GENERAL NOTES

A note on the prehistoric avifauna of the Lower Klamath Basin.—It would be difficult to overemphasize the current importance to migratory waterbirds of northern California's Lower Klamath Lake and the Lower Klamath Basin as a whole. For example, 80% of all the waterfowl (Anatidae) that breed in Alaska, central and northwestern Canada, and the contiguous United States, and that winter in California, western Mexico, and adjacent areas, use the Klamath Basin during their yearly cycle. More than 5,000,000 ducks alone may be found here during the height of fall migration, with most of these individuals utilizing either Lower Klamath or the adjacent Tule Lakes (U.S. Dept. Interior 1955, 1958).

While the modern avifauna of Lower Klamath Lake has been well surveyed, until recently little was known of the history and nature of this fauna in prehistoric times, and inferences as to the length of time that the Lower Klamath Basin has been of importance to migratory waterfowl were drawn primarily from reconstructions of the postglacial climatic history of the region. These reconstructions, based mainly upon archaeological and palynological data, divide the Lower Klamath Basin Holocene into three major climatic stages: (1) a relatively moist and cool early Holocene, dated from about 10,000 to 7500 years ago; (2) a dry and hot middle Holocene, dated from about 7500 to 4000 years ago; and, (3) a moister and cooler late Holocene, dated from about 4000 years ago to the present (Antevs 1940, 1955; Hansen *in* Cressman et al. 1942; Hansen 1947, 1967). These hypothesized climatic shifts are thought to have been strongly reflected in the levels of Lower Klamath Lake. According to Hansen, the pioneer of palynological studies in this portion of the Pacific Northwest and an authority on the postglacial climatic history of this area, "between 8000 and 4000 years ago, the drouth became severe enough to dry up Lower Klamath Lake" (Hansen 1947: 122), a view also stated by Heusser (1966). If this interpretation of Lower Klamath Holocene climatic history, which many hold to apply to most of the North American Desert West, is accepted, then the current general pattern of distribution and abundance of waterbirds in the Lower Klamath Basin must have been established during the last 4000 years. This interpretation of Holocene climatic history also suggests that the period between roughly 8000 and 4000 years ago was characterized by widespread disruption and loss of waterbird habitat, with a large reduction in the number of waterbirds in the Desert West as a whole, as a necessary consequence of the middle Holocene desiccation of Lower Klamath and other Desert West lakes.

Recent archaeological work in the Lower Klamath Basin provides a more detailed view of the nature and history of the prehistoric Lower Klamath avifauna. In 1967 the University of Oregon excavated the Nightfire Island archaeological site on the now dry margin of Lower Klamath Lake. This site revealed a record of human occupation dating from approximately 4000 B.C. to A.D. 1400, and provided large collections of bird, mammal, and fish bones, adequate samples of identifiable pollen, and large numbers of bone and stone artifacts. The analysis of the Nightfire Island bird remains helps shed light on the nature of the Lower Klamath Basin avifauna during the past 6000 years.

Of the 5817 identified bird bones and bone fragments recovered from Nightfire Island, 200 cannot be securely placed in the stratigraphic sequence for the site, leaving 5617 identified specimens whose placement is adequately understood. After being grouped according to the cultural subdivision, or phase, of the site in which they were found, these specimens were converted into the minimum number of individual animals they represent (Table 1). The cultural phases of Nightfire Island

TABLE 1

MINIMUM NUMBER OF INDIVIDUALS (MNI) AND NUMBER OF IDENTIFIED SPECIMENS (E) OF BIRDS BY PHASE FROM THE NIGHTFIRE ISLAND SITE

	Phase 5		Phase 4		Phase 3		Phase 2		Phase 1	
Taxon	MNI	E	MNI	E	MNI	E	MNI	E	MNI	E
Common Loon, *Gavia immer*	0	0	0	0	3	5	5	13	2	4
Horned Grebe, *Podiceps auritus*	0	0	1	1	4	5	6	20	3	5
Eared Grebe, *P. nigricollis*	1	1	1	1	6	15	4	8	2	2
Horned Grebe and/or Eared Grebe, *Podiceps* spp.	0	0	2	4	2	27	2	32	2	6
Western Grebe, *Aechmophorus occidentalis*	1	1	2	2	7	28	47	268	8	32
Pied-billed Grebe, *Podilymbus podiceps*	2	5	4	9	6	27	10	38	6	13
White Pelican, *Pelecanus erythrorhynchos*	0	0	1	1	2	4	0	0	0	0
Double-crested Cormorant, *Phalacrocorax auritus*	1	1	0	0	0	0	2	2	1	2
Great Blue Heron, *Ardea herodias*	1	1	0	0	1	1	1	1	0	0
Black-crowned Night-Heron, *Nycticorax nycticorax*	0	0	1	1	2	3	1	1	1	1
American Bittern, *Botaurus lentiginosus*	1	1	1	1	1	1	0	0	1	1
Whistling Swan, *Olor columbianus*	1	1	4	6	1	1	1	5	1	1
Trumpeter Swan, *O. buccinator*	1	1	0	0	2	2	1	1	0	0
Canada Goose, *Branta canadensis*	1	2	3	4	6	16	2	5	1	1
Goose spp.	3	5	9	15	58	191	8	23	3	6
Mallard, *Anas platyrhynchos*	1	3	8	45	7	95	10	45	3	7
Gadwall, Pintail, American Wigeon, and/or Northern Shoveler, *Anas* spp.	1	3	11	19	31	41	11	47	3	4
Green-winged Teal, Blue-winged Teal, and/or Cinnamon Teal, *Anas* spp.	1	1	1	2	16	36	3	7	3	7
Ring-necked Duck, *Aythya collaris*	0	0	0	0	1	1	44	90	14	32
Canvasback, *A. valisineria*	0	0	1	2	6	15	40	114	7	17
Greater Scaup and/or Lesser Scaup, *A. marila* and/or *A. affinis*	4	10	4	14	8	52	360	1559	45	197
Redhead, Ring-necked Duck, Greater Scaup, and/or Lesser Scaup, *Aythya* spp.	2	4	2	7	5	12	0	0	1	3
Common Goldeneye, *Bucephala clangula*	0	0	0	0	0	0	2	2	0	0
Bufflehead, *B. albeola*	2	3	2	3	5	13	6	17	3	8
Ruddy Duck, *Oxyura jamaicensis*	4	17	4	9	9	48	21	65	8	27
Hooded Merganser, *Lophodytes cucullatus*	0	0	0	0	2	3	20	79	6	24
Common Merganser, *Mergus merganser*	4	8	6	18	8	24	25	89	8	22
Red-breasted Merganser, *M. serrator*	0	0	1	1	0	0	0	0	1	1

