

Secondary Sex Ratios and Egg Sequence in Herring Gulls

JOHN P. RYDER AND BEATRICE M. TERMAAT

Department of Biology, Lakehead University, Thunder Bay, Ontario P7B 5E1, Canada

Variation in the secondary (hatching) sex ratio has been documented for many bird species. Significant deviations from the 1:1 ratio have led to theoretical speculation about adaptive facultative manipulation of the sex ratio (Trivers and Willard 1973). Seasonal changes in the nestling sex ratio of the Common Grackle (*Quiscalus quiscula*; Howe 1977) and the Red-winged Blackbird (*Agelaius phoeniceus*; Fiala 1981) and the biased production of male Zebra Finches (*Poephila guttata*; Burley 1981) by females mated with high-quality males provide some support to the Trivers-Willard hypothesis. Recently, Ankney (1982) found that in newly hatched Lesser Snow Geese (*Chen caerulescens*) the first two eggs of 4-egg clutches produced more males (64%) than females and the last two eggs produced more females (72%) than males. Similarly, Ryder (1983) reported in Ring-billed Gulls (*Larus delawarensis*) the first-laid eggs of 3-egg clutches hatched predominantly more males (66%) than females and the second-laid eggs hatched more females (61%) than males. This phenomenon suggested a facultative manipulation of the sex produced, although the adaptive significance is unexplained. Weatherhead (1985) examined the occurrence of a sex-sequence relationship in the Red-winged Blackbird after Fiala's (1981) documentation that the last-laid egg of this species produced significantly more females than males. Although Weatherhead (1985) found a sex-sequence relationship, the pattern was not consistent among different clutch sizes.

Stimulated by these studies, we examined the secondary sex ratio in relation to laying sequence in newly hatched Herring Gull (*L. argentatus*) chicks on Granite Island (48°43'N, 88°29'W) in Black Bay, northern Lake Superior (see Ryder 1976 for a description of the colony).

During the 1983-1986 nesting seasons, newly constructed Herring Gull nest sites were marked numerically with spray paint and the nests checked daily for the presence of new eggs. Each egg in a clutch was marked in sequence laid by placing dots of nail enamel on the blunt end of the egg (1 dot = first egg

laid, 2 dots = second, 3 dots = third). The latest date we arrived at Granite Island was 11 May in 1983. We thus used 11 May as the standard date to compare the progress of Herring Gull egg laying in the three nesting seasons (1984 data were not available). Close to the expected time of hatching, nests were checked twice daily for signs of pipping eggs. Chicks hatched from 3-egg clutches were collected and their sex determined by gonadal inspection. We used only those clutches from which all eggs hatched and where the position of each chick in the sequence laid was known for statistical analyses.

We compared clutch sizes using ANOVA and Scheffe *a posteriori* tests. The sex-ratio data were analyzed using Chi-square and G-tests (Sokal and Rohlf 1981). Significance was accepted at $P < 0.05$.

Upon our arrival at Granite Island each year, laying in several nests had already commenced. The difference in the proportions of initiated and completed clutches by 11 May each year (Fig. 1) indicates that Herring Gulls breeding in 1983 did so later in the season than those nesting in 1985 and 1986.

The proportion of nests with 3 eggs was much lower in 1983 than in the other years (Table 1). This low 3-egg clutch-size frequency was manifested in the significantly lower average clutch size for 1983 ($F = 5.02, P < 0.05$).

The secondary sex ratio favored females in 1983 and 1985 and males in 1984 and 1986 (Table 2). The deviation from a 1:1 sex ratio, however, was not significant in any of these years. The G-statistic also indicated no significant relationship between sex and sequence for any year. Similar results were obtained from the combined data.

Our results suggest that the allocation of sex chromosomes by the heterogametic female Herring Gull is a random process. A late season, lower average clutch size and hatch of 12% more females than males occurred in 1983. Although it was tempting, at first, to invoke the predictions of the Trivers-Willard (1973) hypothesis, whereby the later-starting females may have been in relatively poor physiological condition

TABLE 1. Herring Gull clutch-size frequency, Granite Island, 1983-1986. Values are the numbers of clutches, with the percentage of all clutches in parentheses.

