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AGE AND SEX DETERMINATION IN BLACK SKIMMER CHICKS

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Abstract.—Post-natal development was studied in 40 southern California Black Skimmer (*Rynchops niger*) chicks in order to develop a reliable method of aging and sexing pre-flying young in this sexually dimorphic species. Ages of chicks were determined from hatching dates and were calculated also from wing chord measurements. At fledging, male and female chicks exhibited the same degree of sexual size dimorphism previously demonstrated in adult birds. Sex of chicks was determined after day 23 when differences in body weight became significant. At day 24 or older, chicks were classified as male if their weight exceeded 320 g, and as female if less than 300 g. This technique should allow a closer examination of sexually related aspects of Black Skimmer demography during the pre-reproductive period.

DETERMINACIÓN DE LA EDAD Y EL SEXO DE POLLUELOS DE *RYNCHOPS NIGER*

Sinopsis.—Se estudió el desarrollo postnatal de 40 polluelos de *Rynchops niger* para desarrollar un método confiable que permitiera determinar la edad y el sexo de volantones de esta especie dimórfica. La edad real de los polluelos se determinó utilizando la fecha de su nacimiento y se calculó ésta utilizando medidas del largo del ala. Al tiempo de comenzar a volar los polluelos exhibieron el mismo dimorfismo sexual que se ha descrito en los adultos. El sexo de los polluelos pudo ser determinado a los 23 días cuando se encontraron diferencias significativas en el peso de estos. A los 24 días (y a mayor edad) se clasificaron como machos aquellos polluelos que pesaron mas de 320 g y como hembras los que pesaron menos de 300 g. Esta técnica permitirá estudiar aspectos relacionados con el sexo y demografía de esta especie durante el periodo pre-reproductivo.

Growth rates have been a topic of much consideration in the study of seabird biology because of their significance to the differing developmental strategies of coastal and pelagic species (Brown 1976; Dunn 1975; Ricklefs 1979; Ricklefs and White 1975, 1978, 1981). Many methods of examining seabird growth rely on either mixed longitudinal or cross sectional sampling designs (See Ricklefs [1983] for a detailed description of these data sets). Ricklefs and White (1975) showed that it is possible to construct a nestling growth curve based on a strictly cross sectional data set. This method is adequate for most monomorphic seabird species. However, in species exhibiting sexual dimorphism in body weight, a method for sex determination in chicks must also be employed.

Unlike the closely related terns and gulls (Laridae), Black Skimmers (*Rynchops niger*) show a pronounced sexual difference in weight (Ridgway 1919) which is evident before fledging (Erwin 1977). In this paper we present a reliable method by which skimmer chicks can be aged by wing chord measurements and sexed based on a combination of age and weight criteria.

STUDY AREA AND METHODS

We studied the growth of 40 Black Skimmer chicks at Bolsa Chica Ecological Reserve, Huntington Beach, California during breeding seasons of 1985–1987. Nests were censused every 2–7 d and all skimmer chicks encountered were weighed and measured. Twenty-three individuals were resampled 1–7 times throughout the season. Chicks were weighed to the nearest 0.1 g with a Pesola spring balance and wing chord was measured to the nearest 1 mm with a metal wing rule.

Growth curves were fitted using a modification of the Richards flexible curve as described by Bradley et al. (1984).

$$W = A(1 + (M - 1)e^{-K(t-1)})^{1/(1-M)}$$

where W is the weight of the organism at time t, A is the asymptote of the curve, K is the growth constant, I is the time to reach inflection point in the curve, and M is the shape constant.

RESULTS

Aging criteria.—A least-squares linear regression of the age/wing chord relationship in seven Black Skimmer chicks followed in 1985 (Fig. 1) is described by the equation

$$\text{Estimated Age (d)} = \text{Wing Chord(mm)} \times (0.109) + 5.40.$$

Wing chord with respect to age was linear after day 8 (wing chord > 33 mm); consequently measurements of chicks younger than day 9 were excluded from the regression analysis. This equation, when applied to wing measurements of unknown age chicks from 1986 and 1987, accurately predicted the amount of wing growth in chicks with multiple data points. That is, if a chick was measured at least twice during the breeding season, the amount of wing growth in the time between measurements agreed with the growth predicted by the equation for such a time interval. On the basis of this close similarity between years and the narrow confidence intervals (Fig. 1), we assigned ages to unknown age chicks, using this age/wing chord equation, that we feel were accurate to within one-half day.

