

MANAGEMENT OF THE WINTER FORAGING HABITAT FOR CANADA GEESE AT QUAIL HILL

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ABSTRACT

As part of its open space plan, the City of Irvine has preserved a winter foraging area for migrating Canada geese (*Branta canadensis moffitti* and *B. c. tavernei*) at Quail Hill, an area supporting flocks of 2,500 to 4,150 birds. In years when there is sufficient rainfall to allow grass and annual herbs to germinate and to produce a forage base, the geese use this grassland area between late November and mid-March; the site is grazed by cattle in winter. The grasslands are predominantly of two types: the first consists of non-native grasses mixed with low, weedy species such as filaree (*Erodium* spp.) and burclover (*Medicago polymorpha*); the second has a higher density of grasses and is dominated by foxtail fescue (*Vulpia myuros*). Of the 67 vascular plant species in 22 families, 29 species are introduced. The preferred goose-forage plants have occurred primarily in the first grassland association and include burclover, red-stemmed filaree (*Erodium cicutarium*), long-beaked filaree (*E. botrys*), slender wild oat (*Avena barbata*), and wild barley (*Hordeum murinum*). Recommended manage-

ment strategies for the site include curtailing the further spread of the non-native cardoon, or wild artichoke (*Cynara cardunculus*).

INTRODUCTION

Quail Hill lies between Sand Canyon Road and the University Drive southern onramp to the San Diego Freeway (I-405). It is approximately 1.5 km from Sand Canyon Reservoir, adjacent to Ridgeline Drive in Irvine. The area grazed by the geese comprises 250 to 300 acres (100 to 120 hectares) (Nelson, 1986) between the San Diego Freeway on the north, Sand Canyon Road alignment on the east, University Drive on the west, and the Quail Hill ridgeline on the south. The broad, sloping flat at the base of Quail Hill has supported a large population of overwintering Canada goose subspecies for many years.

The nearby Sand Canyon Reservoir, a 47-acre impoundment constructed in 1942 and owned by the Irvine Ranch Water District, provides aquatic habitat for these migratory flocks. They spend the nights on the impoundment, departing for diurnal foraging areas after daylight but before actual sunrise, usually between 0630 and 0730. According to Nelson (1986), aggregates of birds ranging from a few to hundreds leave the reservoir every few minutes for up to an hour and a half after daylight. The birds return to the reservoir after sunset but before dark.

While there have been relatively few studies on the geese using this area (the data base comprises personal communications from Dan Yparaguirre, Carl Wilcox, Jack Fancher, other agency representatives, and the research by Nelson, 1986), this is one of the larger regional winter stopover areas in Southern California. Other regional sites, each supporting several thousand

migratory birds, include the Seal Beach Weapons Reserve and, on the Santa Ana River, the riparian habitat behind Prado Dam. The Quail Hill - Sand Canyon Reservoir flocks vary from year to year in number of birds, from approximately 2,500 individuals in 1986 (Nelson, 1986; Table 1) to a high of 4,150 on 27 January 1988 (Fred Worthley, Department of Fish and Game, 1988). The geese usually arrive in early-to-mid-November, reach their greatest numbers in January or February, and decline in concentration until mid-March, when all have migrated elsewhere.

Two subspecies have been recorded from the site: *Branta canadensis moffitti*, breeding in the Great Basin and comprising approximately 90% of the birds, and *B. c. taverneri*, a subspecies breeding in the interior of Alaska. Both are dramatically present in enormous numbers very close to the San Diego Freeway along the base of Quail Hill and have been the subject of intense local public interest. A few snow geese also graze at the base of Quail Hill with the Canada geese.

This significant migratory bird population on eminently developable lands presents substantial

TABLE 1. Counts of Canada Geese on Quail Hill from January through March, 1986 (Nelson, 1986).

Date of Count	No. of Geese counted ¹
Jan 5	1200
Jan 19	2500
Feb 8	2500
Feb 17	1500-2000 ²
Feb 22	2200 ³
Feb 23	2000
Mar 8	2200
Mar 15	20

¹ Counts reflect estimates only, due to the difficulty of making close observations of all geese in the study area at the same time.

