

BIRD DAMAGE TO ALMONDS IN CALIFORNIA

WITH THREE ILLUSTRATIONS

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Almond culture has been an important industry in California for about fifteen years. At present practically all the almonds grown commercially in the United States are produced in California. Of the various enemies of the California almond grower, birds are by no means the least. Almonds are particularly attractive to birds of the families Picidae and Corvidae, and in certain localities may form a major part of the diet of these birds in the summer months. As a consequence, complaints from farmers have been numerous and insistent.

An extreme case illustrating the potentiality of birds for damage to almonds occurred in the Goodnoe Hills of southern Washington in 1919. Entire orchards, it is said, were stripped clean in a few days by the roving flocks of crows numbering approximately 30,000 individuals (Gardner, Auk, vol. 43, 1926, pp. 447-461). Since captive crows at Davis demonstrated their ability to consume 30 almonds a day, it is easy to see how such a flock could do away with a million nuts or 5000 pounds in a single day—the productive capacity of five average acres.

Less gregarious birds do not have the same destructive potentialities, yet may by persistent activity destroy an appreciable portion of the crop. California Woodpeckers (*Balanosphyra formicivora bairdi*) may account for a surprising number of almonds because of their nut-storing habit. The damage by Lewis Woodpeckers (*Asyndesmus lewisi*) to various orchards of the Capay Valley was estimated at from 1 to 10 per cent in 1912 (Bryant, Monthly Bull., Calif. Comm. Hort., vol. 1, 1912, pp. 362-366).

The objects of the present paper are to present detailed statistics on the extent and nature of bird damage in one locality, and to evaluate, in general terms, bird damage to almonds throughout the state. The results of a study in the control of this damage have been left for a future paper.

The intensive observations for the present study were made on the 1079-acre, University of California farm at Davis during the summers of 1935 and 1936. Five almond plantings were kept under close observation: a creek-bank orchard of young trees covering approximately ten acres; a "variety orchard", containing 45 large trees of 15 varieties; and three small groups of almond trees in large, mixed orchards. Casual observations were made on two additional orchards near Davis and on one near Dixon.

Three types of bird damage to almonds were noted: disbudding by linnets and other species in the early spring; trunk injuries by sapsuckers; and taking of the harvestable nuts by crows, jays, and woodpeckers. Since the latter type was by far the most important at Davis, it will be the only one discussed in this paper.

Four species of birds, in order of their importance as destroyers of almonds on the University farm, are the Western Crow (*Corvus brachyrhynchos hesperis*), California Woodpecker, California Jay (*Aphelocoma californica immanis*), and Red-shafted Flicker (*Colaptes cafer collaris*). Of these the crow is the worst offender, due partly to its taste and capacity for almonds and partly to its gregarious feeding habits during the summer.

Crows were irregular in their feeding schedules and made their visits to the almond groves at almost any time of day between sunrise and sunset. Alighting in an orchard, the members of a flock work individually. Nuts, as a rule, are knocked off before the shell has been penetrated. The birds may follow the first nut to the ground, but more

frequently will look farther, dislodging a whole series before dropping down to clean up the harvest. From a quarter to half of the birds of a feeding flock are generally thus engaged on the ground. Nuts are seldom carried away any distance except as the birds are surprised and flushed while feeding. Opening is accomplished with long vigorous strokes of the partly opened bill. An irregular hole is gouged out of one side or edge of the hull and shell in typical samples.

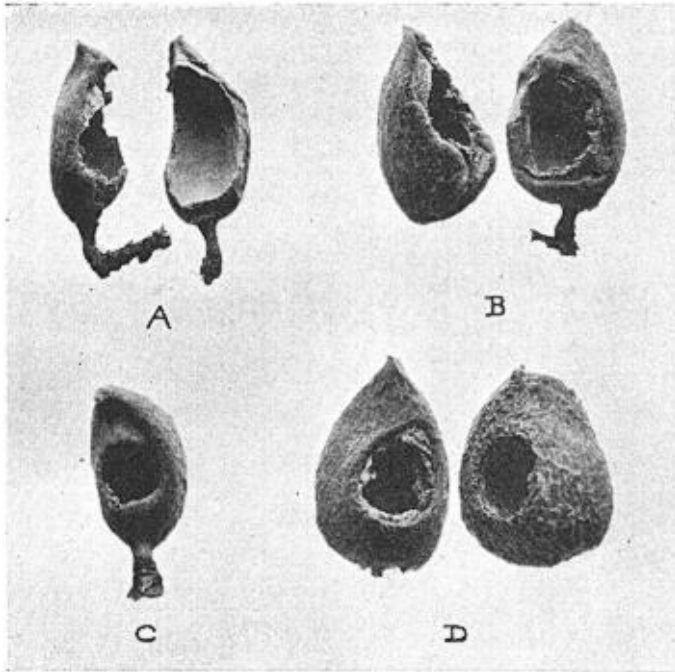


Fig. 55. Almonds opened by various species of birds: A, California Jay; B, Western Crow; C, California Woodpecker; D, Red-shafted Flicker.

