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A Technique for Salvaging Anatomical Material from Study Skins of Rare or Extinct Birds

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Nearly one-third of all species of birds are still represented in collections only by study skins, with no skeletal or fluid-preserved material available (Zusi et al. 1982). The development of alternative techniques for preservation of other organ systems simultaneously with the integument (e.g. Norris 1961, Johnson et al. 1984) arrived too late for the species that are now extinct and for which only study skins exist. The lack of skeletal material of rare or extinct species can be a nearly insurmountable impediment to systematic and paleontological investigations.

Fortunately, most of the skull, wing, and leg bones remain in the standard museum study skin, so skin collections are potential osteological repositories of species for which skeletons can no longer be obtained. We have developed a technique for the recovery of the bones and attached muscles from study skins that preserves the appearance and scientific usefulness of the skin.

When series are available, it is of primary concern to select the specimen in which the bones are best preserved. This will vary according to the preparation technique of individual collectors. The skin may be felt to determine where the back of the skull has been cut or whether the mandibular articulation appears to be intact. Ideally, the specimen is x-rayed to determine exactly how much bone remains. There is a natural tendency to select a skin that appears poorly made, but this may be false economy because the better the initial appearance, the better the final result will be (Fig. 1).

Once a specimen has been selected, detailed measurements should be made and recorded on a separate label, along with the date of repreparation and name of the preparator. The skin is then relaxed in a closed container above a layer of wet sand that has been laced with phenol (carbolic acid) to prevent mold. When the skin is supple, it is opened and the stuffed body removed. In most cases the skin will be too delicate to sustain the inversion of the skull through the neck, as in the usual skinning procedure, so incisions are made along the inside of the mandibular rami to produce a "gular flap" through which the skull is extracted. The skin is then teased away from the fore part of the skull and cut away from the base of the bill so the entire skull and bill can be removed.

At this stage the remaining portions of the humeri can be extracted easily. Removal of the wing bones is facilitated by a longitudinal cut under the wing near the junction with the body. This is concealed by the wing in the finished specimen. It is also possible to skin the wing to retrieve the radius, ulna, and carpometacarpus, although if in poor condition the skin may be damaged when the remiges are separated from the underlying bone. The extracted wing bones are replaced with wire.

The tibia and tarsometatarsus, even in small passerines, can be removed through a longitudinal slit in the podotheca and subsequent dissection of the bones, leaving the toes in place. This leaves the po-

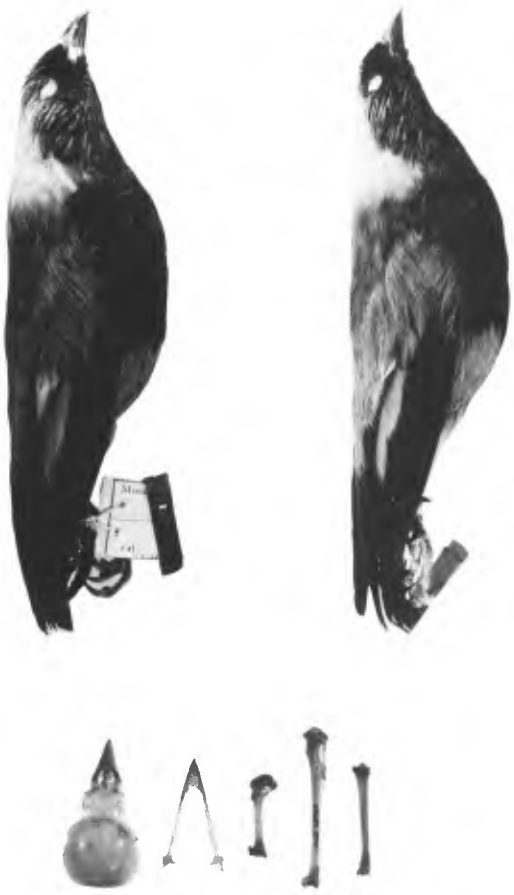

Fig. 1. Harvard specimen of *Ciridops anna* (Drepanidini) before (A) and after (B) repreparation. The bones from this specimen (C) were in excellent condition and perfectly suitable for comparative purposes. Only five specimens of this extinct species exist.

