

V. TERRESTRIAL VERTEBRATES

By Dean Pearson and Deborah Finch

Within the Interior West, terrestrial vertebrates do not represent a large number of invasive species relative to invasive weeds, aquatic vertebrates, and invertebrates. However, several invasive terrestrial vertebrate species do cause substantial economic and ecological damage in the U.S. and in this region (Pimental 2000, 2007; Bergman and others 2002; Finch and others 2010). About 28 species of mammals have been introduced into the U.S.; these include dogs (*Canis familiaris*), cats (*Felis catus*), horses (*Equus caballus*), burros (*E. asinus*), cattle (*Bos taurus*), sheep (*Ovis aries*), pigs (*Sus scrofa*), goats (*Capra hirus*), deer (*Cervus* spp.), rats and other small mammals (Drost and Fellers 1995; Layne 1997). In the Interior West, released burros and horses graze heavily on native vegetation, facilitating invasion by exotic annuals. Many invasive mammal species in the Interior West have escaped or were released into the wild; some have become pests by preying on native animals, by spreading diseases to native animals, by grazing on crops and native vegetation, by increasing soil erosion, or by damaging structures (Pimental 2007; Finch and others 2010).

Approximately 100 of the 1,000 bird species in the United States are exotic (Temple 1992; EPA 2005). Of the introduced bird species, only 5% are considered beneficial whereas the majority are considered pests. The most serious pest bird in the Interior West and throughout the United States is the exotic common pigeon (*Columba livia*), which inhabits most cities (Robbins 1995). Pigeons defecate on buildings, streets, sidewalks, statues, and cars; and they feed on grain. Pigeons act as reservoirs and vectors for human and livestock diseases, such as parrot fever, ornithosis, histoplasmosis, and encephalitis (Weber 1979; Long 1981). Another very recently introduced and expanding dove is the Eurasian Collared Dove (*Streptopelia decaocto*). This species has invaded North America at a record pace. In 1982, it arrived in Florida and has since rapidly spread to places as far as Montana and Alaska. The invasiveness of this species has raised concern over its potential impacts on native species, particularly related species such as the Mourning Dove, but currently very little is known about its impacts on natives. Some birds damage crops. Exotic European starlings (*Sturnus vulgaris*) are common throughout the Interior West where they cost millions in reduced grain production and displace native birds. Another exotic urban bird, the house sparrow (*Passer domesticus*) was introduced in 1853 to control the canker worm, but by 1900, it had become a pest. House sparrows damage plants in residential and public areas, consume wheat, corn, and fruit, and harass and displace native birds (Pimental 2000).

About 53 amphibians and reptile species have been introduced into the United States (Pimental 2000). Perhaps the most significant amphibian pest in the Interior West is the bullfrog (*Rana catesbeiana*). Originally native to eastern North America, the bullfrog has been introduced widely in the West. Bullfrogs are broadly generalist consumers implicated in the decline of native ranid frogs and the Mexican gartersnake (*Thamnophis eques*) (Rosen and Schwalbe 1995). Bullfrogs may expose native amphibians to increased levels of risk by spreading the chytrid fungus (*Batrachochytrium dendrobatidis*). Bullfrogs are suspected to be significant predators of hatchling and juvenile western pond turtles. Some invasive terrestrial animal species are exotic like European wild pigs, nutrias, rock doves, and European starlings, but many are native species like brown-headed cowbirds, common ravens, and red foxes that have expanded into new habitats. Anthropogenic factors contributing to native species becoming invasive include: direct human introductions into new regions (bull frogs, eastern fox squirrels), habitat alterations (coyotes, brown-headed cowbirds), food subsidies (common ravens), facilitation by introduced exotics (brown-headed cowbirds), artificial habitats such as telephone poles used for nesting (common ravens), and suppression of large predators that may facilitate range expansions (red foxes, raccoons). At present, there are relatively few studies within RMRS examining these issues as they relate to terrestrial vertebrate invaders.

