Distribution and abundance of Tule Geese in California and southern Oregon

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Introduction

Hartlaub (1852) first classified North American White-fronted Geese as *Anser albifrons gambelli* from specimens obtained in Texas. Swarth & Bryant (1917), however, identified two distinct forms wintering in California. They designated the larger and darker subspecies as the Tule Goose *A. a. gambelli* and the smaller and lighter bird as the European White-fronted Goose *A. a. albifrons*. Subsequently, the North American form of *A. a. albifrons* became the Pacific White-fronted Goose *A. a. frontalis*, while the Tule Goose remained unchanged (AOU 1957). In 1975, Delacour & Ripley proposed designating the large, dark Whitefront wintering in California as *A. a. elgasi*, which they believed was distinct from *A. a. gambelli* wintering east of the Rocky Mountains. Most recently, the American Ornithologists' Union (1982) designated *A. albifrons* as the Greater White-fronted Goose. In this paper, however, I will continue to refer to *A. a. gambelli* as the Tule Goose.

Attempts to determine distribution and abundance of Tule Geese were hindered because the migration route and breeding area were unknown and field identification was difficult. Observations from wintering areas indicated Tule Geese were rare and local in California (Bauer 1979). In 1979, biologists found Tule Geese nesting in a geographically isolated area at Redoubt Bay in Cook Inlet, 160 km southwest of Anchorage, Alaska. Population estimates of 1100 to 1500 Tule Geese in Cook Inlet supported previous wintering ground estimates (Timm *et al.* 1982).

White-fronted Geese are one of the most sought-after species by hunters in the Pacific Flyway. During the past 20 years, the average annual harvest of White-fronted Geese has been 50,000 birds (Timm & Dau 1979; USFWS, unpubl. data). Because most hunters cannot distinguish Tule Geese from Pacific Whitefronts, there has been growing concern for Tule Geese. Before wildlife managers can determine whether hunting regulations protecting Tule Geese are required, its current distribution and abundance need to be identified. This paper presents information on the distribution and estimated abundance of Tule Geese in California and southern Oregon between 1978 and 1982.

Study area and methods

I conducted ground surveys throughout southern Oregon and northern California in areas known or suspected to be used by Tule Geese, including Summer Lake Wildlife Management Area (WMA), Klamath Wildlife Area (WA) (1), Klamath Forest (2) and Malheur (3) National Wildlife Refuges (NWRs) in Oregon; and Klamath Basin (Tule Lake and Lower Klamath), Modoc (4), Sacramento Refuge Complex (Sacramento, Delevan, Sutter (5), and Colusa (6)), San Luis (7), Merced (8), Kesterson (9), and Kern-Pixley (10) NWRs, and Gray Lodge (11), Grizzly Island, Joice Island, Volta (12), and Los Banos (13) WAs in California. Private lands surveyed in California included the Butte Sink (14), Napa Marsh (15), and Sacramento–San Joaquin River Delta (16), and South Grasslands District (17) (Figure 1; bracketed numbers, above, correspond to those displayed on the figure).

All population estimates were obtained by visual counts during ground surveys. On primary wintering areas (used by >2000 birds), I conducted surveys monthly. On secondary wintering areas (used by 500–2000 birds) and on primary migration stopover areas (used by >1000 birds) surveys were conducted as opportunity permitted. Population estimates were rounded to the nearest 100 birds. Compared to Pacific Whitefronts, Tule Geese were identified by their larger size and darker colour (Bellrose 1980).

The presence of neck-banded birds in the population aided the identification of areas used by Tule Geese. Between 1979 and 1981, 544 geese were captured (200 in California were given yellow collars, Wege, unpubl. data; 344 in Alaska, blue collars,

