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NATURALIZATION OF RUSSIAN-OLIVE: IMPLICATIONS TO ROCKY MOUNTAIN WILDLIFE[1]

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Naturalization and spreading of exotic woody vegetation in riparian zones have received much attention in recent years. This attention has been directed primarily at saltcedar tamarisk (*Tamarix pentandra*) in southwestern states (e.g., Robinson 1965, Horton 1977). Tamarisk along the lower Colorado River does not compare favorably with native woody vegetation as avian habitats (Anderson et al. 1977) and, without control, will competitively displace native riparian vegetation with time (Horton 1977).

Russian-olive (*Elaeagnus angustifolia*) is a native of Europe and western Asia introduced into North America prior to 1900. The spreading, sometimes shrub-like, tree tolerates a wide range of soil and moisture conditions, adapting to local conditions throughout the western United States from Minnesota and Kansas to the Pacific Ocean (Borell 1976). The history of Russian-olive in western states was summarized by Christensen (1963). Briefly, the species was being planted extensively in residential areas by 1900. Russian-olives were first reported escaping cultivation in 1924 in Utah, 1925 in Nevada, 1942 in Arizona and California, 1952 in Idaho, 1954 in Colorado, and 1960 in New Mexico and Texas.

Russian-olive has been promoted, especially by soil conservationists, as an excellent planting for windbreaks, erosion control, and wildlife enhancement (Van Dersal 1939, Wilson 1944, Billings 1945, Graham 1949, Borell 1976). Over 50 species of birds and mammals

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use Russian-olive as a source of food or cover (Borell 1976). Recently, we noticed that extensive, virtually monotypic stands of Russian-olive have invaded riparian zones of some western (Green, Missouri, Snake) river systems. These riparian zones provide critical, limited habitats for many vertebrate species in the West (Johnson and Jones 1977). This paper (1) alerts natural resource conservation personnel to naturalization of Russian-olive in the West, (2) reports on the avian and mammalian associations of monotypic stands of Russian-olive in 3 western states, (3) discusses similarities of those associations to vertebrate communities occurring in nearby native riparian and upslope vegetation types using the analytical approach discussed by Samson and Knopf (1982), and (4) speculates on implications of the continued naturalization of Russian-olive to Rocky Mountain avian and mammalian communities.

STUDY AREAS

Study areas representative of native vegetation in riparian sites and sites upslope from it, plus extensive naturalized Russian-olive stands (Fig. 1), were located near Milliken, Colorado; Murphy, Idaho; and Fort Duchesne, Utah. Each site received little or no grazing by cattle, or other types of disturbance.

Colorado

The native riparian site was along the south side of the Big Thompson River, approximately 5 km northwest of Milliken (1,430 m elevation), Weld County. This site was characterized by an overstory of plains cottonwoods (*Populus sargentii*) and an understory that consisted primarily of grasses. Common cattail (*Typha latifolia*), bulrushes (*Scirpus* spp.), and willows (*Salix* spp.) were present in small numbers. Scattered Russian-olives occurred infrequently on drier sites away from the main river channel.

The native upslope site was 1 km north of the Big Thompson River, approximately 6 km northwest of Milliken. The vegetation consisted primarily of short grasses, especially cheatgrass brome (*Bromus tectorum*), blue grama (*Bouteloua gracilis*), and common buffalograss (*Buchloe dactyloides*). No woody plants occurred in appreciable numbers.

Our Russian-olive study site was located 4 km northwest of Milliken and consisted of trees 5–8 m in height. Canopy coverage was approximately 40%. Cheatgrass brome, Canada thistle (*Cirsium arvense*), and stinging nettle (*Urtica dioica*) dominated the understory. An irrigation ditch ran through the site originating from a pond located in the northeast section of the thicket. A few small (<3 m in height) Siberian elm (*Ulmus pumila*) had colonized spoilbanks adjacent to the irrigation ditch.

Fig. 1. Typical monotypic stands of naturalized Russian-olive on study sites along the Big Thompson River near Milliken, Colorado (top); Snake River at Walter's Ferry (near Murphy), Idaho (middle); and Uinta River near Fort Duchesne, Utah (bottom). Note differences in site dryness as reflected in the herbaceous vegetation at each site.

