

PREHISTORIC BIRD BONE
FROM THE BIG DITCH SITE, ARIZONA

ALAN FERG

Arizona State Museum, University of Arizona
Tucson, AZ 85721

and

AMADEO M. REA

San Diego Natural History Museum, Balboa Park
San Diego, CA 92112

ABSTRACT.—Fifteen individual bones and one nearly complete skeleton, representing eight bird species, were recovered from the Big Ditch Site, a large Hohokam pithouse village in the lower San Pedro River Valley, Pinal County, Arizona. Contexts date primarily from late Santa Cruz and early Sacaton Phases, around A.D. 850-950. We present osteological and provenience data for each bone and note other Hohokam occurrences for each species.

We document a Northern Cardinal premaxilla from Big Ditch (dating apparently around A.D. 550-700) and another premaxilla dating around A.D. 1150-1225 from a site 40 km upstream. The apparent absence of this species from southern Arizona prior to the late 1800s leads us to suggest that brilliantly colored cardinals, like macaws, may have been a prehistoric trade item to southern Arizona derived from somewhere farther south in Mesoamerica.

INTRODUCTION

The Big Ditch Site (AZ BB:2:2 - ASM) is a Hohokam pithouse village located on the second terrace above the east side of the San Pedro River. The locality is about 1.6 km north of the river's confluence with Aravaipa Creek in Pinal County, Arizona (Fig. 1). It was occupied from at least late Snaketown Phase times through the middle of the Sedentary Period (*circa* A.D. 500 to 1050 or 1100). This was possibly followed by a short hiatus, succeeded in turn by a Tanque Verde Phase occupation (*circa* A.D. 1150-1250). Calendrical dates for periods and phases follow Haury (1976: Table 16:1). The earliest occupation at Big Ditch is represented by at least several pithouses, with the greatest extent of the village occurring during the late Santa Cruz and early Sacaton Phases, about A.D. 850-950. At present, it is estimated that as many as 25-30 pithouses may have been occupied contemporaneously at the height of occupation, with the absolute number of structures at the site being much greater (Masse 1980a:208, 216). A ballcourt was also present at the site during this maximum occupation.

As of this writing, nine pithouses and some thirty cremation deposits have been excavated, with test excavations made in six areas of sheet trash and in four of the 48 trash mounds at the site. This excavation probably represents less than 5% of the areal extent of the Big Ditch Site (Masse 1980a:208).

Located in the Lower Sonoran Life Zone (Lowe 1964) at an elevation of approximately 1658 m, the site currently supports a variety of plant species including saguaro (*Cereus giganteus*), mesquite (*Prosopis* sp.), paloverde (*Cercidium microphyllum*), cholla (*Opuntia* spp.) and creosote (*Larrea tridentata*). About 1.2 km north of the site is Cooks Lake, a small marshy body of water that attracts water birds. This natural lake was probably available to water fowl prehistorically as well.

We report here one bird bone recovered during the 1974-1975 excavations directed by Dudley Meade, and all of the bird bones recovered during the 1975-1977 excavations directed by W. Bruce Masse, Arizona College of Technology Archaeological Field School (15 elements and one virtually complete skeleton; Table 1). In the following text and in Table 1, reference is made to upper, middle, lower and floor fill in pithouses. Floor fill