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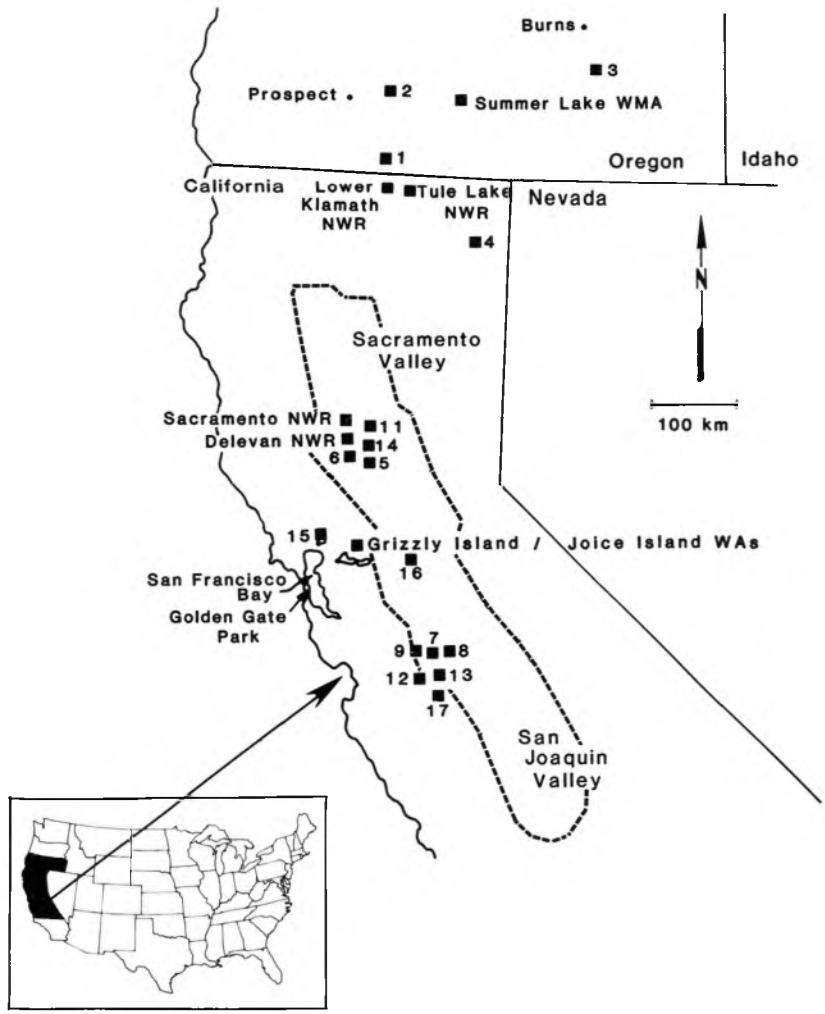

Figure 1. Areas surveyed for Tule Geese. Numbers correspond to the areas listed on page 14.

Timm *et al.* 1982). Each bird was banded with a US Fish and Wildlife Service leg band and fitted with an individually coded, plastic neck-band, the ends of which were sealed to reduce loss. Sightings of these individually identifiable geese established an association between known wintering areas and the recently discovered nesting area in Cook Inlet, Alaska. References in this paper to marked birds include both California and Alaska banded Tule Geese. The number of marked birds available for observation include the total number marked minus those birds known to have died from all causes. No data were available from this study to calculate the annual neck-band loss rate. Therefore, values for the number of marked birds available for observation are theoretical maximum numbers because they include birds that had lost their collars. 'Expected values' refer to the presence of California and Alaska banded geese in proportion to their presence in the marked population.

Results

Distribution

(i) Migration areas

Primary autumn migration stopover areas for Tule Geese were Summer Lake WMA and Klamath Basin NWRs. Birds were

present at Summer Lake WMA from late August to late September (S. Denney, pers. com.; Table 1). Tule Geese arrived at the Klamath Basin NWRs beginning in early September and most departed the refuges by late October (C. Ely, pers. com.). In spring, the only primary migration stopover area located was Klamath Basin NWRs. Birds were present from late February until late April. During both autumn (S. Thompson, pers. com.) and spring migration, Tule Geese used the private lands between Burns, Oregon, and Malheur NWR as a stopover area. No Tule Geese were observed at Summer Lake WMA during spring migration.

(ii) Wintering areas

The primary wintering areas for Tule Geese were Sacramento and Delevan NWRs. Birds began to arrive in early September and remained until the start of spring migration during February.

