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UNITED STATES DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

BIRD DAMAGE TO GRAPES IN THE UNITED STATES WITH EMPHASIS ON CALIFORNIA

by

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ABSTRACT

Results from a questionnaire returned by 375 agricultural specialists, wildlife specialists, and grape growers throughout the United States indicated that bird damage to grapes was at least \$4.4 million in 1972. The loss in California alone was probably more than \$3.7 million. Grapes of various varieties were grown on over 645,600 acres in 13 States. California contained about 85% of the total U.S. acreage and accounted for about 90% of the total U.S. production. Respondents reported that bird damage was generally a serious problem in one State, a moderate problem in three States, a slight to moderate problem in seven States, and a slight problem in two States. Starlings (*Sturnus vulgaris*), sparrows (species undetermined), and finches (*Carpodacus* spp.) were the most important damaging species, but robins (*Turdus migratorius*), bluebirds (*Sialia* spp.), and waxwings (*Bombycilla* spp.) were locally important. Exploders, shooting, electronic sound devices, trapping, and various poisons were listed as the most effective and frequently-used control methods, however, most respondents felt that available control methods are inadequate.

INTRODUCTION

Although wild birds damage a variety of agricultural crops in the United States, little is known about the nationwide severity of these damage problems. To our knowledge, there were no published nationwide surveys of bird damage until 1970, when Stone et al. (1972) conducted an objective survey on bird damage to field corn. Subjective questionnaire surveys have since been conducted on bird damage to sprouting corn (Stone and Mott 1973) and blueberries (Mott and Stone 1973). Although objective surveys are more precise, subjective surveys are much less costly and can be of value in giving an overview of the locations and amounts of damage, the bird species involved, effectiveness of control methods, and other factors related to damage. This paper presents the results of a questionnaire survey of bird damage to grapes in the United States conducted during the spring of 1973. Because about 90% of the Nation's grape tonnage is produced in California (U.S. Statistical Reporting Service 1972), this report is primarily concerned with damage in that State, but a briefer summary of

the damage problem in other grape-producing States is also included.

METHODS

During February 1973, we sent questionnaires and letters of transmittal (Appendix I) to knowledgeable persons in the 13 States where grapes are grown (U.S. Statistical Reporting Service 1972). In the 12 States other than California that contained bearing grape acreage in 1972, we contacted the U.S. Fish and Wildlife Service, State Agricultural Experiment Stations, colleges, Wildlife Extension Specialists, grower associations, wineries, and individual growers. Follow-up letters and questionnaires were sent 1 mo after the initial mailing to the recipients from whom we had not received a response.

In California, questionnaires and letters of transmittal were sent to Agricultural Commissioners and growers in the 39 counties that contained bearing grape acreage in 1972 (California Crop and Livestock Reporting Service 1973). The commissioners were sent

