ARCHAEOLOGY
on the
NORTHERN CHANNEL ISLANDS
OF CALIFORNIA

STUDIES OF SUBSISTENCE, ECONOMICS,
AND SOCIAL ORGANIZATION

Edited by
Michael A. Glassow

COYOTE PRESS
ARCHIVES OF CALIFORNIA PREHISTORY
No. 34 1993
LISTEN TO THE BIRDS?
THE USE OF AVIAN REMAINS IN CHANNEL ISLANDS ARCHAEOLOGY

Daniel A. Guthrie

ABSTRACT
This paper reviews the problems inherent in obtaining archaeological information from avian material recovered from island archaeological sites. Topics considered include species identification, taphonomy, birds as environmental indicators, and human uses of birds. Because of bird migration and the inadequacy of our knowledge of past avian distribution and abundance, bird remains often provide ambiguous information on habitat preference, relative abundance, and climate. However, careful analysis of skeletal completeness and bone breakage patterns can provide useful information on human uses of birds and on agencies of deposition.

INTRODUCTION

Archaeologists are asking ever more sophisticated questions and, among other places, are turning to faunal remains from archaeological sites for information. Whereas once only a faunal list, and perhaps not even that (Olsen 1971), was required of the biologist, today archaeologists seek information about hunting techniques, seasonality of occupation, preferential foraging, and ranges of movement of peoples. If they seek information about living species of birds from published accounts, archaeologists are apt to miss much information relevant to archaeological materials.

Paleontologists have long been aware of the limitations placed on them by the nature of their subject matter. Grayson (1981) has commented cogently on the difficulties inherent in paleoclimatic reconstruction based on faunal remains. Similar cautions could be expressed for the use of these materials in making hypotheses about human activities. Still, the desire to obtain more information than simply a listing of species names is strong, especially for sites on the islands and coast of southern California, in which bird remains often form a significant component.

This article presents a review of the problems inherent in obtaining information from avian material recovered from archaeological sites. Following comments on species identification, sections will focus on taphonomic considerations, use of birds as environmental indicators, and human use of avian material. In all cases the discussion will focus on what can be determined solely from unmodified avian materials. I will not discuss bones that have been modified into cultural artifacts, nor will I consider the use of avian material in conjunction
with other types of material, such as shell and mammal remains, in determining such things as the relative importance of avian resources. My hope is that this paper will serve as a cautionary warning to those who identify avian material and to those who wish to use this material as a source for archaeological information and that it will provide some information that will allow better use of bird remains in archaeological interpretation in the future. Information presented in this paper is based on my work with the identification of avian material from sites along the coast of southern California and from Santa Barbara and San Miguel Islands, as well as from sites in Bandelier National Monument, New Mexico.

**SPECIES IDENTIFICATION**

Olson’s (1985) records of the numbers of bird misidentifications in the literature, even across major ordinal gaps (a shoebill, cormorant, pheasant, owl, and bittern described as herons, for example) and by competent researchers, should provide a caution to anyone, including specialists, trying to identify avian skeletal material. While some groups have diagnostic bone shapes and contain small numbers of species which are easily separated, there are many groups, such as the ducks, where most bones may not be identified even to genus. In other cases, such as with the gulls, cormorants, and *Buteo* hawks, many individual bones may not be identified accurately as to species. Any species list for avian faunal material from an archaeological site that fails to include specimens referred only to genus or family should be regarded with some suspicion.