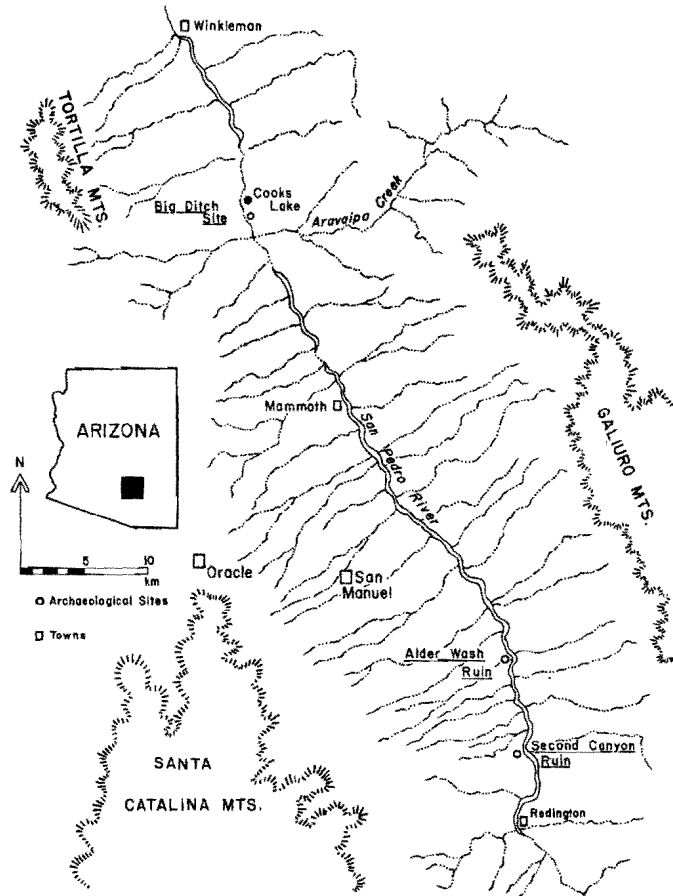


FIG. 1—Locality map for the lower San Pedro River Valley.

is defined as the 10 cm of fill immediately above the pithouse floor, and is so segregated because of its potential for containing materials that were on or near the floor when the structure was abandoned. This is distinct from the rest of the pithouse fill, which, although it contains cultural material, has usually washed in from adjacent areas or been thrown in as trash, and is consequently of little or no use in interpreting activities in the pithouse. It must be stressed that "floor fill" too can consist of materials thrown or washed into an abandoned structure, which may actually be more closely related (contextually) to items above them, rather than to anything on the floor. The two fragments of a Snow Goose humerus discussed below illustrate this well. The species descriptions below are presented in phylogenetic order following the American Ornithologists' Union *Check-List of North American Birds* (1957).

SPECIES DESCRIPTIONS

Order: Anseriformes

Family: Anatidae

Snow Goose (*Anser caerulescens*)

The distal end of a right humerus and part of the shaft of the same bone were recovered from the floor fill and lower fill, respectively, of House 3. Both pieces are burned (except for the tip of the articular end). A presumed food item, this species is distin-

TABLE 1.—Tabulation of bird bone from the Big Ditch Site (AZ BB:2:2 - ASM).

SPECIES	ELEMENTS	PROVENIENCE	AGE
<i>Anser caerulescens</i>	humerus (R)	House 3, lower and floor fill	Santa Cruz/ Sacaton
<i>Buteo jamaicensis</i>	1 skeleton	animal burrow (non-cultural) in Excavation Area 6	Santa Cruz or earlier
<i>Callipepla gambelii</i>	femur (L)	House 2, middle-upper fill	Santa Cruz/ Sacaton
	coracoid (R)	House 2, floor	Santa Cruz/ Sacaton
	coracoid (R)	House 2, floor	Santa Cruz/ Sacaton
	coracoid (L)	House 2, floor	Santa Cruz/ Sacaton
Quail, sp?	sternum	House 2, floor	Santa Cruz/ Sacaton
	radius (R)	Trash Mound 1, Level 3	Santa Cruz
	femur (R)	House 4, floor fill	Tanque Verde
<i>Zenaid macroura</i>	coracoid (R)	House 4, fill	Tanque Verde (?)
<i>Geococcyx californianus</i>	humerus (R)	House 2, middle-upper fill	Santa Cruz/ Sacaton
	tibiotarsus (L)	House 2, middle-upper fill	Santa Cruz/ Sacaton
<i>Tyto alba</i>	ungual phalanx	House 7, lower fill	Santa Cruz
	ulna (L)	House 1, upper fill	Sacaton or Tanque Verde
<i>Salpinctes obsoletus</i>	humerus (L)	House 2, floor	Santa Cruz/ Sacaton
	ulna (L)	House 2, floor	Santa Cruz/ Sacaton
<i>Cardinalis cardinalis</i>	premaxilla	Found in child's burial in or below Trash Mound 1	Gila Butte (?)

guishable from the similar sized *Anser albifrons* (White-fronted Goose) by the shape of the internal and external condyle and of the intercondylar furrow. This bird would have been a winter visitor, available between October and March (Phillips et al. 1964:11). *Anser "hyperborea"* and *Anser caerulescens* are the white and dark morphs, respectively, of a single species, once thought to represent two populations (A.O.U. Committee 1973). Generic usage follows Mayr and Short (1970), Phillips, et al. (1964) and Rea (1983).