Idaho

The native riparian site was located in the Snake River Birds of Prey Area (BOPA) approximately 14 km east-southeast of Murphy, Owyhee County, at the mouth of Sinker Creek (790 m elevation). The site was a densely vegetated alluvial fan where Sinker Creek joins the Snake River. Both sides of the creek contained thickets of willow, with rank stands of Woods rose (*Rosa woodsii*) on the east side. A few black cottonwoods (*Populus trichocarpa*) were present, as were bulrushes adjacent to the river bank.

The native upslope study site, also within the BOPA, was located 5 km southeast of Murphy (1,020 m elevation). Part of the site included a broad valley and rolling slopes with areas of bare ground and a few sedimentary rock faces (mostly <1 m high). Big sagebrush (*Artemisia tridentata*) was the predominant woody species, typical of the Great Basin Desert.

The Russian-olive site was on the north side of the Snake River at Walters Ferry, 18 km north of Murphy (740 m elevation), Canyon County. The site consisted of a thicket of mature (about 10 m height) Russian-olives with cheatgrass brome and a few scattered shrubs. Canopy coverage exceeded 80%. Shrubs were primarily black greasewood (*Sarcobatus vermiculatus*) in canopy openings and Woods rose as understory. A shallow wetland with cattails (*Typha* spp.) and bulrushes bordered the north side of the stand.

Utah

The riparian site was situated 6 km north of Fort Duchesne (1,520 m elevation), Uintah County, on the west side of the Uinta River. Trees were primarily cottonwoods, with scattered Russian-olives and occasional saltcedar tamarisk. Willows dominated the central area of the floodplain.

The upslope site was 5 km southwest of Fort Duchesne. Predominant shrubs were big sagebrush and Douglas rabbitbrush (*Chrysothamnus viscidiflorus*). Other abundant species included cheatgrass brome, Indian ricegrass (*Oryzopsis hymenoides*), and several forbs, especially Prince's plume (*Stanleya pinnata*) and lupine (*Lupinus* sp.).

The Russian-olive site was located 6 km west of Fort Duchesne. Canopy coverage was approximately 50%. Two sizes of Russian-olive trees were present. Most were 5–6 m in height, with the exception of several mature (up to 10 m) trees on the south edge of the site. The south edge of the site was bordered by several mature cottonwood trees. The understory was dominated by cheatgrass brome and forbs (especially *Brassica* sp.), with occasional alfalfa plants.

FIELD METHODS

Birds were surveyed in native riparian, upslope, and Russian-olive sites in each of the 3 study areas using point-transect techniques. A total of 24 plots approximately 50 m apart was sampled at each site. Observations of all birds seen during a 10-min interval were recorded, resulting in 4 hours of intensive observation per site. Censuses were conducted from sunrise until 1000 hours on the following dates: 30 May–1 June 1982 in Idaho, 9–13 and 15 June 1983 in Colorado, and 24–26 June 1983 in Utah.

Surveys of small mammals consisted of 150 trap nights/site at each study area. Trap stations, spaced 20 m apart, each contained 1 rat trap, 1 Museum Special (Woodstream Corp., Lititz, Pa.),[2] and 1 Sherman live trap (H. B. Sherman Traps, Inc., Tallahassee, Fla.). All traps were baited with rolled oats, and the 3 vegetative sites were trapped simultaneously. Small mammals were trapped 29 May–2 June 1982 in Idaho, 8–14 June 1983 in Colorado, and 23–25 June 1983 in Utah. Incidental observations of other mammals observed at the sites were recorded.

Survey information for birds and mammals was combined within vegetative communities among areas rather than analyzed separately. This approach enabled us to examine regional implications of the naturalization of Russian-olive rather than specific-site effects.

RESULTS

Avian Communities

Bird communities varied among the 3 vegetative types. For the Colorado, Idaho, and Utah areas combined, we observed 405 individuals of 56 species in native riparian vegetation, 458 individuals of 40 species in Russian-olive stands, and 235 individuals of 34 species in native upslope sites. The individual species, scientific names, and their frequency of observation are given in Appendix I.

Alpha diversity patterns were compared among vegetative sites and areas. Shannon-Wiener function (Krebs 1972:506–508) calculations generally indicated greater diversity in native riparian communities and poorer diversity in upslope sites (Table 1). Russian-olive sites tended to support intermediate levels of alpha diversity. Evenness calculations were comparable among communities.

