

## POPULATION TRENDS OF INTRODUCED BIRDS IN WESTERN NORTH AMERICA

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*Abstract.* Introduced birds are those captured, transported, and released elsewhere, either intentionally or accidentally. Eighty-three species of birds have been introduced into western North America; about 43 of these now have reproductively competent populations. Nearly half the introductions into western North America have been of gamebirds. Feral pigeons, European Starlings, and House Sparrows are at numerical stasis; Spotted Doves, Ringed Turtle-Doves, and Crested Mynas show major decreases, partly owing to urban environmental succession. Successful introduced species tend to have had multiple introductions, a large area of natural distribution, ability to exploit resources generated and dominated by humans, and high fecundity. Results of avian introductions are difficult to predict, but knowing this means we are not necessarily doomed to repeat the past.

*Key Words:* Distribution; abundance; anthropogenic ecology; colonizing species.

Humans have been modifying the distribution and abundance of birds for thousands of years. In some instances species have been extirpated, in some their numbers increased or decreased, and in others their distributions changed. Causes for increases in range or numbers are several, and include the introduction by humans of individuals from one place to another. It is some population consequences of the latter concerning western North America that is the focus of this review.

Introduced birds are defined as those captured and transported by humans and released elsewhere. Release sites may be where the species has never occurred, no longer occurs, or occurs at low density; an introduction may be accidental or intentional. Instances of human-mediated dispersal of birds are known for most regions of the world. More than 200 pertain to North America (Long 1981), and 84 of them have affected the American west. Currently, about 43 of these have self-replicating populations (Table 1).

The fraction for western North America is small if numbers of species are considered, and even smaller if restricted to viable species. But that is not the only point of reference, or else this chapter would not have been written. In fact, a few introductions have resulted in enormously abundant populations that command our interest because

they tell something about population biology, perhaps certain ecological asymmetries, and the initial stages of the evolutionary process, as well as being possible sources of recreational, public health, agricultural, and economic concerns. The degree to which these concerns are realized varies from place to place, but this examination for western North America probably represents the world in microcosm.

### SPECIES ACCOUNTS

In the accounts below, a few species or groups of species listed in Table 1 are discussed; records of winter population trends at some stations of western occurrence are from Christmas Bird Counts (CBCs; see citations to Bird-Lore, Audubon Magazine, Audubon Field Notes, and American Birds).

#### *Peregrine Falcon* (*Falco peregrinus*)

Decline in population sizes throughout North America in the 1960s, a response to chlorinated hydrocarbon pesticides, almost exterminated Peregrine Falcons. In the west in the early 1970s, just two pairs were known in California, six in Colorado, one in Oregon, three in Washington, and "a few" in New Mexico and Texas (Burnham and Cade 1992). In 1973, private organizations, including the Peregrine Fund, and State and Federal wildlife agencies, began releasing captive-reared peregrines in regions where

