## PART II. PALEO-ORNITHOLOGY OF COPROLITES FROM LOVELOCK CAVE, NEVADA

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In prehistoric times Lovelock Cave, located in the arid Humboldt Sink in west-central Nevada, was an almost completely enclosed chamber into which very little moisture penetrated. As a result of the unique climatological and geological conditions prevailing at this site, the ancient deposits of windblown dust, bat guano, grass, and other materials contained in the dusty cave vault are remarkably well preserved. The powder-dry archaeological midden inside Lovelock Cave contains large quantities of perishable vegetal and faunal material, including avian remains such as feathers, quills, skin, eggshell, several hundred bones, two dozen mummified heads of waterbirds stuffed with grass or tule (Loud and Harrington 1929:49-50, Pl.32), and a number of complete decoys made of bundles of bulrush culms bound together and covered with the heads, skins, and feathers of ducks, geese, and other waterfowl (Harrington 1929:114-115, Pls.33, 34). These specimens probably are one of the oldest examples of taxidermy by North American Indians (Pls.7,8,9).

Many of the artifactual avian remains found in the cave have been identified (Loud 1929:35), but Loud, the original investigator of the cave was of the opinion that the bird bones contained in the archaeological midden had been carried into the cave "by agencies other than the hand of man".[1] Nevertheless, recent study of human coprolites from Lovelock Cave reveals that wildfowl was an important food source during prehistoric times, particularly during the recent phases of Lovelock Cave occupation (Cowan 1967:21-36). The coprolites from Lovelock Cave contain a rich spectrum of food resources taken from the littoral zone of Humboldt Lake, which in prehistoric times was located about two miles from the cave. Feathers and fragmentary bird bones were numerous in a sample of coprolites of recent date (145 $\pm$ 80; UCLA 1071-E) (Tubbs and Berger 1967:89-92), found in a crevice at the entrance of the cave.

The avian remains collected in Lovelock Cave during the excavations of 1912 and 1924 include representatives of at least sixteen species, but no estimate of the number of individuals per species is given in the published report (Loud and Harrington 1929), and recent

investigation at the site suggests that the specific identifications may be based upon an inadequate field sample. A similar avifauna consisting of nineteen species was identified by study of the total osseous assemblage recovered from Humboldt Cave, located some ten miles southwest of Lovelock Cave (Brooks 1956:106-112). Miscellaneous feathers found in the midden deposits of these two caves were not identified unless they had been used in basket decoration, or in the manufacture of decoys and other artifacts (Table I). Identification of the diminutive feather fragments found in the Lovelock Cave coprolites would have been greatly expedited had the much more complete and better preserved feathers contained in the midden been identified and adequately described at an earlier date.

Feathers are of course relatively scarce in archaeological sites, since their survival requires the optimum possible preservation conditions. The dry caves and rock shelters of western America that have produced feathers in archaeological contexts include Danger Cave, Utah (Sperry in Jennings 1957); Woodchuck Cave in Tsegi Canyon, Arizona (Lockett and Hargrave 1953); Glen Canyon, Utah (Hargrave 1960:239-241); and the caves on Wetherill Mesa, Colorado (Hargrave 1965:202-205; Messinger 1965:206-215 Goose feathers were found in archaeological sites in northern Arizona (Guernsey and Kidder 1921).

At this writing, identification of the diminutive feather fragments found in coprolites is a laborious process that often yields only tentative generic identifications. In his exemplary study of the Wetherill Mesa avifauna, Messinger (1965) summarized many of the problems occurring in microscopic identification of feathers, and emphasized the need for basic research in the field of microanalytic ornithological identification--echoing a plea voiced earlier by Hargrave (1938:47-51). Unfortunately, few ornithologists (with the notable exception of Asa Chandler [1916]) have studied the specific micro-characteristics of feathers.