**TAPHONOMETRIC CONSIDERATIONS**

**Skeletal Completeness**

Before any evaluation of the effects of humans on avian material can be made, it is important to know something about the taphonomy of avian skeletal material; what the pattern of distribution and survivability of elements of a bird skeleton is after death if no alteration or disturbance has occurred because of humans or animals. Bickart (1984) has presented information on the distribution of skeletal elements. In general it may be said that while the skull and some neck vertebrae are often separated from the body, the skin and feathers usually serve to keep the remainder of the skeleton together. Bickart (1984) notes that in wet environments the feathers stick the skeleton to the ground and prevent scattering. My observations are that scattering is also prevented in dry environments such as beaches and deserts where the skin hardens and keeps the skeleton together. Of course, once the skeleton is buried the normal processes of decay cause destruction of the soft parts of the anatomy and allow skeletal elements to separate. However,
such separation will be minimal after burial. Archaeological sites are usually excavated incompletely, the excavation often consisting only of a trench or unit within the site. Under such conditions, calculation of skeletal completeness (CSI; Thomas 1971) for species can give a good indication not only of whether the complete skeleton is present in a deposit but also of the amount of scatter of skeletal parts. If the skeleton was discarded whole, more elements of the skeleton are liable to be found within a single excavational unit than if the skeleton were disarticulated and discarded piecemeal.

Although much has been written on the taphonomy of mammals, I have not found many reports on survivability of the various elements of the avian skeleton. Most bones of the avian skeleton consist of extremely lightweight elements with thin walls surrounding a hollow core. Survivability of these elements is controlled by two factors: mechanical treatment such as crushing, and surface effects such as soil acidity and abrasion from wind erosion. Such surface effects were mimicked by Rich and Baird (1986), who placed a bird skeleton in a gem-polishing drum and abraded the skeleton until the elements either disappeared or became unidentifiable. The pattern of survivability of elements of the avian skeleton produced by this method is predictable; larger, denser bones with minimal surface area survive much better than do either small bones or large bones with large surface area. Thus, among the first bones to disappear are vertebrae, the skull (except for the beak), the sternum (except for its articular surface with the coracoid), and the pelvis (except for the sacrum). Bones that survive best are the humerus, coracoid, and ulna. This pattern, produced in the laboratory, is nearly identical to that found in natural conditions. A collection of puffin bones obtained by screening a 35,000-year-old beach deposit on San Miguel Island shows a pattern of survivability of skeletal elements very similar to that produced experimentally (Table 1, Sample 1). That the larger wing elements outnumber leg elements by almost a two-to-one ratio should serve as a warning that such a pattern is not an indication of some butchering technique but rather simply a reflection of normal survivability of skeletal elements.

This pattern of survivorship of bird bones is also found in archaeological sites. When skeletal elements of birds are discarded and trodden into a living floor, much more breakage may occur than when burial occurs away from human activities. Although this leads to greater fracturing of bone and the production of many more unidentifiable fragments, the denser portions of bone, which usually include the articular surfaces, tend to survive. Thus the number of identifiable fragments per bone surviving this mechanical destruction would be the same as that for skeletons subjected only to abrasional forces. Deviations from this pattern would occur only if certain portions of the skeleton were preferentially broken or removed. Removal of the long, hollow tubes of wing bones for use in construction
TABLE 1. Bone Counts for Various Localities on San Miguel Island and the Emeryville Shellmound

Sample 1: Extinct puffin, sample fine-screened from beach deposit 12,000 B.P.
Sample 2: Extinct puffin, sample surface-collected from same location
Sample 3: Cassin's Auklet, material from Daisy Cave, screened through 1/4" mesh
Sample 4: Brandt's Cormorant, material from Daisy Cave, screened through 1/4" mesh
Sample 5: Ducks and geese from Emeryville Shellmound

<table>
<thead>
<tr>
<th>Bone</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>humerus</td>
<td>38</td>
</tr>
<tr>
<td>ulna</td>
<td>29</td>
</tr>
<tr>
<td>radius</td>
<td>19</td>
</tr>
<tr>
<td>carpometacarpus</td>
<td>25</td>
</tr>
<tr>
<td>femur</td>
<td>22</td>
</tr>
<tr>
<td>tibiotarsus</td>
<td>23</td>
</tr>
<tr>
<td>tarsometatarsus</td>
<td>11</td>
</tr>
<tr>
<td>coracoid</td>
<td>21</td>
</tr>
<tr>
<td>scapula</td>
<td>17</td>
</tr>
<tr>
<td>clavicle</td>
<td>11</td>
</tr>
<tr>
<td>pelvis</td>
<td>6</td>
</tr>
<tr>
<td>sternum</td>
<td>15</td>
</tr>
<tr>
<td>vertebra</td>
<td>66</td>
</tr>
<tr>
<td>mandible</td>
<td>3</td>
</tr>
<tr>
<td>skull</td>
<td>11</td>
</tr>
</tbody>
</table>
of needles or flutes, for instance, might alter the normal pattern of element survivability.