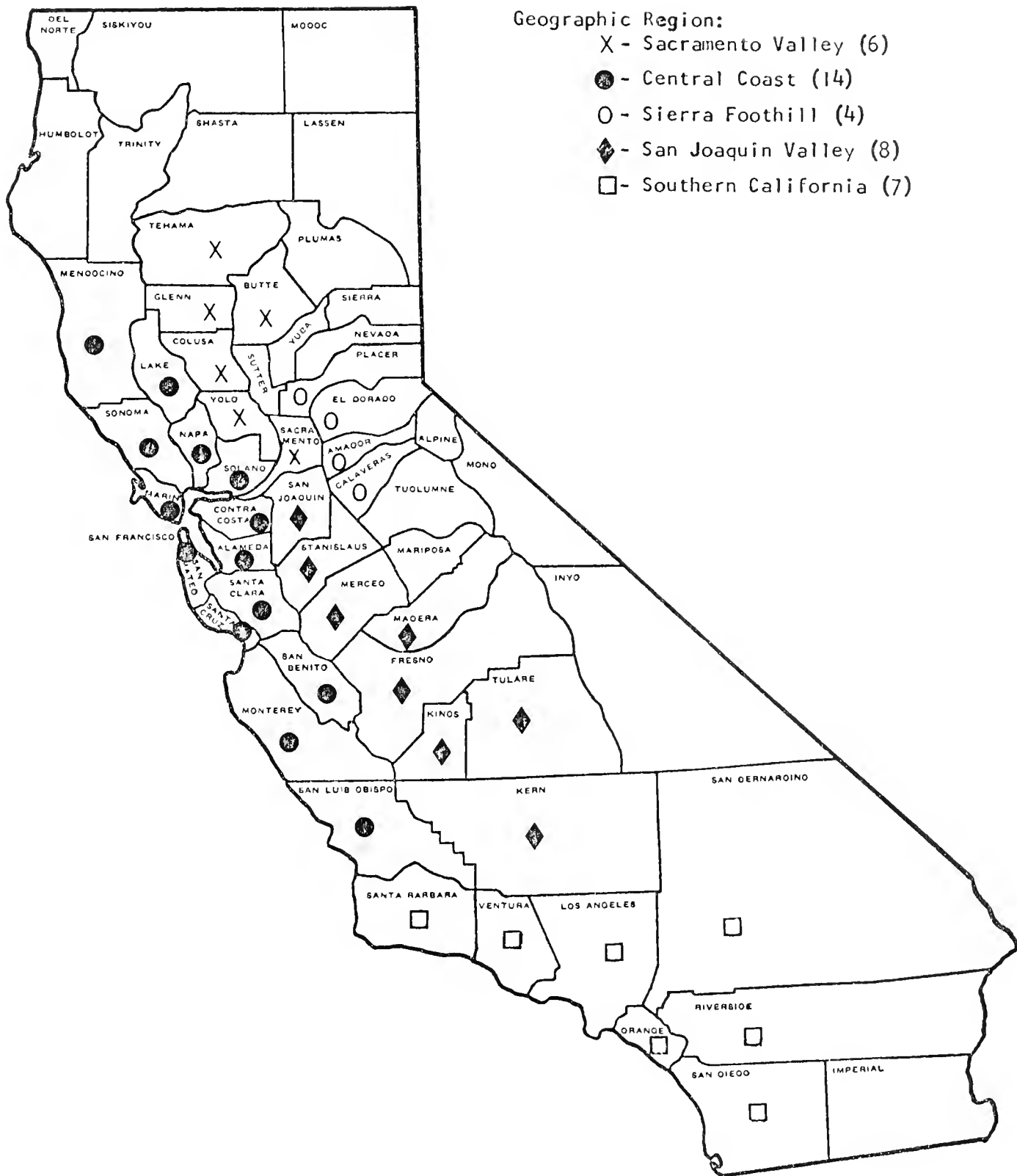


Fig. 1. California counties with bearing acreage during 1972 and geographic regions of grape acreage. (Source: California Crop and Livestock Reporting Service 1973)

county-oriented questionnaires (like Appendix I except that "State" was changed to "county"). We asked that they, or someone in their office knowledgeable about grape damage in their county, answer the questions to the best of their ability. For the grower's portion of the survey, 635 growers selected at random from a list of more than 10,000 growers (confidential listing of the California Crop and Livestock Reporting Service) were sent the same questionnaire except that the questions were oriented toward their individual vineyards. The Reporting Service listing was arranged by county and by parcel (a parcel being one continuous block of grapes); this enabled us to draw a proportional sample which was weighted by the acreage grown and the number of growers per county. Some of the questionnaires were returned by the Postal Service as not deliverable; to replace these, additional names were randomly drawn and new questionnaires sent. To determine the bird damage status in the vineyards of growers who did not respond, we randomly selected 50 of the 336 nonrespondents and attempted to contact them by telephone.

Much of the data from California questionnaires were summarized by geographic regions (Fig. 1), particularly for those questions where more detailed analysis provided more information. The counties assigned to each region have generally similar climatic, topographic, and environmental features.

RESULTS

Response to Questionnaires

Altogether, 375 (49.7%) of 755 questionnaires were returned (Table 1). The number of respondents from each State was roughly proportional to that State's share of the Nation's total grape acreage.

Of the 50 nonrespondent California growers selected for the follow-up phone survey, we successfully contacted 30; 18 (36%) of the 50 had not received the questionnaires because of incorrect or outdated addresses. If a similar proportion (121) of the total (336) nonrespondent growers for the State did not receive questionnaires, then the actual sample population would

be 514 growers. On this basis, we estimated that the 299 returned grower questionnaires represented a return rate of 58.2%. Of the 30 nonrespondent growers contacted by telephone, 22 (73.3%) reported no damage, 3 (10.0%) reported moderate damage, and 5 (16.7%) reported slight damage.

Acreage Grown

A total of about 645,605 acres of grapes were reportedly grown in 1972 in the 13 States surveyed (Table 2). Of this total, 119,512 acres were nonbearing, most of which was newly planted wine grape acreage in California needed to meet rapidly rising consumer demand for wine (Anonymous 1972; Moulton 1973). Of the total U.S. grape acreage, California contained about 85%, New York about 6%, and each of the other States less than 3%. Most of the acreage consisted of wine (41%) and raisin (38%) grapes; the remainder was for harvest as table grapes (15%) or for other uses such as juice (6%).