Sexing criteria.—Weights of chicks from all three years were pooled for analysis. A scatter diagram was constructed by plotting individual weights against age for all chicks (Fig. 2). Two distinct groupings of body weights were apparent in chicks older than 23 days, corresponding to the sex related bimodality in weight previously documented in adult birds (Ridgway 1919, Erwin 1977). As these distributions (Table 1) closely resembled the distribution of body weight in adult male and female Black Skimmers (Table 2), the distribution of heavier weights was assumed to be from male chicks and the lighter weights were assumed to be from female chicks. One such presumed female chick that hatched in 1985 was behaviorally confirmed as a female as a breeding adult in 1987 (B. Massey, pers. comm.).

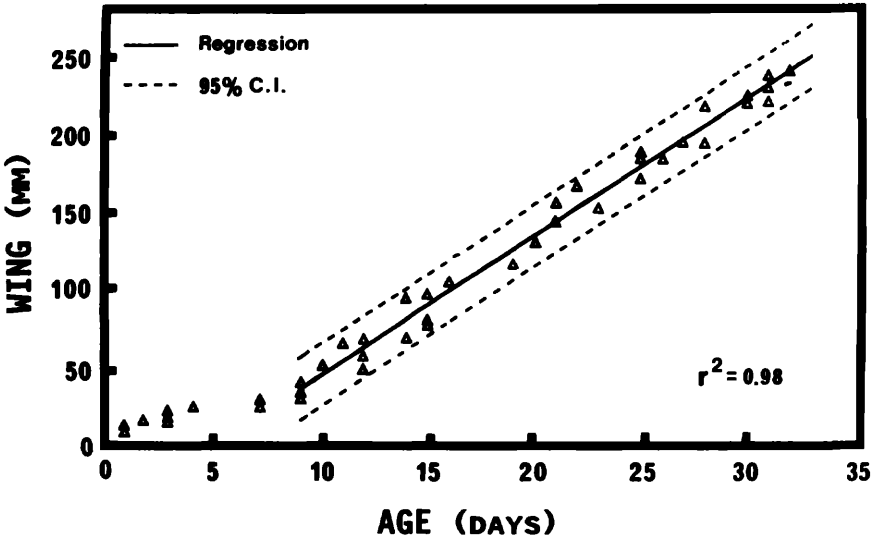

FIGURE 1. Age and wing chord measurements of Black Skimmer chicks in 1985.

Based on this sexual dimorphism, separate growth curves were fitted and asymptotic weights estimated for each sex (Fig. 2, Table 3). Males were found to be significantly heavier than females, reaching a predicted asymptotic weight of 366 g while females reached a predicted asymptote

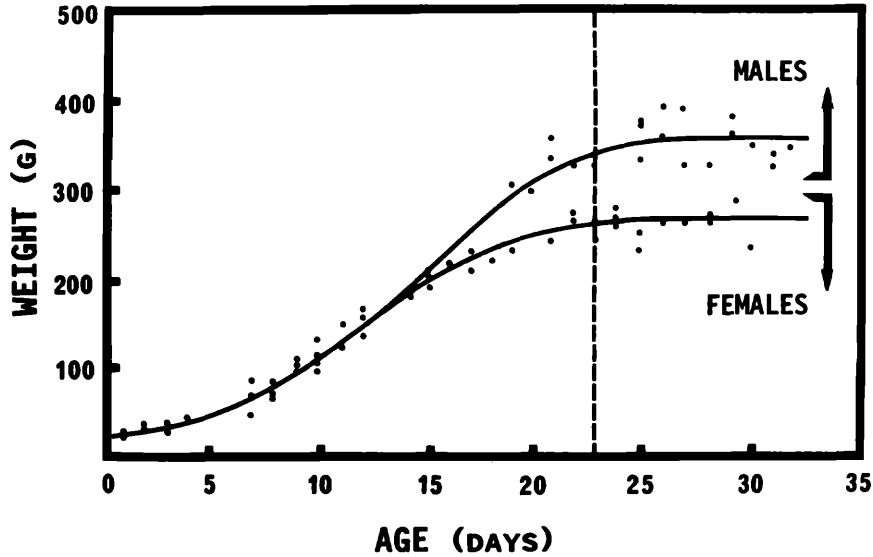

FIGURE 2. Growth of male and female Black Skimmer chicks in 1985, 1986, and 1987. Individual weights of chicks are presented along with growth curves fitted to a flexible Richards curve.