Alpha diversity curves plotted after Patil and Taillie (1979) also showed Russian-olive sites with intermediate levels of diversity (Fig. 2).

[2] Use of commercial trade names does not imply endorsement by the U.S. government.

Table 1. Shannon-Wiener index values of avian diversity in riparian, Russian-olive, and upslope study areas near Milliken, Colorado; Murphy, Idaho; and Fort Duchesne, Utah, 1982–1983. *H* represents the diversity value, and *E* the corresponding evenness value.

Study area	Native riparian		Russian-olive		Upslope	
	H	*E*	*H*	*E*	*H*	*E*
Colorado	3.44	0.81	3.84	0.86	3.26	0.75
Idaho	4.45	0.88	3.41	0.82	2.51	0.72
Utah	4.01	0.83	3.50	0.82	3.62	0.87
All sites	4.14	0.80	4.07	0.82	3.54	0.79

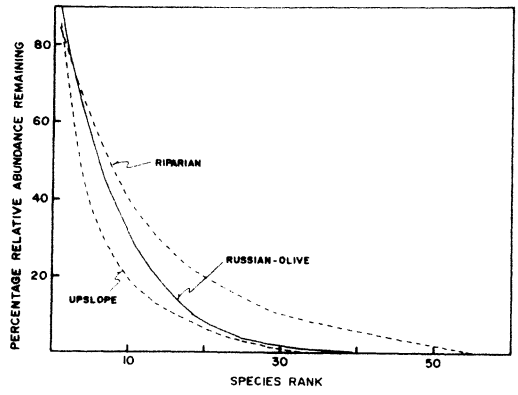

Fig. 2. Intrinsic diversity profiles of avian communities occurring in native riparian, naturalized Russian-olive, and native upslope vegetative communities at the 3 locations in the central Rocky Mountains of the western United States.

Because the respective lines intersected, we concluded no significant differences in alpha diversity among vegetative communities. The curves overlapped along the lower end of the *x* axis, indicating similar patterns of species dominance among sites. Riparian sites held a greater species richness due to a higher proportion of rare species, and demonstrated greater evenness (shallower curve) than the other sites. This latter point contradicts the Shannon-Wiener information.

Beta diversity comparisons (Whittaker 1970: 116; Samson and Knopf 1982) were calculated among vegetative communities at each area and for the sites combined. Community coefficients (*CC*) are a measure of similarity in species richness between sites, with a $CC = 1$ representing total overlap and a $CC = 0$ representing 2 unique communities. These coefficients indicated greater similarity ($CC = 0.69$) between native riparian and Russian-olive bird communities. In addition, those 2 communities were equally dissimilar from the upslope community (riparian-upslope, $CC = 0.38$; Russian-olive-upslope, $CC = 0.40$).

Percentage similarity (*PS*) calculations also provided a measure of beta diversity, but included an element of relative densities of species. Those calculations confirmed the overall pattern of greater similarity between native riparian and Russian-olive bird communities ($PS = 0.54$). However, similarity between Russian-olive and upslope increased ($PS = 0.44$) relative to the riparian vs. upslope comparison ($PS = 0.30$).

Small Mammal Communities

The small mammal community was not sampled in the Utah native riparian site due to flooding. Such flooding was typical along major river systems in the central Rocky Mountains in the spring and early summer of 1983.

For the 3 areas, we captured 43 individuals of 5 species in native riparian sites (Table 2). Two additional species (fox squirrel [*Sciurus niger*] and beaver [*Castor canadensis*]) were observed but not captured. We captured 111 individuals of 7 species and observed 5 others (desert cottontail, fox squirrel, muskrat [*Ondatra zibethicus*], striped skunk [*Mephitis mephitis*], and beaver) in Russian-olive sites, and 145 individuals of 7 species while observing 1 other (white-tailed jack rabbit [*Lepus townsendii*]) in native upslopes.

Including species sighted but not captured, we recorded totals of 7 species in riparian, 12 in Russian-olive, and 8 in upslope sites. Community coefficients revealed approximately 2

Table 2. Small mammals trapped in riparian, Russian-olive, and upslope study sites near Milliken, Colorado; Murphy, Idaho; and Fort Duchesne, Utah, 1982–1983.