Fig. 2. Cast (A) and two-piece mold (B) of the skull of *Drepanis pacifica* (Drepanidini). Cast (C) of the skull of *Psittirostra palmeri* (Drepanidini) and subsequent casts (D) of the internal structure of the ramphotheca with an example of a one-piece mold (E). Both of these species are extinct Hawaiian endemics.

dotheca essentially intact, and when the bones are replaced with wire the substitution is scarcely perceptible. The skin, turned right side out and lightly filled with cotton, is returned to the relaxing chamber while the skull is molded and cast, following the basic procedures for vertebrate fossils (Waters and Savage 1971). The process requires at least 2 days.

For finches and most other birds with relatively short bills, a simple one-piece mold of the skull (Fig. 2) is made with silicone rubber (e.g. GE RTV 700 silicone with Beta 1 curing agent). For species with long, decurved bills, a two-piece mold may be required (Fig. 2). After the mold has set, the skull is removed and a cast made with epoxy resin or similar plastic substances (Re Epoxy 103 and Tapox "4-1" epoxy). The cranial part of the finished cast should be hollowed out to reduce weight. A wire is inserted

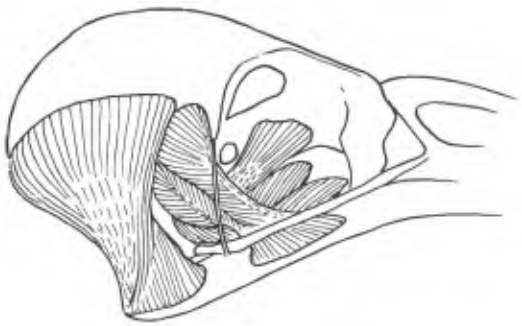

Fig. 3. Sketch showing the degree of preservation of jaw muscles in a dried skull removed from a skin of the extinct Hawaiian endemic *Loxops sagittirostris* (Drepanidini).

into the cast and a new body constructed around it. When the cast and body are replaced in the skin, the edges of the skin around the base of the bill are glued to the cast using 25% polyvinylacetate (PVA-AYAF or PVA-AYAF/AYAT) dissolved in acetone. Adhesive compounds containing cellulose nitrate, which can break down to produce nitric acid, should not be used. The skin is then sewn closed and the bill painted to simulate the original color. The resulting specimen is as good as the original (Fig. 1) for almost any purpose using traditional study skins.

Once the skull has been cast, the jaw muscles, which may be well preserved (Fig. 3), should be dissected and the mandible removed from the skull. In the case of species such as finches, which may have characteristic patterns of the horny palate (Sushkin 1924), the skull and mandible should be molded and cast again (Fig. 2) before the rhamphotheca is removed and the skull cleaned completely.

The scientific value of specimens of extinct birds treated in the above manner is increased greatly by the amount of new information available, whereas practically no information is lost in the process other than minute details of the external nares and the area of attachment of the skin to the bill. We encourage museum curators to permit irreplaceable specimens in their care to be used to the maximum possible advantage whenever circumstances dictate.

We are especially indebted to the enlightened curators of the American Museum of Natural History, the Museum of Comparative Zoology, and the B. P. Bishop Museum, whose generous response allowed us to develop this technique. We are also grateful to the staff of preparators in the vertebrate paleontology laboratory of the Department of Paleobiology, Smithsonian Institution, especially Arnold Lewis and Leroy Glenn, for assistance in casting and molding. We thank Catherine A. Hawks for reading the manuscript and suggesting improvements in some of the materials used. Richard L. Zusi kindly allowed us to use one of his sketches of jaw muscles to show the potential

of skin specimens for myological studies. The photographs are by Victor E. Krantz.

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