Agencies of Accumulation

Bones may enter archaeological sites in various ways. Fortunately, the number of ways is limited for bird material. Birds, unlike lizards and such mammals as gophers, do not burrow in archaeological sites and are therefore unlikely to be incorporated into a site after its deposition. Also, dogs are unlikely to carry off bird bones as there is no marrow cavity, making them of little interest to carnivores. My observations are that bird carcasses on beaches that have been visited by foxes and skunks show a regular pattern of damage to the sternum and ribs as the breast muscles and sometimes the body cavity are eaten. Legs and wings rarely show signs of gnawing, and there are almost never signs that carcasses have been moved any distance. These observations are in contrast to those of Bickart (1984). In his experiment bird carcasses that had been set out in a streambed were often moved by carnivores, and there was evidence of gnawing on the bones. The reason for this difference in observations is not clear. It may be that carnivores that regularly patrol beaches seeking carcasses know better than to bother crunching bones, while predators in an area where few bird carcasses occur naturally are more apt to chew them. It may be, too, that only carnivores with well-developed molars such as dogs and raccoons crunch bones. On the California Channel Islands, where skunks and foxes are the only natural carnivores, I have rarely found a bird bone that showed evidence of having been gnawed by a carnivore. This applies even to bones from archaeological sites where dogs are known to have been present.

Owls regurgitate the skeletons of their prey, and such material may be deposited in caves and below cliffs and even in abandoned pueblos (Guthrie 1982) where owls roost. Although owls seldom eat birds on the mainland, on islands they are known often to feed almost exclusively on birds (Banks 1965; Bennet 1928; Guthrie 1980). In coastal archaeological sites away from possible owl roosts, however, humans may be considered responsible for the presence of avian material. An excellent review of fossils deposited as owl pellets (Andrews 1990) describes surface characteristics of bone that indicate digestion by owls.

Bird Age

Elements of the avian skeleton ossify from the shaft outward toward the ends, much as is the case in reptiles. Bones of young birds are more porous than those of adults and have their articular surfaces incompletely formed. Unfortunately, the timing of bone development does not provide much help to the archaeologist. It is probably not far from the truth to say that if a bird bone has developed enough shape to be identifiable, then the bird can fly! To be sure, young
birds are often not as wary as their parents, and ratios of young to old in a deposit may prove interesting. However, more must be known about the development patterns of avian skeletal material than that bones are incompletely developed before one may assume that there is evidence of young birds being taken from a nesting colony. Although there are some records of large numbers of undeveloped bones from sites that have been taken as evidence of nest robbing (Howard 1929, for cormorants) bones from fledglings usually are unlikely to survive in an archaeological site due to their porosity, and they are also unlikely to be identifiable.

Collecting Bias

There are several sources of collecting bias. Visual collecting of skeletal material will miss smaller bones, as will sieving a deposit only with large sieve sizes. Collectors who are acquainted with the difficulty or ease of identification of the various elements of the avian skeleton are also apt to bias their collection towards whole bones and fragments with the more easily identified articular surfaces intact and away from vertebrae or bone shafts. All these biases will accentuate the normal pattern of element survivability. The sample of Cassin's Auklet material from Daisy Cave (SMI-261) on San Miguel Island is thought to have been deposited in the form of Barn Owl pellets that contained whole skeletons. This material was collected by sieving through a four-meshes-per-inch screen. This process lost many smaller bones, with the result that larger bones such as the ulna and humerus are overrepresented in the collection when compared with the normal pattern of element survivability (Table 1, Sample 3). A collection of puffin bones surface-collected from the same deposit also shows an accentuation of the bias towards carpometacarpus, tarsometatarsus, and coracoid elements (Table 1, Sample 2). These bones are fairly solid compared to other limb bones and therefore more likely to be complete.