Over the years wildlife research specialists have developed techniques useful in determining the age and sex of gamebirds by the size, shape, and color of the feathers (cf. Taber 1963:119-189). Some of the constituents of the Lovelock Cave coprolites analyzed by Cowan (1967) and Ambro (1967) were examined, during 1967-68, by wildlife biologists of the California State Department of Fish and Game.[2] Mr. O. A. Brunetti

volunteered to do whatever was possible toward identifying the fragmentary, stained, and altogether discouraging-looking assortment of feathers and other avian material found in the coprolites. This study, carried out as off-duty time permitted, resulted in the following identifications:

A piece of skin found in a coprolite analyzed prior to 1965 had been identified as snakeskin (Roust 1967:49-88). This specimen is in fact bird-leg skin, possibly representing Anas sp. Another duck foot skin was found in Interior coprolite I-51.

Some of the larger fragments of feathers in the coprolites are contour or flight feathers of mature waterfowl, possibly Anas or Nyroca sp. These identifications are based on examinations of down barbules probably representing several species of adult ducks. Other waterfowl identified in minor numbers were grebe (Aechmophorus sp.), at least one species of goose, and possibly heron (Ardea sp.). A very large percentage of the identifiable feather fragments contained in the Entrance coprolites represent Fulica americana, the common American coot or mudhen.

While Brunetti examined the feathers, non-icthyological bones found in the coprolites were examined by Dr. A. C. Ziegler. The poor condition of these bones made specific identification impossible. Ziegler (personal communication, 1967) noted that all of the non-fish bones in the Entrance coprolites were "finely fragmented". Entrance coprolite E-11 contained approximately 100 bones of a small to medium-sized bird, as well as twelve feathers, at least three of which are "flight feathers". Osseous fragments included the vertebral column, synsacrum, hansas, and ribs. Ziegler was of the opinion that the bones could be those of a "rail, gallinule, or coot". This tentative identification seems to be supported by Brunetti's independent identification of Fulica americana feathers in the same coprolite. Ziegler and Brunetti noted evidence of burning or charring on the tips of some of the better preserved feathers. Brunetti found that singed feathers occurred frequently, and in most cases the remaining portion of the barbules appeared to be of fairly equal length, indicating that singeing may have been a routine practice. The remaining feather fragment usually included the calamus and a small amount of the down structure, indicating that singeing was fairly thorough. In Interior coprolite I-31, Ziegler found "100 feathers, some of which were apparently singed before ingestion".[3]

Coprolite I-41 contained "mostly small 'down' feathers with only a few contour feathers mixed in." Ziegler concluded that all of the bird bones in the coprolites represented adult individuals (i.e., not nestlings) (cf. Loud and Harrington 1929:35).

The distribution in Nevada of the American Coot (Fulica americana americana) is discussed by Linsdale (1936:51-52). Coots are presently classed as "abundant" summer residents in the Stillwater and Humboldt River areas (Table I). According to Linsdale, coots appear in "immense numbers" during autumn at the "tule fields" on Pyramid Lake but are scarce in May and June. (cf. Jones 1940; Alcorn 1946:129-138; Martin 1951).

The Indians of the Great Basin hunted many species of waterfowl, including coots or "mudhens" (Stewart 1941:424). The Northern Paiute took large numbers of coots by means of quite sophisticated hunting techniques. The "communal mudhen drive" staged in autumn by the southern bands of the Northern Paiute was an important food collecting technique, but it has received only minimal description in the ethnographic literature (Steward 1938:127; Stewart 1941:274-275, 369, 407, 424; Curtis 1926: 15, 73). The basic facts of the Northern Paiute mudhen drive outlined by Stewart (1941) indicate that the organizational, sociological, and technological aspects of the mudhen drive were certainly as complex as the better known antelope, grasshopper, and rabbit drives described by Steward (1938:33-44; 1955:109-111). An interesting narrative description of a Northern Paiute mudhen drive is given in Scott (1966:23-25). Unpublished ethnographic data obtained by S. F. Cook[4] includes several brief first-hand accounts of Northern Paiute mudhen drives. An elderly Paviotso woman born in 1868 reported to Cook that many Northern Paiute families took up to 100 mudhens on a single occasion by driving the birds into large nets. All fourteen Northern Paiute bands listed in Stewart (1941:372) ate mudhens (saiya') and mudhen eggs, and all but one of the fourteen bands are said to have practiced some form of the communal mudhen drive.