Species	No. trapped		
	Riparian	Russian-olive	Upslope
Desert cottontail (*Sylvilagus audubonii*)	0	3	0
Least chipmunk (*Tamias minimus*)	0	2	2
White-tailed antelope squirrel (*Ammospermophilus leucurus*)	0	0	7
Great Basin pocket mouse (*Perognathus parvus*)	1	0	15
Ord's kangaroo rat (*Dipodomys ordii*)	0	0	17
Western harvest mouse (*Reithrodontomys megalotis*)	0	13	1
Deer mouse (*Peromyscus maniculatus*)	27	52	102
Canyon mouse (*Peromyscus crinitus*)	1	0	0
Bushy-tailed woodrat (*Neotoma cinerea*)	8	0	0
Montane vole (*Microtus montanus*)	0	21	0
Prairie vole (*Microtus ochrogaster*)	0	1	0
House mouse (*Mus musculus*)	6	19	0
Western spotted skunk (*Spilogale gracilis*)	0	0	1

times greater similarity of Russian-olive sites to native riparian ($CC = 0.63$) than to upslope ($CC = 0.32$) sites. The community coefficient for riparian and upslope sites was comparatively low ($CC = 0.25$). Percentage similarity calculations failed to reveal a pattern in small mammal community relationships.

DISCUSSION

Saltcedar tamarisk and Russian-olive colonize different sites within riparian zones. Tamarisk is the dominant phreatophyte along southern portions of the Rio Grande River in New Mexico, while Russian-olive occurs primarily farther upstream (Campbell and Dick-Peddie 1964). In Utah (Carman and Brotherson 1982), Russian-olive is found on sites of 100–3,500 ppm soluble salts vs. 700–15,000 ppm for tamarisk. Further, herbaceous vegetation associated with Russian-olive is typical of mesic meadows (perennial grasses dominating) vs. more halophytic communities (annuals dominating) in tamarisk. Herbaceous vegetation within our Russian-olive sites contrasted somewhat by being dominated by cheatgrass brome and annual forbs.

Russian-olive appears capable of germinating in a broad range of soil types. We have observed scattered individuals in established cottonwood-dominated floodplains, especially within the Platte River drainage of Colorado and Nebraska. The species also is colonizing naturally wet or irrigated meadows, plus disturbed, gravel-mined sites in northern Colorado (Fig. 3). The monotypic stands that we surveyed each occurred on sites where soil moisture levels were intermediate between those containing native riparian and upslope vegetation. Thus, black greasewood and Woods rose both were found within the Idaho stand. At sites near our study areas we noticed Russian-olives most commonly along the outer edge of native riparian vegetation, where riparian and upslope vegetation normally intergrade. Scattered Russian-olives have been seen under a cottonwood canopy where they are straggly in appearance: the species evidently requires full exposure to the sun to develop a normal shape.

Native upslope vegetation at each study area was a grassland or grassland-shrub community with shrubs <2 m in height. Cottonwoods in riparian zones were generally >20 m. Besides being horizontally intermediate, the 5–10-m tall Russian-olives provided an intermediate-height woody species which was lacking in the native communities at all 3 study areas.

The horizontal and vertical patterning of riparian, Russian-olive, and upslope communities is likely the basis for our observations of vertebrate communities intermediate in species

richness and evenness in the Russian-olive sites. Number of bird species at a site increases with both vertical (Karr and Roth 1971, and others) and horizontal (Roth 1976) structuring of vegetation.

Beta diversity calculations indicated that faunal affinities of the Russian-olive vertebrate community were closer to native riparian communities than to upslope communities. Many predictably riparian bird species (e.g., eastern kingbird, black-billed magpie, American robin, yellow warbler, common yellowthroat, yellow-breasted chat, song sparrow, red-winged blackbird, and northern oriole) occurred frequently in the monotypic Russian-olive stands. These species generally nest in shrubby vegetation. Avian species (e.g., northern flicker, house wren, cedar waxwing, warbling vireo, and black-headed grosbeak) that we consider obligate residents of lowland (<2,000 m elevation) native riparian tracts in the Rocky Mountain region generally were absent from the Russian-olive community, although the American goldfinch was an obvious exception to this observation. The former species tend to occur only in areas of large trees, while the American goldfinch prefers shrubby vegetation. Species, such as western meadowlarks and brown-headed cowbirds, that occurred in large numbers in both riparian and upslope sites also were common in Russian-olive.