² Observation difficult; 150 counted at Laguna Reservoir

³ 40 counted at Laguna Reservoir

management challenges, especially since land use adjacent to Sand Canyon Road has transformed a great deal of former goose habitat into row-crop agriculture, eliminating it for foraging. Laguna Reservoir and the land surrounding it were formerly used by geese (Nelson, 1986). However, Laguna Reservoir will be drained and developed, and the lands around the lake are already unusable by geese due to agricultural expansion in the last few years. Though these sites were not as intensively used as Quail Hill, the habitat lost is more than twice that remaining, leaving a greatly restricted local foraging range.

Negotiations between the City of Irvine and The Irvine Company resulted in an Open Space Plan for the City of Irvine, which was embraced by the voters in spring 1988 and became law in July of that year. Included in the open space legislation was permanent protection for the Quail Hill foraging area and lands adjacent to Sand Canyon Reservoir. This was a tremendous victory for the Irvine public, and there is every promise that overwintering geese will remain a visible part of local natural history. Moreover, the Irvine City Council is addressing the problem of managing all of the city's open space, with special emphasis on sensitive natural-resource areas such as Quail Hill and Sand Canyon Reserve (Agran, 1988).

Nonetheless, management challenges remain. From the little access we have been allowed to the site, we will outline briefly some of the emerging problems.

Quail Hill, the primary foraging area, has an open topography, with good visibility for long distances that precludes surprise attacks by predators. It has been grazed for many years, and parts of it were probably cultivated in the past. Obviously, however, there is still an excellent forage base for geese. What the Quail Hill geese eat is a fundamental question not answered by the Nelson (1986) study or through casual observation. It also remains to be determined how the current, apparently attractive condition can be maintained to optimize continued use by geese; and whether cattle grazing interferes with use by geese or, rather, if it prevents ecological succes-

sion in the plant community that would alter conditions unfavorably for the birds.

FIELD OBSERVATIONS

On-site observations were made between 0900 and 1430 on 21 January 1988, when goose numbers were near their maximum, and again on 14 April 1988, after the geese had departed. In lieu of access to the site, an additional off-site sweep with binoculars in early March censused grass species not easily seen during the January survey. Fred Roberts (UCI Museum of Systematic Biology), John Simon (City of Irvine), and the senior author conducted the surveys. The results are shown in Table 2.

VEGETATION

The Quail Hill site is predominantly grassland, with scattered shrub-dominated areas on Quail Hill and on the flat just beyond the ravine mouth. The grassland species are mostly non-native, dominated by introduced European species such as wild oat (*Avena barbata*), brome grasses (*Bromus diandrus* and *B. rubens*), and wild barley (*Hordeum murinum*). Wild artichoke (*Cynara cardunculus*) is abundant and in places dominant throughout the low-lying areas extending up onto the hillsides. There are two basic types of introduced grassland at this site. The first is a hodgepodge of non-native grasses mixed with low, weedy species such as filaree (*Erodium* spp.) and burclover (*Medicago polymorpha*); the second community has a higher density of grasses and is dominated by foxtail fescue (*Vulpia myuros*).

The rock outcrops on Quail Hill have small remnant stands of coastal sage scrub (a low, open shrub cover) dominated here by California buckwheat (*Eriogonum fasciculatum*) and California sagebrush (*Artemisia californica*); the sagebrush, in particular, spreads and thins as it penetrates the grassland. Other shrubby species include coast goldenbush (*Isocoma veneta*), found in patches on Quail Hill and on hills to the east.

In the lowlands adjacent to the San Diego Freeway, mulefat scrub dominates the flat to the

west of the ravine, indicating subsurface moisture of at least seasonal runoff. Subsequent observation has confirmed that agricultural runoff occurs throughout the summer, and it was still present in October when this paper was prepared. The mulefat scrub is dominated almost entirely by *Baccharis salicifolia* (*S. glutinosa*), with scattered patches of prickly pear cactus (*Opuntia* sp.) and species intruding from the surrounding grassland.

Introduced species dominate the site, and during the field surveys no rare or locally significant species were observed. Of the 67 vascular plant species we identified at Quail Hill, 29 were introduced. There is much evidence that the entire site, with the exception of Quail Hill itself, has undergone a great deal of disturbance, with a subsequent reduction in native species diversity. It is probable that the entire area was once cultivated. The area has recovered substantially, but further restoration is hampered by seasonal cattle and goose grazing. The flat to the west of the ravine mouth is studded with old tree trunks, indicating that at least part of the site was at one time an orchard.