BIRDS AS ENVIRONMENTAL INDICATORS

Habitat Preference

Birds often have very specific habitat preferences. On land, preferences for certain vegetational communities or soil types, as in the case of foraging shorebirds, are well known. Even oceanic birds show specific preferences as to near-shore or far-shore habitat and water depth based on feeding methods and nesting localities (Ashmole 1971). The distribution of avian species is also well known. The localities of all present seabird colonies along the coast of California have been cataloged, and a little is known of their past distribution (Sowls et al. 1980). Several standard works on the North American birds (Robbins et al. 1966; National Geographic
1983) provide excellent distributional maps. Unfortunately, all this information on habitat preferences of living birds may be of little value to the archaeologist. Many species of birds, including nearly all California waterbirds, migrate, and during migration may be found almost anywhere. For instance, the Brant is known as a coastal marine species, feeding on eelgrass in coastal lagoons and migrating just offshore. However, Brant are regularly known to migrate north from Baja California into the Gulf of California, and small groups often summer at the north end of the Salton Sea. A few even continue north, ending up in such unlikely inland places as Banning, Lake Henshaw, and Lancaster. Even oceanic species that are almost never seen near shore, such as Laysan Albatross, may follow this route up the Gulf of California and have been observed as far inland as the north end of the Salton Sea, Palm Springs, and along the Colorado River. While it may be said that resident, nonmigratory species of waterbird, such as Brandt's and Pelagic Cormorant and Black Oystercatcher are almost never found inland (there is a single record of Pelagic Cormorant in Mono County!), almost all other sea birds are occasionally found inland. Often these "out of place" birds are in a weakened condition and easy to catch. Small numbers of bones of these birds in inland sites, therefore, may not be taken as evidence of trade or hunting at shore or offshore sites.

The question is often asked whether the avian fauna represents a fresh water or marine community, and if marine, whether the specimens were obtained from estuary, lagoon, or open ocean. In California there are no species of waterbirds that are restricted to fresh-water habitats. Several species, however, seldom occur in the ocean. These include Pied-billed Grebe, rails, egrets, herons, and many species of "puddle" ducks, including teal, Mallard, Gadwall, Shoveller, and American Merganser.

Among the species of waterbirds generally considered oceanic, several are almost never found in coastal lagoons or estuaries. These include the alcids and Procellariiformes (shearwaters, albatrosses, and petrels). However, all birds in this group, including those which, like shearwaters and albatrosses, are seldom seen in a healthy condition within a mile of shore, commonly wash up as sick or oiled birds on our beaches. The Point Reyes Bird Observatory has kept records of the numbers of each species of birds found dead on beaches along the whole Pacific coast. This list is invaluable not only in determining the likelihood of finding a species sick or dying on a beach but also in obtaining information on population sizes of various oceanic and offshore species. Because of the possibility of beach strandings, however, the presence of albatross or shearwater in an archaeological site may not be taken as evidence that primitive peoples hunted at sea.
Seasonality

Two excellent reviews of bird records for southern California (Garrett and Dunn 1981; Unitt 1984) provide information on the times during the year when each species is present. While there are many land birds present in California only during the summer months, only one of these, the White-winged Dove, is in a group usually used for food. Among the waterbirds, almost all are present in California either year-round or only in winter. The few species that occur in California predominantly during the summer include the Sooty and Pink-footed Shearwater and Black Storm-Petrel, birds not normally considered food items. A few species migrate through California in large numbers during spring and fall, but these also occur in small numbers through the winter months. A few other species, including the Wood and Stork and Magnificent Frigatebird, regularly wander north to California from their more southerly breeding grounds only in late summer. Again, these species are seldom found in archaeological sites and are, therefore, of little use in determining seasonality. For coastal and island sites, seasonality is probably best determined by the presence or absence of species that normally occur only in winter. Of these, loons, geese, and scoter, species regularly occurring in archaeological sites, are common along the California coast from November through April but are rarely observed from May through October. Their presence in an archaeological site may be taken as evidence of winter occupation and their absence as evidence of summer occupation (assuming they were not picked up on the beach during other seasons).

