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FLOOR LOADING CONSIDERATIONS IN A PALAEONTOLOGICAL COLLECTION

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Abstract.—The Royal Ontario Museum, Department of Invertebrate Palaeontology, has developed procedural controls to avoid exceeding floor loading capacity in its collection storage room. Floor loading capacity is a critical factor in planning space-efficient storage for palaeontological collections. Fossil collections are comparable to library stacks in weight. It is essential that a structural engineer be consulted when planning storage on any but a grade level.

Lack of storage space is a problem plaguing museums everywhere. Many systems have been applied to maximize existing storage space, including mobile storage (Pratt, 1986; Fenner, 1992) and adjustable heavy-duty shelving (Owen *et al.*, 1981). With collections of fossils and rocks, however, space is frequently not the only consideration. The ultimate determining factor is the capacity of the floor to bear the weight of the collection.

In 1981, the Royal Ontario Museum (ROM) completed a major expansion project. The third floor facilities for the Department of Invertebrate Palaeontology include a Spacesaver ® compact storage system, designed to carry a live load (cabinets plus contents) of 320 pounds per square foot, covering about one-half of the collection storage floor space. Stationary cabinets, metal shelving, and pallet racking for oversize or crated specimens make up the remainder of the storage facility (Waddington and Rudkin, 1983). A fourteen foot ceiling allows cabinets and shelving to be stacked nine feet high.

In the early stages of the expansion project, the architects carried out detailed needs analyses, including a study of present and projected storage space requirements. At that time the department raised concerns about the advisability of placing a heavy palaeontological collection above grade level; however, a re-examination of the final survey sheets has revealed that no actual weights were ever recorded. Wherever a weight was requested, the word "variable" was entered. The department was asked to provide a maximum cabinet load for designing the mobile storage system after the main building construction was completed.

A much touted feature of the new building was the fact that the central core had enhanced floor loading capacity to accommodate compact storage. When we moved into our new space we did not question the floor loading capacity of the collection room, located in the central core, as we had been assured that it was more than adequate for our needs.

RECOGNITION OF THE PROBLEM

I first became concerned about floor loading capacity in 1988 when ROM acquired ten tons of fossiliferous ironstone nodules from Mazon Creek, IL, mostly unsplit and unsorted. As the specimens were washed and sorted, they were stored in bulk cartons stacked on stationary steel shelving. The calculated potential load on the floor was in the order of 375 pounds per square foot. At this point, I consulted John MacMillan of Robert Halsall and Associates, the structural en-

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gineering firm that had worked on the original design, to make sure that the load was within safe limits. From the original drawings, Mr. MacMillan determined that the floor loading capacity for the room is 200 pounds per square foot. One area of the room, along a concrete bearing wall, can bear 300 pounds per square foot. The shelving units were moved to that wall, and the load was adjusted accordingly.

The concern over housing the Mazon Creek collection prompted a thorough evaluation of floor loading in the collection area. This study was done to determine the actual and potential floor loads in the room given the existing configuration of storage equipment, and to develop procedures to avoid overloading the floor.

On searching the literature for references to floor loading, I was unable to find any useful information regarding rock collections. An analogous situation can, however, be found in libraries. A fully loaded, double-faced library stack three feet wide, 20 inches deep, and seven shelves high, may weigh as much as 2,320 pounds or 464 pounds per square foot (Freifeld and Masyr, 1991). The Canadian Building Code requires a floor loading capacity, on any but a grade level, of 150 pounds per square foot for unlimited placement of stationary library stacks and 250 pounds per square foot for compact storage (Ontario Ministry of Citizenship and Culture, 1986). Considering the figures given above, it is questionable whether these requirements are adequate. The average specific gravity of sedimentary rocks ranges from 2.3 for quartz sandstone to 2.7 for dolomite (Dobrin, 1960), about double that of books. Mineral replacement such as pyrite (specific gravity 5) or limonite (specific gravity 3.6 to 4) will increase the density of the samples (Hewitt, 1965). Thus the floor loading requirements for palaeontological collections may be greater than for libraries. A floor loading capacity of 200 pounds per square foot is clearly inadequate for compact storage of a fossil collection.

Calculation of Floor Load

Floor loading capacity is the maximum load that the floor is designed to carry safely. It may be expressed in pounds per square foot of floor, as in this paper, or as the total weight that may be placed in a particular area. The floor loading capacity is a function of many factors, including the type of construction and the location of load bearing beams and columns in the building. The total load on the floor is made up of a dead load and a live load. Dead load is the weight of permanent fixtures such as immoveable furniture and floor installations, and is more or less fixed. In collection storage it includes the weight of empty storage cabinets and, where compact storage is used, the weight of the rails, carriages, and raised floor. The live load comprises everything else in the room, including moveable furniture, specimens, and people.

Because of the amount of activity along the aisles in the collection room, permanent aisles were not considered in the floor area when calculating the average allowed floor load for areas with stationary storage. Rather, the load was based on the actual area or footprint occupied by the cabinets. Each type of storage unit was measured to determine its footprint (base floor area) in square feet and its empty weight in pounds. The weight divided by the footprint gives the dead load per square foot of the empty storage unit. This was subtracted from the floor loading capacity (in our case 200) to give the live load per square foot that may be added; the calculated live load per square foot was multiplied by the footprint area to give the total load, then divided by the number of drawers or shelves in the unit to give the average allowed load of specimens per drawer or shelf.

The capacity of different types of storage units varies greatly. A description of the various types of storage unit, with their calculated dead load and allowed live load is given in the appendix. Because of their inherent design, the "birch" and "oak" cabinets transferred from the old building are unlikely to be overloaded with respect to the floor. The metal shelving and the "new" cabinets in the compact storage can easily be filled beyond the capacity of the floor. A "new" cabinet, filled with 40 drawers, can safely take only eight pounds of fossils per drawer. The shelving load is limited to 350 pounds per shelf where the floor is rated to 300 pounds per square foot, or 230 pounds per shelf elsewhere in the room. With awkwardly shaped specimens which require a lot of air space, loading is not a problem. However, when bulk specimens are crated and stacked it is very easy to exceed the live load without filling the shelf.

Cabinet construction also affects weight. The "new" cabinets are variously built of plywood or veneer particle board. The particle board cabinets weigh 30 pounds more than the plywood. This translates to a nine percent reduction in storage load capacity, or almost four drawers worth of fossils, per cabinet.

To calculate loading capacity within the compact storage area, the total floor area occupied by rails and carriages was measured and the weight per square foot of the compact storage installation was determined. The weight of the rails, carriages, raised floor, and end panels was provided by Storage-Plus Systems Ltd., the local distributor for the Spacesaver Group. In calculating the allowed live load per cabinet, we assumed that all planned expansion space was filled with mobile carriages. Thus the existing cabinets are not "stealing" storage capacity from cabinets not yet in place.