PRIMARY FOOD PLANTS FOR THE GEESE

Most foraging occurred in low-lying areas, but grazed sites continued two-thirds of the way up both Quail Hill and the hill face to the east. The birds also fed in the valley between Quail Hill and the eastern series of hills, in a position more or less behind and south-southeast of Quail Hill. The geese sometimes grazed within 20 yards of Sand Canyon Road, the San Diego Freeway or University Drive. All of these areas are dominated by non-native grassland, with a high percentage of non-grass species. The geese tended to avoid rock outcrops, shrubs, artichoke plants, and large, robust herbs.

The geese were observed feeding on the broad-leaved annual grasses, such as wild barley and bromes, and several weedy species, particularly the filarees and bur clover. The grasses and weedy plants of grazing areas are strikingly different from those in cactus or artichoke patches, where the geese are reluctant to feed. Wherever these

TABLE 2. Plant listings for the Quail Hill site based on 21 January 1988 and 14 April 1988 site visits (adapted from Bowler, 1988). A, abundant; C, common; F, frequent; L, local and restricted; O, occasional; R, rare; r, found among rock outcrops; *, introduced or naturalized.

FAMILY NAME	SPECIES NAME	COMMON NAME	RELATIVE ABUNDANCE
Primary Goose Food Plants Observed at Quail Hill:			
Fabaceae	<i>Medicago polymorpha</i>	*Burclover	C
Geraniaceae	<i>Erodium botrys</i>	*Long-Beaked Filaree	O
	<i>E. cicutarium</i>	*Red-Stemmed Filaree	C-A
Poaceae	<i>Avena barbata</i>	*Slender Wild Oat	C
	<i>Hordeum murinum</i>	*Wild Barley	C
General Plant List for Quail Hill Site:			
Amaryllidaceae	<i>Dichelostemma pulchellum</i>	Wild Hyacinth	O
Apiaceae	<i>Bowlesia incana</i>	Bowlesia	LOr
	<i>Daucus pusillus</i>	Rattlesnake Weed	O
Asteraceae	<i>Sanicula arguta</i>	Sharp-Toothed Snakeroot	O
	<i>Artemisia californica</i>	California Sagebrush	LC
	<i>Baccharis salicifolia</i>	Mulefat	LC-LA
	(<i>B. glutinosa</i>)		
	<i>Calycadenia tenella</i>	Rosinweed	O
	<i>Cynara cardunculus</i>	*Wild Artichoke	C
	<i>Ericameria pachylepis</i>	Palmer's Goldenbush	O
	(<i>E. palmeri</i>)		
	<i>Filago gallica</i>	*Narrow-Leaved Filago	O
	<i>Grindelia robusta</i>	Big Grindelia (Gumplant)	O
	<i>Hemizonia fasciculata</i>	Fascicled Tarweed	F
	<i>Heterotheca grandiflora</i>	Telegraph Weed	O
	<i>Hypochoeris glabra</i>	*Smooth Cat's-Ear	C
<i>Isocoma veneta</i>	Coast Goldenbush	O-LC	
<i>Senecio vulgaris</i>	*Common Butterweed	O	
<i>Sonchus asper</i>	*Prickly Sow-Thistle	R	
<i>Xanthium strumarium</i>	Cocklebur	LC	
Brassicaceae	<i>Brassica geniculata</i>	*Short-Pod Mustard	O
	<i>B. nigra</i>	*Black Mustard	F
	<i>Descurainia pinnata</i>	Western Tansy Mustard	LOr
Cactaceae	<i>Lepidium lasiocarpum</i>	Hairy Pod Peppergrass	O
	<i>L. nitidum</i>	Shining Peppergrass	O
	<i>Opuntia</i> sp.	Prickly Pear Cactus	C

TABLE 2 (continued).