California Woodpeckers are independent feeders in the almond orchards. Nuts are occasionally opened and eaten in place, but more often are removed to a convenient high crotch, horizontal limb, or telephone-pole top in the vicinity. There a neat, round hole is drilled in one side of the hull and the contents extracted bit by bit, the bird tilting its head first to one side then to the other as it probes into all parts of the shell cavity. California Woodpeckers fed almost exclusively on almonds in the summer months and could be seen in and around the trees at all times of day. Their activities started at or within a few minutes of sunrise and continued, with an early-morning and late-afternoon peak, till a half hour before sunset.

The quantity of nuts consumed by California Jays on the University farm is considerably less than that taken by crows or California Woodpeckers. Jays work singly save when in family groups, generally entering the tree from below and working upward into the central branches to secure the nuts. A low crotch, horizontal limb, or fence-post top serves as the anvil on which nuts are pounded with partly-opened bill. Drawing upward as far as possible the bird, with half-spread wings, throws its full weight into each stroke. One entire side of the hull is generally removed before the kernel has been completely cleaned out. A small number of nuts is carried away to be eaten or stored elsewhere.

Red-shafted Flickers were not sufficiently abundant or persistent in their attacks to be important as almond destroyers. A pair nested in one of the trees of the variety orchard both in 1935 and 1936, and fed to a large extent on the nuts of a few neighboring trees. Over 200 emptied hulls, each drilled with a neat, round hole, were found below this nest in the 1936 season. A small number of flickers worked out into the creek-bank orchard from the tall cottonwood trees along with the California Woodpeckers.

Other species which were observed taking almonds on the University farm were the Nuttall Woodpecker (*Dryobates nuttallii*) and the Willow Woodpecker (*Dryobates pubescens turati*). Blackbirds have frequently been accused of stealing almonds; but although three species, Brewer (*Euphagus cyanocephalus*), Bicolored (*Agelaius phoeniceus*), and Tricolored (*Agelaius tricolor*) were all common in the orchards, there is no definite evidence that they were feeding on almonds during the preharvest months.

Species which were absent from the University farm and which have been reported to feed on almonds include importantly Yellow-billed Magpie and Lewis Woodpecker.

The first objective of the present study was to measure the extent of the preharvest damage to the University farm almond orchards. The usual technique of food-habit study through stomach examination was not applicable. Almond meats are eaten with little undigestible material, and when broken down in a bird's stomach are difficult to recognize. Pellet analyses are unreliable for the same reason. Crows and jays, when feeding on almonds, almost always drop the empty hulls beneath the trees from which they are taken, and thereby provide a reasonably reliable medium for the measurement of the damage.

In the present study hulls were collected and counted every few days and separate records kept for each tree. Up to July 20 measured crow-damage in the variety orchard was approximately 12,000 nuts (1936) or 60 pounds, roughly 10 per cent of the estimated potential crop of that orchard. By September 1 the accumulated loss had reached an estimated total of 30,000 nuts or 150 pounds, about 28 per cent of the potential crop. Damage to individual trees was often more severe, reaching in certain instances as high as 67 per cent by July 20, and 90 per cent by September 1. Similar figures were obtained for the small plantings in the mixed orchard. Crows, however, did not disturb the almonds in the 10-acre stream-bank orchard during the two years of observation.

TABLE 1. EXTENT (PER CENT) OF PREHARVEST DAMAGE IN THREE ALMOND PLANTINGS ON THE UNIVERSITY FARM, DAVIS, CALIFORNIA. (Harvest date for earliest varieties is about August 10 at Davis.)

Orchard	Western Crow	California Woodpecker	California Jay	Red-shafted Flicker	Totals
Creek bank (10 acres)*	0	5	1	1	7
Variety (1 acre)	20	0	0	1	21
Root-stocks (¼ acre)	20	7	1	0	28

* Only 6 of the 10 acres in this orchard were producing in the seasons of 1935 and 1936.

