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OREGON JUNCO FOODS IN CONIFEROUS FORESTS

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## ABSTRACT

A food analysis was made from the gizzard contents of 262 Oregon juncos (*Junco oreganus*) collected in western Oregon from 1954 through 1962. The average annual diet was about half seed and half insect material. Juncos ate the seeds of many plants and also some germinants (sprouting seeds, and seedlings with seed coat on the cotyledons); those of Douglas-fir (*Pseudotsuga menziesii*), blackberry and raspberry (*Rubus spp.*) and hawkweed (*Hieracium albiflorum*) were the most important. A great variety of insects was taken but ants (Formicidae), snout beetles (Curculionidae), ground beetles (Carabidae), and leafhoppers (Cicadellidae) comprised the greatest volume. Douglas-fir seeds and germinants were an important sought-after junco food averaging 12%. They represented a trace in seed failure years, 6% in light seed years, and 32% in moderate to heavy seed years. Hemlock (*Tsuga spp.*) averaged only 1% of the food, even though it was a consistent seed producer. Seeds of redcedar (*Thuja plicata*) were not taken. Destruction of Douglas-fir seeds and germinants by juncos should be considered when evaluating factors that may hinder regeneration.

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## INTRODUCTION

As the acreage of logged timberland increases in the Douglas-fir belt, the problem of forest regeneration becomes increasingly important. Many factors, including wildlife, high and low temperatures, drought, disease, frost heave, and others, retard or prevent adequate regeneration on clearcuts. The relationship of songbirds to the forest seed crops has not been extensively investigated in the Douglas-fir belt. Although ground-feeding songbirds often frequent clearcuts in relatively large numbers, their influence on the seed crop and germinants has been largely ignored. In order to understand and to evaluate more accurately the causes of regeneration problems, all influences need to be recognized and considered. As far as we know, Hagar's (4) article is the most recent and extensive one bearing on bird influences on the seed crops in the Douglas-fir belt.

Since juncos are known tree seed-eaters and are one of the most abundant species on the clearcuts, they seemed a logical subject for investigation. Isaac (5) reported that wintering juncos and sparrows were heavy consumers of tree seeds. In 1954, 19 juncos were collected on the Lakes Ranger District, Mt. Hood National Forest, at an elevation of about 2,000 feet. The other 243 birds were taken in following years on the H. J. Andrews Experimental Forest and immediate vicinity, which is within or adjacent to the Willamette National Forest, at an elevation of 1,300 to 4,000 feet. Both areas had old-growth Douglas-fir, hemlock, and redcedar trees interspersed with small clearcuts. Until the end of 1962 small monthly bird collections were made whenever time would permit and juncos could be found on the study area.