Year	Clutch size			Mean	SD	n
	1 egg	2 eggs	3 eggs			
1983	6 (8.9)	17 (25.4)	44 (65.7)	2.57	0.66	67
1984	3 (3.6)	7 (8.4)	73 (88.0)	2.84	0.45	83
1985	2 (1.8)	18 (16.1)	92 (82.1)	2.80	0.44	112
1986	4 (3.7)	10 (9.3)	93 (86.9)	2.83	0.47	107

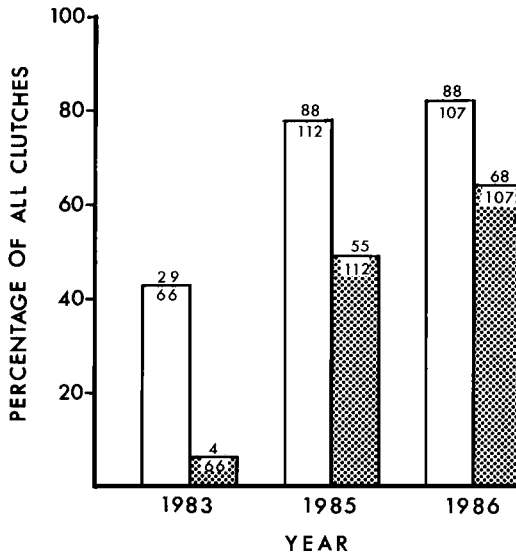


Fig. 1. Herring Gull clutches initiated and completed by 11 May in 1983, 1985, and 1986 on Granite Island. Numbers in the bars are the total clutches examined each year. Numbers above the bars are the total clutches initiated (open bars) or completed (shaded bars) by 11 May each year.

in that year and thus produced more daughters than sons, similar ratios were documented in 1985, which was not a late season. We conclude that seasonality alone had little effect on sex ratios at hatching.

Our results agree with those reported by Cooke and Harmsen (1983), who found no relation between sex and sequence in Lesser Snow Geese. Recently, Meathrel (1986), using 5 years of data from the Granite Island Ring-billed Gull colony, disagreed with the earlier suggestion (Ryder 1983) of a sex-sequence relationship in that species. As Meathrel collected more data and the sample size increased, the sex-sequence relationship became progressively weaker. We thus concur with Cooke and Harmsen's (1983) statement that perhaps the small sample sizes in Ankney's (1982) study of Lesser Snow Geese and in our earlier study of Ring-billed Gulls may have suffered from a typical type I statistical error whereby the small sample sizes gave statistical significance to a nonexistent phenomenon. At present, we can only conclude that there appears to be no relation between sex and sequence in 3-egg clutches of Herring Gulls and that the annual 1:1 hatching sex ratio is characteristic of the species.

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TABLE 2. Number of male and female Herring Gull chicks in relation to egg sequence, Granite Island. Results of all Chi-square and G-tests were nonsignificant.

Year	Sex	Egg ^a			Total ^c
		a	b	c	
1983 (n = 10) ^b	Male	4	4	5	13 (43.6)
	Female	6	6	5	17 (56.4)
G = 0.268, $\chi^2 = 0.533$					
1984 (n = 19)	Male	11	8	14	33 (57.9)
	Female	8	11	5	24 (42.1)
G = 3.96, $\chi^2 = 1.421$					
1985 (n = 23)	Male	9	10	11	30 (43.5)
	Female	14	13	12	39 (56.5)
G = 0.119, $\chi^2 = 1.174$					
1986 (n = 14)	Male	5	10	9	24 (57.1)
	Female	9	4	5	18 (42.9)
G = 4.114, $\chi^2 = 0.857$					
1983-1986 (n = 66)	Male	29	32	39	100 (50.5)
	Female	37	34	27	98 (49.5)
G = 3.208, $\chi^2 = 0.020$					

^a First, second, and third eggs laid in a clutch.

^b n is the number of clutches.

^c Total number of the sex (percentage of all chicks).

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The Vocalizations of the Slender-billed Wren (*Hylorchilus sumichrasti*): Who Are Its Close Relatives?