Because it rides on rails, compact storage can be designed to take advantage of structural elements in the floor to increase the effective floor loading capacity without making any structural changes in the building. This is done, for example, by placing the rails to span floor beams so that the load is spread over structurally independent areas of the floor. Such installations should always be designed in consultation with a structural engineer. The compact storage installation in our collection room, designed to make maximum use of the space available, has rails running parallel to the floor beams. Ironically, rather than increasing the floor loading capacity in this area, the effective capacity is actually decreased by about four pounds per square foot, the dead load of the mobile installation components.

Procedural Controls

It might be possible to increase the load bearing capacity of the compact storage by turning it ninety degrees so that the rails span two floor beams; however, this orientation would accommodate fewer cabinets. Any attempt to increase the overall floor loading capacity would require structural alterations to the building. Because of the expense and disruption involved, neither option is being considered at this time. For now, the floor loading problem is being addressed through awareness and a set of procedural controls to avoid overloading.

The contents of shelves are weighed and the average allowed load of about 350 pounds per shelf is maintained. If more shelves are added, for example to accommodate thin slabs, the allowed weight per shelf will be adjusted accordingly and noted on the shelves. Where cabinets are filled to capacity with drawers, or the material in the drawers is especially heavy or tightly packed, each drawer is weighed, and the totals noted on the cabinet door, to ensure that the allowed weight per cabinet is not exceeded. In the "new" cabinets, we make a point of not exceeding the allowed average live load per drawer unless it is impossible to fit more drawers into the cabinet. That is, if a specimen protrudes above the top of a drawer in a "new" cabinet, forcing the space above to be left blank, that drawer may contain more than the allowed average load of eight pounds. In situations where an individual fossil weighs more than the allowed drawer load, a note is placed on the cabinet door indicating the space that must be left to accommodate the weight. Cabinets containing exceptionally light fossils, such as leached silicified collections, help to counteract exceptionally heavy cabinets on the same carriage. This compensation must be accounted for in any future reorganization of the collection in order to avoid overloading by substituting a heavy load for a light load.

Summary

The above figures are offered as an illustration of the type of floor loading limitations that may be met in a palaeontological collection. Although the floor area and high ceiling in the ROM Department of Invertebrate Palaeontology collection storage room give an impression of a large storage space, the load bearing capacity of the floor puts serious limitations on its use. Different buildings have different floor loading characteristics. The actual load imposed by a collection depends on the character and storage density of the collection and on the size and construction of cabinets. The configuration of storage layout may also affect its impact on the floor. Compact storage rails and carriages can be designed and installed to take advantage of structural support elements in the floor, and thus may actually increase the effective floor loading capacity. In planning collection storage, it is necessary to make a thorough study of weight as well as space requirements. It is essential that a structural engineer be consulted before planning any type of space-efficient collection storage.

Acknowledgments

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Literature Cited

Dobrin, M. B. 1960. *Introduction to Geophysical Prospecting.* McGraw-Hill Book Company, New York, 446 pp.

Fenner, D. 1992. High-density mobile storage systems (compactors). Pp. 235–237 in *Storage of Natural History Collections: Ideas and Practical Solutions* (Carolyn L. Rose and Amparo R. de Torres, eds.). Society for the Preservation of Natural History Collections, 346 pp.

Freifeld, R., and C. Masyr. 1991. *Space Planning in the Special Library.* Special Libraries Association, Washington, D.C., 150 pp.

Hewitt, D. F. 1965. Rocks and minerals of Ontario. Ontario Department of Mines, Geological Circular No. 13, 108 pp.

Ontario Ministry of Citizenship and Culture. 1986. *Building Libraries: Guidelines for the Planning and Design of Public Libraries.* Ministry of Citizenship and Culture, Province of Ontario, Toronto, 61 pp.

Owen, H. G., E. Parsons, and R. Paternoster. 1981. Rationalized storage of fossils in the British Museum (Natural History). Curator, 24:77–88.

Pratt, G. 1986. Design considerations for compact storage. Pp. 89–91 in *Proceedings of the 1985 Workshop on Care and Maintenance of Natural History Collections* (Janet Waddington and David M. Rudkin, eds.). Royal Ontario Museum Miscellaneous Publication, 121 pp.

Waddington, J. B., and D. M. Rudkin. 1983. Relocation of the Royal Ontario Museum's invertebrate palaeontology collections. Pp. 93–101 in *Proceedings of 1981 Workshop on Care and Maintenance of Natural History Collections* (Daniel J. Faber, ed.). Syllogeus, 44.

Appendix

Description of collection storage equipment used in the Royal Ontario Museum, Department of Invertebrate Palaeontology.

"Birch cabinets".—Old chest-style specimen storage cabinets with twenty fixed drawers each. Cabinets are double stacked.

Empty weight: 500 lb each, including drawers
Area: 11.5 ft^2
Dead load, double stacked: 87 lb per ft^2
Allowed live load: 113 lb per ft^2
Allowed load per cabinet: 650 lb
Average load per drawer: 32.5 lb, not including drawers

"Oak cabinets".—Old display storage bases with runners spaced one inch apart to accommodate drawers at variable spacing. Two doors per cabinet. Cabinets are triple stacked.

Empty cabinet weight: 165 lb
Area: 7.6 ft^2
Dead load, triple stacked: 65 lb per ft^2
Allowed live load: 135 lb per ft^2
Allowed load per cabinet: 342 lb, including drawers

Many cabinets are in poor repair and have space lost to internal braces or missing runners.

"New cabinets".—Custom-made plywood or particle board cabinets built for the mobile storage carriages, to accommodate the same size drawers as the old "oak" cabinets. Each double-doored cabinet has runners for a maximum of 40 drawers. Drawers are approximately 19 inches square and three inches deep and weigh about four pounds each. Cabinets are double stacked.

Empty cabinet weight (plywood): 135 lb
Area: 6.3 ft^2
Dead load, double stacked: 43 lb per ft^2
Allowed live load: 153 lb per ft^2
Allowed load per cabinet: 482 lb, including drawers
Average weight per drawer: 12 lb, including drawer

The allowed live load is based on a total load of 196 lb per ft^2 taking into account the dead load of the compact storage installation.

Metal shelving.—Shelving units 27 in. deep, 48 in. wide, 9 ft high, constructed from heavy-duty construction angle, with seven shelves of ¾ in. plywood. Metal construction angle weighs about one pound per running foot; plywood weighs about 1.6 lb per ft^2.

Empty weight of unit: 200 lb
Area: 9 ft^2
Dead load of empty shelving: 22 lb per ft^2
Allowed live load: 278 lb per ft^2
Allowed load per shelf: 357 lb

Total load based on 300 lb per ft^2, the capacity of the floor in the area of the shelving.

PACKING FLUID-PRESERVED HERPETOLOGICAL SPECIMENS FOR SHIPMENT

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Abstract.—The theory and practice of packing fluid-preserved herpetological specimens for shipment are reviewed. Specimens are wrapped in moist cloth and sealed inside plastic bags for shipment. Bagged specimens should be well-padded and shipped by a reliable courier.