TABLE 1. SUCCESSFULLY INTRODUCED BIRDS OF WESTERN NORTH AMERICA<sup>1</sup>

Family/species	Locality and date <sup>1</sup>	References
<b>Anatidae</b>		
<i>Olor buccinator</i>	USA: OR, NV 1957, WA 1964 CAN: BC	Johns and Erickson 1970 Godfrey 1966
<i>Cygnus olor</i>	USA: OR CAN: BC	Wing 1956 Long 1981
<i>Branta canadensis</i>	USA: AZ 1966 CAN: BC 1931	Palmer 1976 Carl and Guiguet 1972
<b>Cathartidae</b>		
<i>Gymnogyps californianus</i>	USA: CA 1991	Snyder and Johnson 1992
<b>Falconidae</b>		
<i>Falco peregrinus</i>	Western USA: 1973–	Burnham and Cade 1992
<b>Phasianidae</b>		
<i>Perdix perdix</i>	USA: 1877. CA, OR, WA, ID, UT, MO	Guiguet 1961
<i>Francolinus pondicerianus</i>	CAN: 1904. BC, Alta., Sask. USA: CA 1959, NV	Carl and Guiguet 1972 Christensen 1963, Bohl 1968, Bump and Bohl 1964
<i>Tetraogallus himalayensis</i>	USA: 1962. NV	Christensen 1963, Bump and Bohl 1964
<i>Alectoris chukar</i>	USA: 1893. CA, OR, WA, MN, WY, ID, CO, NV, AZ, NM, UT CAN: 1940. BC, Alta. MEX: Baja	Bump 1968, Whitney 1971, Gott- schalk 1967 Carl and Guiguet 1972 Long 1981
<i>Phasianus colchicus</i>	USA: 1730. CA 1889, OR 1882, MN 1895, UT 1900, and all other western states CAN: 1882. BC, Alta. MEX: Baja	Roberts 1960, Allen 1962 Carl and Guiguet 1972 AOU 1983
<i>Pavo cristatus</i>	USA: CA	Hardy 1973
<i>Dendragapus canadensis</i>	USA: AK 1957	Long 1981
<i>Dendragapus obscurus</i>	CAN: BC 1970	Carl and Guiguet 1972
<i>Bonasa umbellus</i>	USA: NV CAN: BC	McColm 1970 Carl and Guiguet 1972
<i>Lagopus leucurus</i>	USA: CA, UT	Gaines 1988, Behle et al. 1985
<i>Meleagris gallopavo</i>	USA: 1925–. CA, OR, WA, MD, ID, NV, AZ, NM, UT, CO, WY	Walker, E. 1949
<i>Colinus virginianus</i>	USA: 1865–. OR, WA, ID, MN, WY, CO, AZ CAN: 1900–. BC	Goodrum 1949 Carl and Guiguet 1972
<i>Callipepla californica</i>	USA: 1865–. CA, OR, WA, ID, UT CAN: 1860–. BC	Phillips 1928, Johnsgard 1973 Carl and Guiguet 1972
<i>Callipepla squamata</i>	USA: NV 1960s, WA 1913	AOU 1957, Johnsgard 1973
<i>Oreortyx pictus</i>	USA: WA 1860s, NV, ID CAN: BC 1860s	Carl and Guiguet 1972 Guiguet 1961
<b>Columbidae</b>		
<i>Columba livia</i>	USA: 1621. now in all western states CAN: 1606. BC, Alta., Yukon MEX:	Schorger 1952 Schorger 1952 Peterson and Chalif 1973
<i>Streptopelia risoria</i>	USA: CA 1930s	Cooke and Knappen 1941
<i>Streptopelia chinensis</i>	USA: CA 1917?	Reuther 1951, Storer 1934
<b>Psittacidae</b>		
<i>Aratinga mitrata</i>	USA: CA 1980s	CBCs, Los Angeles region
<i>Melospittacus undulatus</i>	USA: CA 1930s	Cooke and Knappen 1941, Hardy 1973
<i>Psittacula krameri</i>	USA: CA 1956	Hardy 1964
<i>Myiopsitta monachus</i>	USA: CA 1972	Hardy 1973, Davis 1974
<i>Nandayus nenday</i>	USA: CA 1968	Hardy 1973

TABLE 1. CONTINUED

Family/species	Locality and date <sup>1</sup>	References
<i>Rhynchopsitta pachyrhyncha</i>	USA: AZ 1986, 87, 91	Snyder and Johnson 1992
<i>Brotogeris versicolurus</i>	USA: CA 1971	Hardy 1973
<i>Amazona viridigenalis</i>	USA: CA 1980s	CBCs, Los Angeles region
<i>Amazona finschi</i>	USA: CA 1977–1981?	CBCs, Los Angeles region
<i>Amazona autumnalis</i>	USA: CA 1968	Hardy 1973
<i>Amazona oratrix</i>	USA: CA 1962	Hardy 1973
<b>Alaudidae</b>		
<i>Alauda arvensis</i>	CAN: BC 1903	Scheffer 1935, Carl and Guiguet 1972
<b>Pycnonotidae</b>		
<i>Pycnonotus jocosus</i>	USA: CA 1968	Hardy 1973
<b>Mimidae</b>		
<i>Mimus polyglottos</i>	USA: CA 1891, OR 1892	Phillips 1928, Jewett and Gabrielson 1929
<i>Mimus gilvus</i>	CAN: BC, Alta. PANAMA: 1932	Godfrey 1966 Ridgeley 1976
<b>Sturnidae</b>		
<i>Sturnus vulgaris</i>	USA: 1890. CO 1938, NV 1938, MN 1939, UT 1939, ID 1941, CA 1942, OR 1943, WA 1943, AK 1952 CAN: 1914. BC 1945, Yukon 1962, NW Terr. 1969 MEX: Tamps. 1935, Coah. 1939, Nuevo L. 1948, Yucatan >1973	Long 1981; Kessel 1953 Godfrey 1966, Carl and Guiguet 1972 Coffey 1959, Yocum 1963, Long 1981
<i>Acridotheres cristatellus</i>	USA: WA 1920s CAN: BC 1894–1897	Jewett et al. 1953 Wood 1924, Carl and Guiguet 1972
<b>Emberizidae</b>		
<i>Cardinalis cardinalis</i>	USA: CA 1880	Hardy 1973
<b>Passeridae</b>		
<i>Passer domesticus</i>	USA: 1852. CA 1871, UT 1873 CAN: BC 1886 MEX: SLP 1930, Isthmus of Tehuan. 1947, Chiapas 1950 COSTA RICA: 1974–1975	Robbins 1973 Godfrey 1966, Carl and Guiguet 1972 Coffey 1959, Wagner 1959, Peterson and Chalif 1973 Reynolds and Stiles 1982
<b>Estrildidae</b>		
<i>Estrilda melopoda</i>	USA: 1965. CA	Hardy 1973