A secondary wintering area was located at Grizzly Island WA. Tule Geese arrived during the latter part of September and used the refuge until the end of the hunting season in late January. Tule Geese used Colusa NWR, Butte Sink, Sacramento–San Joaquin River Delta and San Joaquin Valley intermittently and in small numbers.

Abundance

About 3200 Tule Geese used the primary autumn migration stopover areas in 1980 and 1981. Autumn peaks at Summer Lake WMA were 1500 birds in 1980 and 2100 birds in 1981 (S. Denney, pers. com.). At Klamath Basin NWRs, however, the peak number of Tule Geese declined from 2000 birds in 1980 to 1200 birds in 1981 (C. Ely, pers. com.). The estimated spring peaks at Klamath Basin NWRs were 1000 birds in 1980 and 3000 birds in 1981.

The winter population of Tule Geese was estimated to be 2100 birds for winters 1978–79 and 1979–80 (Table 2). Peak populations of Tule Geese occurred on Sacramento and Delevan NWRs in November 1978 and in late October 1979. I did not observe Tule Geese at nearby Colusa NWR (9 km south of Delevan NWR) or Sutter NWR (32 km southeast of Delevan NWR) during the 1978–79 winter, but about 100 Tule Geese used Colusa NWR from November 1979 to January 1980 (C. Ely, pers. com.). Ground surveys located 200 to 300 Tule Geese in the Butte Sink and 800 to 1000 at Grizzly Island WA, but none in the San Joaquin Valley.

The winter population of Tule Geese was estimated to be 4800 birds in 1980–81 and 5000 birds in 1981–82 (including 300 birds

Table 1. First observation of individual neck-banded Tule Geese at primary migration stopover areas and wintering areas.

	Number of marked geese					
	Summer Lake WMA[1]		Klamath Basin NWRs[2]		Sacramento NWR Complex	
Date	1980–81	1981–82	1980–81	1981–82	1980–81	1981–82
1–10 September	2	15	2	65		
11–20 September	24	26	2	3	8	
21–30 September	2	9	2	37	80	9
1–10 October			11	5	45	53
11–20 October			20	13	60	21
21–31 October				2	26	103
1–10 November					5	25
11–20 November					15	36
21–30 November					13	3
1–10 December					5	18
11–20 December					6	16
21–31 December					1	4
1–10 January						1
11–20 January					1	
21–31 January						1
Totals[3]	28	50	37	125	265	290

[1] Data supplied by S. Denney, Oregon Department of Fish and Wildlife.
[2] Data supplied by C. Ely, University of California, Davis.
[3] Totals represent all the marked birds observed at each area.

Table 2. Peak population estimates for Tule Geese.

Month	Sacramento NWR Complex	Butte Sink	Grizzly Island WA
1978–79			
November	1300	–	–
December	900	200	1000
1979–80			
October	1300	–	500*
November	1000	–	–
December	1000	300†	800
1980–81			
September	1000	–	–
October	3000	–	500*
November	3500	–	–
December	3000	–	1500
1981–82			
September	500	–	–
October	2000	–	1000*
November	3500	–	–
December	3500	–	1200

*Data supplied by H. George, California Department of Fish and Game.
†Data supplied by I. Stone, Berry Patch Gun Club.

assumed to be present in the Butte Sink, although ground surveys were not conducted). The birds continued to use primarily Sacramento and Delevan NWRs and peaks occurred in November and December (3500 birds). The peak population of Tule Geese at Grizzly Island WA was 1500 birds in 1980–81 and 1200 birds in 1981–82.

Observation of neck-banded Tule Geese

(i) Autumn migration

S. Denney (pers. com.) observed a similar proportion of the available marked birds during autumn migration at Summer Lake WMA in 1980 (8.1% of 345 birds) and in 1981 (10.5% of 478 birds; Table 1). At Klamath Basin NWRs, however, C. Ely (pers. com.) observed significantly more ($P<0.001$) of the available marked birds in 1981 (26.2% of 478 birds) compared to 1980 (10.7% of 345 birds; Table 1). Over 85% of the neck-banded Tule Geese in the Klamath Basin were observed at Lower Klamath NWR.