Climate

Whereas many species of birds have altitudinal and latitudinal limits to their ranges, many of these species also migrate, making them useless as climatic indicators. Furthermore, many species of waterbirds have been drastically reduced in population and restricted in range by hunting in the last century. As data on bird populations and distribution from earlier times are poor, it is difficult to tell whether current ranges are due to climatic preferences or are artifacts of human-induced population declines.

While most migratory waterbirds have wintering grounds that cover most of California and Baja California, a few species seem to move south only as far as is necessary to avoid frozen water or severe weather conditions. Today swans and eiders seldom winter south of the Central Valley or the San Francisco area. These migratory species presumably would have extended their ranges farther south during periods of severe northern climate and stayed farther north during periods of mild climate.
None of the species that breed along our coast seems to have much potential as a climatic indicator. Although puffins are today seldom seen south of the San Francisco area, Tufted Puffins once nested along the San Luis Obispo coast and on the Northern Channel Islands. They were reduced in population in southern California by egg collecting during the 1800s. Two species, the Elegant Tern and Heermann's Gull, are of special interest. Nearly the whole world population of Elegant Terns nests on islands in the Gulf of California. The northernmost nesting colony of Heermann's Gull is on San Benito Island off the coast of Baja California. Both species could be considered indicators of warm climate; although both are present in southern California in the winter, they are almost never found inland and are extremely rare much north of San Francisco. However, in 1959 Elegant Terns began nesting near San Diego Bay and more recently at Bolsa Chica Lagoon near Los Angeles. Heermann's Gulls have attempted nesting near Vandenberg Air Force Base in western Santa Barbara County and on Alcatraz Island in San Francisco Bay! These rather spectacular range extensions indicate that much of waterbird distribution may be due to habit rather than to climatic preference. Many waterbirds nest in colonies and return to the same breeding colony every year, ignoring seemingly suitable habitat elsewhere along the coast. If a colony is destroyed through egg collecting, hunting, or the introduction of rats, cats, foxes, or dogs, recolonization may not occur for many years, especially if there is no overpopulation of the species in their surviving breeding colonies. Destruction of sardine and anchovy populations along the California coast certainly has had a negative effect on many seabird populations. This may keep existing populations at lower levels than in the past, delaying the recolonization of old breeding sites.

INFORMATION FROM RELATIVE ABUNDANCES OF SPECIES

It would be nice if the relative abundances of birds in archaeological sites could be used as evidence of preferential foraging. However, this information is very difficult to interpret. Certainly some species are more common than others. Data from breeding and winter bird surveys and Audubon Christmas Counts, published in the journal American Birds, are especially useful in determining current relative abundances of different species. Also useful is information on seabird colony size (Sowls et al. 1980) and numbers of beached birds. Unfortunately, data on relative abundances of species prior to 1800 are almost totally lacking. We know that commercial market hunting and egg collecting reduced the numbers of many species, as have changes in offshore fish populations. As an example, Short-tailed Albatross were once abundant on the California coast but today are almost extinct due to egg collecting on their nesting islands off Japan. In addition, human alteration of habitats has affected relative abundances of birds. Snow Geese were once a common wintering species on the grassy plains of the Northern Channel Islands before the great wildfowl areas of the Central Valley were developed.
Today geese stop in these federal wildlife refuges and seldom reach the Channel Islands. Destruction of coastal marshes in southern California has undoubtedly caused the shift of populations of many duck species away from coastal areas and toward inland locations such as the Salton Sea and central California. The net effect of all these changes is that, without knowledge of past abundances in nature, it is almost impossible to interpret relative abundances of birds in archaeological sites.

