

Pitelka and Donald L. Beaver critically read the manuscript. This work was conducted under the I.B.P. Analysis of Ecosystems-Tundra Program and supported by a grant to F. A. Pitelka from the National Science Foundation.—THOMAS W. CUSTER, *Department of Zoology and Museum of Vertebrate Zoology, University of California, Berkeley, California 94720*. Accepted 9 May 72.

Growth and development of Long-billed Curlew chicks.—Compared with the altricial nestlings of passerines and the semiprecocial young of gulls, few studies of the growth and development of the precocial chicks of the Charadrii have been made (Pettingill, 1970: 378). In Europe, von Frisch (1958, 1959) described the development of behavior in 14 plovers and sandpipers. Davis (1943) and Nice (1962) have reported on the growth of Killdeer (*Charadrius vociferus*), Nice (1962) on the Spotted Sandpiper (*Actitis macularia*), and Webster (1942) on the growth and development of plumages in the Black Oystercatcher (*Haematopus bachmani*). Pettingill (1936) studied the atypical American Woodcock (*Philohela minor*). Among the curlews, Genus *Numenius*, only the Eurasian Curlew (*N. arquata*) has been studied (von Frisch, 1956). Because of the scant knowledge about the development of the young in the Charadrii and the scarcity of information on all aspects of the breeding biology of the Long-billed Curlew (*N. americanus*) (Palmer, 1967), I believe that the following data on the growth and development of Long-billed Curlew chicks are relevant.

I took four eggs, one being pipped, from a nest 10 miles west of Brigham City, Box Elder County, Utah, on 24 May 1966. One egg was preserved immediately for additional study, the others I placed in a 4' × 3' × 2' cardboard box with a 60-watt lamp for warmth in a vacant room in my home until they hatched. I moved the three chicks to the aviary in Department of Zoology, Utah State University, on 31 May. After hatching, the three young were hand-reared on a diet of mealworms, earthworms, and chopped hard-boiled egg. The birds were color-marked for individual recognition at hatching. The young survived to ages of 5, 9, and 17 days respectively. They all died of a suspected bacterial infection. I weighed each bird to the nearest 0.1 g with a triple-beam balance, and with calipers measured the length of the exposed culmen, tarsus, and middle toe to the nearest millimeter. I made notes and took photographs of the color of soft parts, plumage, and behavior. I also gained information from a 7 week-old chick caught on 11 July 1966, 3.3 miles west of Logan, Cache County, Utah.

TABLE 1
GROWTH IN WEIGHT OF LONG-BILLED CURLEW CHICKS

Age (days)	Chick 1 Weight (g)	Chick 2 (7) ¹ Weight (g)	Chick 3 (15) Weight (g)
0	56.6	55.6	57.6
1	53.8	55.1	55.9
2			64.7
3	63.3	68.6	
5			Died
6	68.2		
9	Died		
11		78.6	
17		81.2 (died)	

¹Numbers 1-3 indicate sequence of hatching. Numbers in parentheses indicate number of hours each egg hatched following hatching of the first egg.

TABLE 2
GROWTH IN LENGTH (MM) OR EXPOSED CULMEN, TARSUS, AND
MIDDLE TOE OF LONG-BILLED CURLEW CHICKS

Age (days)	Chick 1			Chick 2			Chick 3		
	Culmen	Tarsus	Toe	Culmen	Tarsus	Toe	Culmen	Tarsus	Toe
0	22	35		21	31		21	41	
1							23	41	39
2	22	42	41	25	43	37	23	45	42
3	27	44	43	27	45	43			
5	33	47	45				23	46	43
11				33	60	44			
17				43	76	51			

After hatching (see Forsythe, 1967 for a description of the egg teeth and hatching process), the chicks remained motionless, resting on the tarsi with eyes open and bill touching the ground. The neossoptiles were wet, and dried in 5 hours. The downy plumage had numerous brown spots and stripes on a yellow-tan background as described by Bent (1929). The iris was chocolate-brown, the tarsi and feet light gray tinged with pink. The upper mandible was black from the tip to the nares and grayish pink from there to the base. The distal one-half of the lower mandible was gray and the proximal one-half, reddish-pink. A yellow yolk sac with associated blood vessels was evident near the vent. The vent was blood red and swollen. In the first 2 days after hatching, the yolk sac was reabsorbed and the bill and tarsi assumed the adult coloration with the loss of the pink. The vent remained swollen but turned pink.