In California, 39 counties contained 547,920 acres of grapes as of 1 July 1972 (California Crop and Livestock Reporting Service 1973). Of this total, 246,349 acres were in raisin grapes (5,964 nonbearing), 69,140 were in table grapes (3,311 nonbearing), and 232,431 were in wine grapes (95,222 nonbearing). The grape acreages by geographic region were: Sacramento Valley—2,809 (0.5%), Central Coast—65,566 (12.0%), Sierra Foothills—1,059 (0.2%), San Joaquin Valley—453,286 (82.7%), and Southern California—25,200 (4.6%). About 98% of the raisin grapes (246,349 acres), 93% of the table grapes (64,012 acres), and 63% of the wine grapes (146,759 acres) were grown in the San Joaquin Valley. The Central Coast region contained 28% (65,430 acres) of California's wine grape acreage. The county with the largest grape acreage was Fresno (183,386 acres); Ventura County had the least (4 acres). Only 11 counties (3 in the Central Coast region, 7 in the San Joaquin Valley, and 1 in Southern California) had more than 10,000 acres of grapes. The 299 grower respondents reported that they owned or farmed 54,818 acres of grapes (range 1–6,800), or an average of 183.3 acres per grower. Thus, the grower sample accounted for about 10% of California's total grape acreage.

Table 1. *Number of questionnaires concerning bird damage to grapes sent to and returned from agricultural specialists, wildlife specialists, and grape growers in the United States in 1973.*

Region	Questionnaires		
	No. sent	No. returned	Percentage returned
California Commissioners	39	39	100.0
California Growers			
Sacramento Valley	11	6	54.6
Central Coast	113	55	48.7
Sierra Foothill	7	4	57.2
San Joaquin Valley	479	218	45.5
Southern California	25	16	64.0
Grower Subtotal	635	299	47.1
California Total	674	338	50.2
Other grape-producing states			
Arizona	3	1	33.3
Arkansas	13	6	46.2
Georgia	3	1	33.3
Michigan	15	7	46.7
Missouri	9	4	44.4
New Jersey	5	2	40.0
New York	5	3	60.0
North Carolina	5	2	40.0
Ohio	4	1	25.0
Pennsylvania	4	1	25.0
South Carolina	4	2	50.0
Washington	11	7	63.6
Other-state Total	81	37	45.7
Totals	755	375	49.7

Table 2. *Estimated acreages of grapes grown in the United States in 1972.*^a

State	Grape acreage			Percentage of U.S. total	Total acreage by type of grape			
	Bearing	Non-bearing	Total		Wine	Table	Raisin	Other
Arizona	2,800	100	2,900	0.5	0	2,900	0	0
Arkansas	2,500	500	3,000	0.5	1,000	0	0	2,000
California	443,423	104,497	547,920	85.0	232,431	69,140	246,349	0
Georgia	1,000	600	1,600	0.2	600	1,000	0	0
Michigan	17,000	0	17,000	2.6	500	0	0	16,500
Missouri	1,300	300	1,600	0.2	400	1,200	0	0
New Jersey	550	105	655	0.1	600	55	0	0
New York	36,500	2,500	39,000	6.0	17,500	21,500	0	0
North Carolina	600	2,000	2,600	0.4	2,600	0	0	0
Ohio	4,000	550	4,550	0.7	2,000	0	0	2,550
Pennsylvania	1,200	550	1,750	0.3	1,500	250	0	0
South Carolina	4,100	700	4,800	0.7	4,600	200	0	0
Washington	11,120	7,110	18,230	2.8	1,790	0	0	16,440
Totals	526,093	119,512	645,605	100.0	265,521	96,245	246,349	37,490

^a California and Washington estimates are from the California Crop and Livestock Reporting Service (1973) and Folwell and Dailey (1972), respectively; the remaining estimates are from questionnaire responses of agricultural and wildlife specialists.

Table 3. Occurrence and severity of bird damage to grapes in the United States according to questionnaire respondents.

State	Total respondents	Number of respondents reporting					
		Bird damage			Severity of damage as		
		Yes	No	Some years only	Serious	Moderate	Slight
Arizona	1	1	0	0	0	0	1
Arkansas	6	3	1	2	1	0	3
California	338	170	139	29	47	76	76
Georgia	1	1	0	0	0	1	0
Michigan	7	4	3	0	1	1	2
Missouri	4	3	0	1	1	1	2
New Jersey	2	0	0	2	0	1	1
New York	3	3	0	0	0	3	0
North Carolina	2	0	1	1	0	0	1
Ohio	1	1	0	0	0	1	0
Pennsylvania	1	1	0	0	1	0	0
South Carolina	2	2	0	0	0	1	1
Washington	7	7	0	0	2	1	4
Totals	375	196 (52.3) ^a	144 (38.4)	35 (9.3)	53 (23.0)	86 (37.4)	91 (39.6)

^a Percentage of total respondents to that question.