The advent of bags made of polyethylene sheet revolutionized packing of fluid-preserved herpetological specimens for shipment (Loveridge, 1952). Plastic bags made possible lightweight but liquid-tight packages, which in turn made shipment of wet specimens through the mails feasible. Probably every natural history museum of any age has a collection of antique milk cans in a "dead storage" area, a reminder of shipping difficulties before the age of plastics.

It can also be argued that plastic bags revolutionized the study of museum specimens of amphibians and reptiles, as thousands of specimens are passed annually between institutions in loans for study or identification. The techniques of packing fluid-preserved amphibians and reptiles for shipment are described in the standard references on herpetological collecting and collections management. Both Zweifel (1966) and Pisani (1973) recommended wrapping specimens in dampened cheesecloth, sealing them in plastic bags, and shipping in well-padded rigid containers. Simmons (1987) reviewed packing and shipping techniques in greater detail, as noted below.

Nevertheless, this museum continually receives shipments that are inadequately or inappropriately packed, resulting in damage to irreplaceable specimens. The purpose of this paper is to synthesize, in greater detail, standard procedures for packing fluid-preserved herpetological specimens for shipment. I have not addressed the special problems of packing vials, cleared and stained specimens, or skeletal materials. The packing of these special preparations is reviewed in Simmons (1987).

Theory and Practice of Wrapping Specimens

Fluid-preserved specimens are wrapped in cloth before they are packed in plastic bags for shipment. The cloth wrapping performs three functions: (1) provides padding to prevent mechanical damage to fragile specimens or appendages; (2) separates specimens to prevent rubbing together, which can damage skin or scales; and (3) holds fluids to prevent drying. Many kinds of cloth have been used, but the cloth of choice is cheesecloth (grade 10, 20 × 12 threads/sq. in.). It is soft and does not damage specimens, thin but can be layered to provide padding, holds fluid well, is light, and is relatively inexpensive.

Other kinds of cloth should be used with caution. Printed or dyed fabrics should be avoided, as dyes can leach unpredictably and stain specimens. Fabrics with

* Deceased.

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heavy sizing can be used only after thorough washing to remove soluble additives. Loosely woven or nappy fabrics can snag on claws or scales, or leave bits of fiber clinging to specimens. Tightly-woven fabrics may abrade fragile specimens and may not hold an adequate amount of fluid.

Pisani (1973) suggested using either cotton batting or white paper towels as an alternative to cheesecloth. Cotton batting absorbs too much fluid, which can become a hazard during shipment, and clings with terminal tenacity to spines, scales and claws. Paper toweling may disintegrate when dampened, and both media lose their padding capacity when wet.

The wrapping techniques suggested by Simmons (1987:49) are excellent. Briefly summarized, he advised enveloping specimens in at least a single layer of cheesecloth by laying them out on a strip of cloth, folding the edges over, and rolling the strip. I have only a few things to add. Pieces of cheesecloth, cut to appropriate lengths depending on the number and size of specimens to be wrapped, should be folded lengthwise to at least double thickness before wrapping begins. Smaller specimens such as most lizards, salamanders, and frogs are laid out on a length of cheesecloth, the sides of the cloth are folded over to cover the specimens, and the entire length is rolled. The specimens are placed with the long axis of the body across the length of the cloth (Simmons, 1987:fig. 6), with tails and tags laid parallel to the body. Care is taken to position tags so that they do not damage or stress the specimens to which they are tied or gouge adjacent specimens. Specimens with long tails are aligned in pairs, with heads pointing in opposite directions, the nose tip of one even with the tail tip of its partner. In that position the rigid body of one prevents the tail of the other from flexing, and vice versa. Adequate empty cloth is left at the end of the length to go around the roll once to secure it and provide further padding. Rolls should not be more than about 10 cm in diameter for the smallest specimens, proportionately larger for rolls of larger specimens.

Coiled snakes are difficult to wrap in rolls, but the same general principles apply. Specimens should be completely separated and adequately padded. Several coiled snakes of similar size are stacked, with layers of cheesecloth between, then the entire stack is wrapped in a length of cheesecloth. Very large coiled snakes are wrapped individually by passing a length of cloth around the body and through the inside of the coil on each turn. Large specimens of all kinds, in general, are wrapped individually, mummy-fashion, or with no more than two or three to a bundle.

Specimens with sharp claws, snakes preserved with the mouth open, and turtles with sharply pointed scutes present special problems. Any sharp projection can pierce bags in transit, allowing fluid loss. If enough fluid leaks, the package can become weakened and disintegrate or, worse, it may be discarded as a hazard by postal inspectors. In packing turtles, large lizards, and crocodilians, the feet are first wrapped in "booties" made of several layers of cheesecloth, tied on with cloth strips or secured with string before the entire specimen is wrapped in cloth. The "booties" should be thick enough to prevent penetration of the claws and should be tested before bagging. If necessary, additional padding of cotton balls is applied before the "booties" are wrapped. As a general rule, any sharp projection should receive additional padding.

Rubber bands or string should not be used to secure rolled or bundled specimens, as the pressure from a tight band or string can indent or otherwise damage specimens. Furthermore, rubber bands have the potential to dissolve in preserving fluid and discolor specimens. If loose bundles must be secured, they should be tied with a cheesecloth strip wide enough to avoid grooving specimens and loose enough to prevent distortion or damage.

It is good practice to maintain some order in wrapping specimens. For example, sequences of catalog numbers should be in order, and members of a series should be together. This facilitates checking lists or invoices, both as the specimens are wrapped and as they are unpacked, and reduces the chance that a specimen will be overlooked and inadvertently discarded. If several species are involved, all specimens of a species are wrapped together. However, whatever system is used, it will not apply to large specimens wrapped and bagged individually or in twos or threes.

Bagging Wrapped Specimens

Packing cheesecloth-wrapped specimens in plastic bags has only one function: to maintain a moist environment to prevent desiccation. As Simmons (1987) noted, not all plastic bags are created equal. Bags for shipping specimens should be of relatively thick (at least 3 mil) virgin polyethylene and made from tubular stock. Thus only the bottom and mouth of the bag require seals. A well-equipped laboratory maintains stocks of several sizes of bags, but the dimensions should always be about three to four times deeper (longer) than wide.

The size of the packets of wrapped specimens and the size of the specimens inside the wrapping both dictate selection of an appropriate bag size. Rolls of small or fragile specimens are bagged individually. For larger (and more durable) specimens, several packets are bagged together. The appropriate bag size is the smallest that will accommodate the packet (or packets) without stressing the plastic. Large or hard specimens should never be bagged with smaller or softer ones.