The only other Hohokam site that has produced Snow Goose bones is Snaketown, where McKusick (1976) reported (as *Chen hyperborea*) four occurrences from the Pioneer Period (300 B.C.-A.D. 550), considerably earlier than this Santa Cruz/Sacaton Phase specimen (circa A.D. 850-950). We have examined the Snaketown Phase (A.D. 350-550) perforated furcula listed as "Blue Goose (?)" from the 1934-1935 excavations at Snaketown (Gladwin, et al. 1937:Plate CXXIXc - ASM Cat. No. GP-47549), and find it is in fact a White-fronted Goose (*Anser albifrons*). This latter bone is distinguishable from the furculae of Snow Goose, Canada Goose (*Branta canadensis*), and Ross' Goose (*Anser rossii*) by the strong intermuscular lines on the interior surface which continue to the apex of its very pronounced furcular process. Also, the large pneumatic foramen in the ramus of *A. albifrons* is absent in the other three species. This is the only bird bone that has survived from the first dig at Snaketown, undoubtedly because it was worked.

Other Southwestern cultural groups also used geese furculae for pendants. Four perforated Canada Goose furculae, the two illustrated being virtually identical to the White-fronted Goose specimen from Snaketown, were found in the A.D. 1300s deposits at Pindi Pueblo near Santa Fe, New Mexico (Stubbs and Stallings 1953:138, Plate 34h).

Order: Falconiformes

Family: Accipitridae

Red-tailed Hawk (*Buteo jamaicensis*)

A single, almost complete skeleton of a Red-tailed Hawk was found partially articulated in an animal burrow in Excavation Area 6. All major elements were present except the left humerus, the right coracoid, the right carpometacarpus, both scapulae and the mandible. The specimen was compared with other expected buteonine species including *Buteo lineatus* (Red-shouldered Hawk), *B. albonotatus* (Zone-tailed Hawk), *B. regalis* (Ferruginous Hawk), *B. nitidus* (Gray Hawk), *Parabuteo unicinctus* (Harris' Hawk), and *Buteogallus anthracinus* (Common Black Hawk). Although this specimen is non-cultural, the burrow mouth was sealed by Santa Cruz/Sacaton Phase trash and it can be considered of Santa Cruz age (A.D. 700-900) or slightly earlier. Red-tailed Hawks are year around residents virtually statewide in Arizona.

Culturally deposited remains of Red-tailed Hawk of an approximately equal age have been found at the Cemetary Ridge Site along the middle Santa Cruz River (S. Olsen 1977:178), dating around A.D. 900. Utilization of all species of hawks and eagles is much greater during the Classic Period, at which time they often show up as single or multiple burials (Bradly 1979:10; Emslie and Hargrave 1979:123-126; Ferg, in press; Fewkes 1912:91, 93; Gerald 1975:190; McKusick 1976; Mills and Mills 1969:136; Sparling 1974:237). Additionally, from a site near Santan, McKusick identified a Swainson's Hawk and Red-tailed Hawk burial (materials and notes in the Additional Site Information File for AZ U:14:8 at the Arizona State Museum). Found in a trash mound, associated with primarily Santa Cruz and Sacaton Red-on-buff sherds, this burial may be intrusive into the mound and actually of Classic Period age.

Order: Galliformes

Family: Phasianidae

Gambel's Quail (*Callipepla gambelii*)

Four bones representing at least two individuals were collected in House 2. The proximal left femur, one left and two right coracoids all date to Santa Cruz/Sacaton times. As might be expected from this quail's wide distribution and its relative ease of

hunting and trapping, bones from this ready source of meat are found in Hohokam sites of virtually all ages. Of the two quail species expected from the San Pedro drainage, the Scaled Quail (*Callipepla squamata*) is partial to grasslands and Gambel's Quail to mesquite and cactus (Phillips et al. 1964; Rea 1973; Gavin and Sowls 1975). Because of the presence here of the Gambel's Quail, it would appear that there were probably no grasslands in the immediate vicinity of the Big Ditch Site. Generic usage follows Phillips et al. (1964), Mayr and Short (1970) and Rea (1983).

