorum
Mitella breweri

Appendix A. (Continued)

Mitella nuda
M. pentandra
M. stauropetala
Parnassia fimbriata
Saxifraga bronchialis subsp. austromontana
S. lyallii
S. rhomboidea
Tiarella unifoliata

Scrophulariaceae
Castilleja hispida
C. miniata
C. rhexifolia
Linaria vulgaris
Mimulus guttatus
M. lewisii
Pedicularis bracteosa
P. racemosa
Penstemon albertinus
P. confertus
P. ellipticus
P. lyallii
Penstemon nitidus*
Veronica arvensis

Umbelliferae
Angelica arguta
A. dawsoni
Heracleum lanatum
Lomatium dissectum
L. macrocarpum
L. montanum
L. simplex
Osmorhiza obtusa
O. occidentalis

Urticaceae
Urtica lyallii

Valerianaceae
Valeriana sitchensis

Violaceae
Viola adunca
V. bellidifolia
V. glabella
V. orbiculata
V. vallicola

Shrubs, Vines, and Trees

Aceraceae
Acer glabrum

Araliaceae
Oplopanax horridum

Berberidaceae
Berberis repens

Betulaceae
Alnus sinuata
A. tenuifolia
Betula papyrifera var. occidentalis

Caprifoliaceae
Lonicera involucrata
L. utahensis
Sambucus melanocarpa
Symphoricarpos rivularis
Viburnum edule

Celastraceae
Pachistima myrsinites

Cornaceae
Cornus sericea f. stolonifera

Elaeagnaceae
Elaeagnus canadensis

Ericaceae
Arctostaphylos uva-ursi
Ledum glandulosum
Menziesia glabella
Phyllodoce empetriformis
Vaccinium membranaceum
V. myrtillus
V. scoparium

Leguminosae
Lathyrus ochroleucus**
Vicia americana

Pinaceae
Abies lasiocarpa
Juniperus communis var. montana
Larix occidentalis

Appendix A. (Continued)

Picea engelmanni
Pinus albicaulis
P. contorta
var. murrayana
P. monticola
P. ponderosa
Pseudotsuga menziesii
var. glauca
Thuja plicata
Ranunculaceae
Clematis columbiana
Rosaceae
Amelanchier alnifolia
Crataegus douglasii
Holodiscus discolor
Potentilla fruticosa
Prunus emarginata
P. virginiana
var. demissa
Rosa gymnocarpa
Rubus idaeus
var. strigosus
R. parviflorus
Sorbus scopulina
S. sitchensis
Spiraea betulifolia
S. splendens
Salicaceae
Populus tremuloides
P. trichocarpa
Salix spp.
Saxifragaceae
Philadelphus lewisii
Ribes inerme
R. lacustre
R. viscosissimum
Taxaceae
Taxus brevifolia

Grasses, Grass-like Plants, and Sphenopsids

Cyperaceae
Carex geyeri
C. spp.
Eriophorum viridi-carinatum
Equisetaceae
Equisetum arvense
E. hyemale
var. californicum
E. sylvaticum
E. variegatum
Gramineae
Agropyron repens
A. spicatum
Agrostis alba
A. scabra
A. thurberiana
Bromus ciliatus
B. carinatus
B. tectorum
B. vulgaris
Calamagrostis canadensis
C. purpurescens
C. rubescens
Cinna latifolia
Dactylis glomerata
Deschampsia atropurpurea
D. elongata
Danthonia unispicata
Elymus glaucus
Festuca idahoensis
Glyceria elata
Hordeum jubatum
Melica smithii
M. spectabilis
M. subulata
Oryzopsis asperifolia
Phalaris arundinacea
Phleum alpinum
P. pratense
Poa alpina
P. annua
P. epilis
P. longiligula
P. palustris
P. pratensis
Trisetum cernuum

Appendix A. (Continued)