During wrapping, the completed cheesecloth packets are usually stored temporarily in a container filled with fluid and absorb adequate fluid for shipment. If only one or a few packets are to be wrapped, the dry cheesecloth packet is put immediately into the initial bag and a small amount of fluid is poured in. In either case, excess fluid is removed by inverting the bag and gently pressing the packets. The objective is a moist but not wet environment. Excess fluid becomes a liability if bags leak during transit.

A wet-strength label printed with the name and address of the owner of the specimens and a request for return is placed in the initial bag, with the printed side against the bag so it can be read without opening the bag. Type specimens are bagged separately and the bag is conspicuously labeled. If the specimens are packed in any fluid other than standard concentrations of ethyl alcohol, a conspicuous note identifying the fluid and its concentration is included in the initial bag. Bags are best closed, after expression of excess fluid and air by gentle squeezing, by twisting and then knotting the top of the bag, hence the preferred bag proportions (length 3× or 4× width). The bag is knotted as close to the packet of specimens as possible and any excess plastic is trimmed. Rubber-band closures (Pisani, 1973) are not reliable and should be avoided. Specimens are always double-bagged, with the initial bag inverted after closure in a second bag which is also securely closed. Bags may also be closed with a heat sealer instead of knotting, but care must be taken to ensure an unbroken fused seal of adequate width.

The qualities of the bags specified above are important. Zip-lock bags are never appropriate, as they can open unpredictably in transit. Bags with wire ties ("whirl pack") bags are also suspect. Although their seals may be reasonably secure, there is always a danger that the wire ends will pierce the bag or other bags and cause leaks. Most plastic bags available in general retail outlets are not suitable for specimen packing. It is best to obtain bags from commercial plastic suppliers so that the materials and dimensions can be specified. Samples should be solicited in advance of purchase and checked for quality (uniform thickness of polyethylene without lumps or thin places) and secure bottom seals. It is always risky to re-use plastic bags for shipping specimens, as they may develop virtually invisible leaks, with dire results.

Packing Bagged Specimens for Shipment

As in bagging wrapped specimens, the size and fragility of specimens dictate packing technique. Bags containing packets of small, fragile specimens are not packed with bags of turtles. It is better to pack multiple packages, each containing specimens of similar size and fragility. Bags are usually packed in cardboard shipping cartons with adequate packing material separating bags from other bags and from carton walls. If integrity of the bags during shipment is suspect (large turtles, for example), or time in transit is likely to be long, a larger plastic bag about the inside volume of the box is used as an outer safety barrier. Everything (bags of specimens and packing material) is packed inside this large bag, and it is sealed. Alternatively, bags of specimens can be packed inside a coated metal can or sealable polyethylene box (freezer container) and that container in turn can be packed in a shipping carton. In that case the bagged specimens are carefully cushioned to prevent contact with the rigid container walls. Cans with friction closures (paint cans) are secure, but plastic boxes should be bagged for security, as they may crack or become unsealed during transit.

The most common cushioning material is polystyrene foam pellets (plastic popcorn, etc.). It has the advantages of lightness and excellent cushioning capacity. A disadvantage is that it is non-absorbent. Crumpled newspaper is an often-used alternative, as it will absorb leaked fluid and prevent weakening of or leakage from the box. However, it compacts when soaked and loses cushioning capacity, and printing inks can stain specimens if damp newspaper contacts cheesecloth specimen bundles. Real popcorn is a possibly superior replacement for polystyrene foam pellets, as it is light and cushions well and moreover is absorbent. Starch-based biodegradable foam pellets are not suitable for packing herpetological specimens, as they readily dissolve in alcohol solutions (J. E. Simmons, personal communication).

For shipments likely to be long in transit, a combination of packing media, selected for maximum cushioning and absorbency, may be advantageous. Cartons are completely filled with bags and packing so that no motion of the contents is possible.

Cartons are sealed, wrapped, and addressed following the recommendations of Simmons (1987), as follows. An address label (with return address) is placed inside the container and another is pasted to the outside. The container is then wrapped in strong paper, strapped with nylon filament tape, and a third address label securely attached.

Other Recommendations

Domestic mail shipments should always be registered (Zweifel, 1966) or insured (Pisani, 1973; Simmons, 1987). Although scientific specimens are unique and irreplaceable, they have no intrinsic monetary value, so the intent is to facilitate tracing an errant shipment rather than to recover damages. Commercial package delivery services may also be used, and their package tracing systems are usually superior to that of the post office.

International shipment method will vary according to the size of the shipment (surface or air), expense involved (surface or air), and customs regulations. A provident museum will have available either a customs manual or the telephone number of a knowledgeable Postal Service employee and a supply of customs forms. Shipments of endangered or CITES-listed species are subject to additional requirements for declarations, permits, and package labeling. It is a good idea to obtain a rubber stamp with a standard disclaimer such as "preserved specimens for scientific study, no commercial value, no endangered or CITES species enclosed," for use on international shipments.

It is a wise practice to send no more than about half of a museum's holdings of a species in one loan. Although this practice usually arouses the wrath of researchers, it protects against total loss if disaster strikes a shipment. Moreover, if the initial loan comes back in poor condition, further loans can be withheld for cause.

Invoices of shipments should always include too much rather than too little information. Terse invoices lead to misunderstandings between parties to a transfer of specimens. In addition to the addresses of shipper and recipient, the invoice includes the date and mode of shipment, value (for insurance, see above), name of the technician who packed the loan, and reason for the loan (Simmons, 1987). Loan transactions are assigned unique numbers in a series to facilitate tracking and subsequent correspondence. Catalog numbers, the data required by the recipient, and the total number of specimens included in the loan are recorded on the invoice. The preservative in which the specimens are to be stored is specified, and any special instructions (permission for dissection, etc.) are fully outlined (Zweifel, 1966). If any specimen is in other than perfect condition (parts missing or broken off, previous dissections, etc.), the damage is described.

A persistent nightmare of curators is inadvertently discarding specimens along with their wrapping when a shipment is unpacked. Two practices may help avoid this common disaster. First, invoices for a shipment should be mailed well in advance of the shipment, so that the list is in hand for checking as the specimens are unwrapped. Second, cheesecloth wrapping materials should be rinsed and spread for drying immediately after the shipment is unpacked (J. E. Simmons, personal communication), thereby revealing any specimens overlooked in the wrapping materials.

Conclusions

Most of these recommendations for packing specimens are common sense, rather than arcana. Nevertheless, many curators, technicians and researchers do not follow these practices, with the result that specimens are lost, damaged or destroyed. The ease of shipping fluid-preserved specimens that is conferred by plastic bags makes possible many journeys during an individual specimen's museum lifetime. Proper packing is thus extremely important if specimens are to achieve maximum longevity and usefulness to science.

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Literature Cited

Loveridge, A. 1952. Toward reducing cost in mailing reptiles. Copeia, 1952(4):280.

Pisani, G. R. 1973. A guide to preservation techniques for amphibians and reptiles. Society for the Study of Amphibians and Reptiles, Herpetological Circular, 1:1–22.