Unidentifiable Quail

Three quail bones (a partial sternum, a distal right radius and a partial right femur shaft) were too fragmentary to be identified as either Scaled Quail or Gambel's Quail. The sternum from House 2 may well be from a Gambel's Quail in that the other four quail bones from this pithouse are Gambel's.

Order: Columbiformes

Family: Columbidae

Mourning Dove (*Zenaida macroura*)

The right coracoid of a Mourning Dove was found in the fill of House 4 and is probably Tanque Verde Phase in age (A.D. 1150-1250). This bird would have been a year around resident in the San Pedro Valley and is distinguished osteologically from its close relative the White-wing Dove (*Z. asiatica*) by smaller size.

Various archaeological finds of Mourning Dove have been made, including specimens of both older and younger age than the Big Ditch specimen, from Snaketown (McKusick 1976), Ventana Cave (Haury, et al. 1950:Table 11), the Davis Ranch Site (Gerald 1975:Table 3), and the Hardy Site (Gregonis, in prep.; Gregonis and Reinhard 1979). Mourning Doves, like quail, were probably utilized as a food resource.

Order: Cuculiformes

Family: Cuculidae

Greater Roadrunner (*Geococcyx californianus*)

This full-time resident of southern Arizona is represented by a distal left tibiotarsus and a distal right humerus. Both are from the middle-upper fill of House 2 and could well be from the same individual.

Archaeologically, the Roadrunner, too, is present at a number of sites, in contexts both older and younger than the Big Ditch specimens, including Snaketown (McKusick 1976), Ventana Cave (Haury et al. 1950:Table 11), the Davis Ranch Site (Gerald 1975:Table 3), Las Colinas (Rea 1981), Pisinimo (Masse 1980b:270) and the University Indian Ruin (Ferg, in press). Roadrunner feathers continue to be used in Pueblo ceremonial items, but among historic Pimans they were avoided as being a source of sickness (Bahr et al. 1974).

Order: Strigiformes

Family: Tytonidae

Barn Owl (*Tyto alba*)

One complete ungual phalanx (claw) was recovered from the lower Santa Cruz (A.D. 700-900) age fill of House 7, and the distal end of a left ulna came from the Sacaton or Tanque Verde age upper fill of House 1. Barn Owls are permanent residents in the San Pedro Valley.

The only other known archaeological occurrences of the Barn Owl in a Hohokam site are three bones from the upper (dry) midden (levels 1 through 4) in the upper cave at Ventana Cave (Haury et al. 1950:Table 11). While these bones are probably from the Hohokam occupation, because of the considerable mixing of the upper deposits (Haury

et al. 1950:341-342) all that can be said with certainty is that they probably date after about A.D. 1. Upper level bones *could* relate to Papago use of the cave, or could even be post-occupational (as the White-wing Dove may be; see Rea 1983:159-160).

Order: Passeriformes

Family: Troglodytidae

Rock Wren (*Salpinctes obsoletus*)

A complete left humerus and left ulna were found on the floor of House 2. Both bones are well preserved and appear to be from the same individual. These are larger than the Cañon Wren (*Catherpes mexicanus*) and Bewick's Wren (*Troglodytes bewickii*). This bird is probably a full-time resident in the San Pedro Valley, and prefers living in cliffs, hills, and even in areas with high dirt banks. No other archaeological specimens are known for the Hohokam area.

Family: Emberizidae

Northern Cardinal (*Cardinalis cardinalis*)

During the 1974-1975 work at Big Ditch, the premaxilla of a Northern Cardinal was found, apparently associated with what is seemingly a Gila Butte Phase (A.D. 550-700) burial in or below Trash Mound 1. The burial was that of a child, three to six years of age, with Gila Butte Red-on-buff ceramics in the lower fill of the grave (Dudley Meade, pers. comm.).

Only two other prehistoric occurrences of the Northern Cardinal in Arizona are known. The first is from another Hohokam site, Alder Wash Ruin (AZ BB:6:9 - ASM), located 40 km upstream (south) from Big Ditch, on the west bank of the San Pedro River (Fig. 1). This specimen is also a premaxilla, but dates to about A.D. 1150-1225, having been found on the floor of an early Classic Period pithouse, House 17 (Masse, in prep; Johnson n.d.a.).