Severity of Bird Damage

Respondents in 11 of the 13 States reported annual bird damage to grapes (Table 3). The two respondents in New Jersey reported damage in some years only and of the two respondents in North Carolina, one reported no damage and the other thought that bird damage only occurred some years. The 139 respondents in California reporting no damage were growers referring only to their vineyards or commissioners referring only to their counties. Overall, damage appears to be a serious problem in one State (Pennsylvania), a moderate problem in three States (Georgia, New York, and Ohio), a slight to moderate problem in seven States (Arkansas, California, Michigan, Missouri, New Jersey, South Carolina, and Washington), and a slight problem in two States (Arizona and North Carolina).

In California, most (61.5%) of the commissioners and about half (48.8%) of the growers reported bird damage to grapes (Table 4). About one-fourth of both the commissioners and growers considered this damage to be serious.

By geographic region, bird damage was generally rated moderate to serious in the Central Coast, Sierra Foothills, and Southern California and slight to moderate in the Sacramento and San Joaquin Valleys. Of the three regions with relatively large grape acreages, the Central Coast appeared to have the most serious bird depredations problem. Combining the grower responses with the results of the phone survey, it appears that about 40% of all California grape growers experienced some bird damage to their crop. Further, they considered about 41% of this damage as moderate to serious.

Nationwide, damage was generally reported to be increasing each year in Georgia, Missouri, Ohio, and Pennsylvania; remaining the same to increasing in California, New York, and South Carolina; and remaining about the same in Arizona, Arkansas, Michigan, New Jersey, North Carolina, and Washington. Only five respondents in California and one in Washington reported that damage was decreasing. Within California, most of the respondents

Table 4. Occurrence and severity of bird damage to grapes in California geographic regions according to questionnaire respondents.

Region	Number (and percentage) of respondents reporting					
	Bird damage			Severity of damage as		
	Yes	No	Some years only	Serious	Moderate	Slight
Commissioners						
Sacramento Valley	1 (16.7)	5 (83.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)
Central Coast	9 (64.3)	3 (21.4)	2 (14.3)	4 (36.4)	5(45.5)	2 (18.2)
Sierra Foothill	4 (100.0)	0 (0.0)	0 (0.0)	1 (25.0)	1 (25.0)	2 (50.0)
San Joaquin Valley	7 (87.5)	0 (0.0)	1 (12.5)	1 (14.3)	2 (28.6)	5 (71.4)
Southern California	3 (42.9)	4 (57.1)	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)
Totals	24 (61.5)	12 (30.8)	3 (7.7)	7 (25.9)	9 (33.3)	11 (40.7)
Growers						
Sacramento Valley	3 (50.0)	3 (50.0)	0 (0.0)	1 (33.3)	2 (67.7)	0 (0.0)
Central Coast	30 (54.6)	20 (36.4)	5 (9.1)	11 (31.4)	14 (40.0)	10 (28.6)
Sierra Foothill	3 (75.0)	1 (25.0)	0 (0.0)	1 (33.3)	2 (67.7)	0 (0.0)
San Joaquin Valley	96 (44.0)	101 (46.3)	21 (9.7)	19 (16.2)	44 (37.6)	54 (46.2)
Southern California	14 (87.5)	2 (12.5)	0 (0.0)	8 (57.2)	5 (35.7)	1 (7.1)
Totals	146 (48.8)	127 (42.5)	26 (8.7)	40 (23.3)	67 (39.0)	65 (37.7)

Table 5. Yearly trends of bird damage to grapes in California geographic regions according to questionnaire respondents.

Region	Number of respondents reporting damage as		
	More each year	About same each year	Less each year
Commissioners			
Sacramento Valley	0	1	0
Central Coast	6	3	1
Sierra Foothill	0	2	0
San Joaquin Valley	1	7	0
Southern California	2	0	1
Totals	9	13	2
Growers			
Sacramento Valley	1	2	0
Central Coast	6	24	1
Sierra Foothill	1	1	1
San Joaquin Valley	39	64	1
Southern California	7	6	0
Totals	54	97	3

reporting increasing damage were in the Central Coast, San Joaquin Valley, and Southern California counties (Table 5). Large new acreages of grapes have been planted in these regions in recent years (California Crop and Livestock Reporting Service 1973), and the increasing importance of bird damage in these areas likely reflects this acreage increase. In addition, starling (*Sturnus vulgaris*) populations are continuing their rapid expansion within the State (DeHaven 1973).

Relative to other sources of grape damage, losses to birds were reported to be more severe than losses to rain, similar to losses to insects and heat, and less than losses to frost.