(1) Prevention. Europe is the main source of North American exotic vertebrates. Recent studies suggest that new introductions of exotic mammals and birds from Europe to North America peaked in the mid 19th century and have since declined to very low levels (Jeschke and Strayer 2005). This suggests that most such introductions have already occurred or that contemporary

laws are reasonably effective at preventing new exotic mammal and bird introductions. However, within the Rocky Mountain Region, certain exotic and native North American invaders are still expanding into new locations, e.g., Eurasian collared doves, European wild boars, bull frogs, common ravens, and brown-headed cowbirds. Research can contribute to addressing this problem by developing new understanding of the factors facilitating expansion of these invaders (Finch and others 2010). RMRS Scientist Deborah Finch led the recovery team for the southwestern willow flycatcher, a species often parasitized by cowbirds. The recovery plan included steps for preventing cowbird parasitism. Past RMRS research has documented the link between anthropogenic disturbance and brown-headed cowbird invasion (Tewksbury and others 1999). Current research is underway to determine the habitat and landscape factors influencing the presence and distribution of cowbirds, their hosts, host selection, and host reproductive success (Finch ongoing). However, current RMRS research examining the potential range expansion of other animal invaders is limited or absent.

(2) Early Detection and Rapid Response. Given the continued expansion of extant invaders, such as bull frogs and Eurasian Collared Doves, into new locations, development of methods to monitor for nascent foci of vertebrate invaders and rapidly address them is warranted. Past and current RMRS research has clarified the role of habitat in influencing where brown-headed cowbirds are present or absent and where hosts are not affected or are severely affected in southwestern river systems (Finch 1982, 1983; Finch and Stoleson 2000; Schweitzer and others 1998; Brodhead and others 2007). Other invasive species research in this area is lacking, however, but is justified based on increasing rates of new introductions of invasive species, including invasive vertebrates (Finch and others 2010). Climate change is likely to influence the movement or spread of some invasive vertebrates. Finch and others (2010) advocate research to detect migration of invasives into new areas as habitats shift in response to changing climates.

(3) Control and Management. Effective management of invasive vertebrates requires (1) understanding the biological and ecological factors that determine invader success so management can target those causal factors for control and (2) identifying the invader's impacts on native species to ensure that management actions effectively mitigate invader impacts. Past RMRS research has documented how variation in managed habitats impacts the distribution of brown-headed cowbirds and their hosts and influences which hosts are selected to be parasitized (Finch 1982, 1983; Finch and Stoleson 2000; Schweitzer and others 1996, 1998; Brodhead and others 2007). Such information is valuable in designing habitat management approaches that will limit cowbird brood parasitism. Current RMRS research is evaluating the impacts of brown-headed cowbirds on native birds to determine whether host species may need active intervention (Finch, ongoing). Other collaborative studies are evaluating factors that determine brown-headed cowbird success (e.g., Tewksbury and others 2006). Research is needed to determine mechanisms for invader success and quantify invader impacts for other species, such as bull frogs, that have increasing impacts in the Interior West. In addition, studies of invasive urban species are needed to determine the extent they will need to be managed in rapidly expanding urban environments such as Phoenix, Denver, and Las Vegas.

(4) Rehabilitation and Restoration. Rehabilitating and restoring native communities impacted by invasive terrestrial vertebrates requires understanding the invader's impacts and the capacities of native species to recover from these impacts once the invader has been effectively controlled or removed. RMRS research in this area is currently limited to studies evaluating whether cowbird abundance and impacts on hosts increase or decrease after restoration and whether restoration for other purposes (e.g., fuel reduction) has benefits in controlling cowbird parasitism (Finch ongoing). Additional research is needed for other invasive terrestrial animal species, especially in habitats where restoration is beneficial in controlling damage and also to determine whether restoration for other purposes has incidental effects, positive or negative, on invasive vertebrates.

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