Three Northern Cardinal elements (one mandible and one right tibiotarsus with an associated terminal phalanx) have been reported from the fourteenth century Grasshopper Pueblo (AZ P:14:1 - ASM) in the White Mountains of east-central Arizona (J. Olsen 1980:163-164; 1982:66). None show any modification.

The bill of the related Pyrrhuloxia (*Cardinalis sinuatus*) is quite differently shaped. Both Hohokam archaeological specimens are illustrated in Fig. 2, along with modern specimens of the Northern Cardinal and Pyrrhuloxia.

DISCUSSION

All eight bird species in the archaeological assemblage (including the non-cultural Red-tailed Hawk) can be found year-round in the vicinity of the site today, except for the winter visitor Snow Goose. Although the Northern Cardinal is now a common resident of southeastern Arizona north to the Mogollon Rim, such was apparently not always the case. Phillips (1968:151) notes that "This gorgeous bird, apparently rare and local in the early 1870's and conceivably absent from Arizona a few years before, had spread by 1885 north to the Agua Fria River." Its colonization of the Big Sandy-Bill Williams drainage has occurred since about 1940 (Monson and Phillips 1981). A similar recent northward range extension in south-central Arizona has been documented for the closely related Pyrrhuloxia (Rea 1983:89, 230-231). Based on the Northern Cardinal premaxilla from Alder Wash Ruin, Johnson (n.d.a) suggested that the recent range expansion of the Cardinal into Arizona represents a re-occupation of an area from which it had previously been extirpated by unknown factors. An alternative (and not mutually exclusive) explanation proposed herein is that these Cardinal beaks represent the remains of live birds or skins that were traded into the Hohokam area from somewhere farther south, in the "original" range, in prehistoric times. It has been well documented that other birds, such as macaws, obtained originally from far to the south in Mesoamerica, were traded into the