Trisetum spicatum	Juncus parryi
Juncaceae	J. regelii
Juncus drummondii	J. saximontanus
J. ensifolius	Luzula glabrata
J. mertensianus	L. parviflora

* Identification involved use of manual by Hitchcock et al. (1959).
**Identification involved use of manual by Fernald (1950)

Appendix B. Initial and final periods of food item occurrence in scats and stomach samples

Food Item	Year	Period or Date of Initial Occurrence	Period or Date of Final Occurrence
Amelanchier alnifolia	1959	July 7-July 20	Oct. 1-Oct. 7
	1960	June 23-July 8	Oct. 20-Oct. 21
Angelica arguta	1959	Prior to June 12	Aug. 12-Sept. 6
	1960	On May 22	Oct. 5-Oct. 21
A. dawsoni	1959	Prior to June 12	Aug. 28-Sept. 15
	1960	On May 20	Oct. 5-Oct. 21
Aralia nudicaulis	1960	On Sept. 12	
Arctostaphylos uva-ursi	1959	July 10-July 24	July 28-Aug. 11
	1960	On June 28	Oct. 5-Oct. 21
Berberis repens	1960	On Sept. 13	
Birds	1959	July 24-Aug. 10	On Sept. 2
	1960	On Sept. 21	
Bombidae	1959	Prior to July 14	Aug. 10-Aug. 27
	1960	July 8-July 22	Aug. 10-Aug. 24
Castilleja spp.	1959	Prior to June 29	July 10-July 28
	1960	Prior to May 17	July 20-Aug. 5
Cervidae	1959	Prior to June 12	Oct. 1-Oct. 7
	1960	On June 2	Aug. 20-Sept. 14
Citellus columbianus	1959	Prior to June 29	
C. lateralis	1960	Aug. 10-Aug. 24	
Coleoptera	1959	Prior to June 29	Prior to Sept. 4
	1960	Prior to June 16	Prior to Sept. 30
Cornus stolonifera	1959	July 28-Aug. 11	Oct. 1-Oct. 7
	1960	On Aug. 5	Sept. 14-Oct. 4
Crataegus douglasii	1959	Sept. 6-Sept. 20	
	1960	On Sept. 10	
Cyperaceae	1959	Prior to June 12	Aug. 21-Sept. 4
	1960	Prior to May 17	Prior to Sept. 26

Appendix B. (Continued)

Food Item	Year	Period or Date of Initial Occurrence	Period or Date of Final Occurrence
Dermacentor andersoni	1959	Prior to June 22	
Disporum spp.	1960	Sept. 25-Oct. 5	
Elaeagnus canadensis	1959	July 10-July 24	Aug. 3-Aug. 18
	1960	On July 19	Aug. 4-Aug. 18
Equisetum spp.	1959	Prior to June 12	Oct. 1-Oct. 7
	1960	Prior to May 10	Oct. 5-Oct. 21
Eutamias ruficaudus	1960	Prior to Oct. 9	
Fragaria spp.	1960	July 3-July 17	July 8-July 22
Gramineae	1959	Prior to June 12	Aug. 28-Sept. 15
	1960	Prior to May 6	Oct. 5-Oct. 21
Heracleum lanatum	1959	Prior to June 12	Aug. 12-Sept. 6
	1960	On May 20	Oct. 5-Oct. 21
Hieracium spp.	1959	Prior to June 12	Prior to Aug. 6
	1960	On May 22	Prior to Sept. 20
Hydrophyllum capitatum	1959	Prior to June 16	July 1-July 14
	1960	May 25-June 4	July 20-Aug. 5
Juncaceae	1959	Prior to June 17	Aug. 28-Sept. 15
	1960	Prior to June 22	On Oct. 14
Lathyrus ochroleucus	1960	On Sept. 15	
Lomatium montanum	1960	June 2-June 4	
L. simplex	1959	Prior to June 29	Prior to July 10
	1960	Prior to May 17	Prior to June 27
Lonicera involucrata	1959	Prior to June 29	Aug. 28-Sept. 15
	1960	On June 28	Oct. 5-Oct. 21
L. utahensis	1959	July 10-July 24	On Sept. 4
	1960	Prior to July 26	July 11-July 26
Menziesia glabella	1959	Prior to June 15	July 10-July 30
	1960	July 4-July 19	