Simmons, J. E. 1987. Herpetological collecting and collections management. Society for the Study of Amphibians and Reptiles, Herpetological Circular, 16:i–ii + 1–70.

Zweifel, R. G. 1966. Guidelines for the care of a herpetological collection. Curator, 9(1):24–35.

A DATABASE FOR FROZEN TISSUES AND KARYOTYPE SLIDES

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Abstract.—A database system was designed to manage a frozen tissue and karyotype slide collection of approximately 5,000 specimens. This menu-driven system permits the user to produce a variety of printouts routinely used to respond to information inquiries, cross-reference the database with voucher specimens, edit data, and assist with documentation of karyotype slides. This database system can function independently without modification of any of the programs and is applicable to any taxon. A two-tier database system was also developed to integrate this ancillary material database with an existing voucher specimen database and to deal with the immediate information needs of ongoing research projects in-house.

"Ultracold storage space is very expensive to purchase and maintain, and it is important that materials be stored in a very space-efficient manner. It is therefore imperative that the access and inventory procedures for frozen tissue collections be extremely well organized" (Baker and Hafner, 1984). The need for good organization and prompt accessibility of information, and the constant monitoring of tissue consumption and loans present an obvious application for an automated database management system.

As the direction of current research in the biological sciences concentrates more upon molecular analysis techniques, it is necessary for tissue collections to become an integral part of field work and other types of specimen acquisition. Although numerous authors have suggested and discussed collection, storage, and curation guidelines, no automated database management system for tissues, karyotype slides, and tissue loans has been reported (Sherwin, 1991; Dessauer *et al.*, 1990, 1988; Baker and Hafner, 1984).

The system outlined here can operate as a stand-alone tissue database with its associated programs, for any taxon. Within the Mammalogy Department at the Royal Ontario Museum (ROM), the database structure and format have been integrated with the in-house accession and voucher specimen databases (Woodward, 1990). Herein, database and field names are capitalized to avoid confusion with commonly used museum terminology.

DATABASE ORGANIZATION

Table 1 illustrates the data fields captured and structure of the dBase III+ databases in which the fields appear. A single database (Temporary Database) is used to initially house both tissue/karyotype data and voucher specimen data. The Temporary Database (Table 1) functions as a data storage hold-up when the voucher specimen collections have not been completely processed. Only field identifications are available and all data have not been verified and edited. The data, however, are available for retrieval for research purposes. The need for immediate retrieval of current tissue data and the development of a two-tier system was prompted by in-house researchers and graduate students.

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Table 1. List of fields in the Temporary, Tissue, and Specimen Databases. An "X" indicates the presence of a field in the respective database. All fields are alphanumeric in format except two numeric fields marked with an asterisk (*). See Woodward (1990) for definitions of most of the fields.

		Permanent databases	
Field name	Temporary	Tissue	Specimen
Accession information			
Diskette number	X	•	X
ROM catalogue number	X	•	X
Museum acronym	X	X	•
Catalogue number*	X	X	•
Collector number	X	•	X
Acronym	X	X	•
Number*	X	X	•
Inventory number	X	•	X
Taxonomic information			
Order	X	X	X
Family	X	X	X
Subfamily	X	X	X
Genus	X	X	X
Subspecies	X	•	X
Hybrid	X	X	X
Synonyms	X	•	X
Locality information			
Continent	X	•	X
Country	X	X	X
Province	X	X	X
County	X	X	X
Locality name	X	X	X
Locality description	X	X	X
Origin	X	•	X
Latitude	X	X	X
Longitude	X	X	X
Location accuracy	X	X	X
UTMG reference	X	•	X
UTMG coordinates	X	•	X
Elevation	X	X	X
Habitat	X	•	X
Specimen information			
Specimen nature	X	•	X
Sex	X	X	X
Age	X	•	X
Total length	X	•	X
Tail length	X	•	X
Hindfoot	X	•	X
Ear	X	•	X
Tragus	X	•	X
Forearm	X	•	X
Weight	X	•	X
Breeding data	X	•	X
Colour	X	•	X
Parasites	X	•	X
Type	X	•	X

Table 1. Continued.

Field name	Temporary	Permanent databases	
		Tissue	Specimen
Collector information			
Collector	X	X	X
Collection	X	X	X
Date collected (beginning)	X	X	X
Date collected (end)	X	•	X
Season collected	X	•	X
Date died	X	X	X
Extra information	X	•	X
Collection management information			
Treatment	X	•	X
Location	X	•	X
Errors	X	•	X
Restriction details	X	•	X
Tissue specific information			
Tissue flag	X	X	•
Collection flag	X	•	•
Tubes	X	X	•
Box	X	X	•
Karyotype mitotic	X	X	•
Karyotype meiotic	X	X	•
Karyotype box number	X	X	•
Status	X	X	•
Contact	X	X	•
Loan location	X	X	•
Loan date	X	X	•
Loan material	X	X	•
Returned material	X	X	•
Remarks	X	X	•
Karyotype remarks	X	X	•

One permanent database houses tissue/karyotype data (Tissue Database). The field identifications and other specimen data in this database have been "verified" by curatorial staff. A specimen's presence in the Tissue Database indicates that all the data are accurate and complete. On the rare occasion that tissues appearing on the Temporary Database are loaned externally, researchers are notified of any changes to field identifications once records are verified, edited, and transferred to the permanent Tissue Database.

The Specimen Database was developed to permit in-house data entry and editing and production of cards and labels for voucher specimen data. Once in-house activities are complete, these data are converted and uploaded to the Canadian Heritage Information Network (CHIN) database for permanent storage and future data retrieval.

A number of fields are present in the Temporary Database that facilitate in-house operations. These include Collection Number, Collector Number, and ROM Accession Number (referred to as Catalogue Number at other institutions). The in-house Specimen Database is not used for retrieval activities. To facilitate data conversion and uploading to CHIN, these fields are alphanumeric. The remainder of this paper describes and comments on the Tissue Database structure and functioning.

In the Tissue Database the collector number (also referred to as field number or tissue number) is used to uniquely identify both tissues and karyotype slides belonging to a particular voucher specimen. The collector number is housed in two fields—the Acronym and Number fields—for purposes of searching and editing the database and for producing lists and reports. By inputting the alpha data into the Acronym field and the numeric data into the Number field, indexing on the Number field is right-justified. In a single field that is alphanumeric in format, data would be left-justified and when indexed would sort from left to right (e.g., FN1, FN10, FN100, FN11). Zero-filling the numbers (e.g., FN001, FN010, FN011, FN100) would create problems with legibility and consistency of data format in supporting materials such as field catalogues, etc. By indexing on the Acronym plus the Number, records sort logically (e.g., FN9, FN10, FN11, FN100).