**Temporal Changes in Avian Populations**

Temporal changes in species composition or relative abundances of species within archaeological sites are often interpreted as evidence of changes in hunting pattern or cultural technology. Although long-term climatic changes probably caused changes in distribution and relative abundances of waterbirds along the California coast, most changes of this type occurred on such a long time scale that they are unlikely to be reflected in archaeological deposits. On the other hand, many short-term climatic changes do affect bird populations. El Nino events that cause water warming on the California coast have a drastic effect on marine fish and invertebrate populations and on the birds dependent on them. During the El Nino event of the early 1980s, large numbers of Red Phalarope died along the California coast, and puffin and cormorant nest success diminished greatly. Such an event may cause significant changes in the distribution pattern of species and also may cause birds to become weak and easy to capture. Indeed, this type of event rather than past differences in avian distribution may be the explanation for the unique occurrence of a large number of Tufted Puffin skeletons in a coastal archaeological site at Point Mugu (Howard and Dodson 1933), a locality currently near the southern end of the range of this species.

More interesting in an archaeological site may be the disappearance of species during the time of occupation. *Chendytes*, an extinct flightless goose, once was widespread on California islands, apparently nesting in large colonies on San Miguel and probably on other islands. The extinction of this species, however, did not occur until about 7,000 B.P., well after the first appearance of humans on the Channel Islands. *Chendytes* bones in an archaeological site may, therefore, serve as an important indicator that the site dates to about 7,000 B.P. Disappearance of other species, such as puffin and murre, may indicate effects of egg collecting at nearby nesting colonies.
HUMANS AND BIRDS

Hunting Techniques

Birds may be obtained by humans in various ways. Hunting with bow and arrow is possible on either land or sea. Many seabirds such as loons and grebes allow rather close approach of boats, trusting in their diving ability for protection. Snares work especially well for quail, and it is known that Indians have used bait to attract eagles to within reach of a hidden hunter. Modern fishermen often catch fish-eating birds accidentally when the birds ingest baited hooks. It is possible that diving cormorants might have been caught through ingestion of Chumash abalone hooks on set lines. Some birds, such as eider and puffin, moult all their flight feathers at the same time and are unable to fly during this period. These species are often at sea during this time and may be chased in boats and caught. Many species of roosting birds may be captured at night while asleep on cliffs. Other species refuse to leave nests during incubation and may be caught at this time. Species that nest in caves (such as cormorants) or in burrows (such as murrelets, petrels, and shearwaters) may be caught by digging them out of their burrows or by impaling them in their burrows with a sharp stick. Finally, sick or dead seabirds may be picked up on the beach. Unfortunately, there is little in the skeletal material from archaeological sites that allows any differentiation between these possible methods of hunting. I know of no instance of an arrow found stuck in a bird bone or of any indication of damage to bird bones from arrows. None of the other methods of obtaining birds mentioned here would leave any mark on skeletal elements. Furthermore, there is no species of bird that could not be obtained by a number of the methods mentioned above.

Human Uses of Birds

Bird bones, especially the shafts of limb bones, are often found modified in form to serve as ornaments, needles, or whistles. In such instances the cut ends of the bones as well as the artifacts are often found. Most bird bones recovered from archaeological sites, however, are unmodified. Identification of human uses based on these elements is more difficult. It is often assumed that if the species is eaten today, or contains significant amounts of meat, then it was used for food. Thus, geese, ducks, cranes, and even loons, cormorants, and albatross—the latter three species fish-eating and distasteful by modern standards—have all been considered as potential food items.