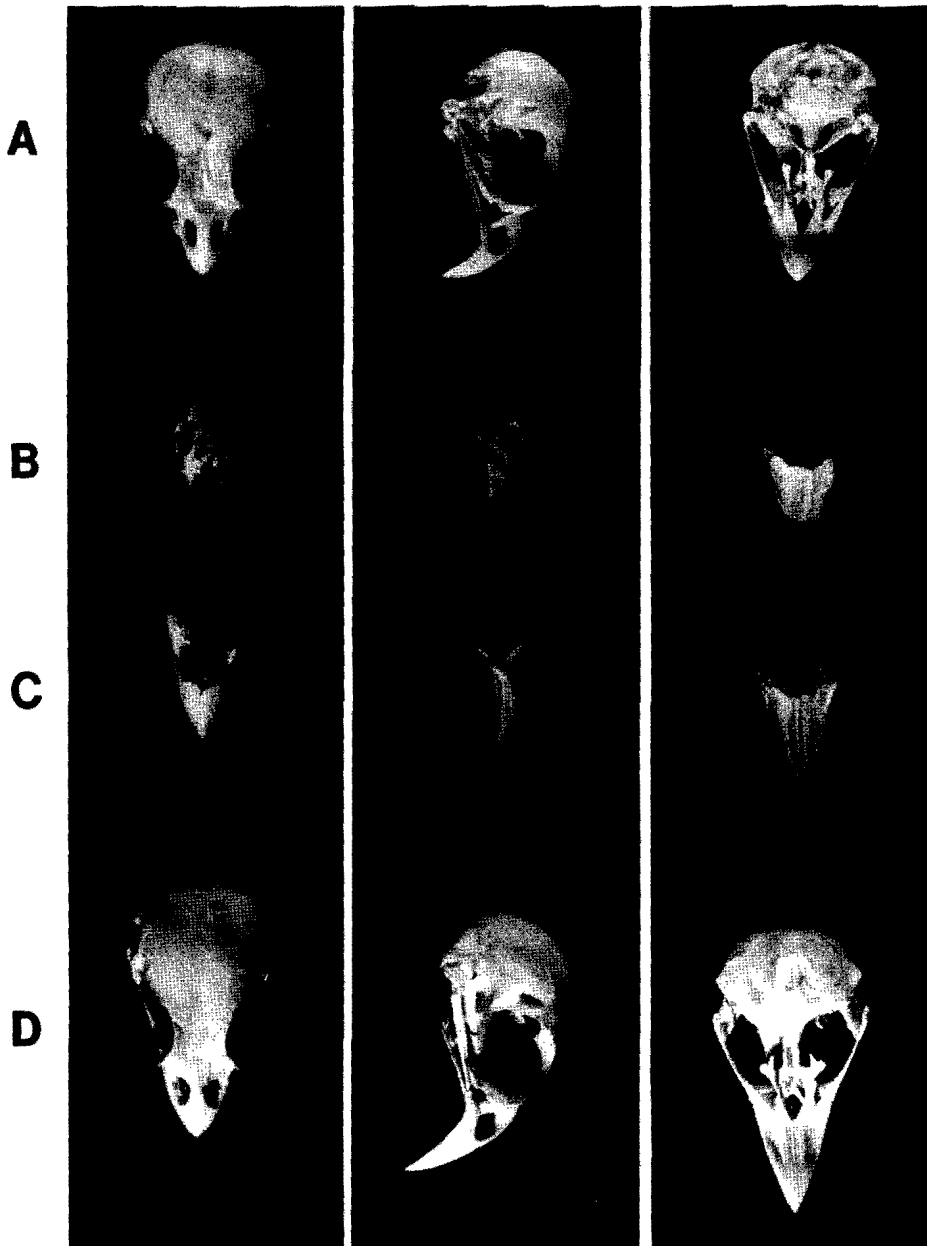


FIG. 2.—Dorsal, lateral, and palatal views of (A) modern *Pyrrhuloxia* skull (No. 6202 in the University of Arizona Department of Ecology and Evolutionary Biology Bird Collection), (B) prehistoric Northern Cardinal premaxilla from Alder Wash Ruin (AZ BB:6:9), (C) prehistoric Northern Cardinal premaxilla from Big Ditch Site (AZ BB:2:2), (D) modern Northern Cardinal skull (No. 11840 in the University of Arizona Department of Ecology and Evolutionary Biology Bird Collection).

Southwest (Hargrave 1970). Presumably the Cardinals traded would have been the males with their brilliant red plumage and bills.

With the present data it is not possible to say whether the Cardinal was a trade item or occurred naturally on the San Pedro in prehistoric times. The reinvasion hypothesis is unlikely. Archaeological dry cave deposits in the Hohokam area could yield identifiable Cardinal feathers, but so far have not, to the best of our knowledge. The recovery of Cardinal bones or feathers from dated prehistoric but non-cultural deposits, such as fossil packrat middens, would argue strongly for the natural presence of Cardinals in Arizona prior to the late 1800s. Again though, no such specimens are presently known.

The distribution of bird bones within the site also merits some comment. Of the sixteen bird bones reported here (the non-cultural Red-tailed Hawk being excluded), over half (nine bones or 56%) came from a single provenience, House 2 (Table 1). Of these, six bones representing at least two Gambel's Quail and one Rock Wren, were directly associated with the floor. Although the fill of House 2 represented the largest single trash deposit excavated at the site, virtually all proveniences were screened through ¼ inch mesh screens (Masse, pers. comm.), hence the high proportion of bird bones in House 2 cannot be dismissed as a problem in the manner in which the various proveniences were sampled. When the analysis of the complete floor assemblage (including all artifactual, floral and faunal materials) is completed by Masse, some further comments on this distributional situation may be possible.

A second notable relationship is that only two (12.5%) of the bones were recovered from non-pithouse proveniences even though the sampled trash mounds produced large quantities of large and small mammal bones. It is uncertain whether this restricted distribution of bird bone at the site is the result of cultural practices or of differential preservation of bird bone in different types of features.

Finally, from the 1975-1977 excavations, 2618 mammal bones were recovered, 820 of which were considered identifiable (Johnson n.d.b). Accordingly, bird bone (15 elements) represents 0.6% of all recovered bone, and 1.8% of all identifiable bone. At first glance, this proportion of bird to mammal bone seems quite low, but there are no large, analyzed faunal assemblages from Hohokam sites with which to compare these figures. They are noted here for comparison with any future faunal reports which may be sufficiently clearly presented that similar proportions may be calculated from them.