California Woodpecker damage, on the other hand, was greatest in the stream-bank orchard and in one of the small plantings in the root-stocks orchard, but was negligible or absent elsewhere. These birds do not generally open nuts in the orchard. In the stream-bank orchard the nuts were removed to some near-by cottonwood trees before opening. From a blind located beneath these trees counts of passing woodpeckers were easily and accurately made. Observations covering two months were distributed so as to include all of the daylight hours. From the plotted curves of hourly and daily activity thus obtained, it was possible to compute the total woodpecker harvest with considerable accuracy.

Approximately 700 nuts (3½ pounds) were removed every day from the creek-bank orchard during the height of woodpecker activity. This meant a loss of about 300 pounds or 5 per cent of the estimated potential yield of that orchard during the season. Damage

by California Jays and Red-shafted Flickers was estimated not to exceed one per cent in any University farm orchard.

Almond-eating activities of the various species commenced from 5 to 13 weeks after the termination of the blossoming season and from 5 to 13 weeks before the beginning of the harvest. Ground squirrels were found taking the green nuts as early as May 20

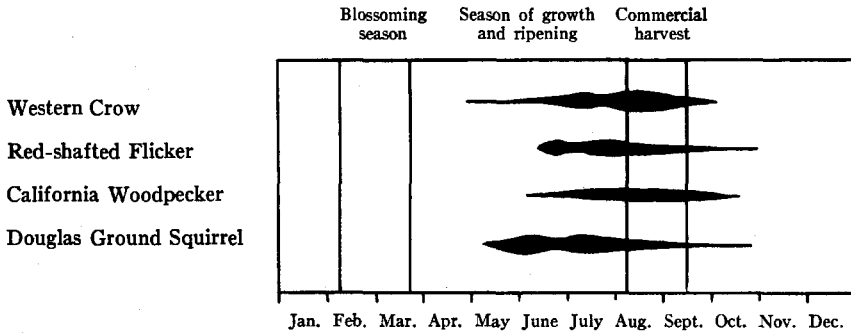


Fig. 56. Seasonal activity of birds and mammals in almond orchards on the University Farm, Davis, California.

and had stacked a quantity of empty hulls by the time accurate daily counts were begun in the variety orchard on June 2. Crows made occasional visits to the variety orchard for nuts as early as April 25, but did not commence their regular almond-feeding activities until the first of June. Jays were first seen opening almonds in the latter part of May. Flickers were present in the variety orchard all spring, but apparently did not start opening almonds until June 15. The California Woodpeckers in the creek-bank orchard began their activities in late June or early July.

The daily deposit of bird-opened nuts under the 45 trees of the variety orchard increased slowly through the first half of June, but rose suddenly about June 20, when crows began working in earnest on two or three trees. From June 30 to July 10 the daily consumption increased rapidly, reaching a peak of over 1000 nuts a day on July 11, 12, and 13. The last 10 days of July saw a slight drop, and from then on, crow activity in this orchard was irregular, due partly, at least, to the presence of workmen in the vicinity. The number of crows increased greatly during August, and since no attempt was made to harvest the crop, flocks of as high as 200 were occasionally seen feeding in and around the trees until the end of that month. By this time the most attractive trees were practically stripped of nuts, and the crows gradually lost interest. A few jays and flickers continued to visit the orchard for the remaining nuts through the fall and winter. California Woodpeckers in the creek-bank orchard not only started later in the season but continued in full swing in the unharvested sections through September.

The intensity of damage in the various trees and orchards was by no means uniform. An unusual opportunity for a comparative study of variety preferences of the crow was offered, particularly in the variety orchard where 14 of the most important varieties were each represented by a row of 3 trees. Two successive years of hull-counting in this orchard thus gave 6 tree counts for each variety. Nonpareils, first in commercial importance, received the greatest attention from the birds during the preharvest weeks, averaging 1036 nuts per tree between June 1 and July 20. Kings were second with a 965 average. Princess, represented by only two trees in each season, was third with 548. Ne Plus Ultra was fourth; California paper shell, fifth; and I.X.L., sixth. (This last-named variety was the most attractive in Gardner's Washington study [Gardner, *loc. cit.*].) Varieties which

received slightly less attention at Davis were Languedoc, Texas, Reams, Lewelling, Peerless, and Drake. No variety was entirely immune, even the iron-shelled Jordans occasionally being opened.