<sup>1</sup> For western North American localities unless otherwise stated.

they had formerly nested. This program has been successful, and peregrines now occur again in most regions of the west. A discussion of details is presented by White (1994).

#### *Galliform birds (Phasianidae)*

Some 19, or 44%, of the successful avian introductions to western North America are of birds important in recreational hunting.

These species have been extensively studied, propagated in confinement, transported, and released into habitat likely to support free-living populations. Management of game species has commanded significant fractions of State fish and game department budgets, and the resultant gamebird populations can be important to local human economies. The literature is enormous and cannot be covered here in any depth, but

the ecology and behavior of many introduced species has been treated at book length a number of times.

One species, the Ring-necked Pheasant, *Phasianus colchicus*, has had multiple introductions of a variety of genetic stocks for more than 200 years in North America, for more than 100 years in many places in the west beginning in Alberta, British Columbia, Montana, and Oregon, and ultimately in all western states. Introductions have been made by both private and governmental agencies, and continue to the present time (Long 1981).

In a few places in the west, such as the Central Valley of California, the Ring-necked Pheasant is wholly successful as a free-living bird, despite human predation each autumn, and needs little except population monitoring and adjustment of hunting seasons and bag limits to maintain itself. Other populations need occasional augmentation, and others, in rapidly urbanizing regions such as southern California, have almost entirely disappeared.

Introductions of genetic stocks from populations different from those used historically, namely *P. c. colchicus* and *P. c. torquatus*, are still underway. Recent work has featured birds from the Near and Middle East, taken from populations identified as *P. c. talischensis*, *P. c. persicus*, their hybrids, and their hybrids with other named stock; for introductions into western dryland habitats (as well as others) see Long (1981).

The White-tailed Ptarmigan (*Lagopus leucurus*) was introduced from Colorado to the Sierra Nevada of California, near Yosemite National Park, in the early 1970s; it has spread within the alpine zone along some 75 km of range (Gaines 1988). It has also been introduced into Utah (Behle et al. 1985).

The Wild Turkey (*Meleagris gallopavo*) is another species of intense management interest, and provides as good a case history of the efficacy of modern wildlife management policies as one could wish. Subsequent

to essentially unrestricted hunting and degradation of forest habitats following European colonization of North America, turkeys were markedly reduced in numbers and distribution, a condition that persisted until perhaps 65 years ago (E. Walker 1949). But introductions, reintroductions, restocking, and transplants since then have been successful, and turkeys are now found in southwestern Canada and nearly throughout the lower 48 states of the U.S.A., at localities where they had never historically occurred (AOU 1983). Distribution is disjunct, in accord with distribution of woodlands, and some populations may depend on restocking for their maintenance. Seasonal and bag limits are monitored relative to population numbers wherever hunting is feasible.

#### *Feral Pigeon (Rock Dove, Columba livia)*

Feral pigeons developed in the west following introductions of domestic pigeons by settlers and merchants, presumably to most localities at a relatively early time; there is, however, no documentation of any such activity. Ferals today occur commonly in urban centers, smaller towns, cattle feedlots, grain storage facilities, and family farms. Colonies in large cities and elsewhere, as along the Front Range in Colorado (R. Ryder, pers. comm.), have served as foraging foci for Peregrine Falcons being reintroduced to their former range.