One of the major collections of avian material from an archaeological site is that from the Emeryville Shellmound, reviewed by Howard (1929). This collection contains over 2,200 bones of ducks and geese, which represent over two-thirds of the identified avian material. It is generally presumed that the large numbers of ducks
and geese indicate that these birds were used as food items. Examination of these duck remains reveals a characteristic pattern of bone alteration. Whereas all elements of the skeleton are present, there is a clear pattern of breakage and charring of certain elements. The shafts of both humerus and tibiotarsus are usually broken, and the broken ends are often charred. It is as if the wings and feet of ducks and geese were removed and the birds then placed in a fire, causing the charring of the exposed bone ends. Such treatment could be either for removing feathers or for roasting. Few other bones show evidence of charring or breakage. Very few bones show any butcher marks. Both these observations fit the hypothesis of cooking. A roasted or boiled duck may be disarticulated for eating by hand without the use of a tool. As no marrow is present in bird bones, breakage of other bones of the skeleton is unnecessary. This pattern of breakage also increases the number of identifiable humerus fragments in relation to other bone elements (Table 1, Sample 5).

Few bird bones from San Miguel Island show any signs of charring. Most of those that do, however, are referable to cormorant. Reexamination of this cormorant material shows the same pattern of breakage and charring that was found on duck material from the Emeryville Shellmound (Table 1, Sample 4). Previously (Guthrie 1980) I felt that cormorant on San Miguel Island had been taken for feathers and not eaten; I now feel that the evidence supports the use of some cormorants for food. The much lower percentage of charring may indicate that cormorants were also being used for feathers, as I feel other seabirds were, but this is not clearly determinable from the skeletal material.

A second major use of birds, especially seabirds, is as a source of feathers for insulation. Robes made of a patchwork of bird skins are made today by Eskimo peoples and were once manufactured along the coast of California (Guthrie 1980). The presence in an archaeological site of complete skeletons (high CSI value) of densely feathered seabirds that show no evidence of charring and very few butcher marks distributed mostly on the humerus and tibia may indicate that these birds were sought for feathers and not for food (Guthrie 1980).

Finally, many birds in California, such as flickers, were sought so that their feathers could be used for ornamentation. Other birds such as condor, raven, and owls were sought for rituals. None of these uses, which usually involve only feathers or wings and claws, would require cooking or charring of bones. Although the removal of claws, bills, or wing bones might require cutting, feathers could be obtained without causing butcher marks on bones. These ritualistic uses of bird parts, however, would lead to scattering of the skeleton and possibly low CSI values.
SUMMARY

While unmodified remains of birds from archaeological sites prove of great value to the ornithologist in providing information on past distributions of species, they provide very little clear-cut information for the archaeologist. The comments in this paper should serve as a warning to those seeking archaeological information from bird bones in archaeological sites. The migratory ability of many species and our lack of knowledge about past distributional patterns make using birds in the determination of climatic changes or habitat preferences difficult. Birds are more useful in determining seasonal use of sites, but again, the lack of species whose presence clearly indicates summer use and the possibility of birds remaining as carcasses on beaches for many years may cloud seasonal interpretations.

Bird bones provide almost no information about hunting techniques. Some types of food preparation, however, leave characteristic patterns of bone breakage and charring. Use of seabirds as sources of feathers rather than for food also may be determined through careful analysis of skeletal completeness and charring and butcher mark patterns.
REFERENCES CITED

Andrews, P.

Ashmole, N. P.

Banks, R. C.
1965 Some information from Barn Owl Pellets. *Auk* 82:506.

Bennett, P.

Bickart, K. Jeffrey

Garrett, K. and Jon Dunn

Grayson, Donald K.

Guthrie, Daniel A.

Howard, H.

Howard H. and L. M. Dodson
1933  Bird Remains from an Indian Shellmound near Point Mugu, California. *Condor* 35:235.

National Geographic Society

Olsen, Stanley J.

Olson, Storrs L.

Rich, P. V., and R. F. Baird

Robbins, C. S., B. Brunn, H. S. Zim and A. Singer


Thomas, David H.

Unitt, Philip