TABLE 2. BIRD PREFERENCES AND SHELL TEXTURE OF THE MORE IMPORTANT ALMOND VARIETIES

Variety	Order of preference	Shell texture	Variety	Order of preference	Shell texture
Nonpareil*	1	paper	Texas	8	medium
King	2	paper	Reams	9	medium
Princess	3	paper	Lewelling	10	medium
Ne Plus Ultra*	4	soft	Drake*	11	hard
California paper shell	5	paper	Peerless*	12	hard
I.X.L.*	6	medium	Eureka	13	soft
Languedoc	7	medium	Jordan	14	hard

* Varieties of commercial importance.

Qualities of the nuts which might be considered to influence the birds in their preferences are size, degree of ripeness, sweetness, and thickness of shell. Size apparently is unimportant. Degree of ripeness, strangely enough, showed no correlation with bird attack after feeding in the orchard had once started, early and late attractive varieties being attacked simultaneously and with equal avidity. Bitter almonds were found to be highly distasteful and even somewhat toxic to captive crows. Aside from sweetness, however, "soft" or "paper" shell seems to be the most important quality of a desirable almond from the birds' standpoint. A list of varieties, graded according to thickness and toughness of shell, closely parallels the birds' order of preference.

It is remarkable how rapidly crows and jays learned to concentrate on the trees bearing the most desirable types of nuts. On one Nonpareil tree in the root-stocks orchard, 60 out of 72 nuts specially marked by the Division of Pomology for growth studies were taken between July 11 and August 3, while a neighboring Texas tree did not lose a single marked nut. Woodpeckers with their adaptations for drilling were less restricted in their choice of varieties.

Variety preferences, however, do not begin to account for the uneven distribution of bird attack in different orchards and in the various trees within an orchard. A supply of almonds in order to be acceptable to a bird species must be supplemented with some kind of loafing or escape cover in the near vicinity. Crows are easily satisfied in this respect and may find the orchard trees with the surrounding fields adequate for the purpose. If the orchard trees are old and large they may also provide adequate cover for flickers, but jays and California Woodpeckers generally require more. California Woodpeckers, for instance, were absent from the variety orchard, where a single row of tall black walnuts was the only supplementary cover, but abounded along the creek bank half a mile away where large half-dead cottonwoods, oaks, and walnuts were more widely distributed.

Crows seldom feed in areas disturbed by frequent human activity. Plantings in close proximity to dwellings or to busy thoroughfares in the vicinity of Davis lost a small percentage of their nuts to jays, flickers, and California Woodpeckers but, so far as is known, were never visited by crows.

The size and shape of an orchard are also important features from the birds' standpoint. Generally speaking, the peripheral trees of an orchard receive the first and greatest attention from birds. Isolated trees, small plantings, or single rows in which all of the trees are peripheral seem to suffer most. A large orchard with a smaller ratio of peripheral to central trees is likely to receive less injury. In the three longitudinal rows of the variety orchard the outer rows, composed of the same varieties as the middle row, lost four times as many nuts.

Financial losses due to birds in commercial production are deducted, of course, from the gross income side of the ledger while the production costs may be raised through expensive control measures. The net profit is therefore seriously affected. Since most California almond orchards are operated at a narrow margin of profit, a 5 per cent to 25 per cent loss, such as that described above for the University farm, would often be sufficient to cancel all profit. Fortunately, in the large commercial orchards losses as high as this appear to be exceptional.

Although it is impossible to make direct comparisons between relative statements and the quantitative measurements given above, a summary of reports from county agents and farmers in 15 of the 16 major almond producing counties of California is useful in giving a general picture of conditions throughout the State. Reports from Contra Costa and Riverside counties indicate that the damage is so small as to be negligible. In Tehama, Butte, Yolo, Sacramento, San Joaquin, Stanislaus, Merced, and San Luis Obispo counties losses were generally light. Instances of damage were apparently more frequent in Yuba, Calaveras, and Monterey counties. Marginally located orchards, particularly small groves located in hilly or wooded sections, were most subject to attack. In no county was heavy damage general.

Jays and California Woodpeckers were accused most frequently in the foothill orchards, while over the lowland areas Western Crows appear to be the worst offenders.

University of California, Branch of the College of Agriculture, Davis, California, July 12, 1937.



Fig. 57. Distribution and intensity of bird damage to almonds in California; season of 1936. The principal almond-growing districts are circumscribed with a heavy line. Plain areas showed no appreciable damage; stippled areas, light damage; hatched areas, moderate damage. No district reported widespread heavy damage.