Bird Species Involved in Damage

Nationwide, the most important species damaging grapes were considered to be starlings, sparrows (species undetermined), and finches (*Carpodacus* spp.), in that order (Table 6). Robins (*Turdus migratorius*), bluebirds (*Sialia* spp.), and waxwings (*Bombycilla* spp.) were less important but still inflicted damage in some regions. Starlings were considered the most important damaging species in Arizona, California, Georgia, New York, Ohio, and South Carolina; robins were considered the most important in Missouri and Washington. Grackles were rated highest by the one respon-

Table 6. Importance index of bird species causing grape damage in the United States according to questionnaire respondents.^a

State	No respondents replying	Starlings	Finches	Sparrows	Robins	Bluebirds	Others
Arizona	1	5	1	4	0	0	0
Arkansas	4	2	0	0	1	0	4 ^b
California	199	426	181	289	95	74	111 ^c
Georgia	1	5	0	3	0	0	4 ^d
Michigan	4	13	1	13	9	0	9 ^e
Missouri	4	2	2	1	7	0	13 ^f
New Jersey	2	5	1	5	1	0	3 ^g
New York	3	11	0	2	6	0	18 ^h
North Carolina	1	1	0	1	4	0	11 ⁱ
Ohio	1	5	0	1	4	0	7 ^j
Pennsylvania	1	1	1	1	1	0	0
South Carolina	2	6	0	1	0	0	3 ^k
Washington	7	12	2	2	14	0	1 ^l
Totals	230	494	189	323	142	74	184

^a Because respondents were asked to rate species in their order of importance, the following point system was used to provide an index of species importance: Rated 1st = 5, 2nd = 4, 3rd = 3, 4th = 2, 5th or checked = 1.

^b Mockingbird-2, brown thrasher-1, blue jay-1.

^c Cedar waxwing-36, blackbirds-19, mockingbird-13, quail-10, crow-9, yellow-billed magpie-6, scrub jay-5, oriole-2, California thrasher-1, mourning dove-1, goldfinch-1, pheasant-1, red-shafted flicker-1, rufous-sided towhee-1, turkey vulture-1, western kingbird-1, western tanager-1, woodpecker-1.

^d Brown thrasher-4.

^e Grackle-8, mockingbird-1.

^f Waxwings-4, blue jay-4, brown thrasher-2, crow-1, mockingbird-1, woodpecker-1.

^g Grackle-2, catbird-1.

^h Orioles-7, grackles-4, waxwings-2, catbird-2, grosbeaks-1, tanagers-1, thrashers-1.

ⁱ Grackles-5, brown thrasher-3, catbird-1, mockingbird-1, waxwings-1.

^j Warblers-3, catbird-1, mockingbird-1, orioles-1, thrashers-1.

^k Brown thrasher-2, mockingbird-1.

^l Black-billed magpie-1.

dent from North Carolina. In Arkansas, starlings and mockingbirds (*Mimus polyglottos*) were rated similarly as the most damaging species, as were starlings and sparrows in Michigan and New Jersey. The one respondent in Pennsylvania did not rate the importance of the species. Other birds mentioned as damaging grapes in local vineyards but of relatively minor overall importance were black-billed magpies (*Pica pica*), blue jays (*Cyanocitta cristata*), brown thrashers (*Toxostoma rufum*), California thrashers (*T. redivivum*), catbirds (*Dumetella carolinensis*), crows (*Corvus* spp.), goldfinches (*Spinus* spp.), mourning doves (*Zenaidura macroura*), ring-necked pheasants (*Phasianus colchicus*), common flickers (*Colaptes auratus*), rufous-sided towhees (*Pipilo erythrophthalmus*), scrub jays (*Aphelocoma coerulescens*),

turkey vultures (*Cathartes aura*), western kingbirds (*Tyrannus verticalis*), western tanagers (*Piranga ludoviciana*), yellow-billed magpies (*P. nuttalli*), and unspecified blackbirds, grackles, grosbeaks, orioles, tanagers, thrashers, warblers, and woodpeckers. In all, over 30 species of birds were reported to damage grapes in the United States.

The importance of sparrows in grape damage may have been exaggerated in this survey. Although sparrows were ranked high in California by the growers, the commissioners reported that finches were more important than sparrows (Table 7), and a follow-up damage survey confirmed this (DeHaven 1974). The growers may have incorrectly grouped finches and sparrows together as "sparrows."

Table 7. Importance index of bird species causing grape damage in California according to questionnaire respondents.^a

Region	Starlings	Finches	Sparrows	Robins	Bluebirds	Others
Commissioners						
Sacramento Valley	4	0	0	5	0	0
Central Coast	41	38	11	6	17	5 ^b
Sierra Foothill	15	4	9	4	0	1 ^c
San Joaquin Valley	28	28	7	10	0	1 ^d
Southern California	11	3	4	0	4	0
Totals	99	73	31	25	21	7
Growers						
Sacramento Valley	6	1	4	9	0	0
Central Coast	54	32	34	26	25	30 ^e
Sierra Foothill	4	2	10	4	3	3 ^f
San Joaquin Valley	243	62	200	31	25	66 ^g
Southern California	20	11	10	0	0	4 ^h
Totals	327	108	258	70	53	103

^a Because respondents were asked to rate species in their order of importance, the following point system was used to provide an index of species importance: Rated 1st = 5; 2nd = 4; 3rd = 3; 4th = 2; 5th or checked = 1.