Nesting mourning doves and territorial yellow-breasted chats occurred in densities that appeared abnormally high at the Idaho Russian-olive site. The Russian-olive stands also may provide excellent foraging habitats for some bird species that nest elsewhere. Migrating western tanagers and evening grosbeaks were especially common-to-abundant in the Idaho stand. Neither species was seen nesting at the site. Large numbers of swallows (northern rough-winged, cliff, barn) foraged just above the canopy at all sites.

Deer mice were observed at all sites that we trapped, and likely were present at the flooded Utah riparian site also. Within Russian-olive sites, the house mouse was the only other mammalian species in Idaho. Eight other species were observed in the Russian-olive site in Colorado, and 3 others at the Utah site. Riparian sites contained 4 and 5 species in Idaho and Colorado, respectively. Upslope sites contained 5, 4, and 2 species in Idaho, Utah, and Colorado, respectively. From these observations we concluded that factors other than woody vegetation (e.g., soil characteristics, rock outcroppings, and herbaceous vegetation) strongly influenced the community structure of small mammals at a site. The 21 montane voles captured in the Russian-olive site in Utah indicated that the vegetative association (heavy grass understory, open overstory) may be providing something unique for this species in eastern Utah.

SUMMARY

Since its introduction before 1900, Russian-olive has become naturalized in many areas throughout the Rocky Mountain states. We assessed implications of naturalization to wildlife resources by inventorying avian and mammalian communities at areas of monotypic stands in Colorado, Idaho, and Utah. Russian-olive stands tended to support avian communities intermediate in species richness and alpha diversity to native riparian and upslope communities. Beta diversity comparisons indicated stronger relationships between

←

Fig. 3. Irrigated meadow (top) and abandoned gravel pit (bottom) colonized by Russian-olive within city limits of Fort Collins, Colorado. Note cottonwood saplings in gravel pit site only. Native riparian vegetation along the Cache la Poudre River (Platte River drainage) is seen behind the irrigated meadow site.

Russian-olive and riparian communities than upslope communities. Small mammal communities contained low species richness, but followed the pattern of intermediate diversity between the native sites. Russian-olive is intermediate in height to the native communities, and frequently establishes along the interface of the two. The species appears to be competitively inferior to native overstory species. We conclude that the continued naturalization of Russian-olive will increase the width of lowland riparian zones at some locations, providing additional habitats for especially those avian species that are associated with tall-shrub vegetation.

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APPENDIX I

Avian species observed at native riparian, naturalized Russian-olive, and native upslope study sites near Milliken, Colorado; Murphy, Idaho; and Fort Duchesne, Utah.

Species	No. observed		
	Riparian	Russian-olive	Upslope
Double-crested cormorant (*Phalacrocorax auritus*)	1	0	0
Great blue heron (*Ardea herodias*)	2	1	0
Canada Goose (*Branta canadensis*)	2	0	0
Mallard (*Anas platyrhynchos*)	6	3	0
Blue-winged teal (*Anas discors*)	7	2	0
Cinnamon teal (*Anas cyanoptera*)	4	2	0
Redhead (*Aythya americana*)	2	0	0
Northern harrier (*Circus cyaneus*)	0	0	1
Swainson's hawk (*Buteo swainsoni*)	0	0	1
American kestrel (*Falco sparverius*)	3	0	1
Ring-necked pheasant (*Phasianus colchicus*)	3	0	1
California quail (*Callipepla californica*)	1	3	0
Sora (*Porzana carolina*)	1	0	0
Killdeer (*Charadrius vociferus*)	7	7	7
Spotted sandpiper (*Actitus macularia*)	2	1	0
Long-billed curlew (*Numenius americanus*)	0	0	1
Common snipe (*Gallinago gallinago*)	3	0	0
Mourning dove (*Zenaida macroura*)	18	33	11
Common barn-owl (*Tyto alba*)	0	1	0
Western screech-owl (*Otus kennicottii*)	0	1	0
Burrowing owl (*Athene cunicularia*)	0	0	2
Long-eared owl (*Asio otus*)	5	0	0
Common nighthawk (*Chordeiles minor*)	1	2	0
Common poorwill (*Phalaenoptilus nuttallii*)	0	0	1
Northern flicker (*Colaptes auratus*)	11	0	0

APPENDIX I

(Continued).

