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SEX AND AGE RATIOS IN WINTERING WHITE-CROWNED SPARROWS

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Differential migration of the sexes occurs in many species of North American songbirds. The resultant asymmetry in distribution on the wintering grounds has a consistent pattern in that males tend to occur farther north than females (Ketterson and Nolan 1976). In Gambel's White-crowned Sparrow (*Zonotrichia leucophrys gambelii*) the latitudinal cline thus generated is quite marked. Populations near the northern limit of the winter range in Washington contain about 80% males whereas those to the south near the Mexican border may be only about 25% males (King et al. 1965). Major informational gaps still exist, however, concerning the winter distribution of *Z. l. gambelii*. Especially lacking are large unbiased samples from discrete locations. Herein are presented additional data on sex ratios in wintering *Z. l. gambelii* as well as evidence that they experience differential mortality with both age and sex.

METHODS

Wintering populations were sampled by mist-netting at two locations in California, one in the Owens Valley (Inyo Co.) and the other near Thousand Oaks (Ventura Co.). The Owens Valley is a deep, narrow corridor in eastern California that is bordered on its western edge by the Sierra Nevada. Birds were captured there from fence-crows and on fallow lands between Olancho and Bishop, a distance of 130 km. At Thousand Oaks, 50 km northwest of Los Angeles, *Z. l. gambelii* (and a few *Z. l. pugetensis*) were captured on agricultural lands lying 4 km or less to the west of the city. All birds were sexed by laparotomy and aged by crown color.

RESULTS AND DISCUSSION

In the Owens Valley significantly more males were captured than females (366 vs. 281, $\chi^2 = 11.17$, $P < 0.005$, Table 1). This proportion of males (57%) is considerably lower than that reported for Washington populations by King et al. 1965 (80%) and Lewis et al. 1968 (77%) (Table 2), thus supporting the putative latitudinal cline in sex ratio. It is higher, however, than ratios obtained from museum specimens also collected east of the Sierra Nevada (38%, Emlen 1943; 45%, King et al. 1965) and does not lend support to Emlen's (1943) suggestion that the mountains divide wintering populations with highly disparate sex ratios favoring males to the west and females to the east.

The small sample collected in 1969 (Table 1) has significance in that the Owens Valley had received more snow than usual. Numbers of *Z. l. gambelii* in the area appeared

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to be much lower than in other years and our netting efforts were relatively unsuccessful.

At Thousand Oaks there was a consistent yearly pattern to the sex ratio data (Table 1). Significantly fewer males were captured than females (626 vs. 897, $\chi^2 = 48.22$, $P < 0.001$). The proportion of males (41%) was lower than in the Owens Valley sample or in one netted to the north near Bakersfield (Kern Co.) by Hardy et al. (1965), again supporting the trend for fewer males to winter at lower latitude (Table 2).

Given that *Z. l. gambelii* consistently return to the same wintering area (Mewaldt 1964, 1976; Cortopassi and Mewaldt 1965), the latitudinal cline in sex ratio is maintained because immature males stop their southward migration sooner than immature females. Presumably this benefits males because it would facilitate their early return to the breeding area and procurement of a territory (King et al. 1965). In addition, they would experience a shorter, less hazardous migration. Natural selection should favor the same response in females except that they are smaller than males and may be displaced from food by them (Parsons and Baptista 1980). Intersexual behavioral dominance is probably greater in harsher (more northern) climates (Ketterson and Nolan 1979). Female *Z. l. gambelii* also cannot fast as long as males (Ketterson and King 1977) and presumably are less likely to survive severe storms.

In large netted samples the percentage of immatures in wintering flocks declines from about 70% in southern Washington, 46°N, to about 50% in southern California, 34-35°N (Table 2). Since the proportion of immatures at a given location remains unchanged throughout the winter (King et al. 1965), they apparently experience a differential increase in mortality rate over adults as migration distance increases. This seems sensible because immatures are inexperienced navigators and more are prone to go astray during migration (Stewart et al. 1974). Guidance could be provided by adults but there is no assurance that such always occurs. The first flocks that form on the breeding

TABLE 1. Sex and age of *Zonotrichia leucophrys gambelii* captured from two wintering areas in California.