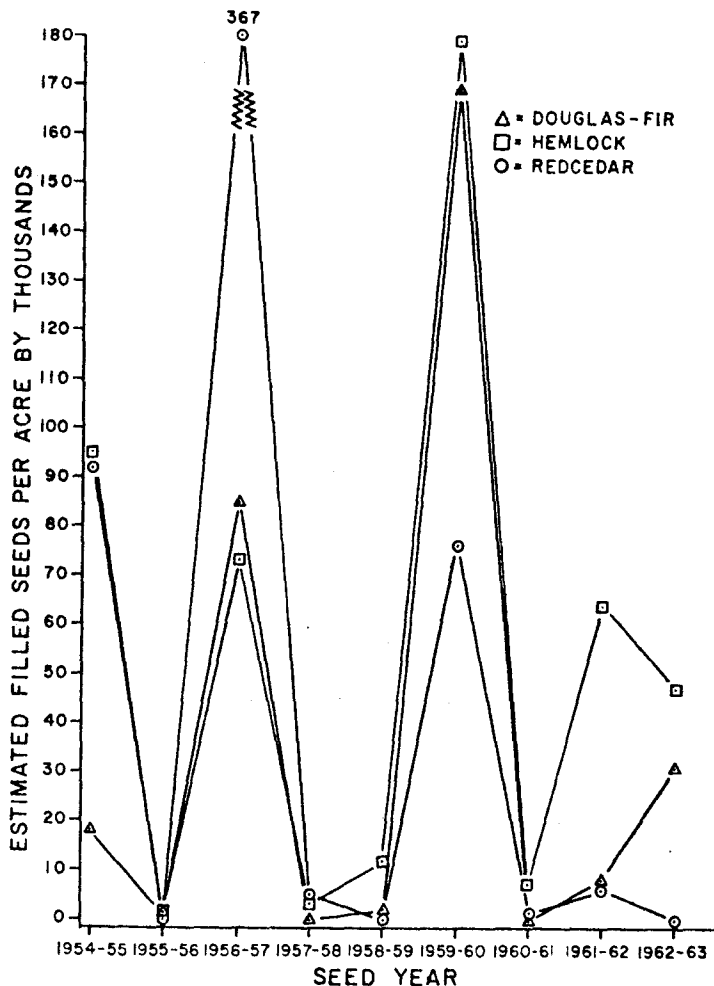


Table 1. Average percentage by volume and by frequency of occurrence of food items that totaled 1% or more of the contents of 262 junco gizzards

The junco work unit was subordinate to other units; consequently, the samples were sometimes not so extensive or well distributed as desired.

#### METHODS

The estimated annual crops of tree seed were obtained by means of seed traps. Seed data used in this paper are being reported by Gashwiler (2).

Efforts were made to collect juncos every month, but sometimes during the winter they apparently moved off the study area to lower elevations along the McKenzie River. Birds were taken primarily by shotgun and recovered with the aid of a beagle. A few were taken with kill traps set for small mammals. The gizzards were removed, tagged, and preserved in formalin.

The gizzard contents were examined at the Denver Wildlife Research Center by the authors. After the contents were washed and dried, the food items were identified and separated. The percent volume of each item was estimated by visual appraisal. Data are presented by the aggregate percentage and frequency of occurrence methods described by Martin et al. (6).

The entire sample of 262 junco gizzards, for all months of the year, was combined in Table 1. Percentages were rounded to the nearest whole number, and items forming less than 1% were deleted. Unfortunately, identifying numbers eroded from the tags of the 1954 sample, and the 19 gizzards from that year could not be used in the monthly compilations. Since the yearly samples were small and unevenly distributed, it seemed best to combine similar years on the basis of the estimated Douglas-fir seed fall.

Fig. 1.—Estimated filled seed fall per acre by seed years on the H. J. Andrews Experimental Forest.

	Percentage by volume	Percentage by frequency of occurrence
Plants (mostly seeds):	51	92
Trees	14	40
Douglas-fir seeds and germinants	12	37
Hemlock	1	2
Others ( <i>Taxus brevifolia</i> and <i>Alnus oregona</i> )	1	2
Shrubs	9	54
Blackberry or raspberry	5	36
Huckleberry ( <i>Vaccinium</i> spp.)	2	15
Salal ( <i>Gaultheria shallon</i> )	1	7
Elderberry ( <i>Sambucus</i> spp.)	1	15
Others — miscellaneous	1	1
Grass and grass-like	10	40
Melic ( <i>Melica harfordii</i> )	2	5
Sedge ( <i>Carex</i> spp.)	2	19
Rye-grass ( <i>Lolium</i> sp.)	2	5
Wood rush ( <i>Luzula</i> spp.)	2	5
Velvet grass ( <i>Holcus lanatus</i> )	1	2
Others — miscellaneous	1	8
Weeds	17	55
Hawkweed	3	18
Oregon tea ( <i>Satureja douglasii</i> )	2	10
St. John's wort ( <i>Hypericum</i> sp.)	2	4
Fireweed ( <i>Epilobium minutum</i> )	2	5
Fireweed ( <i>Epilobium angustifolium</i> )	1	3
Violet ( <i>Viola</i> spp.)	1	7
Knot-weed ( <i>Polygonum aviculare</i> )	1	6
Miner's lettuce ( <i>Montia</i> spp.)	1	4
Canada thistle ( <i>Cirsium arvense</i> )	1	5
Mint ( <i>Labiatae</i> )	1	3
Others — miscellaneous	2	23
Unidentified seeds and vegetation	1	21
Animals:	49	94
Insects	46	93
Beetles ( <i>Coleoptera</i> )	19	58
Snout beetles	7	26
Ground beetles	5	16
Leaf beetles ( <i>Chrysomelidae</i> )	2	10
Lamellicorn beetles ( <i>Scarabaeidae</i> )	1	6
Tiger beetles ( <i>Cicendellidae</i> )	1	1
Miscellaneous adults and larvae	3	25
Ants, bees, and wasps ( <i>Hymenoptera</i> )	16	72
Ants	14	61
Unidentified bees and wasps	2	16
Hoppers and aphids ( <i>Homoptera</i> )	4	28
Leafhoppers	3	24
Aphids ( <i>Aphididae</i> )	1	5
True bugs ( <i>Hemiptera</i> )	3	24
Lace bugs ( <i>Tingidae</i> )	1	15
Stink bugs ( <i>Pentatomidae</i> )	1	15
Unidentified	1	7
Flies, including larvae and pupae ( <i>Diptera</i> )	1	8
Butterflies and moths, including larvae and pupae ( <i>Lepidoptera</i> )	1	5
Grasshoppers ( <i>Orthoptera: Locustidae</i> )	1	3
Miscellaneous and unidentified	1	19
Other animals	3	14
Spiders ( <i>Araneae</i> )	2	6
Miscellaneous and unidentified	1	5