Numbers of feral pigeons are small where few humans live, as in the Great Basin and in high montane sites, but the birds occur in low density at all seasons of the year in central Utah, southwestern Wyoming, southeastern Colorado, and central montane New Mexico. In such regions the pigeons behave much more like wild *C. livia* of the Old World than urban pigeons; they nest in canyon cliffsides (vertical limestone rimrock above steep talus slopes) and commute to cattle feeding stations in tight, high-speed flocks only a few meters above ground level.

CBCs at four western cities (Table 2) show larger numbers in the 1980s than earlier,

TABLE 2. TOTALS AND YEARLY MEANS OF ROCK DOVES ON WINTER BIRD COUNTS IN FIVE-YEAR PERIODS FOR FOUR STATIONS IN WESTERN NORTH AMERICA<sup>1</sup>

Period	El Paso		Salt Lake City		Spokane		Oakland	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
1972–1976	304	101	nc <sup>2</sup>	—	1457	486	2365	788
1977–1981	3248	650	1518	304	3208	642	5709	1142
1982–1986	4890	978	2094	419	3024	605	6371	1274
1987–1991	3136	1568	1321	330	2497	624	5299	1419

<sup>1</sup> Data from American Birds.<sup>2</sup> No counts.

but the most recent counts suggest little yearly increase. Pigeons are frequently the target of population control programs, usually with limited success (Murton et al. 1972). Only if availability of food is severely restricted can feral pigeon populations be kept within acceptable limits (e.g., Haag 1987).

#### *Ringed Turtle-Dove* (*Streptopelia risoria*)

The Ringed Turtle-Dove was established in the Los Angeles region, from captive escapes in the early 1900s, but apparently spread little beyond the urban core of the city of Los Angeles. As with many exotic species, the geographic limits and population parameters of established populations of these doves have been confounded by ongoing escapes or releases of caged individuals; escaped Ringed Turtle-Doves are reported widely, but generally singly, from much of the urban west.

A representative CBC from Los Angeles, CA (Table 3), shows that numbers increased to a peak in the 1940s and 1950s and subsequently declined, probably reflecting some consequences of urban succession there. At present, the population of Ringed Turtle-Doves around downtown Los Angeles has almost completely disappeared.

#### *Spotted Dove* (*Streptopelia chinensis*)

The Spotted Dove was introduced into southern California in the early 1900s, and became established from the Los Angeles area northwest to Santa Barbara County, south to San Diego and immediately adjacent Baja California Norte, and east to the Coachella Valley by the 1960s (Long 1981).

Outlying populations in the Central Valley, centered in Bakersfield, may have been part of this range expansion or the result of separate introduction events. This dove appeared on Santa Catalina Island some time after the mid-1970s, probably through a secondary introduction from the mainland, and is regularly noted in a recently-established CBC from the island. CBCs at Pasadena-San Gabriel and at Los Angeles (Table 3) suggest that numbers peaked from the early 1950s to the early 1970s; the subsequent decline at both CBC sites probably is due to urban succession. Current dynamics of the species' distribution in California appear to include a degree of range contraction in Santa Barbara County, after having become "fairly common" by the early 1980s (Lehman 1982), and in the San Diego re-

TABLE 3. TOTALS AND YEARLY MEANS OF *Streptopelia* DOVES ON WINTER BIRD COUNTS IN FIVE-YEAR PERIODS FOR FOUR STATIONS IN WESTERN NORTH AMERICA<sup>1</sup>

Period	Spotted Dove				Ringed Turtle-Dove	
	Pasadena, CA		Los Angeles, CA		Los Angeles, CA	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
1938–1941	0	0	274	69	54	14
1942–1946	—	—	423	85	47	9
1947–1951	444	89	534	107	542	108
1952–1956	982	196	1041	208	575	115
1957–1961	596	119	366	73	386	77
1962–1966	862	172	952	190	277	55
1967–1971	323	65	480	120	243	49
1972–1976	431	86	999	200	210	42
1977–1981	297	59	625	125	94	24
1982–1986	368	74	417	83	48	10
1987–1991	117	29	287	72	80	20

<sup>1</sup> Data from Bird-Lore, Audubon Magazine, Audubon Field Notes and American Birds.

gion. But they seem also to include continued expansion in the San Joaquin Valley.