The mudhen drive, as Scott (1966) explains, necessitated construction of a flotilla of "balsas"(boats made of tule culms), some of which were eight to twelve feet long and were capable of transporting four individuals (cf. Heizer n.d.; Wheat 1959). The "balsas" were propelled in the shallow lakes by poling. Long nets were fashioned for

the annual drive. It is possible that some of the large nets (and mudhen decoys) found in Lovelock, Humboldt and Ocala Caves were used in connection with these seasonal drives. Loud and Harrington (1929:88) mention that "in a cave near Ocala, 14 miles to the south of Lovelock Cave, a net was reported with birds entangled in it."

The feathers found in the Lovelock coprolites suggest that mudhens were taken in substantial numbers, almost certainly from Humboldt Lake. We do not know, of course, if the communal mudhen drive technique was used by the inhabitants of Lovelock Cave, but most of the constituents of the Lovelock coprolites were obtained during autumn, and it was during this season that the Northern Paiute staged their annual mudhen drives.

Summary: Preliminary analysis of avifaunal remains found in the Lovelock Cave coprolites reveals that significant information may be obtained from studies of paleo-ornithological material. Remains of duck (?), grebe, goose, heron (?) and coot (Fulica americana americana) feathers were identified by microanalytic techniques.[5] As Hester (1964:19-23) has observed, it is sometimes possible to determine the time of year during which a given site was occupied by examination of the age-group composition of the avifaunal remains (cf. Howard 1939:301-394).

Paleo-ornithological remains are preserved in many of the dry caves and rockshelters located in Nevada, and it is likely that detailed analysis of this often-neglected material would contribute much significant information to studies of the ecology, ornithology, and prehistory of the Great Basin.

TABLE I. AVIFAUNA

Lovelock Cave[1]

| Specific Name[2] | Common Name | Coprolites[15] | Feathers | Bone | Decoy Heads |
|---|---|---|---|---|---|
| Colymbiformes | | | | | |
| Aechmophorus occidentalis | Horned Grebe | X | X | | |
| Pelecaniformes | | | | | |
| Pelecanus erythorhynchos[3] | White Pelican | | X | X | X |
| Ciconiiformes | | | | | |
| Ardea herodias | Great Blue Heron | X | X | | |
| Anseriformes[4,5] | | | | | |
| Cygnus[6](Olor)[7] columbianus | Whistling Swan[11] | | | | |
| Chen hyperboreus | Lesser Snow Goose[12] | | | | |
| Branta canadensis[8] | Canada Goose | X | | X | X |
| Anser albifrons | White-fronted Goose | | X | | X |
| Anas platyrhynchos[9] | Mallard[13] | | X | | |
| Nyroca sp.[10] | Ring-necked duck | X | | | X |
| Dafila acuta | Sprig[14] Pintail duck | X | | | X |
| Mareca americana | Widgeon[11], Baldpate[14] | | | | |
| Mergus merganser[9] | American Merganser[11] | | | | X |
| Gruiformes | | | | | |
| Fulica americana | American Coot(Mudhen) | X | X | X | X[16] |
| (Other) | | | | | |
| Bubo virginianus | Great Horned Owl | | X | | |
| Sialia mexicana | Western Bluebird | | X | | |
| Larus californicus | California Gull | | | | |
| Corvus brachyrhynchos | Crow | | | | |