Table 1 shows the growth in weight for the three chicks. Birds lost weight during the first day, but increased in weight thereafter, probably reflecting the initiation of feeding late on the first day. A similar growth pattern has been reported for the Black Oystercatcher (Webster, 1942) and may be characteristic of all precocial birds (Pettingill, 1970). The hatching weights were 5 to 10 g lower than those Graul (1971) reported for three wild-hatched birds.

The growth in length of the exposed culmen, tarsus, and middle toe of the three chicks is shown in Table 2. In addition a wild chick about 7 weeks of age had an exposed culmen measuring 65 mm, tarsus 90 mm, and middle toe 45 mm. The growth in length was linear but not at equal rates. The tarsus grew faster than the others, perhaps reflecting the necessity for quick development of locomotor structures for evading predators and obtaining food.

By the 11th day, teleoptiles were present on the alar tract. They were about 7 mm long with 1 mm projecting from the feather sheath. The neossoptile still adhered to the tip of the teleoptile. By the 14th day teleoptiles were present in the caudal tract. At 7 weeks the remiges, about one-third unsheathed, had grown considerably (Table 3), and teleoptiles were present on all pterylae except the cervical and spinal. The development of the juvenal plumage in the curlew conforms to that found in other precocial terrestrial young (Pettingill, 1970: 379).

The chicks hatched with eyes open, and able to cheep and to right themselves. The development of vocal behavior in this species has been presented elsewhere (Forsythe, 1970; 1972). The chicks were active from hatching. They were able to walk within 5 hours; drink and feed within 10. Graul (1970) reported that the young spent much time out of the nest within a few hours after hatching. The

TABLE 3
LENGTH (MM) OF REMIGES OF A 7-WEEK-OLD LONG-BILLED CURLEW

Side	Remex number									
	1	2	3	4	5	6	7	8	9	10
Right	115	121	121	130	134	147	147	130	121	115
Left	104	112	117	124	126	134	117	126	124	107

birds first defecated 12 hours after initial feeding. The feces were green in color unlike normal bird droppings. When defecating the bird crouched and flapped its wings. One instance of feces ingestion was observed. The young reacted to loud noises and sudden movements by crouching on the tarsi, retracting their necks and becoming silent. This behavior was first observed 2 days after hatching. The birds slept close together. No aggression was recorded among the chicks, probably because they were not old enough. von Frisch (1956) reported the development of dominance orders at the end of 3 weeks in hand-reared *N. arquata*. Head-scratching was indirect (one observation) (Simmons, 1961). Both direct and indirect head-scratching have been reported for the Charadrii (Nice, 1962: 61). The development of behavior patterns in the Long-billed Curlew follows the development in other shorebirds as outlined by Nice (1962: 58-74).

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LITERATURE CITED

- BENT, A. C. 1929. Life histories of North American shore birds. U. S. Natl. Mus., Bull. 146.
- DAVIS, E. 1943. A study of wild and hand reared Killdeers. Wilson Bull., 55: 223-233.
- FORSYTHE, D. M. 1967. Egg teeth and hatching methods of the Long-billed Curlew. Wilson Bull., 79: 340-341.
- FORSYTHE, D. M. 1970. Vocalizations of the Long-billed Curlew. Condor, 72: 213-224.
- FORSYTHE, D. M. 1972. Clicking in the egg-young of the Long-billed Curlew. Wilson Bull., 83: 441-442.
- FRISCH, O. VON. 1956. Zur Brutbiologie und Jungendentwicklung des Brachvogels (*Numenius arquata* L.). Z. Tierpsychol., 13: 50-81.
- FRISCH, O. VON. 1958. Die Bedeutung des elterlichen Warnrufs für Brachvogel und andere Limicolenkuckern. Z. Tierpsychol., 15: 381-382.
- FRISCH, O. VON. 1959. Zur Jugendentwicklung, Brutbiologie und vergleichenden Ethologie der Limicolen. Z. Tierpsychol., 16: 545-583.
- GRAUL, W. D. 1971. Observations at a Long-billed Curlew nest. Auk, 88: 182-184.
- NICE, M. M. 1962. Development of behavior in precocial birds. Trans. Linnaean Soc. New York, 8: 1-211.
- PALMER, R. S. 1967. Pp. 183-184 in *The shorebirds of North America* (C. D. Stout, Ed.). New York, Viking Press.
- PETTINGILL, O. S., JR. 1936. The American Woodcock *Philohela minor* (Gmelin). Mem. Boston Soc. Nat. Hist., 9: 167-391.