ACKNOWLEDGEMENTS

Dudley Meade of Central Arizona College, Coolidge, kindly loaned us the Northern Cardinal beak found at the Big Ditch Site and provided information on its provenience. W. Bruce Masse of Southern Illinois University, Carbondale, provided all data for the 1975-1977 excavations. Bruce also read and made valuable suggestions on an earlier draft of this paper. Ronald J. Beckwith, Arizona State Museum, University of Arizona, drafted the locality map, and Alison Habel of Tucson photographed the Cardinal premaxillae (the negatives are accession number 80-27 at the Arizona State Museum, Tucson).

LITERATURE CITED

- AMERICAN ORNITHOLOGISTS' UNION.
1957. Check-list of North American birds.
5th edition. Lord Baltimore Press, Inc.,
Baltimore.
- AMERICAN ORNITHOLOGISTS' UNION
CHECK-LIST COMMITTEE. 1973. Thirty-
second supplement to the American Orni-
thologists' Union Check-list of North Amer-
ican birds. *Auk* 90:411-419.
- BAHR, DONALD M., JUAN GREGORIO,
DAVID I. LOPEZ and ALBERT ALVAREZ.
1974. Piman shamanism and Staying Sick-
ness (*Ká:cim Múmkidag*). Univ. Arizona
Press, Tucson.
- BRADLEY, BRUCE. 1979. *Arizona* BB:11:2
—Redington Ruin: report on the excavation
of Feature No. 1. Unpubl. Ms. deposited at
Arizona State Museum Library, Univ.
Arizona, Tucson.
- EMSLIE, STEVEN D. and LYNDON L. HAR-

LITERATURE CITED (continued)