Location	Year	Adults		Immatures	
		Males	Females	Males	Females
Owens Valley					
	1968	100	72	108	76
	1969	17	24	9	2
	1970	83	46	49	61
	Total	200	142	166	139
Thousand Oaks					
	1977	58	67	35	49
	1978	65	94	54	85
	1979	76	73	59	75
	1980	41	65	59	108
	1981	77	110	57	100
	1982	18	37	27	34
	Total	335	446	291	451

TABLE 2. Percentage of males and immatures in *Zonotrichia leucophrys gambelii* wintering at various latitudes. Latitudes given often only approximate the center of collection areas. Large samples obtained by mist-netting from reasonably discrete areas are italicized.

Location or area	Lat.	Males		Immatures		Data source
	°N	%	(n)	%	(n)	
Snake River Canyon, WA	46.5	80	(1899)	69	(2256)	King et al. 1965
Yakima River, WA	46.3	77	(706)	68	(706)	Lewis et al. 1968
Central Valley, CA	38.5	79	(181)	—	—	Emlen 1943
Utah	38.3	67	(67)	—	—	King et al. 1965
Great Basin	37.0	38	(109)	—	—	Emlen 1943
Central California	37.0	—	—	60	(2343)	King et al. 1965
Central Valley, CA	37.0	66	(112)	—	—	King et al. 1965
Owens Valley, CA	37.0	57	(647)	47	(647)	Morton, present study
Central California & Great Basin	36.6	50	(391)	—	—	King et al. 1965
Central California Coast	35.5	69	(39)	—	—	Emlen, 1943
Bakersfield, CA	35.5	49	(869)	50	(949)	Hardy et al. 1965
Thousand Oaks, CA	34.3	41	(1523)	49	(1523)	Morton, present study
Southern California	33.6	54	(408)	—	—	King et al. 1965
Southern California & adjacent	33.5	55	(163)	—	—	Emlen 1943
Brawley, CA	33.1	9	(23)	48	(23)	Morton, present study
Southern Arizona	32.0	25	(24)	—	—	King et al. 1965
Northwestern Mexico	28.6	39	(95)	—	—	King et al. 1965

ground are composed of immatures (Morton et al. 1969) and many of these disappear well before adults are physiologically prepared for migration. Other possible hindrances to young birds are that they are naive about favorable locations for feeding during migration and may not be as accomplished as adults in foraging. Still, adults migrate along broad fronts and do not themselves have regular annual stopping places (Cortopassi and Mewaldt 1965).

If immature sparrows have the same lean body mass as adults but are relatively inept at foraging, they might be lighter than adults during migration. Adult *Z. l. gambelii* of both sexes in passage in September at Pullman, Washington were consistently about 2% heavier than immatures (King and Mewaldt 1981). *Z. l. gambelii* also migrate through my study area in the Sierra Nevada at Tioga Pass (37.9°N) in September and October (Morton et al. 1973). For the past four years (1979–1982) my students and I have trapped, banded and weighed these birds. Adults of both sexes were significantly heavier (*t*-test) than their immature counterparts upon arrival, i.e., upon first capture (Table 3). Only 30.4% (188 of 618) of the Tioga Pass *Z. l. gambelii* were immatures (Table 3). The dynamics of migration through this high-altitude route are still under investigation.

In three locations where age and sex have been reported for wintering *Z. l. gambelii*, the percent of males among adults is higher than among immatures. The reverse is true for females (Table 4). This change in sex ratio with age is highly significant ($\chi^2 = 28.54$, $P < 0.001$). Given faithfulness to the wintering area, these data indicate that

mortality is higher in adult females than in males. Additional support for this comes from a study in progress on *Z. l. oriantha*, a migratory race that breeds at high altitude. Each year slightly more females than males have been recruited to our study population at Tioga Pass (Baptista and Morton 1982). In *Z. l. nuttalli*, a nonmigratory race, mortality rates in adults were not different (Baker et al. 1981). Another explanation for the age ratio change with latitude is that some individuals shift their wintering area southward after the first year. I have no data on *Z. l. gambelii* but a movement of this type has been discovered in Dark-eyed Juncos (*Junco h. hyemalis*) by Ketterson and Nolan (1982).

