

GEESE AS FRUGIVORES AND PROBABLE SEED-DISPERSAL MUTUALISTS

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Abstract.—Two species of geese (*Chloephaga* spp.) are important frugivores and possible seed dispersers in Tierra del Fuego. In other parts of the world, geese, gulls, swans, and shorebirds consume fruit regularly and may be seed dispersers. Thus, in habitats where passerine diversity is often low, such as tundra, bogs, and shoreline meadows, nonpasserine "waterbirds" may interact mutualistically with plants.

GANSOS COMO FRUGÍVOROS Y PROBABLES MUTUALISTAS DISPERSADORES DE SEMILLAS

Sinopsis.—Dos especies de gansos (*Chloephaga* spp.) son frugívoros importantes y posibles dispersadores de semillas en Tierra del Fuego. En otras partes del mundo, gansos, cisnes, gaviotas y playeros consumen frutas regularmente y podrían ser dispersantes de las semillas de estos. Por lo tanto, en habitats tales como la tundra y en anegados, en donde hay muy poca diversidad de paserinos, las aves acuáticas podrían interactuar mutualísticamente con las plantas.

The diversity of seed-dispersing frugivorous birds in the tropics is relatively high; outside the tropics, the best known avian seed dispersers are passerines, woodpeckers, and ratites (Willson 1989, 1991). However, other nontropical birds are potential or probable mutualists as well. Among the birds in which frugivory is perhaps unexpected are a number of species commonly associated with bodies of water and shorelines. For example, gulls in various parts of the world are known to eat fruit (Cramp and Simmons 1983; M. F. Willson, unpubl. data), and large shorebirds (e.g., *Numenius tahitiensis*; B. McCaffrey, pers. comm.) and swans (*Cygnus*, J. King, pers. comm.) in Alaska consume significant amounts of fruit. Geese are customarily considered to be herbivores (grazers), and some dry seeds are also consumed (Martin et al. 1951), but non-incidentally frugivory has also been reported (Ridley 1930, Sedinger and Raveling 1984, Summers

TABLE 1. Frequency of seeds in 198 seed-containing goose feces in coastal matorral and tideflats near Puerto Arturo, Tierra del Fuego, February 1995.

Species	Frequency of occurrence (%)	Frequency of exceeding 50% of deposit (%)
<i>Empetrum rubrum</i>	96	36
<i>Berberis empetrifolia</i>	26	<1
<i>Pernettya mucronata</i>	15	<1
<i>B. buxifolia</i>	2	—
<i>B. ilicifolia</i>	<1	—

and Grieve 1982). However, the possibility that they are regular frugivores and mutualistic seed dispersers represents a departure from conventional wisdom.

Two species of geese (Magellan or Upland Goose or Caiquén, *Chloephaga picta*; Ashy-headed Goose or Canquén, *C. poliocephala*) commonly co-occur in mixed, post-breeding flocks of various sizes on tide flats, in low-growing coastal scrub (matorral), and sphagnum bogs (turberas) near Puerto Arturo in western Tierra del Fuego, and less commonly in wet pastures near Vicuña in the interior part of the Island. In February 1995, we collected goose feces from tideflats and matorral and made ocular estimates (in quartiles) of their contents; we also counted seed-containing feces in turberas. This report documents the frequency of seeds of fleshy-fruited plants in feces of these two species of goose (collectively); it was not possible to distinguish the excreta of each species.

Of 250 goose feces collected from coastal matorral and adjacent tideflats, 79% contained seeds of fleshy-fruited plants and 11% contained only seeds and fruit-pulp remnants. Most of the feces (89%) contained remains of digested leaves, and 21% of them contained only leaves. Five species of seed were swallowed and passed by geese (Table 1). The most frequently occurring species of seed in goose feces was *Empetrum rubrum* (Empetraceae), which occurred in almost all of the seed-bearing feces and often comprised >50% of the fecal deposit (Table 1; see also Summers and Grieve 1982). *Berberis empetrifolia* (Berberidaceae) and *Pernettya mucronata* (Ericaceae) also occurred fairly frequently but usually in small proportions. Thus, *Empetrum rubrum* was, by far, the most commonly eaten fruit in terms of both frequency of occurrence and proportional composition of the deposits, although it averaged only 15% of the fruit available in matorral ($n = 480$ quadrats of 2-m radius). In turberas, 60% of the 178 goose feces contained seeds, almost entirely *E. rubrum*, which was the most common fruit available in this habitat (87% of all fruit censused; $n = 278$ quadrats). Virtually all the passed seeds appeared to be intact; the sole exception was broken seeds of *B. buxifolia* in one fecal deposit.

A number of vertebrates at high southern latitudes eat fruits and defecate intact seeds, including foxes (*Pseudalopex*), rheas (*Pterocnemia*), and several passerines (Ridley 1930, pers. obs.). Geese probably also should

be included as seed-dispersing mutualists. Although we did not examine germination behavior, it is probable that passed seeds would germinate well, as they do in most cases in which intact seeds are excreted by frugivorous vertebrates (Herrera 1989; M. F. Willson, pers. obs.). However, many seeds undoubtedly fail. Geese often rest on tidflats, and the numerous feces deposited there are washed away by the tides. The large number of seeds in many feces increases the potential for intense seedling competition, both intraspecific and interspecific, because 39% of the seed-containing deposits contained seeds of two or three species (see also Loiselle 1990). Dense concentrations of seeds also provide foraging opportunities for seed predators (refs. in Willson 1989). In addition, some seeds of *P. mucronata* (especially in old, pale-colored fruits) had germinated within the fruit, producing green seedlings 1–2 mm long. It is likely that all germinated seeds are killed by passage through a consumer digestive tract. Our sample was limited in both time and space, but our observations indicate that geese and some aquatic birds may be possible seed-dispersal mutualists in tundra, shore, and bog habitats, where passerine diversity is often low.

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