- PETTINGILL, O. S., JR. 1970. Ornithology in laboratory and field. Minneapolis, Minnesota, Burgess Publ. Co.
- SIMMONS, K. E. L. 1961. Problems of head-scratching in birds. *Ibis*, 103a: 37-49.
- WEBSTER, J. D. 1942. Notes on the growth and plumages of the Black Oyster-catcher. *Condor*, 44: 205-211.

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Pleistocene birds from the Valley of Mexico.—Through the kindness of Prof. Ticul Alvarez we have been able to study the Pleistocene birds from Chimalhuacán in the eastern part of the state of Mexico. They represent the first published records of fossil birds from the Valley of Mexico, although a mimeographed preliminary report exists on Pleistocene birds from Tlapacoya, a site farther east in the Valley (Brodkorb and Phillips, 1970).

Chimalhuacán is locality 66-5, Departamento de Prehistoria, Instituto Nacional de Antropología e Historia, Mexico, D.F. It is situated at 19° 25' N, 98° 56' W, about 20 km east of the Zócalo in Mexico, D.F. About 2.5 km southwest of the settlement is the Cerro Chimalhuacán, a small extinct volcano that was an island during a higher stage of Lake Texcoco when the fossils were deposited. The present shore of the lake lies about 8 km to the north.

The fossils, which are preserved in the Departamento de Prehistoria, are black and heavily mineralized. They were collected below the remains of a mammoth and are of late Pleistocene age. They represent six species, only two of which have previously appeared in the Mexican fossil record. Two of the birds, a grebe and a flamingo, are extinct. The flamingo remains are from a juvenile bird that probably hatched nearby. The other four species are winter visitants in the Valley of Mexico at the present time (Friedmann et al., 1950). All six species occur in the Pleistocene of Fossil Lake, Oregon (Howard, 1946), which is also the type locality of the two extinct birds (Shufeldt, 1891, 1913).

1. *Aechmophorus occidentalis* (Lawrence). Western Grebe. Left coracoid, lacking the head. Miller (1911) described the Fossil Lake bird as an extinct species, *A. lucasi*, which Howard (1946) reduced to the status of a temporal subspecies *A. occidentalis lucasi*, with slightly larger average size than the living Western Grebe. The specimen from Chimalhuacán is also large, with a distal width of 15.8 (14-15.0 in Recent males), least width of shaft 4.0 mm.

2. *Podiceps parvus* (Shufeldt). Complete left coracoid and distal end of left humerus. In size this extinct grebe falls between *P. grisegena* and *P. auritus*. Measurements of the Chimalhuacán specimens are as follows: length of coracoid to internal distal angle 38.5, width of head 6.8, least width of shaft 12.1; distal width of humerus 9.8 mm. Howard gives the length of two coracoids from Fossil Lake as 35.5-38.0 mm. The humerus is unknown from the type locality.

Qualitative characters of the coracoid of this species have not been described. In the Chimalhuacán specimen the anterior intermuscular line swings abruptly to the middle of the shaft after leaving the sternal facet. In other species of *Podiceps* examined (*P. dominicus*, *chilensis*, *ruficollis*, *caspicus*, *auritus*, *grisegena*, and *cristatus*) and in *Aechmophorus* the intermuscular line inclines regularly toward the head, whereas in *Podilymbus* the line lies along the outer edge of the bone.

3. *Phoenicopteropus copei* Shufeldt. Left tibiotarsus and detached tarsal "epiphysis" of left tarsometatarsus of a juvenile bird. These bones have the somewhat larger