| Hidden Cave[17] Midden | Humboldt Cave[18] No. of Individuals | Winnemucca Caves 19, 20 | Danger Cave[21] Midden | Stillwater Preserve[22] Residence[23] | Stillwater Preserve[22] Quantity | Great Salt Lake[24] Residence |
|---|---|---|---|---|---|---|
| X | 1 | X | | Permanent | Abundant | Summer |
| X | 5-8 | X | | Summer | Abundant | Summer |
| | | | | Permanent | Common | Summer |
| | 4-8 | | | Winter | Abundant | Winter |
| X | 4-5 | | X | Winter | Abundant | Migrant |
| | 2 | X | | Winter | Uncommon | Migrant |
| | 1 | | | Winter | Uncommon | Migrant |
| X | 1 | | | Permanent | Abundant | Permanent |
| X | 11-17 | | X | Winter | Occasional | Migrant |
| X | | | | Permanent | Abundant | |
| | | X | | Permanent | Common | |
| | 1 | X | | Winter | Common | Migrant |
| X | 2 | X | | Permanent | Abundant | |
| X | | | X | Permanent | Uncommon | Summer |
| | | | | Accidental | Rare | Migrant |
| X | | | | Summer | Common | Summer |
| | | | | Permanent | Occasional | Migrant |

## NOTES TO TABLE I

1. Lovelock Cave avian bones total 275, weight 821.5 grams. There are 193 non-artifact bones. No estimate of number of individuals represented is given by Loud and Harrington (1929).

2. Avifauna arranged in the sequence used by Brooks (1956:107).

3. Cf. Hall (1940:87-88).

4. Cf. Hall (1926:87-91).

5. Cf. Kortright (1942).

6. Listed as Olor columbianus by Loud and Harrington (1929:35).

7. Generic designation given in Loud and Harrington (1929:35).

8. Elder (1946:93-111).

9. Feathers were used as basket decoration (Loud and Harrington 1929:68).

10. Bones of the canvasback duck (Nyroca valisineria) found in Humboldt Cave comprised some 11-17 individuals. The head of a canvasback duck decoy was found in Cache Pit 13 (Heizer and Krieger 1956:66). The apparent absence of this species in the Lovelock avifaunal assemblage may be spurious, in view of the fact that the feathers found in the midden of the latter site have never been studied (see text).

11. All avifauna entered in Table I (except swan, widgeon, and merganser) are listed as having been part of the diet of several bands of Northern Paiute (Stewart 1941:372).

12. Rienecker (1960:481-506).

13. Anderson (1956:115-130).

14. Common name listed by Linsdale (1936:36).

15. Brunetti, personal communication, 1967.

16. A mudhen (coot) decoy was found in nearby Humboldt Cave (Heizer and Krieger 1956:13).

17. Roust and Grosscup (n.d.). Only 114 feathers were found in Hidden Cave.

18. Frequency of bird remains is based solely on identification of skeletal elements (Brooks 1956:106).

19. Orr (1956:6, 8).

20. Roust (1958:1-13).

21. Listed in Jennings (1957:305-306).

22. From data compiled by U.S. Fish and Wildlife Service, Stillwater Wildlife Management Area, Fallon, Nevada.

23. See Bent (1932) for additional data.

24. Listed by Behle (1958).

## NOTES

[1] Loud (1929:35) was of the opinion that "most bird bones other than [26] artifacts were deposited in [Lovelock] cave by natural agencies, rather than by hand of man." This assertion seems to be irreconcilable with the evidence now at hand.

[2] The authors wish to thank Walter Steinecker, Bruce Browning, Dr. Alan Ziegler, and Norman Messinger for their contributions to this study.

[3] In his ethnographic notes concerning the Northern Paiute of Humboldt Lake, Heizer (n.d.) mentions that ducks were cooked in an earthen pit, and that "the feathers were not removed before cooking."

[4] These field notes are now in the possession of Professor R. F. Heizer, University of California, Berkeley.

[5] Quantification and tabulation of species represented by the identified feather fragments found in each coprolite is in progress.