Caprifoliaceae	<i>Sambucus mexicanus</i>	Mexican Elderberry	O	
Caryophyllaceae	<i>Silene gallica</i>	*Windmill Pink	R	
	<i>Spurgula arvensis</i>	*Corn Spurry	O	
Chenopodiaceae	<i>Atriplex semibaccata</i>	*Australian Saltbush	O	
	<i>Chenopodium murale</i>	*Nettle-Leaved Goosefoot	O	
	<i>Salsola australis</i>	*Russian Thistle	O	
Convolvulaceae	<i>Calystegia macrostegia</i>	S. Calif. Morning Glory	Or	
	<i>Convolvulus arvensis</i>	*Field Bindweed	F	
Crassulaceae	<i>Crassula connata</i>	Sand Pygmy-Stonecrop	C	
Cucurbitaceae	<i>Cucurbita foetidissima</i>	Calabazilla (Wild Gourd)	O	
	<i>Marah macrocarpus</i>	Wild Cucumber	Or	
Euphorbiaceae	<i>Chamaesyce polycarpa</i>	Golondrina	Or	
Fabaceae	<i>Lotus scoparius</i>	Deerweed	LO	
	<i>Lupinus bicolor</i>	Miniature Lupine	O	
	<i>L. succulentus</i>	Arroyo Lupine	C	
	<i>L. truncatus</i>	Collared Lupine	O	
	<i>Medicago polymorpha</i>	*Burclover	C	
Geraniaceae	<i>Erodium botrys</i>	*Long-Beaked Filaree	O	
	<i>E. cicutarium</i>	*Red-Stemmed Filaree	C-A	
	<i>E. moschatum</i>	*White-Stemmed Filaree	O	
Hydrophyllaceae	<i>Phacelia cicutaria</i>	Caterpillar Phacelia	R	
Malvaceae	<i>Malva parviflora</i>	*Cheeseweed	O	
Nyctaginaceae	<i>Mirabilis californica</i>	Wishbone Bush	Or	
Plantaginaceae	<i>Plantago erecta</i>	California Plantain	LF	
Poaceae	<i>Avena barbata</i>	*Slender Wild Oat	C	
	<i>Bromus diandrus</i>	*Ripgut Grass	C	
	<i>B. hordeaceus</i>	*Soft Chess	C	
	<i>B. rubens</i>	*Foxtail Chess	C	
	<i>Distichlis spicata</i>	Saltgrass	LO	
	<i>Lamarckia aurea</i>	*Goldentop	O	
	<i>Lolium perenne</i>	*English Ryegrass	O	
	<i>Melica imperfecta</i>	Small-Flowered Melic Grass	LOr	
	<i>Stipa lepida</i>	Foothill Needlegrass	F	
	<i>Hordeum murinum</i>	*Wild Barley	C	
	<i>Vulpia myuros</i>	Foxtail Fescue	C	
	Polygonaceae	<i>Eriogonum fasciculatum</i>	California Buckwheat	Cr
		<i>Polygonum aviculare</i>	*Common Knotweed	O
<i>Rumex crispus</i>		*Curly Dock	O	
Scrophulariaceae	<i>Antirrhinum nuttallianum</i>	Nuttall's Snapdragon	Or	
	<i>Orthocarpus purpurascens</i>	Red Owl's Clover	C	
	<i>Scrophularia californica</i>	California Figwort	LFr	
Solanaceae	<i>Nicotiana glauca</i>	*Tree Tobacco	O	

patches occur, the grass and herbs are tall and well-developed; otherwise they are low and neatly trimmed as if mowed to the height of 1 inch. The geese will not put their heads into or under the canopies of artichoke plants; thus, areas inhabited by artichoke are lost to the geese.

All areas of intense goose feeding were similarly cropped close to the ground. Wherever the filaree-burclover type of introduced grassland was replaced by fescue grass, goose feeding decreased dramatically. This is likely due to the fescue's narrow blade, which may be uninteresting to the geese, and also to the reduction in number of filaree and burclover plants. The geese avoided lupine (*Lupinus truncatus* and *L. bicolor*).

NOTES AND RECOMMENDATIONS

To encourage the geese to keep returning, it is essential to preserve the Quail Hill area as it is, from Sand Canyon Road to University Drive and to the ridge tops of the southern hills. Heavy automobile traffic does not seem to bother the geese; they appear to tolerate cattle grazing nearby but are very wary of humans approaching on foot.

Ironically, the geese are supported by sites that require light seasonal disturbance, such as grazing. If grazing were entirely halted, weedy species such as filaree would eventually be crowded out. These weedy species are evidently one of the features drawing geese to the site. The geese themselves perform a strong grazing influence, so that cattle may not be necessary to maintain the site in its present condition; it is likely that grazing pressure by the geese retards flowering and seed set.