I found no clear pattern in observations of California and Alaska banded birds at Summer Lake WMA and Klamath Basin NWRs during autumn migration (Table 3). In 1980 both groups were observed in proportion to expected values. In 1981, however, significantly more Alaska banded birds were observed at Summer Lake WMA while more California banded birds were present at Klamath Basin NWRs.

Despite their relatively close proximity (130 km), separate segments of the Tule Goose population used Summer Lake WMA and Klamath Basin NWRs. Only one neck-banded bird from Summer Lake WMA was observed at Lower Klamath NWR in 1980 and none were observed at either Lower Klamath or Tule Lake NWRs in 1981. I found no significant difference

Table 3. Observation of neck-banded Tule Geese at autumn migration stopover areas in 1980 and 1981.

	1980					1981				
	California banded birds n=61 (17.7%)		Alaska banded birds n=284 (82.3%)			California banded birds n=176 (36.8%)		Alaska banded birds n=302 (63.2%)		
Location	Observed	Expected	Observed	Expected	P*	Observed	Expected	Observed	Expected	P*
Summer Lake WMA	3 (10.7)	5	25 (89.3)	23	>0.70	11 (22.0)	18	39 (78.0)	32	<0.05
Klamath Basin NWRs	3 (8.1)	7	34 (91.9)	30	>0.10	66 (52.8)	46	59 (47.2)	79	<0.001

*Calculated using the Fisher Exact Probability Test.

between the resighting rate for marked birds observed at Summer Lake WMA (14.0%) in 1980 and again in 1981 and at Klamath Basin NWRs (8.9%) for the two years.

In 1980 and 1981, S. Thompson (US Fish and Wildlife Service) observed two Alaska banded Tule Geese on private lands between Burns, Oregon and Malheur NWR.

(ii) Wintering areas

During the 1980–81 winter, I estimated a maximum 342 (61 California and 281 Alaska) neck-banded Tule Geese were alive. During each 10-day period between 1 September and 31 October, an average of 14.7% of the marked birds observed for the first time at the Sacramento NWR Complex had previously been observed at Summer Lake WMA or Klamath Basin NWRs. The large number of marked birds that arrived during this period, however, indicated that many Tule Geese by-passed these migration stopover areas. By 31 January 1981, 85.7% of the marked birds from Summer Lake WMA and Klamath Basin NWRs had been resighted at the Sacramento NWR Complex.

Observations on wintering areas accounted for 276 (80.7%) of the marked birds in the population. At the Sacramento NWR Complex, California and Alaska banded birds were observed in proportion to their presence in the marked population. At Grizzly Island WA, however, the 64 (18.7%) marked birds observed contained significantly more Alaska birds than expected ($P<0.05$) and included 11 Alaska banded birds which were not observed on the Sacramento NWR Complex.

Ground surveys in 1981 indicated that the Tule Geese arrived later at the Sacramento NWR Complex than in 1980 (Table 2). Perhaps for this reason, marked birds from Summer Lake WMA and Klamath Basin NWRs made up an average of 58.7% of the marked birds observed for the first time at Sacramento NWR Complex during each 10 day period from 1 September to 31 October, compared to the 14.7% figure for 1980 (Table 1). By 31 January 1982, 94.9% of the marked birds from these areas had been observed at the Sacramento NWR Complex.

During the 1981–82 winter, the Tule Goose population contained a maximum of 475 (176 California and 299 Alaska) marked birds. Despite a reduction in field observation time, 297 (62.5%) marked Tule Geese were observed on wintering areas in 1981–82. California and Alaska banded birds were again present at expected frequencies at the Sacramento NWR Complex ($P = 0.08$). The 70 (14.7%) marked birds observed at Grizzly Island WA represented no significant difference from 1980–81 in the proportion of marked birds observed. This total included 7 (1 California and 6 Alaska) marked birds which were not observed on the Sacramento NWR Complex. California and Alaska banded birds were observed in proportion to their presence in the marked population.

Twenty-two observations of 20 neck-banded Tule Geese were made at locations other than the Sacramento NWR Complex and Grizzly Island WA during the 1980–81 and 1981–82 field seasons. These included the Sacramento–San Joaquin River Delta (17), Butte Sink (2), San Francisco Bay and Golden Gate Park in San Francisco and Prospect, Oregon (1 each; D. Timm, pers. com.) (Fig. 1). A few reports of Tule Geese have come from the San Joaquin Valley (Merced and San Luis NWRs, Los Banos WA, and the South Grasslands District), but marked birds have not been sighted.