These were (1) crop failure—no seeds per acre; (2) light seed fall—1,000 to 10,000 filled (the endosperm fills the seed coat) seeds per acre; and (3) moderate to heavy seed fall—over 10,000 filled seeds per acre. To simplify the discussion, plant food items, with the exception of Douglas-fir and hemlock, were combined into broad groups. These included other trees, shrubs (mostly berries), grass and grass-like plants (sedges, spike, and wood rushes), weeds (forbs), and unidentified seeds and vegetation. Animal foods were grouped under insects (all true insects) and other animals (spiders, mites, centipedes, snails, miscellaneous, and unidentified).

## RESULTS

**Seed fall.** During the 9-year period there were two years when the Douglas-fir seed crop failed, three with light seed fall, and four with moderate to heavy crops (Fig. 1). At the same time, hemlock had three light and six moderate to heavy crops. Hemlock is noted as a consistent seed producer in the Douglas-fir belt. No filled redcedar seeds were trapped during three of the years, three years had a light crop, and the other three years a moderate to heavy crop. Redcedar was the most variable seed producer of the three species, having the most failures and also the largest single crop.

The seed fall data were secured from only one clearcut each year. Since the crop sometimes varies by elevation and by exposure, it is not necessarily uniform over large areas. However, the larger seed crops seem to be much more evenly distributed than smaller ones (7). Consequently, the data in figure 1 are not precise measures of the yearly abundance of tree seeds where the juncos were collected; they are only intended to represent gross abundance.

**Food habits.** The gizzards of 262 juncos for all seasons and years by volume, contained 51% plant and 49% animal material (Table 1). Juncos ate the seeds of many plants; those of Douglas-fir, blackberry and raspberry, and hawkweed were the most important. Douglas-fir and blackberry and raspberry were present in over 35% of the gizzards. Sedge, hawkweed, huckleberry, and elderberry were also widely taken.

Animal food was almost entirely of insect origin. Ants, snout beetles, ground beetles, and leafhoppers were the most important items by volume. A great variety of beetles was taken; if they are considered as a group, they exceed the ants in importance, since they formed 19% of the food by volume. Spiders, centipedes, and a few snail remains were the bulk of the non-insect animal food.

Sixty-seven gizzards formed the sample for the years when the Douglas-fir seed crop was a failure (Table 2). December, January, and February were not represented. Only trace amounts of Douglas-fir seeds were found. Plant food, mostly weed and seeds of grass-like plants, formed 40% of the diet; the remainder was nearly all of insect origin.

Table 2. Average percentage by volume of food in 67 junco gizzards from failure Douglas-fir seed years of 1957-58 and 1960-61.

	Sept.	Oct.	Nov.	Mar.	Apr.	May	June	July	Aug.	Ave.
No. gizzards	11	3	4	4	14	10	6	5	10	7
Plants (mostly seeds)	36	10	76	100	40	1	14	18	62	40
Douglas-fir	0	0	0	0	1	0	0	0	0	T
Other trees	0	0	0	17	0	0	0	0	0	2
Shrubs	14	3	3	14	5	T	3	12	19	8
Grass and grass-like	2	2	16	51	4	0	2	1	19	11
Weeds	20	2	57	18	29	1	7	0	23	18
Other plants	T	3	0	0	1	0	2	5	1	1
Animals	64	90	24	T	60	99	86	82	38	60
Insects	64	73	24	T	58	98	83	82	38	58
Other animals	0	17	0	T	2	1	3	0	T	2

Seventy-five gizzards constituted the sample for the years when the Douglas-fir seed crop was light (Table 3). No gizzards were collected for the December to February period. Douglas-fir seed formed 6% of the food and hemlock 2%.