In summary, these data support the traditional notion that wintering *Z. l. gambelii* exhibit a latitudinal cline in sex ratio. There also appears to be a cline in immature birds such that their abundance, relative to adults, decreases with latitude, i.e., fewer immatures winter farther south. I hypothesize that differential mortality, related to migration distance, occurs in immatures. Finally, the age and sex ratios within given samples indicate that the mortality rate of adult females is higher than that of adult males.

Over the years many Occidental College students have joined me on pre-dawn treks to netting areas. Their efforts and enthusiasm were most welcome and helpful. I would like to acknowledge in particular the assistance of Paul Mead, Maria Pereyra, May Wakamatsu and Eileen Zerba. Reviewers Ellen D. Ketterson and L. Richard Mewaldt made several helpful suggestions and I thank them also.

TABLE 3. Body weights of migrating *Zonotrichia leucophrys gambelii* upon arrival at Tioga Pass, Mono County, California.

	Mean	SD	(n)	P
Adult males	26.38	2.16	(249)	<0.01
Immature males	25.30	2.00	(99)	
Adult females	23.86	1.99	(181)	<0.01
Immature females	23.20	2.06	(89)	

TABLE 4. Sex distribution in adult and immature *Zonotrichia leucophrys gambelii* from three wintering areas in California.

Location	Adults, %		(n)	Immatures, %		(n)
	Males	Females		Males	Females	
Owens Valley	58.5	41.5	(342)	54.4	45.6	(305)
Thousand Oaks	42.9	57.1	(781)	39.2	60.8	(742)
Bakersfield*	54.8	45.2	(449)	43.8	56.2	(420)

* Data from Hardy et al. 1965.

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SUPER-NORMAL CLUTCHES IN HERRING GULLS IN NEW ENGLAND

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Several authors have recently reported an unexpectedly high frequency of polygyny and female-female pairing in several species of gulls (*Larus* spp.). Polygyny is characterized by the building of double nests that are only a few centimeters apart (Shugart and Southern 1977, Shugart 1980), whereas female-female pairing is characterized by the laying of clutches of four to seven eggs in one nest (Hunt and Hunt 1977, Shugart 1980). One or both of these phenomena have been reported for Western Gulls (*L. occidentalis*) in southern California (Hunt and Hunt 1973, 1977, Hunt et al. 1980), Ring-billed Gulls (*L. delawarensis*) in eastern Washington (Conover et al. 1979), Manitoba (Koontz 1980) and the Great Lakes (Ryder and Somppi 1979), and Herring Gulls (*L. argentatus*) in the Great Lakes (Shugart and Southern 1977, Fitch 1980, Shugart 1980). Interpretation of these findings is hampered by the lack of information on the frequency of non-monomogamous nesting in other gull populations (Shugart 1980).

We know of no other reports of double nests, and clutches of more than three eggs are known to be infrequent, but their precise frequency has not been reported on the basis of large samples. This note reports the frequency of super-normal clutches laid by Herring Gulls on the coast of New England.

Between 1963 and 1969, we conducted extensive and intensive studies of Herring Gulls on the New England coast between Rhode Island and eastern Maine (Kadlec and Drury 1968, Drury and Nisbet 1972, Nisbet and Drury 1972). Between 1970 and 1980, we continued to monitor Herring Gulls at several colonies in Massachusetts. In the course of these observations, we visited 83 colonies and examined more than 45,000 nests. Including data supplied by collaborators (see Acknowledgments), we have precise notes on clutch-sizes in 24,183 nests (Table 1).

About 60% of the counts in Table 1 were derived from complete surveys of small colonies containing 60-250 pairs. The remainder were obtained in sample areas within larger colonies, but the areas were selected to be representative by including both central and peripheral nests. Most of the counts were obtained on visits timed just before the first eggs in the colony hatched and thus included nests that had been started throughout the first 25-30 days of the season. At this time, most pairs should have had complete clutches. However, 11.5% of the nests contained one egg and 22% contained two eggs. In our experience, most one-egg clutches and some two-egg clutches encountered at this stage of the season are incomplete, either because the birds have not laid their last eggs or because one or two eggs have been lost. Hence the number of complete clutches in our sample was probably about 80% of the total, or about 19,000.