The Catalogue Number field contains the number assigned to the voucher specimen by the institution in which it is housed. The institution housing the voucher specimen is identified in the Museum Acronym field. If ROM houses the set of tissues and another institution houses the associated voucher specimen, the Museum Acronym and Catalogue Number fields are entered. Presence of an entry in Museum Acronym and none in Catalogue Number tells the database manager that the information should be requested once the institution has accessioned the voucher specimen. If there is no voucher specimen, as is often the case with tissues from zoo specimens, no data will appear in the Museum Acronym or Catalogue Number fields. The post-mortem number used by the zoo to identify their specimen is used as the collector number (Acronym and Number) in the Tissue Database.

The Status field is used to monitor consumption of tissue. Single letter codes indicate the status of a set of tissues. A "set" of tissues typically includes the heart, liver, spleen, and kidneys, but may also include testes, embryos, and/or muscle. An "F" (for Freezer) indicates that the complete set of tissues is in one of the freezers in the department. "P" (for Partially used) designates tissues included in an outgoing loan to ROM staff or students, or to external researchers. "L" (for Loan) represents an incoming loan of tissues to ROM from another institution. Incoming loan material will be fully consumed during research activities. Finally, a "U" (for Used) indicates that all of the tissue sample has been used or consumed in analysis.

Presently, records with a Status of "U" are still housed in the Tissue Database. Although Dessauer *et al.* (1990) suggested that records of depleted samples should be deleted from databases, we do not concur that data ever be discarded in this context. Instead, it is preferable to create an archival database to house these inactive records to retain the information without affecting the operation of the active Tissue Database.

Information regarding where and to whom the tissues have been sent, what tissues, what proportion of the tissues, and the corresponding loan dates are housed in separate fields. A semicolon separates the data concerning one loan from the data relevant to a subsequent loan. The sequence of the data in the Loan Location, Loan Date, Loan Material, and Returned Material fields is important. If more than one loan has originated from a set of tissues, the relevant data for a single loan should appear in the same position in each of the loan-related fields within the series of loans. The four loan-related fields are "phrase-linked" and serve to create a loan "audit trail" (Documentation Research Group, 1992). Records can easily be retrieved to provide researchers with lists of specimens from which tissues were examined, for citation in publications, as suggested by the American Society of Mammalogists (Systematic Collections Committee, 1992).

Each of these loan-related fields has many potential uses. The data may serve to cross-reference, to act as a "handle" for data retrieval, or they may simply help to document the tissue collection record. The Loan Date field cross-references the Tissue Database data with typed loan invoices containing the external researchers' names and complete addresses. When internal researchers use material, a loan invoice is not completed, and the researchers' initials are entered in lieu of a loan date. The Loan Material field houses the information concerning the type and proportion of each tissue loaned to a researcher. Examples of Returned Material include samples of whole DNA or amplified DNA from tissues or possibly from ROM voucher specimens.

The Contact field contains the name and affiliation of the person who has donated a series of tissues to the ROM, Mammalogy tissue collection. Although the tissues legally belong to the ROM, it was decided by the Curator-in-Charge, M. D. Engstrom, that the contact should be consulted before approving a loan of the pertinent tissues.

A variety of other tissue-specific fields (Table 1) are allocated to document the tissue collection and manage the database. Complete locality data, including latitude and longitude as advocated by Sherwin (1991), are housed in the Tissue Database to afford maximal flexibility in extracting geographically-based subsets of data. External measurements and other voucher specimen data are not present in the Tissue Database. This avoids redundancies on the Specimen Database and helps to discourage researchers from *not* referring to voucher specimens.

Listings

A number of activities can be chosen from a hierarchical series of menu-driven programs. The user may choose to edit records, run in-house conversions, backup data, or produce printouts on the Temporary or Tissue Database.

Summary listings belong to one of three categories, based on the number of fields printed for each record. They are used to plan karyotyping activities or as cross-referenced inventory listings. More detailed listings are routinely used to satisfy information inquiries and document loans (including loan invoices and specimen data associated with loaned material). Figure 1 illustrates the menu from which the user can choose the appropriate listing to fulfill a specific information request. The index used and the contents of the chosen listing are provided in the menu so that a user unfamiliar with dBase and/or the system can generate the information listings that are required. This same information also appears on the printout.

A tissue accession book (Fig. 2) is generated as a hardcopy backup of the contents of the database. It also acts as a cross-reference to any other printouts generated by this database management system and as the "edit sheet" for the Tissue Database.

```
MENU FOR R.O.M. MAMMALOGY TISSUE DATABASE

MEDIUM PRINT OUTS

1.  GENUS (LOCALITY NAME, GENUS, SPECIES)

2.  LOCAL (GENUS, SPECIES, COUNTRY, PROVINCE, ACRONYM, NUMBER)

3.  PLACE (GENUS, SPECIES, LOCALITY NAME)

4.  EXIT TO DBASE (CLOSES FILE)

5.  EXIT TO SYSTEM

PLEASE SELECT ONE OF THE ABOVE:  __
```

Figure 1. Medium listing menu.

Karyotype sheets are produced for specimens for which karyotype slides have been made. The format of the karyotype sheet produced by this system mirrors that illustrated in Baker and Hafner (1984).

Discussion

Initially, the Tissue Database was developed as a system unrelated to the Specimen Database and functioned independently. Many of its field names and its data format differed from those of the Specimen Database (or "Departmental Database") and the Accession Database (Woodward, 1990). In an effort to improve the efficiency of the department and to meet new demands, the Tissue and Specimen Databases were integrated. This resulted in data being entered and edited only once. Field names and data format have been standardized among databases. Copying inconsistencies and confusing format differences are minimized, where previously they created problems for all staff dealing closely with the automated collections.

It is highly recommended that those aiming to automate a department's activities standardize information and documentation systems early in the process. This permits easy transfer of data and encourages consistent data entry in all activities involving documentation. It also facilitates the use of generic programs that generate reports and listings for more than one database.