^b Cedar waxwing-2; blackbird-1; crow-1; mockingbird-1.

^c Yellow-billed magpie-1.

^d Mockingbird-1.

^e Cedar waxwing-11; quail-7; jay-4; blackbirds-1; red-shafter flicker-1; orioles-1; towhee-1; turkey vulture-1; western kingbird-1; western tanager-1; woodpecker-1.

^f Cedar waxwing-1; quail-1; yellow-billed magpie-1.

^g Cedar waxwing-22; blackbirds-17; mockingbird-10; crow-8; yellow-billed magpie-4; California thrasher-1; dove-1; scrub jay-1; quail-1; pheasant-1.

^h Goldfinch-1; mockingbird-1; oriole-1; quail-1.

Factors Related to Damage

Wine grapes were reportedly damaged more than the other grape types (Table 8), but this may reflect the relative proportions of the types grown in various areas. In California, for example, the Central Coast counties contained mostly wine grapes, and reports from these counties indicated that wine grapes were the most heavily damaged type. Similarly, in the San Joaquin Valley counties, where table and raisin grapes predominate, damage to these two types was reported most often. Also, some wine grape varieties were worth considerably more per ton than other varieties, and many respondents may have considered damage to wine varieties more important. Over half of the respondents (55.3%) thought that birds preferred certain varieties, but when asked to name them, their replies showed no particular

varieties as being consistently preferred by birds. In California alone, 30 varieties were reported preferred by birds; however, only 56 varieties were grown in any significant acreage (at least 500 acres) in the State (California Crop and Livestock Reporting Service 1973).

Peck damage was reported more often than pluck damage (Table 8). Apparently the larger birds, such as starlings and robins, tend to pluck whole grapes from the bunch, whereas smaller species, such as finches, sparrows, and bluebirds, tend to peck holes in the individual fruit. Respondents from California's Central Coast counties rated the starling as the most important damaging species and also reported the most pluck damage. Respondents from Southern California counties, where starlings and finches were rated about equal in importance, reported about equal amounts of pluck and peck damage. For the State in general,

Table 8. *Most heavily damaged grape type and most serious type of damage in California and other grape-producing States according to questionnaire respondents.*

Region	Number of respondents reporting heaviest damage						
	By grape type				By type of damage		
	Wine	Table	Raisin	No preference	Pluck	Peck	No preference
California Commissioners							
Sacramento Valley	1	0	0	0	1	0	0
Central Coast	11	0	0	0	7	2	2
Sierra Foothill	4	0	0	0	2	1	1
San Joaquin Valley	2	3	5	0	4	4	0
Southern California	2	0	0	1	1	1	1
Subtotal	20	3	5	1	15	8	4
California Growers							
Sacramento Valley	2	1	0	0	2	1	0
Central Coast	27	1	0	2	12	13	6
Sierra Foothill	1	0	0	0	1	1	1
San Joaquin Valley	28	29	31	15	22	83	8
Southern California	8	3	1	1	6	7	1
Subtotal	66	34	32	18	43	105	16
California Subtotal	86	37	37	19	58	113	20
Other Grape-producing States							
	16	6	0	8	8	16	7
Totals	102	43	37	27	66	129	27

California growers reported more peck than pluck damage, whereas the commissioners reversed the order of importance. This is consistent with the belief of the growers that the smaller species of birds caused more damage than the larger species. Several respondents said that peck damage often leads to greater damage by insects (by attracting the insect), disease, and seepage onto undamaged grapes.

The sugar content of the grapes was reported as the most important factor influencing bird damage (Table 9). Sugar content is a measure of grape maturity, and apparently a certain level of sugar is required before birds begin to feed on grapes. Stevenson and Virgo (1971), and Boudreau (1972) have also reported the apparent correlation between sugar content and bird damage, although the exact relationship is not well understood. Other factors such as the variety and type of grapes grown, presence or absence of nesting and loafing cover, size of

migrant and resident bird populations, and proximity of vineyards to roosts or other food were also rated as important factors influencing bird damage.

In California, both the commissioners and growers recognized the importance of grape sugar in relation to bird damage. The growers rated proximity of the vineyard to roosting areas higher than did the commissioners, but the two groups rated most other factors similarly. Regarding migrant birds, many growers commented that migrant starlings arrive in California a few weeks after the harvest and if the harvest were delayed or if the starlings arrived early, an extremely serious problem could result. Most respondents reported that damage generally begins in July or August, and a few mentioned that the critical sugar level of 11-12% is reached during this period. Damage continues until harvest.