Species	No. observed		
	Riparian	Russian-olive	Upslope
Olive-sided flycatcher (*Contopus borealis*)	1	0	0
Western wood-pewee (*Contopus sordidulus*)	3	0	0
Empidonax sp.	0	2	1
Gray flycatcher (*Empidonax wrightii*)	0	1	0
Western kingbird (*Tyrannus verticalis*)	2	3	2
Eastern kingbird (*Tyrannus tyrannus*)	19	20	0
Violet-green swallow (*Tachycineta thalissina*)	0	1	0
Northern rough-winged swallow (*Stelgidopteryx serripennis*)	0	36	3
Cliff swallow (*Hirundo pyrrhonota*)	1	12	19
Barn swallow (*Hirundo rustica*)	2	14	2
Blue jay (*Cyanocitta cristata*)	1	0	0
Black-billed magpie (*Pica pica*)	21	31	3
Common raven (*Corvus corax*)	0	0	2
Black-capped chickadee (*Parus atricapillus*)	2	1	0
Rock wren (*Salpinctes obsoletus*)	0	0	10
House wren (*Troglodytes aedon*)	19	1	0
Black-tailed gnatcatcher (*Polioptila melanura*)	2	0	0
American robin (*Turdus migratorius*)	15	16	5
Northern mockingbird (*Mimus polyglottos*)	0	0	1
Sage thrasher (*Oreoscoptes montanus*)	0	0	2
Brown thrasher (*Toxostoma rufum*)	0	0	1
Cedar waxwing (*Bombycilla cedrorum*)	5	0	0
European starling (*Sturnus vulgaris*)	31	1	0
Warbling vireo (*Vireo gilvus*)	10	0	0
Yellow warbler (*Dendroica petechia*)	9	9	0
MacGillivray's warbler (*Oporornis tolmiei*)	1	0	0
Common yellowthroat (*Geothlypis trichas*)	3	9	0

APPENDIX I
(Continued).

Species	No. observed		
	Riparian	Russian-olive	Upslope
Wilson's warbler (*Wilsonia pusilla*)	1	0	0
Yellow-breasted chat (*Icteria virens*)	14	11	0
Western tanager (*Piranga ludoviciana*)	2	10	0
Black-headed grosbeak (*Pheucticus melanocephalus*)	8	0	0
Lazuli bunting (*Passerina amoena*)	2	2	2
Green-tailed towhee (*Pipilo chlorurus*)	1	0	0
Rufous-sided towhee (*Pipilo erythrophthalmus*)	5	0	0
Chipping sparrow (*Spizella passerina*)	1	0	1
Brewer's sparrow (*Spizella breweri*)	0	0	10
Vesper sparrow (*Pooecetes gramineus*)	1	0	1
Lark sparrow (*Chondestes grammacus*)	0	0	33
Sage sparrow (*Amphispiza belli*)	0	0	33
Savannah sparrow (*Passerculus sandwichensis*)	1	0	4

APPENDIX I
(Continued).

Species	No. observed		
	Riparian	Russian-olive	Upslope
Grasshopper sparrow (*Ammodramus savannarum*)	0	0	1
Song sparrow (*Melospiza melodia*)	5	11	0
Dark-eyed junco (*Junco hyemalis*)	0	0	1
Red-winged blackbird (*Agelaius phoeniceus*)	67	21	0
Western meadowlark (*Sturnella neglecta*)	23	34	34
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)	3	0	0
Brewer's blackbird (*Euphagus cyanocephalus*)	2	6	4
Common grackle (*Quiscalus quiscula*)	8	26	7
Brown-headed cowbird (*Molothrus ater*)	20	46	26
Northern oriole (*Icterus galbula*)	11	20	0
American goldfinch (*Carduelus tristis*)	1	5	0
Evening grosbeak (*Coccothraustes vespertinus*)	1	47	0
House sparrow (*Passer domesticus*)	0	2	0