The implementation of the Temporary Database resulted from the need by curatorial staff and graduate students to access current data on tissues brought back from collecting trips. Combining these unedited and unverified data with those in the fully edited Tissue Database would produce a disorganized, unreliable system that would be virtually impossible to manage. In light of situations like this, and to permit orderly editing and movement of data for collections with voucher specimens still undergoing processing, a temporary, hold-up database was the obvious solution. The quality and reliability of data appearing in and printed from the two databases is clearly defined.

```
=======================================================================================================
FN 33714        CN:  ROM 98620          SEX: F      STATUS: F      RECNO:  1

CARNIVORA: MUSTELIDAE: GULO GULO
CANADA: NORTHWEST TERRITORIES:                          67 25 N     117 40 W  ACCURACY=V
COPPERMINE: COPPERMINE AREA
GUNN, A -
COLL DATE: 19900000


REM :     2HLKS; TISSUE FROM FROZEN CARCASS

TUBES: 5+2E             BOX:   2                    KTMIT:    KTMEI:    KTBOX:
KTREM:

=======================================================================================================
RAN 36          CN:  0                  SEX: M      STATUS: P      RECNO:  2

ARTIODACTYLA; CERVIDAE: RANGIFER TARANDUS
CANADA: NORTHWEST TERRITORIES: KEEWATIN                72 03 N     125 07 W  ACCURACY=G
EASTER CR: 40 KM RADIUS OF SACHS HARBOUR, BANKS IS
HUNTER, A -
COLL DATE: 19911119
LOANS:      .5H; 1K; .25 L  -  MDE; 19920300; JLE  -  ROM; UOFT; ROM

REM :     3HLKS; NOT STERILE


TUBES: 12L              BOX:   L9                   KTMIT:    KTMEI:    KTBOX:
KTREM:

=======================================================================================================
PM 12535        CN:  0                  SEX:        STATUS: F      RECNO:  3

CARNIVORA: FELIDAE: PANTHERA PARDUS
CAPTIVE: CAPTIVE: CAPTIVE
CAPTIVE: METRO TORONTO ZOO; ZOO BORN; PARENTS FROM AFRICA
METRO TORONTO ZOO -
COLL DATE:              DIED DATE: 19920507


REM :     2LKS; 1HM; VIALS NUMBERED 16565

TUBES: 8L               BOX:   L11                  KTMIT:    KTMEI:    KTBOX:
KTREM:

=======================================================================================================
FN 28959        CN:  ROM 95154          SEX: F      STATUS: U      RECNO:  4

RODENTIA: ARVICOLIDAE: DICROSTONYX KILANGMIUTAK-H: DICROSTONYX KILANGMIUTAK; DICROSTONYX GROENLANDICUS
CANADA: NORTHWEST TERRITORIES:                          69 50 N     122 45 W  ACCURACY=C
LAB STOCK; PEARCE PT
BOONSTRA, R - DICROSTONYX - LAB        CONTACT: BOONSTRA, R; UOFT
COLL DATE: 19881117
LOANS:      HLK  -  19900200  -  UOFT
RETURNS:    WHOLE DNA
REM :


TUBES: 0                BOX:   51                   KTMIT: Y  KTMEI: Y  KTBOX: 1+M3
KTREM: C-BANDS; G-BANDS
=======================================================================================================
```

Figure 2. Long listing illustrating a page of the tissue accession book and edit sheet for the Tissue Database.

Conclusions

The two-tiered system described in this paper permits the documentation of voucher specimens, associated tissues, and karyotype slides in one operation. One temporary database houses all data pertinent to each single catalogue number. Once specimens and their associated data are fully prepared, verified, and edited, the records are partitioned to the relevant permanent databases. Tissue data are available for editing and retrieval at all stages of a collection's preparation.

The Tissue Database reported here can function independently without modification of any of the programs. The data fields and listings presented are those which would be required by any taxon of animals for which tissues have been collected, karyotype slides have been made, or loan transactions will result. If more than one Class were to be housed on a single database, appropriate fields could easily be added without affecting the operation of the associated programs. The system programs reported here do, however, assume that Genus, or Genus and Species, are the crucial fields for taxonomic searches. The programs address the majority of the information retrieval needs experienced by ROM to date. The menu-driven system permits new users to quickly become familiar with the system organization and production of listings. It also provides a means of meeting the constant demands of active use of the ancillary collections.

Note.—For information on how to obtain a copy of the database structure, all of the associated programs, and the documentation of the Tissue Database, please contact the first author. All routines specific to the two-tier system including the Temporary Database have been removed. The structure of this dBase III+ system is fully transportable into dBase IV or FoxPro2. With minor modifications to the menu command language, this system should run smoothly with either of these software packages and an Epson-type dot-matrix printer.

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Literature Cited

Baker, R. J., and M. S. Hafner. 1984. Section III. Curation of collections of frozen tissues. Curatorial problems unique to frozen tissue collections. Pp. 35–40 in *Collections of Frozen Tissues: Value, Management, Field and Laboratory Procedures, and Directory of Existing Collections* (H. C. Dessauer and M. S. Hafner, eds.). Association of Systematic Collections Report to the National Science Foundation, 24–26 May 1983, at The Academy of Natural Sciences of Philadelphia by the Association of Systematic Collections, 75 pp.

Dessauer, H. C., C. J. Cole, and M. S. Hafner. 1990. Collection and storage of tissues. Pp. 25–41 in *Molecular Systematics* (D. M. Hillis and C. Moritz, eds.). Sinauer Associates, Inc. Publishers, Sunderland, 588 pp.

Dessauer, H. C., M. S. Hafner, R. M. Zink, and C. J. Cole. 1988. A national program to develop, maintain, and utilize frozen tissue collections for scientific research. Association of Systematic Collections Newsletter, 16(2):3, 9–10.

Documentation Research Group. 1992. *Natural Sciences Data Dictionary of the Canadian Heritage Information Network, Revision 2.* Museum Services, Communications Canada, 295 pp.

Sherwin, W. B. 1991. Collecting mammalian tissue and data for genetic studies. Mammal Review, 21(1):21–30.

Systematic Collections Committee. 1992. Special collections survey: Problems and potential solutions. American Society of Mammalogists. Available from S. B. George (Chairman), Los Angeles County Museum, Los Angeles, 7 pp.

Woodward, S. M. 1990. Integrating specimen documentation, processing, and data automation in a mammal collection: A case study of an accession database. Collection Forum, 6(2):82–98.

GUIDELINES FOR DEVELOPING POLICIES FOR THE MANAGEMENT AND CARE OF NATURAL HISTORY COLLECTIONS

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Abstract.—Written collection management and care policies affect the long-term direction and activities associated with natural history collections. Although the use of such documents is beneficial for beginning as well as established collections, it is often difficult to start and to maintain a document that fulfills the needs of the collection and its staff in a concise and effective form. For this reason, a set of guidelines is provided to address major issues that affect most natural history collections. The issues addressed in this contribution include ethics, documentation, acquisition, preventive conservation, access, loans, sampling, treatment, pest control, health and safety, emergency preparedness, and deaccessioning.

The parameters for the management and care of natural history collections have expanded dramatically in recent years (Simmons, 1993; Cato, 1990). There have been extensive developments within the museum profession that directly affect institutional responsibilities relative to collections. Consider, for example, the legal issues relating to repatriation, endangered species and threatened habitats, and increased professionalization that has resulted in new and revised codes of ethics and standards of practice (American Institute for Conservation Committee on Ethics and Standards, 1993; Museums & Galleries Commission, 1992a, b, c; American Association of Museums, 1991, 1988; Alberta Museums Association, 1990; IIC-CG and CAPC, 1989). Other policy developments relate to the philosophy and practices for collecting, registration and conservation (e.g., Webster, 1990; Messenger, 1989), changes in demands for specimen use as a result of more sophisticated technology (Cato, 1993), and a renewed emphasis on mission-driven operations and accountability (Boyd, 1991). As a result of one or more of these issues, many institutions have recognized the need to revise collections policies, or in many cases, to develop new policies altogether.