#### Parrots (*Psittacidae*)

Reproductive populations of several species of exotic parrots have developed from escapes in southern California in the past 30 years (Table 1). Information on population status and reproductive ecology of these exotic psittacids remains sketchy, in part because standard monitoring schemes, such as the USFWS Breeding Bird Survey and Christmas Bird Counts, fail to provide relevant data, the former because of poor coverage in urban and suburban habitats, and the latter because of selective and erratic treatment of exotics. Difficulties in field identification, especially in the genera *Amazona* and *Aratinga*, also contribute to the confusion about the current status of feral parrots in the region. Information on the ecology of feral parrots in southern California is provided by Froke (1981) and Hall (1988).

Of the psittacids noted by Hardy (1973) to have established feral populations in southern California, several (*Nandayus nenday*, *Psittacula krameri*, *Amazona oratrix*, and *A. viridigenalis*) have maintained or increased their populations; it is not clear, however, whether the specific populations mentioned by Hardy are still extant, because current populations may not have descended from those established in the 1960s and early 1970s.

Specimen evidence (Los Angeles County Museum of Natural History) shows that the populations of "Canary-winged Parakeets" noted from coastal Los Angeles County by Hardy (1973) were of the nominate subspecies, *Brotogeris versicolurus versicolurus*. By the 1980s, the species had spread over much of the Los Angeles basin, but more recent specimen samples are of *B. v. chiriri*, the "Yellow-chevroned Parakeet," whose native South American range lies to the south of that of the nominate form, from which it may be specifically distinct (Sibley and Monroe 1990). This temporal replacement

of *versicolurus* by *chiriri* in the 1980s exactly duplicates their history in southern Florida (Robertson and Woolfenden 1992), and probably represents a shift in the source regions of the birds imported into the U.S.A.

The Mitred Parakeet (*Aratinga mitrata*) increased throughout the Los Angeles basin in the 1980s and now appears to be the most numerous feral psittacid in the region; the regional population probably has reached several hundred thousand individuals (CBC data; Garrett, unpubl. data). Other species of *Aratinga*, especially *A. acuticaudata* and *A. erythrogenys*, are sporadically seen, often with flocks of *mitrata*.

Noteworthy is the failure of the Monk Parakeet (*Myiopsitta monachus*) and Budgerigar (*Melopsittacus undulatus*) to have established long-lived populations in southern California. Both species are present in numbers elsewhere in North America and, while mentioned by Hardy (1973) as having nested, appear not to be established in southern California at present.

Concerning a non-exotic introduction: Thick-billed Parrots became extinct in the United States some time after 1938 (Monson and Phillips 1981). The birds are locally common in the Sierra Madre Occidental of Mexico, and are caught there for sale as captives. Releases of federally confiscated Thick-billed Parrots illegally sold in the U.S.A. were made in 1985 in the Chiricahua Mts. of Arizona, and in 1987 and 1991 of cage-reared birds (Snyder and Johnson 1992). Although pairing and nesting of some of the confiscated birds was seen in 1988 and 1989, none of the released birds are thought to be alive in the wild as of 1992.

#### European Starling (*Sturnus vulgaris*)

European Starlings were introduced to North America in the 1870s and reached the west coast through natural dispersal by 1942 (Howard 1959). Winter populations seem to have stabilized at El Paso and Salt Lake City, and have perhaps declined from peaks reached in the 1970s in Spokane and Oakland (Table 4). Counts for the latter two

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Page 226, second column, second paragraph, first sentence beginning with; "The Mitred Parakeet (*Aratinga mitrata*)..." should read; "...has reached several hundred individuals..."  
NOT "...several hundred thousand individuals..."

TABLE 4. TOTALS AND YEARLY MEANS OF EUROPEAN STARLINGS ON WINTER BIRD COUNTS IN FIVE-YEAR PERIODS FOR FOUR STATIONS IN WESTERN NORTH AMERICA<sup>1</sup>

Period	El Paso		Salt Lake City		Spokane		Oakland	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
1947–1951	939	188	30,856	6171	0	0	0	0
1952–1956	1052	210	39,333	9833	5	1	0	0
1957–1961	2811	718	nc <sup>2</sup>	—	376	75	241	48
1962–1966	7602	1520	56,373	11,275	1063	213	14,948	2989
1967–1971	273	55	65,157	13,031	1132	226	27,311	9140
1972–1976	609	122	77,566	15,513	2524	504	61,026	12,205
1977–1981	976	195	71,553	14,311	7990	1598	38,312	7662
1982–1986	1051	210	72,224	14,245	4786	957	20,483	4097
1987–1991	570	143	59,260	14,815	2195	1544	14,810	3703