- GRAVE. 1979. Avifauna from the Curtis Site, southeastern Arizona. *Kiva* 44(2-3): 121-131.
- FERG, ALAN. in press. Avifauna of the University Indian Ruin, Tucson, Arizona. *Kiva*.
- FEWKES, J.W. 1912. Casa Grande, Arizona. 28th Annu. Rep. Bur. Amer. Ethn., Washington, D.C.
- GAVIN, THOMAS A. and LYLE K. SOWLS. 1975. Avian fauna of a San Pedro Valley mesquite forest. *J. Arizona Acad. Sci.* 10 (10):33-41.
- GERALD, REX ERVIN. 1975. Drought correlated changes in two prehistoric pueblo communities in southeastern Arizona. Unpubl. Ph.D. dissert. (Anthr.), Univ. Chicago.
- GLADWIN, H.S., EMIL W. HAURY, EDWIN B. SAYLES, and NORA GLADWIN. 1937. Excavations at Snaketown: material culture. *Medallion Papers* 25. Gila Pueblo, Globe, Arizona.
- GREGONIS, LINDA M. in prep. The Hardy Site at Fort Lowell Park.
- GREGONIS, LINDA M. and KARL J. REINHARD. 1979. Hohokam Indians of the Tucson Basin. Univ. Arizona Press, Tucson.
- HARGRAVE, LYNDON L. 1970. Mexican macaws: comparative osteology and survey of remains from the Southwest. *Anthrop. Papers Univ. Arizona* 20, Tucson.
- HAURY, EMIL W. 1976. The Hohokam: desert farmers & craftsmen. Univ. Arizona Press, Tucson.
- HAURY, EMIL W., K. BRYAN, E.H. COLBERT, N.E. GABEL, C.L. TANNER and T.F. BUEHRER. 1950. The stratigraphy and archaeology of Ventana Cave, Arizona. Univ. Arizona Press and Univ. New Mexico Press, Tucson and Albuquerque.
- JOHNSON, PAUL C. n.d.a. An analysis of animal remains from Alder Wash Ruin (BB:6:9) and the Dos Bisnagas Site (BB:6:6). Appendix D, in *The Peppersauce Wash Project: excavations at three multicomponent sites in the lower San Pedro Valley, Arizona* (W. Bruce Masse). *Contr. to Highway Salvage Arch. in Arizona* 53 (in prep.). Arizona State Museum, Univ. Arizona, Tucson.
- . n.d.b. Archaeological fauna from the Big Ditch Site. Unpubl. Ms. deposited with the author.
- LOWE, CHARLES H. (ed.). 1964. *The vertebrates of Arizona*. Univ. Arizona Press, Tucson.
- McKUSICK, CHARMION RANDOLPH. 1976. Avifauna. Pp. 374-377, in *The Hohokam: desert farmers & craftsmen* (Emil W. Haury). Univ. Arizona Press, Tucson.
- MASSE, W. BRUCE. 1980a. The Hohokam of the lower San Pedro Valley and the northern Papagueria: continuity and variability in two regional populations. Pp. 205-223, in *Current issues in Hohokam prehistory, proceedings of a symposium* (David Doyel and Fred Plog, eds.). Arizona State Univ. *Anthrop. Res. Papers* 23, Tempe.
- . 1980b. Excavations at Gu Achi: a reappraisal of Hohokam settlement and subsistence in the Arizona Papagueria. *Western Archaeol. Center Publ. Anthr.* 12. National Park Service, Tucson.
- . in prep. The Peppersauce Wash Project: excavations at three multicomponent sites in the lower San Pedro Valley, Arizona. *Contr. to Highway Salvage Arch. in Arizona* 53. Arizona State Museum, Univ. Arizona, Tucson.
- MAYR, ERNST and LESTER L. SHORT. 1970. Species taxa of North American birds: a contribution to comparative systematics. *Publ. Nuttall. Ornith. Club* 9.
- MILLS, JACK P. and VERA M. MILLS. 1969. The Kuykendall Site: a prehistoric Salado village in southeastern Arizona. *El Paso Archaeol. Soc. Special Rep.* 6.
- MONSON, GALE and ALLAN R. PHILLIPS. 1981. Annotated checklist of the birds of Arizona, 2nd edition. Univ. Arizona Press, Tucson.
- OLSEN, JOHN W. 1980. A zooarchaeological analysis of vertebrate faunal remains from the Grasshopper Pueblo, Arizona. Univ. Microfilms, Inc., Ann Arbor.
- . 1982. Prehistoric environmental reconstruction by vertebrate faunal analysis, Grasshopper Pueblo. Pp. 63-72, in *Multidisciplinary research at Grasshopper Pueblo, Arizona* (William A. Longacre, Sally J. Holbrook and Michael W. Graves, eds.). *Anthrop. Papers Univ. Arizona* 40, Tucson.
- OLSEN, SANDI L. 1977. Faunal analysis of four sites. Pp. 178-181, in *Excavations in the Middle Santa Cruz River Valley, southeastern Arizona* (David E. Doyel). *Contr. to Highway Salvage Arch. in Arizona* 44. Arizona State Museum, Univ. Arizona, Tucson.
- PHILLIPS, ALLAN R. 1968. The instability of the distribution of land birds in the Southwest. Pp. 129-162, in *Collected*

LITERATURE CITED (continued)

- papers in honor of Lyndon Lane Hargrave (Albert H. Schroeder, ed.). Papers Archaeol. Soc. New Mexico 1. Albuquerque.
- PHILLIPS, ALLAN, JOE MARSHALL and GALE MONSON. 1964. The birds of Arizona. Univ. Arizona Press, Tucson.
- REA, AMADEO M. 1973. The Scaled Quail (*Callipepla squamata*) of the Southwest: systematic and historical consideration. Condor 75(3):322-329.
- _____. 1981. Avian remains from Las Colinas. Pp. 297-302, in The 1968 excavations at Mound 8, Las Colinas Ruins Group, Phoenix, Arizona (Laurens C. Hammack and Alan P. Sullivan, eds.). Arizona State Mus. Archaeol. Ser. 154. Arizona State Museum, Univ. Arizona, Tucson.
- _____. 1983. Once a river: bird life and habitat changes on the middle Gila. Univ. Arizona Press, Tucson.
- SPARLING, JOHN B. 1974. Analysis of faunal remains from the Escalante Ruin Group. Pp. 215-253, in Excavations in the Escalante Ruin Group (David E. Doyel). Arizona State Mus. Archaeol. Ser. 37. Arizona State Museum, Univ. Arizona, Tucson.
- STUBBS, STANLEY A. and W.S. STALLINGS, JR. 1953. The excavation of Pindi Pueblo, New Mexico. Monographs of the School of American Research and the Laboratory of Anthropology 18. Santa Fe, New Mexico.