Unfortunately, grazing also encourages artichoke to spread, both discouraging the geese and gradually eliminating the grassland on which they depend. Artichoke has been proliferating rapidly in recent years, and its curtailment and eventual removal are becoming increasingly important, since it effectively excludes geese from its areas of dominance. Removal of the artichoke should be accomplished in the spring, after the geese have departed.

The upper areas of the hills, particularly around rock outcrops, would be suitable for the restoration of coastal sage scrub plants that have been extirpated by overgrazing. As part of the mitigation for Irvine-area development, portions of the Quail Hill site should be considered for revegetation with significant and suitable native plants.

PROBLEMS AND CHALLENGES

Research Needs

Access to the site by researchers is fundamental, so that quantitative and consistently timed data can be used in forming and systematically updating the management plan. Research can supply data on the timing on the number of visits by goose subspecies; quantitative documentation of plant forage species (for which some exclosure research will also be needed); and determination of the need, or lack of need, for cattle grazing.

Also, an occasionally used portion of the UCI campus behind the Farm School is slated for development. This potential loss needs to be assessed. Undoubtedly there are other similar sites, infrequently used by the geese, that could be evaluated after additional observation and research. The cumulative losses of Laguna Reservoir and the former grassland habitat between Laguna Canyon Road and Sand Canyon Road have focused migratory goose foraging on Quail Hill. A better understanding is needed of less frequently used sites.

In addition, assessment must be made of the impacts of adjacent human activity: the intensive row-crop agriculture, with permanent human presence along the Sand Canyon alignment; the planned residential development nearby; and the proposed golf course on the Phase IV area of Mason Regional Park. As residential development and Sand Canyon Road are extended inland, agricultural use of adjacent lands will be phased out. It is important that mitigative measures (screening by native plants, timing of construction to avoid goose disturbance) are successful in ameliorating the impacts of development.

The proposed golf course below the Sand Canyon Reservoir Dam must be carefully considered beforehand, not only because of its negative impact on the goose population, but also because grazing geese could become a significant problem on the golf green itself. "Nuisance geese" on golf courses are a well-documented and serious concern (Conover and Chasko, 1985; Waldman, 1989).

Clearly there are many other research needs, but little can be accomplished until access is granted.

Management Goals

A management plan is essential, with funding to manipulate the habitat as necessary. Although we have had little access to the site, several management needs are apparent.

Artichoke removal is increasingly important. Local conservation groups and the UCI (University of California at Irvine) Cooperative Outdoor Program have volunteered labor for this, but were also denied access throughout the 1988 spring and summer. This would be an excellent community service project for such groups after the geese have left the site in the late spring. Hillyard (1987) has developed a successful artichoke-removal methodology at similar habitats in Crystal Cove State Park.

It is vital to maintain the plant associations preferred by the geese. Preventing successional change on the forage sites is central to providing the geese with the forage needed to remain at the Quail Hill site.

Also, with irrigation runoff from the new agriculture areas along Sand Canyon Drive, *Baccharis* has proliferated along the base of the forage area. Ideally, nutrient-laden runoff is controlled at its source, but this may not be feasible here. If not, rather than flowing into the goose-forage area en route to the flood-control channel, agricultural runoff should be piped directly into the channel.

Maintaining Sand Canyon Reservoir as a habitat suitable for geese will require periodic dredging.

The retention of water adequate for Canada geese during the winter months is critical.

The coastal sage scrub community should be restored along the bluffs and on the face of Quail Hill. This is an important native component needed amid an otherwise introduced flora.

ACKNOWLEDGEMENTS

We thank Irvine Mayor Larry Agran and City Councilperson Cameron Cosgrove for their enthusiasm, support and enlightened commitment to preservation of the Quail Hill and Sand Canyon Reservoir Canada goose habitat. Michael LeBlanc and Dean Bushinger of The Irvine Company allowed us to visit the site twice, for which we are grateful. The Conservancy, an Irvine-based conservation group, and the UCI Cooperative Outdoor Program sponsored several "goose watches" during the 1988 winter season, which allowed careful observation of the geese and enabled us to inform interested citizens about the natural history of this site. The Irvine City Council is to be complimented for addressing the issue of habitat maintenance on Quail Hill and the significance of the geese as a natural heritage resource at three city council meetings.

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