<sup>1</sup> Data from Audubon Field Notes and American Birds.<sup>2</sup> No counts.

cities were in force prior to the arrival of starlings, so the totals provide a summary of how this successful invader fared numerically in two climatically distinctive regions. Starlings appeared in Alaska 40 years ago and currently overwinter; CBCs for 1991 showed Sitka with 66 individuals, Mitkoff Is. 100, the Matanuska Valley (61°36'N) 125, Wrangell Is. 12, and Juneau 69. They appeared in Yellowknife, NWT, 24 years ago. To the south, starlings were found in Yucatan 20 years ago, and their breeding occupancy of Middle American highlands may not be far off.

#### *Crested Myna (Acridotheres cristatellus)*

Crested Mynas were introduced to the Vancouver, B.C. region in the period 1894–1897. The population increased until about 1927, when approximately 20,000 birds were estimated to live in the region; num-

bers then decreased and were estimated at 2000 to 3000 birds in 1960 (Mackay and Hughes 1963). CBCs were not taken (or, not published in *Audubon Field Notes*) until 1957. The species had its CBC peak in the period 1960–1972 (Table 5) and since then has gradually decreased in abundance on counts at Vancouver and Ladner, B.C. Mynas in 1989 were considered to be close to extinction in Vancouver (Weber and Cannings 1990).

#### *House Sparrow (Passer domesticus)*

House Sparrows were introduced into western North America in 1871 or 1872 at San Francisco, California, perhaps from North American sources, and in 1873 or 1874 at Salt Lake City, Utah, from European sources (Robbins 1973). Numbers of sparrows have apparently declined from a high that was reached around 100 yrs ago in eastern North America (Robbins 1973, who suggested the decline of family farming and of the horse as transportation as possible causes of population decreases), but are stable in the west at present (Table 6). Breeding Bird Survey data show House Sparrows living in all parts of the western USA and Canada, but at low densities in eastern Oregon, southern Idaho and Montana, western Wyoming, Colorado, and Arizona, and most of Utah, which is to say desert, montane, and basin and range sectors of the west (Robbins et al. 1986). Even so, local densities may be appreciable, and

TABLE 5. TOTALS AND YEARLY MEANS OF CRESTED MYNAS ON WINTER BIRD COUNTS IN FIVE-YEAR PERIODS IN SOUTHERN BRITISH COLUMBIA<sup>1</sup>

Period	Vancouver		Ladner	
	N	$\bar{X}$	N	$\bar{X}$
1957–1961	2941	588	200	67
1962–1966	3347	669	504	126
1967–1971	3777	775	281	70
1972–1976	1190	238	96	24
1977–1981	709	142	80	20
1982–1986	317	79	63	16
1987–1991	70	18	12	3

<sup>1</sup> Data from Audubon Field Notes and American Birds.



TABLE 6. TOTALS AND YEARLY MEANS OF HOUSE SPARROWS ON WINTER BIRD COUNTS IN FIVE-YEAR PERIODS FOR FOUR STATIONS IN WESTERN NORTH AMERICA<sup>1</sup>

Period	El Paso		Salt Lake City		Spokane		Oakland	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
1947-1951	8101	1636	24,965	4993	1276	255	1679	336
1952-1956	2427	485	32,000	8000	2572	514	4136	827
1957-1961	2773	555	nc <sup>2</sup>	—	7626	1525	3189	638
1962-1966	1616	323	10,618	2124	5312	1062	2353	471
1967-1971	2329	466	12,702	2540	1132	226	879	293
1972-1976	2787	558	9006	1801	2928	586	6533	1307
1976-1981	6669	1334	4485	897	3655	731	3342	668
1982-1986	4250	850	4129	826	4298	860	2430	486
1987-1991	2536	1268	4556	1139	4786	1197	1475	369

<sup>1</sup> Data from Audubon Field Notes and American Birds.

<sup>2</sup> No counts.

populations at Salt Lake City are sometimes extremely large, to judge by CBCs from 1938 to 1990.

