J. Field Ornithol., 68(1):144–146

GEESE AS FRUGIVORES AND PROBABLE SEED-DISPERSAL MUTUALISTS

MARY F. WILLSON
Forestry Sciences Laboratory
2770 Sherwood Lane
Juneau Alaska 99801 USA

ANNA TRAVESET
Institut d'Estudis Avançats de les Illes Balears
Crtra, Valldemossa Km. 7.5
Palma de Mallorca-07071
España

CARLOS SABAG
Depto, de Biología, Facultad de Ciencias
Universidad de Chile
Casilla 653
Santiago, Chile

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-incidental 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 (%)
Empetrum rubrum	96	36
Berberis empetrifolia	26	<1
Pernettya mucronata	15	<1
B. buxifolia	2	—
B. ilicifolia	<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* (*Gaultheria*) *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 tideflats, 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.

ACKNOWLEDGMENTS

We thank M. Arroyo and Trillium Forestal for the opportunity to make these observations, A. Peñalosa and V. Ferrada for superlative logistical support, and P. Jordano and A. Rodríguez for helpful references.

LITERATURE CITED

CRAMP, P. S., AND K. E. S. SIMMONS. 1983. Handbook of the birds of Europe, the Middle East and North Africa: the birds of the western Palearctic. Vol. 3: Waders to gulls. Oxford University Press, Oxford, United Kingdom. 913 pp.

HERRERA, C. M. 1989. Frugivory and seed dispersal by carnivorous mammals, and associated fruit characteristics, in undisturbed Mediterranean habitats. Oikos 55:250–262.

LOISELLE, B. A. 1990. Seeds in droppings of tropical fruit-eating birds: importance of considering seed composition. Oecologia 82:494–500.

MARTIN, A. C., H. S. ZIM, AND A. L. NELSON. 1951. American wildlife and plants. A guide to wildlife food habits. Dover, New York. 500 pp.

RIDLEY, H. N. 1930. The dispersal of plants throughout the world. Reeve, Ashford, Kent. 744 pp.

SEDINGER, J. S., AND D. G. RAVELING. 1984. Dietary selectivity in relation to availability and quality of food for goslings of cackling geese. Auk 101:295–306.

SUMMERS, R. W., AND A. GRIEVE. 1982. Diet, feeding behaviour and food intake of the upland goose (*Chloëphaga picta*) and ruddy-headed goose (*C. rubidiceps*) in the Falkland Islands. J. Appl. Ecol. 19:783–804.

WILLSON, M. F. 1989. Gut retention times of experimental pseudoseeds by emus. Biotropica 21:210–213.

———. 1991. Dispersal of seeds by frugivorous animals in temperate forests. Revista Chilena de Historia Natural 64:537–554.

Received 25 Mar. 1996; accepted 16 May 1996.