JOHN WILLIAM HARDY¹ AND DALE J. DELANEY²

¹Florida State Museum, University of Florida, Gainesville, Florida 32611 USA, and

²944 North Layman Avenue, Indianapolis, Indiana 46219 USA

The Slender-billed Wren (*Hylorchilus sumichrasti*) is one of the rarest and least-known members of the family Troglodytidae. It is endemic to Mexico and has restricted geographic and ecological distributions. The species is known only from a few localities in central western Veracruz (and possibly adjacent northern Oaxaca), and from a small area 26 km north of Ocozacoatlá, Chiapas (Crossin and Ely 1973). First described in 1871 by Lawrence (reference not seen by us), who placed it in the genus *Catherpes* with the Canyon Wren (*C. mexicanus*), it was then known only from Veracruz. Nelson (1897) erected the new genus *Hylorchilus* and stated that it seemed to be intermediate between *Catherpes* and *Microcerculus*, the nightingale wrens. In 1925 W. W. Brown collected a series near Presidio, Veracruz. The last specimens taken in Veracruz until 1985 were those obtained by Chester Lamb in the years 1942-1945 and now in the Moore Laboratory of Zoology, Occidental College, Los Angeles, California. Crossin and Ely (1973) described the disjunct population first discovered by Santos Farfan B. (in the field with Allan R. Phillips) in Chiapas in December 1969. Crossin and Ely named the new subspecies *H. s. navai*. Their paper was accompanied by a color plate of the bird by John O'Neill.

The Slender-billed Wren is apparently confined to midelevations (around 760 m) in steep hill country covered by lush tropical forest, of semideciduous or evergreen aspect. All known locations of occurrence are characterized by extensive limestone outcropping and heavy undergrowth. The bird remains at or near ground level and forages among the rocks.

Crossin and Ely (1973) offered what seems to be the first mention of voice, though not song, of this wren. They mentioned a Canyon Wren-like call, described as a "loud metallic 'peenk' that the bird utters at intervals while moving about." They reported that when calling the bird performs a bouncing crouch similar to that of the Canyon Wren.

On 29 April 1985 at 1000, one of us (Delaney) was exploring limestone hills between 10 and 15 km south of Cordoba, Veracruz, Mexico. He carried a Sony TCM-5000 cassette tape recorder (Mineroff modified), mi-

crophone amplifier, and Sennheiser K3U/ME-88 unidirectional electret condenser microphone. He was attempting to record the song of a Black-faced Ant-thrush (*Formicarius analis*) when a Slender-billed Wren burst into song almost underfoot. He had encountered this species and heard it a few days earlier at nearby Amatlan, also south of but nearer Cordoba. Over the next 10 min he recorded several songs and call notes and gave accompanying data on the tape. His recording is now on Florida State Museum Master tape No. 782, cut 1.

The songs of the Slender-billed Wren and Canyon Wren (Fig. 1) are very similar spectrographically, and to the ear. Both consist of a series of rapidly descending, mostly L-shaped figures given until the bird seems to run out of breath. The figures are clear whistles similarly inflected in both species. The call notes (Fig. 2) are also similar, consisting of sharply and downwardly inflected, abrupt, shrill whistles, quite unlike call notes we have heard from other wren species. Most importantly, the songs of these two species do not resemble closely the songs of any other wrens. The call notes (Fig. 2) were both recorded in the same context, namely, after the singing birds had been ex-

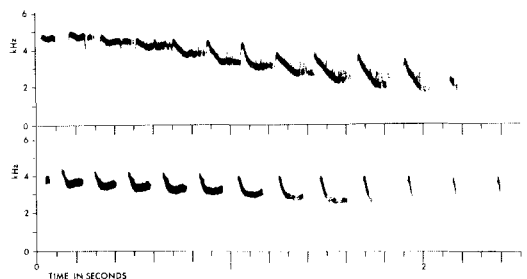


Fig. 1. Top: song of *Hylorchilus sumichrasti*. FSM 782-1-1. See text for details. Bottom: song of *Catherpes mexicanus*. FSM 156-6-1. Anza Borrego Desert, San Diego Co., California, 17 April 1976, by Luis Baptista and Hardy (1977). (Sonograms made on Kay Sonagraph 7029A with 300 Hz filter.)