The moderate to heavy Douglas-fir seed years were represented by 101 gizzards (Table 4). June was the only month when no collections were made. Douglas-fir seeds formed 29% and hemlock a trace of the plant food.

#### DISCUSSION

The average yearly volume of junco food was about half of plant and half of animal origin. In northwestern California, the average volume of food for a 3-year period was about 61% seeds, 33% insects, and 6% miscellaneous (4). Seeds and insects formed the bulk of the junco diet in Oregon. The great number of seed and insect items, many of which are not shown in Table 1, suggests that these birds have a varied taste and that availability probably plays an important, though not exclusive, role in food consumption. This is further borne out when the average monthly percentages are considered (Table 5). These show that seed consumption is very high from November to March; this would coincide with reduced numbers of available insects and with the abundance of relatively large quantities of conifer and other seeds. April had about equal amounts of seeds and insects consumed, but May showed a marked decrease in seed consumption with a sharp rise in insects. This would correlate well with the spring increase of insects and with the physiological need of nestlings for large amounts of animal protein. June and July were also high insect food months. In August, however, a large volume of seeds were eaten. This may have been due to insufficient samples, but examination of the more detailed data revealed that some of the early seed crops had started to ripen (berries, miner's lettuce, huckleberries, etc.) and that the birds were feeding on them. In addition, the nestlings were probably not so numerous nor their requirements for soft insect food so pressing by that time. Cooper (1) stated, "As a rule scarcely any of the birds of California, south of latitude 38°, raise two broods in a season. . . . This is the effect of the rapidity with which the breeding season passes, corresponding to the rapid but short growing season of vegetation after the frosts cease and before it becomes too dry. Caterpillars and other soft insects suitable for the young become scarce when the vegetation gets dry." September and October were months when seeds and insects were of nearly equal importance on the Andrews Forest. General observations, made during intensive checks for germinants and seedlings indicated a large terrestrial insect population, at least at the 2,000 to 3,000 foot level.

Douglas-fir seeds are an important food of juncos (Table 1). These birds also feed, to some extent, on germinants when the cotyledons are still

Table 3. Average percentage by volume of food in 75 junco gizzards from light Douglas-fir seed years of 1955-56, 1958-59, and 1961-62.

	Sept.	Oct.	Nov.	Mar.	Apr.	May	June	July	Aug.	Ave.
No. gizzards	14	11	3	8	16	7	4	4	8	8
Plants (mostly seeds)	57	47	55	83	43	23	5	20	82	46
Douglas-fir	0	11	T	22	19	T	1	0	0	6
Hemlock	0	0	0	11	6	0	0	0	0	2
Other trees	T	0	0	0	0	0	0	0	1	T
Shrubs	16	1	3	7	4	2	1	0	16	6
Grass and grass-like	2	4	30	26	5	19	1	T	3	10
Weeds	37	25	20	16	7	T	2	20	56	20
Other plants	2	6	2	1	2	2	T	0	6	2
Animals	43	53	45	17	57	77	95	80	18	54
Insects	42	52	33	16	50	75	90	79	18	51
Other animals	1	1	12	1	7	2	5	1	0	3

encased by the seed coat. They clip off the seed coat and eat the endosperm, and sometimes the tip of the cotyledons if germination is sufficiently advanced. Observations suggest that seeds and germinants are especially vulnerable to animal depredations on freshly burned cutovers. They are highly visible against the barren black background to the human eye and would appear to be readily seen by birds with their keen sight. Field observations indicate that junco depredations on germinants cease when the seed coat is cast. This was also found to be the case in forest nurseries (7). During periods of seed fall, juncos can often be observed searching for tree seeds along roads, cuts, banks, or other more or less barren places. That Douglas-fir seeds and germinants are a sought-after, preferred junco food, is also indicated by their first rank among the plant items (12%) and by the large number of birds (37%) feeding on them (Table 1). An interesting bit of information along this line is as follows: In 1957-58 no filled Douglas-fir seeds were trapped and it was a failure crop. However, in April one junco's gizzard contained 10% Douglas-fir seeds—the bird had either hunted for the seed or been quick to take advantage of an opportunity. Juncos' fondness for Douglas-fir seed was also noted by Hagar (4).