Appendix B. (Continued)

Food Item	Year	Period or Date of Initial Occurrence	Period or Date of Final Occurrence
Oplopanax horridum	1959	July 28-Aug. 11	Prior to Sept. 15
	1960	Aug. 11-Aug. 24	Oct. 5-Oct. 21
Osmorhiza spp.	1959	Prior to June 12	Aug. 28-Sept. 15
	1960	On May 20	Oct. 5-Oct. 21
Pinus albicaulis	1959	Aug. 11-Aug. 27	Aug. 28-Sept. 15
	1960	Aug. 4-Aug. 18	Oct. 5-Oct. 21
Polypodiaceae	1959	Prior to June 14	Aug. 27-Sept. 11
	1960	On May 20	Oct. 5-Oct. 21
Prunus spp.	1960	Sept. 2-Sept. 14	Sept. 25-Oct. 5
Rhamnus alnifolia	1959	Sept. 6-Sept. 20	
	1960	Aug. 18-Sept. 2	Oct. 5-Oct. 21
Ribes inerme	1960	On July 20	July 11-July 26
R. lacustre	1959	On Aug. 27	Sept. 1-Sept. 18
	1960	July 26-Aug. 10	Sept. 14-Sept. 22
Rosa spp.	1960	On Sept. 12	Oct. 5-Oct. 21
Rubus parviflorus	1959	Aug. 7-Aug. 8	Aug. 27-Sept. 11
	1960	On Sept. 12	On Oct. 21
Sambucus melanocarpa	1959	Aug. 28-Sept. 15	Sept. 1-Sept. 18
Smilacina spp.	1960	Aug. 18-Sept. 22	Oct. 5-Oct. 21
Sorbus spp.	1959	Prior to Sept. 15	Prior to Oct. 13
	1960	Aug. 24-Sept. 7	Oct. 5-Oct. 21
Streptopus sp.	1959	July 28-Aug. 11	Aug. 27-Sept. 11
	1960	Aug. 19-Aug. 27	Sept. 14-Sept. 22
Symphoricarpos spp.	1960	On Sept. 13	Oct. 5-Oct. 21
Taraxacum officinale	1959	Prior to June 12	Aug. 1-Aug. 14
	1960	On May 22	Prior to Sept. 21
Trifolium spp.	1959	Prior to June 12	Aug. 4-Aug. 19
	1960	Prior to May 22	Oct. 5-Oct. 21

Appendix B. (Continued)

Food Item	Year	Period or Date of Initial Occurrence	Period or Date of Final Occurrence
Vaccinium spp.			
Blossoms	1959	Prior to June 13	June 14-July 9
	1960	Prior to May 6	Prior to July 6
Fruit & seeds	1959	June 14-July 9	Oct. 1-Oct. 7
	1960	Prior to July 19	Sept. 25-Oct. 5
Vespidae	1959	On July 26	Aug. 22-Sept. 6
	1960	On Aug. 4	July 26-Aug. 10
Vicia americana	1960	May 28-May 31	On Sept. 15