Table 9. Mean importance ratings of factors influencing bird damage to grapes in the United States according to questionnaire respondents.^a

Factors	California		Other grape-producing States
	Commissioners	Growers	
Sugar content of grapes	2.35	1.11	1.09
Variety and type	1.69	0.48	2.09
Vegetative cover	1.27	0.38	0.86
Migrant bird population	1.15	0.40	0.82
Breeding bird population	1.00	0.45	0.59
Proximity to roost	0.73	0.65	0.95
Proximity to other food	0.73	0.28	0.41
Vineyard size	0.19	0.15	0.32
Weather	0.04	0.04	0.36

^a Because respondents were asked to rate factors in their order of importance, the following point system was used to score the responses: Rated 1st = 4; 2nd = 3; 3rd = 2; checked = 1. The mean importance rating is not comparable between columns (because of grossly different sample sizes); it is used to show the relative importance of each factor within each column.

Control Methods

Of nine methods used to control bird damage to grapes, exploders, often supplemented with shooting (bird-minding); shooting only; electronic sound devices; trapping; poisons; and reflectors were reported to be the most frequently used and currently the most successful (Table 10). Of 149 respondents who rated the overall effectiveness of current control methods, only 15 (10.1%) thought that the methods were very effective, whereas 72 (48.3%) said that they stop only some damage and 62 (41.6%) said that they do little good. Several respondents indicated that new methods of control would be welcome and that nonlethal repellents were badly needed.

In California, growers and commissioners differed in their view of the effectiveness of control methods. Most commissioners felt that their control methods stopped some damage or were very effective. However, only nine growers

thought their control methods were very effective; most (92) thought that current methods do little good or stop only some damage.

The only responses on the costs of controlling bird damage during 1972 came from California. Many growers did not know what they spent on control, but 82 reported spending a total of \$46,782 (mean \$570.51; range 0-\$25,000). Together with what the commissioners reported spending for their counties, we can estimate that at least \$1.1 million was spent on control in California in 1972. Assuming proportionate costs in the other grape-producing states, the total spent on control in the United States in 1972 would be at least \$1.3 million. This estimate would be conservative because many growers said that their cost estimate did not include their time or other hidden costs but only "cash out of pocket" expenses.

Table 10. *Most frequently and successfully used methods of controlling bird damage to grapes in the United States according to questionnaire respondents.*

Method	Number (and percent) of respondents reporting method as	
	Most often used	Most effective
Exploders	31 (29.8)	17 (21.2)
Shooting	28 (26.9)	19 (23.8)
Electronic sound devices	14 (13.5)	15 (18.8)
Trapping	11 (10.6)	12 (15.0)
Poison	10 (9.6)	9 (11.2)
Reflectors	6 (5.8)	2 (2.5)
Prayers	2 (1.9)	2 (2.5)
Netting	1 (1.0)	3 (3.8)
Habitat manipulation	1 (1.0)	1 (1.2)
Totals	104 (100.1)	80 (100.0)

Economic Importance of Bird Damage to Grapes in California

The best estimate of the cost of bird damage to grapes came from California growers. Of 57 growers listing a value for their damage, 35 reported losses averaging \$1,837 (range \$20-\$15,000) and the other 22 reported losses averaging 9.6% (range 0.1-30.0%) of their crop. By combining these averages and assuming an average production of 8 tons per bearing acre, or \$1,300 worth of grapes, the total loss to these 57 growers was about \$210,000. Since our sample included about 10% of California's grape acreage, \$2.1 million would be a reasonable estimate of bird losses in California for 1972. If only 25% of this value is added to the total to take into account losses of growers represented by nonrespondents and the 142 respondents who reported bird damage but could not estimate the cost, then the total State estimate would be \$2.6 million. This figure is close to DeHaven's (1974) minimum statewide loss estimate of \$3 million based on a 1973 damage survey. Together with the \$1.1 million spent by counties and growers on control, \$3.7 million would be a reasonably conservative estimate of the total cost of bird damage to grapes in California during 1972. If other states where grapes are grown had similar losses, then a conservative nationwide cost estimate for bird damage to grapes in 1972 would be \$4.4 million. With large new acreages coming into production each year, costs will probably increase if prices paid per ton remain stable or increase.

ACKNOWLEDGMENTS

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complete the questionnaire. Many of these respondents offered helpful comments that greatly increased our understanding of the problem. Jerome F. Besser, Joseph L. Guarino, Willis C. Royall, Jr., C. Edward Knittle, and Ann H. Jones of the Denver Center offered many helpful suggestions throughout several phases of the project.

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APPENDIX I



United States Department of the Interior

FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
BUILDING 16, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

February 28, 1973

Dear

It is necessary to know the importance and distribution of bird damage to crops before setting research and management priorities. Could you take the time to help us define the problem of bird damage to grapes in the U.S.?

The attached questionnaire should be answered by the specialist most knowledgeable about grape damage in your state, so please don't hesitate to pass it on if you do not feel qualified, or to reply negatively (hopefully with the name of someone more knowledgeable).