Hemlock was a consistent seed producer and frequently had larger crops than Douglas-fir (Fig. 1). However, it constituted only 1% of the juncos' food (Table 1). Consequently, in this study junco depredations on hemlock seeds were of minor importance. It is difficult from the field data to state definitely whether Douglas-fir seeds are more palatable to juncos than hemlock. During the seed years of 1954-55 and 1961-62 the hemlock crop was much greater than the Douglas-fir crop (Fig. 1), but no hemlock seeds were present in the gizzards, contrasted to 3 to 4% for Douglas-fir. This does not prove a preference, however, since Douglas-fir seeds are much larger, and though not so numerous, may have actually been more available than the more abundant hemlock seeds. Douglas-fir germinants are also much larger and would display the seed coat to better advantage. In any event, the Douglas-fir seeds and germinants were taken in much larger amounts than hemlock by juncos.

Although redcedar was a variable seed producer over the 9-year period, large crops were available at times (Fig. 1). It is interesting to note that it was not represented among the junco foods in Table 1. Although redcedar seeds are small, the wings persist, and this probably makes them more conspicuous than hemlock seeds, which soon become wingless. This is especially true for sightings at right angles to the wing's surface. This suggests that redcedar seeds are not palatable to juncos. However, this is not true for all birds, since pine siskins (*Spinus pinus*) displayed a definite preference for redcedar seeds (3).

Table 4. Average percentage by volume of food in 101 junco gizzards from moderate to heavy Douglas-fir seed years of 1954-55, 1956-57, 1959-60, and 1962-63

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	July	Aug.	Ave.
No. gizzards	14	11	12	9	4	2	5	21	12	4	7	9
Plants (mostly seeds)	47	81	82	93	89	95	86	69	22	70	79	74
Douglas-fir	4	57	38	62	15	22	40	63	21	13	17	32
Hemlock	3	1	0	0	0	0	0	0	0	0	0	T
Other Trees	0	0	0	0	0	0	0	0	0	5	0	T
Shrubs	16	9	10	15	3	3	5	2	1	35	41	13
Grass and grass-like	12	11	29	8	16	62	9	1	0	4	9	15
Weeds	12	3	4	7	43	5	15	T	0	12	11	10
Other plants	T	T	1	1	12	3	17	3	T	1	1	4
Animals	53	19	18	7	11	5	14	31	78	30	21	26
Insects	47	19	18	6	11	5	13	29	72	30	21	25
Other animals	6	0	0	1	0	0	1	2	6	0	0	1

Perusal of Table 4 for the moderate to heavy Douglas-fir seed years shows that in every month represented Douglas-fir seed was eaten by juncos. Seed consumption was light in September but increased rapidly until December. During January and February, which often had snow cover, consumption decreased. March and April were also months of high Douglas-fir seed consumption. The use percentage then fell until the last of August. Annual junco tree seed consumption roughly followed the seed fall abundance pattern as reported by Gashwiler (2). The total average percentage of all seeds, except Douglas-fir, was roughly comparable in Tables 2, 3, and 4. When Douglas-fir seed consumption rose during the moderate to heavy Douglas-fir seed years, a decrease occurred in the animal food group (Table 4). One can only conjecture, but it seems probable the birds found the Douglas-fir seeds easier to harvest than an equal quantity of insects. In addition, Douglas-fir seeds may be more palatable than insect food.

Although junco consumption of Douglas-fir seeds could help to retard regeneration, especially in years of small seed production, the birds have valuable qualities too. Besides their well-known aesthetic value, they feed on a great variety of weed seeds and insects (Table 1). It does not seem likely that they completely control the abundance of any single species because of the "law of diminishing returns." However, their constant attrition of the crops of seeds and insects must have a repressive influence. Circumstances are largely responsible for determining whether a weed or insect species is desirable, neutral, or undesirable to man's interests.

#### CONCLUSIONS

Of the three conifers studied, juncos ate appreciable amounts of only Douglas-fir. When large numbers of juncos are present, they could consume many Douglas-fir seeds and germinants and they should be considered along with other factors which may retard Douglas-fir regeneration. This seed consumption may be especially important during years of light seed fall. The birds also ate large numbers of other seeds and insects.

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Table 5. Average monthly percentage by volume of junco plant and animal food for the 9-year period.

Months	Plant	Animal
Sept.	47	53
Oct.	46	54
Nov.	71	29
Dec.	93	7
Jan.	89	11
Feb.	95	5
Mar.	90	10
Apr.	51	49
May	15	85
June	10	90
July	36	64
Aug.	74	26