(iii) Spring migration

I observed 33 (62.3%) and 176 (40.8%) marked birds at Klamath Basin NWRs in 1980 and 1981, respectively. In 1981 significantly more California banded birds were observed than expected ($P<0.001$). Similar to findings for the autumn migration, Tule Geese occurred almost exclusively on Lower Klamath NWR (100% of 33 birds and 96.6% of 176 birds). Among birds using the private lands between Burns, Oregon, and Malheur NWR during spring migration, however, no neck-banded Tule Geese have been observed.

Discussion

Population estimates and observations of marked birds indicated that a portion of the Tule Goose population did not use known migration stopover areas during autumn and spring. Because other species of geese make long non-stop migration flights (Bellrose 1980), Tule Geese may not use any other autumn migration stopover area(s) between Cook Inlet, Alaska and California's Sacramento Valley. In spring, however, the requirements for successful reproduction in

northern geese (Raveling 1978a) make the existence of a spring stopover area(s) north of Lower Klamath and Malheur NWRs very likely.

The main wintering areas are the Sacramento NWR Complex and Grizzly Island WMA. Occurrences of Tule Geese outside these areas were incidental, as was probably true for past sightings (Bauer 1979).

The Tule Goose population wintering in California was estimated to be about 2000 birds in 1978–79, and 5000 birds in 1980–81 and 1981–82. Although surveys early in the study may have under-estimated the population, they became more accurate because increasing numbers of neck-banded birds in the population aided the identification of areas used by Tule Geese. In addition, the large percentage of marked birds observed each year (see below) indicated that the winter distribution of Tule Geese was accurately known. Winter surveys indicating 30–35% young in the population (Wege, unpubl. data) and reduced harvest in California due to restrictive hunting regulations give optimism for future increases in the population.

A smaller percentage of the marked birds was observed during the 1981–82 winter (62.5%) compared to 1980–81 (80.7%) because field observation time was reduced and estimates for the number of available marked birds in the population included birds that would have lost their neck-bands. The neck-band loss rate for Canada Geese *Branta canadensis* has approximated to 20% per year (Fjetland 1973; Raveling 1978b; Craven 1979). Applying this rate to the present study, 80–91% of the marked birds retaining their neck-bands were observed during each field season.

The cause of the differential use of Summer Lake WMA by Alaska banded birds during autumn 1981, of Klamath Basin NWRs by California banded birds during autumn and spring 1981, and of Grizzly Island WA by Alaska banded birds during winter 1980, is unknown. Daily and seasonal movements of marked birds suggest that sub-populations exist within the Tule Goose population (Wege, unpubl. data). This factor or differential use of these areas by birds of different age or social class could account for this pattern. In contrast, the equal use of Sacramento NWR Complex by California and Alaska banded birds and the large proportion of marked birds observed there, suggest that nearly the entire Tule Goose population probably used this area at some time during the winter.

If disturbance by man can be minimized, the coastal and subarctic breeding grounds should continue to provide good annual production (Timm *et al.* 1982). Threats to Tule Geese on the wintering grounds include loss of marsh habitat through both agricultural and urban development (Gilmer *et al.* 1982). Tule Geese are clearly highly dependent on the habitat provided by state and federal refuges, and the maintenance of these areas is essential to sustain the population.

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Summary

Migration stopover areas, wintering areas, and winter population estimates were recorded for Tule Geese *Anser albifrons gambelli* from 1978 to 1982. Autumn migration stopover areas were Summer Lake WMA, Oregon (1500–2100 birds) and Klamath Basin NWRs, California (1200–2000 birds). The primary wintering areas were the northern Sacramento Valley (Sacramento and Delevan NWRs, 3500 birds) and the Suisun Marsh (Grizzly Island WA, 1200–1500 birds). Klamath Basin NWRs (1000–3000 birds) were the only major spring migration stopover areas located. The 1980–81 and 1981–82 winter populations of Tule Geese in California were estimated to be about 5000 birds.

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