TABLE 1—(Cont'd)

Taxon	Phase 5		Phase 4		Phase 3		Phase 2		Phase 1	
	MNI	E	MNI	E	MNI	E	MNI	E	MNI	E
Golden Eagle, *Aquila chrysaetos*	1	1	1	1	3	61	0	0	0	0
Bald Eagle, *Haliaeetus leucocephalus*	1	3	2	3	1	1	1	1	0	0
Marsh Hawk, *Circus cyaneus*	0	0	0	0	1	1	1	1	0	0
Sage Grouse, *Centrocercus urophasianus*	1	1	0	0	1	4	0	0	0	0
American Coot, *Fulica americana*	4	20	16	53	65	387	183	951	42	269
Killdeer, *Charadrius vociferus*	0	0	1	1	0	0	0	0	0	0
Herring Gull, *Larus argentatus*	0	0	0	0	0	0	1	1	0	0
Great Horned Owl, *Bubo virginianus*	0	0	0	0	0	0	1	1	0	0
Snowy Owl, *Nyctea scandiaca*	0	0	0	0	1	1	0	0	0	0
Short-eared Owl, *Asio flammeus*	0	0	0	0	0	0	1	1	0	0
Common Raven, *Corvus corax*	0	0	0	0	0	0	1	1	0	0

indicated in Table 1 have been defined by artifact typology and dated on the basis of 20 radiocarbon determinations: phase 5 dates from 4000 B.C. to 3000 B.C., phase 4 from 3000 B.C. to 2200 B.C., phase 3 from 2200 B.C. to A.D. 0, phase 2 from A.D. 0 to A.D. 1000, and phase 1 from A.D. 1000 to A.D. 1400.

The information in Table 1 casts doubt on the hypothesis that Lower Klamath Lake was desiccated between 8000 and 4000 years ago. The large number of waterfowl, and of waterbirds in general, present in Nightfire Island phases 5 and 4 (4000 B.C. to 2200 B.C.), and therefore in Lower Klamath Lake, the only reasonable source of these individuals, shows that this lake was in existence during at least the last half of the hypothesized 4000 year period of its desiccation. Indeed, detailed analysis of the composition of the Nightfire Island avifauna suggests that Lower Klamath Lake levels were actually higher during phases 5 and 4 of the occupation of this site than they were during phases 3 and 2, a suggestion confirmed by independent interpretation of other data from the site (Grayson 1976).

The Nightfire Island data make it unreasonable to hypothesize that the importance of Lower Klamath Lake to migratory waterfowl, and to waterbirds in general, is a function of the relatively recent past. Instead, it becomes more reasonable to hypothesize that the general parameters of the distribution and abundance of waterbirds here were established early in Holocene times, with the major local restraint to the establishment of such parameters relating to the retreat of Pleistocene Lake Klamath (Meinzer 1922) to the extent necessary to allow the development of lake and marsh habitats capable of supporting large numbers of waterbirds. Whether or not similar hypotheses may reasonably be forwarded for other regions of the northern Great Basin and adjacent areas will not be known until sufficiently detailed paleoecological analyses are available for those regions.

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DONALD K. GRAYSON, *Bureau of Land Management, Portland, Oregon 97208. Present address: Department of Anthropology, University of Washington, Seattle, Washington 98195.* Accepted 1 May 75.

Common Goldeneyes hatching from cracked eggs.—The literature contains few records of eggs found to be cracked while incubation is in progress. Cracking may be a more common phenomenon than is generally recognized. Freezing temperatures and especially competition for nest sites among cavity nesting species are among the causes. It has been generally assumed that cracked eggs of wild birds do not hatch. Greenwood (1969) reported frost cracking of Mallard (*Anas platyrhynchos*) eggs in the central Missouri Coteau of eastern North Dakota. He noted five nests each with one or more cracked eggs. One of these cracked eggs hatched.

Allen Brooks (*in* Bent 1925), described Bufflehead (*Bucephala albeola*) nests and eggs and stated that, "In many cases the eggs had fine cracks, evidently made by the compression of the bird's body when entering the small aperture." Philips (1925) reports cracked eggs in Bufflehead and Barrow's Goldeneye (*B. islandica*) nests. Erskine (1960) found a cracked and dried out Bufflehead's egg among the residue of a hatched clutch of mixed Barrow's Goldeneye and Bufflehead eggs.

The cause of cracked eggs Greenwood (1969) reported was frost, but among cavity nesting ducks competition for nest sites may be a factor. Severe fighting may even lead to the death of some females. Erskine (1959, 1960) and McLaren (1969) recorded dead female Buffleheads in Barrow's Goldeneye nests. Grenquist