In addition to the statewide survey, we would appreciate any help you can give us as to names and addresses of grape-growing associations and/or major wineries in your State, so that we can make some direct contacts.

We would be happy to send you a report of the findings when completed, if you so indicate on the questionnaire. Thank you for your cooperation.

Sincerely,

Charles P. Stone

Donald F. Mott

Charles P. Stone
Donald F. Mott
Wildlife Research Biologists

Attachment: questionnaire

QUESTIONNAIRE ON BIRD DAMAGE TO GRAPES

1. About how many acres of grapes are grown in your state?

	<u>wine grapes</u>	<u>table grapes</u>	<u>raisin grapes</u>
a. Bearing acres	_____	_____	_____
b. Non-bearing acres	_____	_____	_____
c. Total	_____	_____	_____

2. Do birds damage grapes in your state?

- a. Yes _____
- b. No _____
- c. Some years only _____

DO NOT ANSWER REMAINING QUESTIONS IF YOU ANSWERED "NO" ABOVE

3. How would you describe the bird damage to ripening grapes in your state?

- a. Serious _____
- b. Moderate _____
- c. Slight _____

Comments _____

4. What birds damage grapes in your state? (Rate 3 most important and check others you think are responsible for causing damage.)

- | | |
|--------------------------|-------------------------------|
| a. Starlings _____ | h. Tanagers _____ |
| b. Orioles _____ | i. Waxwings _____ |
| c. Grackles _____ | j. Finches _____ |
| d. Robins _____ | k. Sparrows _____ |
| e. Catbirds _____ | l. Grosbeaks _____ |
| f. Brown Thrashers _____ | m. Others (please list) _____ |
| g. Mockingbirds _____ | _____ |

Comments _____

5. What type of grapes are most heavily damaged by birds in your state?

- a. Wine grapes _____
- b. Table grapes _____
- c. Raisin grapes _____
- d. No type preference _____

Comments _____

6. What type of damage is more serious in your state? (Check One)

- a. Pluck damage (birds taking whole berries) _____
- b. Peck damage (birds taking parts of berries) _____
- c. No preference _____

Comments _____

7. In your state, are some grape varieties more heavily damaged than others?

- a. No _____
- b. Yes (list varieties) _____

Comments _____

8. About when does damage begin and end each year?

- a. Begin (month) _____
- b. End (month) _____

Comments _____

9. What factors influence bird damage to grapes in your state?
(Rate 3 most important and check others you think reflect damage.)

- a. Variety and type _____
- b. Size of vineyard _____
- c. Breeding bird populations _____
- d. Migrant bird populations _____
- e. Proximity to roosting areas _____
- f. Amount of rain _____
- g. Proximity to other food sources _____
- h. Nesting and loafing cover _____
- i. Sugar content of grapes _____
- j. Weather _____
- k. Tillage of vineyard _____
- l. Other (list) _____
- m. Don't know _____

Comments _____

10. How do other losses compare with losses to birds in your state?

	More than birds	Similar to birds	Less than birds	Don't know
a. Insects	_____	_____	_____	_____
b. Frost	_____	_____	_____	_____
c. Heat	_____	_____	_____	_____
d. Rain	_____	_____	_____	_____

Comments _____

11. What method(s) are used in your state to reduce bird damage to grapes?

- a. Shooting _____
- b. Poisons (which?) _____
- c. Repellents (which?) _____
- d. Nest destruction _____
- e. Trapping _____
- f. Netting _____
- g. Exploders _____
- h. Electronic scare devices _____
- i. Reflectors _____
- j. Revolving or flashing lights _____
- k. Plastic hawks and owls _____
- l. Scarecrows _____
- m. Other (which?) _____
- n. None _____

Comments _____

12. What method is most often used? Most effective?

- a. Most often used _____
- b. Most effective _____

Comments _____

13. In general, how would you describe the control measures used in your state?

- a. Very effective _____
- b. Stop some damage _____
- c. Do little good _____

Comments _____

14. Is the amount of bird damage to grapes in your state remaining about the same each year?

- a. About same _____
- b. More each year _____
- c. Less each year _____

Comments _____

15. Can you provide a rough estimate of the annual grape losses to birds in your state (excluding control costs)?

- a. No _____
- b. Yes. My estimate is:
\$ _____ per acre OR \$ _____ total loss OR _____ % of crop.

Comments _____

16. How much do you believe is spent on controlling bird damage to grapes in your state?

- a. Don't know _____
- b. Estimate: \$ _____ per acre OR \$ _____ total

Comments _____

17. Would you like to receive copies of the report resulting from this questionnaire?

- a. No _____
- b. Yes _____
- c. Number of copies _____

NAME

AFFILIATION

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.



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DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
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