TABLE 1. Asymptotic weight (g) and 95% confidence intervals for male and female Black Skimmer chicks, 1985, 1986, 1987.

Sex	Asymptotic weight		
	95% CI lower limit	Estimate	95% CI upper limit
Males	354	366	379
Females	251	271	292

of 271 g. Both sexes reached asymptotic size around day 24. The 95% confidence intervals around these asymptotes did not overlap (Table 1).

DISCUSSION

Studies of avian biology can be complicated by logistical and developmental problems. In many instances, detailed demographic data such as timing of egg laying, chick growth, and fledging period cannot be collected because of the susceptibility of the birds to human disturbance. This is particularly true for species known to be susceptible to disturbance such as the Black Skimmer (Gochfeld 1981, Safina and Burger 1983). Therefore, a methodology for aging and sexing Black Skimmer chicks based on minimal visits to a colony would be beneficial.

Wing lengths can be utilized as an accurate and dependable estimate of chick age. Year to year variation in wing/age relationship appears to be insignificant. Feather growth in terns has been shown to be similarly resistant to year to year environmental fluctuations (Collins pers. obs., K. Keane unpubl., Lecroy and Collins 1972). Thus, the linear age/wing chord relationship we have described can be used to accurately determine the age of Black Skimmer chicks older than 8 days (wing chord > 33 mm). It should be generally applicable to other populations of this species, although this deserves further study. An accurate method for estimating chick age is essential for sexing Black Skimmer chicks. Once the age is determined, sex can be assigned by observation of chick weights after day 23. Growth curves of chicks studied in 1985, 1986, and 1987 provide an estimate of expected asymptotic weights for each sex. Confidence intervals for these asymptotes (Table 1) do not overlap indicating a significant

TABLE 2. Sexual dimorphism in Black Skimmer chicks and adults.

Criterion	*n*	Males (±SD)	*n*	Females (±SD)	*Z* Value Mann-Whitney *U*-test	Source
Weight of chicks older than 23 days (in grams)	11	357.2 ± 22.6	10	260.2 ± 28.2	$Z = 3.8$ $P < 0.01$	This study
Adult weight (g)	13	343.5 ± 38.7	8	255.4 ± 18.1	$Z = 7.1$ $P < 0.01$	Erwin (1977)

TABLE 3. Fitted growth parameters[1] for male and female Black Skimmer chicks.

Sex	*n*	A	K	I	M
Males	11	366.4	0.274	14.25	2.40
Females	10	270.9	0.289	11.73	2.32

[1] A = asymptote; K = growth constant; I = time to inflection; M = shape constant.

separation of male and female weights by day 24. Therefore, if a skimmer chick is known to be 24 d old or older, or if its wing chord is greater than 172 mm (at day 24 wing chord is approximately 172 mm), sex can be assigned using weight as a criterion. On the basis of the 95% confidence intervals a chick may be classified as a male if its body weight is >354 g and as a female if it is <292 g. Using the full range of weights observed in this study the limits were 328 and 297 g respectively. More conservative limits which might encompass the variation expected in larger samples could be set subjectively at 320 g for males and 300 g for females. It should be noted that in Erwin's study of Black Skimmers in Virginia, the mean fledging weight for males was 295 g, but females were proportionately lighter with a mean of 264 g. Thus, the actual weight range of male and female chicks may vary with geographic range and may also reflect year to year variation in food resources during the growth period. However, the distinct non-overlapping distributions of male and female weights should be readily apparent in any sample of chick weights obtained in the pre-fledging period; the actual range of weights used to assign the sex of chicks can be adjusted on an annual basis.

Annual survival, other aspects of the demography and behavior of a species, as well as the consequence of any sex related bias in chick provisioning, need to be analyzed separately for each sex. All too often the sex of an individual is not determined until reproductive status is achieved and sex-specific behavior is observed. The technique reported here should allow reliable sex determination of Black Skimmer chicks and thus enable separate analyses to be made for the late pre-fledging and pre-reproductive period.

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