Appendix C. Observations made of black bears feeding on specific food items

Items Consumed	Date	Vegetation or Habitat Type	Observer
Agropyron spicatum	April 25, 1960	Pseudotsuga menziesii type	C. Jonkel
Angelica dawsoni	July 10, 1959	South-facing snowslide area	E. Tisch
Balsamorhiza sagittata	April 25, 1960	Dry mountain meadow	C. Jonkel
Balsamorhiza sagittata	May 20, 1960	Pseudotsuga menziesii type	C. Jonkel
Elymus glaucus	June 18, 1959	Roadside	E. Tisch
Equisetum arvense	June 13, 1960	Roadside in Picea-Abies/ Pachistima habitat type	E. Tisch
Erythronium glandiflorum	June 28, 1959	Dry mountain meadow	E. Tisch*
Formicidae	Aug. 24, 1959	Trapsite in Picea-Abies/ Xerophyllum habitat type	E. Tisch
Heracleum lanatum	July 10, 1959	South-facing snowslide area	E. Tisch
Hieracium albiflorum	July 10, 1959	South-facing snowslide area	E. Tisch
H. albertinum	June 28, 1959	Dry mountain meadow	E. Tisch*
Hydrophyllum capitatum	June 13, 1960	Dry mountain meadow	E. Tisch
Lonicera involucrata	July 21, 1959	Wet mountain meadow	E. Tisch

Appendix C. (Continued)

Items Consumed	Date	Vegetation or Habitat Type	Observer
Osmorhiza obtusa	June 29, 1959	Roadside in Picea-Abies/ Pachistima habitat type	E. Tisch
Poa pratensis	June 29, 1959	Roadside in Picea-Abies/ Pachistima habitat type	E. Tisch
Senecio integerrimus	June 13, 1960	Dry mountain meadow	E. Tisch
Sorbus spp.	Oct. 14, 1960	Picea-Abies/Pachistima habitat type	C. Jonkel
Symphoricarpos spp.	Sept. 12, 1960	South-facing snowslide area	C. Jonkel*
Taraxacum officinale	June 12, 1959	Roadside in Picea-Abies/ Pachistima habitat type	C. Jonkel
Taraxacum officinale	June 13, 1959	Roadside in Picea-Abies/ Pachistima habitat type	E. Tisch
Trifolium spp.	June 29, 1959	Roadside in Picea-Abies/ Pachistima habitat type	E. Tisch
Trifolium spp.	July 8, 1960	Roadside in Picea-Abies/ Pachistima habitat type	G. Gier
Vaccinium membranaceum (blossoms)	June 12, 1959	Picea-Abies/Pachistima habitat type	E. Tisch

Appendix C. (Continued)

Items Consumed	Date	Vegetation or Habitat Type	Observer
Vaccinium membranaceum (fruit)	July 24, 1959	Picea-Abies/Pachistima habitat type	?
Vaccinium membranaceum (fruit)	July 29, 1960	Picea-Abies/Pachistima habitat type	E. Tisch

*Tentative observation
?Observer unknown

Appendix D. Phenological data pertaining to some common plants found on the Big Creek study area

Plant Species	Approximate Date Initial Blooming 1959	1960	Approximate Date Fruit Maturation 1959	1960
Amelanchier alnifolia	June 15*	June 4	Aug. 3	July 21
Arnica spp.	June 22*	May 16	-	-
Berberis repens	-	-	Aug. 10	July 31
Cornus stolonifera	-	June 25	-	Aug. 6
Elaeagnus canadensis	-	-	July 22*	-
Fragaria spp.	June 15*	June 9*	June 25	-
Lonicera involucrata	-	June 9*	July 15	July 2
L. utahensis	-	June 9*	July 2	July 15*
Prunus virginiana	June 27*	June 18	-	-
Ribes inerme	-	-	July 30	July 21
R. lacustre	-	June 9	Aug. 5*	July 21
R. viscosissimum	-	June 11	Aug. 10	Aug. 10
Rubus idaeus	June 24*	-	July 23	July 25
R. parviflorus	June 29	June 22	Aug. 12	Aug. 9
Sambucus melanocarpa	June 21	June 14	July 29	July 26
Sorbus spp.	-	June 14	-	Aug. 24
Vaccinium membranaceum	June 12*	June 9*	July 10	July 13
V. scoparium	-	June 13	July 21	July 23*
Xerophyllum tenax	June 12	June 7	-	-

*Event probably occurred one week or more prior to indicated date