Maximum recorded densities on the Breeding Bird Survey have been in the San Joaquin Valley, California, and the vicinity of Portland, Oregon, almost certainly reflecting the intensely agricultural habitats of those regions (Robbins et al. 1986). Over the past 20 yrs of CBC information (Table 6), House Sparrows have been at relatively stable numbers per count area, averaging around 500 (Oakland), 1000 (El Paso and Spokane), or 1500 (Salt Lake City).

#### *Exotic finches (Ploceidae and Estrididae)*

Occasional, apparently ephemeral, populations of exotic finches have appeared since the 1960s in the Los Angeles region and elsewhere in the urban west. The population of *Estrilda melpada* mentioned by Hardy (1973) appears to be no longer extant, but other species of *Estrilda* and *Lonchura* are seen frequently, sometimes in flocks, in rank, weedy areas of the Los Angeles basin. The Northern Red Bishop (*Euplectes franciscanus*) also is seen frequently in similar habitats and was documented as breeding along the Los Angeles River, Los Angeles County, California, in 1991 (Garrett, unpubl. data). The frequent appearance of small, "incipient" populations underscores the need for tracking and documenting occurrences of exotic species as well as

for incorporating carefully identified exotics into standard census efforts such as CBCs.

#### DISCUSSION

Approximately half the 84 avian species introduced to western North America can now be found there, which means that the probability of success is modest. The survivors of course include some of the world's most gifted colonizing species—the House Sparrow, the European Starling, and the Rock Dove. These three have occupied an important part of the anthropogenic ecology of the west in the past century. We may ask, given that humans keep caged birds and modify habitats, was this inevitable—would even these top-level colonizing species have persisted without intentional human-mediated dispersal?

Colonizing species are those for which environments provide little or no reproductive or demographic constraints. Thus, a species predisposed toward colonizing will inevitably be assisted by deliberate multiple releases. Lapses in keeping caged birds confined eventually would have allowed sparrows and starlings to have had their opportunities in the west, if we are to judge by what happened to domestic pigeons, which had relatively few intentional releases. Successful invasions require a range of conditions, however, and these occur unpredictably for any species. Additionally, no single characteristic of birds themselves guarantees their colonizing capability.

In a comprehensive examination of cause and effect in introduced or invading species, Smallwood (1990) identifies a complex of variables that help explain success or failure of an introduced species. These include 1) the size of the initial introduction, 2) the ultimate number of introductions, 3) the area of natural range of the introduced species, 4) the ability to exploit resources generated and dominated by humans, and 5) the fecundity of the species. This requires us to think of a multivariate world, with interacting causes and effects. We have in the past handled such a complexity by conceiving of the "empty niche," an ecologic hyperspace waiting to be occupied. But it is only when a colonizing species is found to succeed that a niche is identified.

The niche may be a difficult abstraction, but humans have never had difficulty visualizing habitat components of niche, and have persistently maintained a confrontational attitude toward natural habitats. Some habitats are powerfully affected, with some destroyed (and thus some created); others are not changed so dramatically. At one extreme, urban habitat for exotic doves and psittacids currently is being subtly changed in parts of southern California occupied by humans at high density; at the other, the woodland habitat formerly occupied by Passenger Pigeons (*Ectopistes migratorius*) was strongly modified and largely destroyed over a century of heavy human use.

This is to say that humans do not sensitively react to important aspects of their natural environment. Whether by intention, as with House Sparrows and gamebirds, or by indirection, as with Rock Doves, we do not keenly anticipate the consequences of our ecologic behavior. We still lack the ability to make high-probability predictions concerning introductions (although we are getting close); for now we know only enough to avoid repeating earlier mistakes. Thus, providing potentially colonizing species a foothold in a new region is something we can avoid. Nevertheless, we will almost certainly continue to foster

introductions, one way or another. The small size and ephemeral nature of many of these introductions in western North America suggests that most will be biologically insignificant. But, so were the initial stages in the colonization of North America by House Sparrows and Eurasian Collared-Doves.

The accelerating urbanization of the west, with modification of native habitats and addition of non-native life forms, virtually guarantees that exotics of many taxa will constitute an increasing percentage of the avifauna of western North America. Careful monitoring of all free-flying exotics will help insure that important early stages of population development are understood and will also aid in the development of strategies for control of exotics when such action is deemed necessary.

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