As part of this realization as well as a general trend to improve the level of professionalization of staff, there has been an increased emphasis on in-service education for staff responsible for collection management and care. In 1992, the authors were asked to give a two-hour workshop on "Collection Management" at the *International Symposium and World Congress for the Preservation and Conservation of Natural History Collections* in Madrid, May, 1992. Recognizing the broad scope of collection management and the realization that the audience would consist of a wide spectrum of the international community with different levels of understanding of the subject, the challenge became one not only to clarify what is meant by collection management, but to provide meaningful and practical information that might be implemented in respective institutions. It was unquestionably evident that the most useful information that would benefit a collection over the long term would be guidelines for developing a set of written policies based on the institution's mission. Such a document would not only serve the immediate needs of the collection, but future needs as well (Cato, 1986).

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To assist others in developing such a document, the authors identified policies that would be generic to most collections, whether housed in a university department or a free-standing museum. Each topic was systematically reviewed using literature and examples of existing institutional policies to identify critical objectives and the primary issues that should be addressed during the development of policies and procedures. Pertinent references from the museum, scientific and conservation disciplines were incorporated. This process resulted in a set of guidelines that can be useful in developing working drafts of policies related to the functions of management, care, and use for most natural history collections.

General Considerations

Strategic planning and mission statement.—Policies governing the collections cannot be written in the absence of a mission statement for the institution. The mission statement provides a mechanism for focusing and directing the functions and activities of the collections, for setting priorities, and for determining resource needs. Thus, in the absence of an institutional mission statement, the process for developing policies must start with a strategic planning effort to clarify the mission and objectives for the institution. It is beyond the scope of this paper to describe in depth the planning process, but there are several references available to guide such an effort (McGinley, 1990; Kovach, 1989; Ames, 1985; Simerly, 1982; McHugh, 1980). The planning process should involve an analysis of existing functions for all facets of the museum relative to available resources and professional standards. Some institutions have successfully pursued self-study programs, but often it requires the objectivity of outside consultants to obtain a more thorough assessment. The analysis will rely on input from staff (Cato, 1990) as well as data gathering efforts such as those used for the conservation assessments (Wolf, 1990; Beale, 1987; Hutchins, 1987; Appelbaum and Himmelstein, 1986) and Museum Assessment Program, or models such as the one developed at the Canadian Museum of Nature (Emery, 1990) that might assist with an analysis of personnel responsibilities and expectations. Such assessments should result in a report that documents the extent to which existing resources (money, staff, facilities, time, etc.) are effectively supporting the institution's missions and goals relative to the specific function analysed. These reports should record weaknesses as well as strengths and assist the organization in the development of priorities for improving the effectiveness of functions such as collection management, care, and use. The priorities should be an integral facet of the institution's overall planning effort.

It is important to stress that even an individual discipline-based collection, whether in a free-standing museum or housed in a university academic department, should develop a mission statement to help guide priorities and decision-making. Such a collection-level mission statement supplements and refines the institutional mission statement, rather than competing with or attempting to supersede the broader statement. Collections policies should be developed first at the broadest institutional level possible (e.g., museum-wide policies) before more specific discipline-oriented policies can logically be completed.

The ultimate determination of policies is the responsibility of appropriate administrative entities (e.g., Director, Board of Trustees) with recommendations submitted by staff. However, the procedures for fulfilling the policies will be developed by the staff based on professional guidelines and practices (e.g., Simmons, 1987; Cato, 1986; Williams *et al.*, 1977). The value of written manuals that document collections policies and procedures in promoting quality and consistency cannot be overstated (Yang, 1989).

Policies and procedures.—Policies are the working set of parameters that provide a framework for decision-making and desired action in a given situation. They must provide guidance for situations that may not have occurred; thus they must be broad enough to be flexible but not so broad as to be useless. Procedures, by contrast, provide the mechanism and details needed to implement the policy. Policies and procedures must take into account professional standards and guidelines and mold them into the institutional setting, with a consideration of the institutional mission, objectives, and available resources. Written policies and procedures provide direction, continuity, and predictability, but only if the staff is familiar with and agrees to respect such policies and procedures.

There are several approaches to developing policies for the management and care of natural history collections. By far, the best approach is to start from scratch and to develop a holistic document that insures that the major issues are all addressed, and that they complement and supplement each other in the most efficient and effective manner possible. More realistically, many institutions may be faced with revising a set of existing policies, adding individual policies not previously developed. However, the committee that has been formed to revise a set of policies should anticipate complete rewrites of major sections if the entire set of policies would be made more effective by doing so.

The process of developing a set of policies is as important as the resulting document (Simmons, 1991). The committee assigned this task should represent differing perspectives as represented in the institution: researchers, collection managers, conservators, administrators, and public programming (education, exhibits). There should be a mix of those who manage the procedures with those who implement them (Cato, 1990). As with strategic planning, policy development is a time consuming process if it is to be effective. Issues should be discussed from a variety of perspectives including museum functions related to collections (use, management, preservation), disciplines represented, and the specific institutional context. How does the ideal fit relative to the institutional mission and resources?

Twelve general categories are recognized within this paper as primary issues of concern for an institution with responsibilities for the management, care, and use of natural history collections. The degree to which some of the institution-wide policies, such as sampling or pest control, affect an individual collection depends on the discipline. However, it is essential that collection-level policies do not contradict the intent and focus of institution-level policies. Policies developed at the collection level must remain in the context of the institution at large.

A collection that operates independently within some structure other than a free-standing museum should develop a level of policies and procedures that is appropriate for its size and institutional structure. Because there is no overriding museum framework, it is even more critical for the independent collection to clarify in writing those policies that reflect professional museum standards and that serve as a framework for decisions.

Two of the 12 categories discussed affect all aspects of collection management, care, and use: ethics and documentation. The other ten deal with more specific concerns: acquisitions, preventive conservation, access, loans, sampling, treatment, pest control, health and safety, emergency preparedness, and deaccessions. The need for some of these policies (such as emergency preparedness) has been recognized only during the last 10 to 15 years. Some policies, such as those for pest control and health and safety, will probably change frequently to reflect changes in federal legislation or museum standards of practice. Policies such as those for repatriation have greater application to specific collections and have been excluded from this paper. Additional, specialized policies relevant to institutions with collections might include ones covering copyrights, photography, reproductions, computer use, and access to electronic data. General institutional policies (e.g., personnel policies) that apply to all staff are excluded as well; however, it is recognized that personnel issues are critical to effective management and care of collections and probably worthy of a separate publication. The 12 categories are briefly discussed below; outlines for each are provided in Appendix I to facilitate policy development. Because the reason for developing a policy should be clear, a general description and objectives are listed for each category. The degree to which an institution or individual collection will address the issues listed depends on the relevance of the issues to that organizational structure.

Categories for Policies

Ethics.—Policies setting forth a code of ethics provide a mechanism for insuring proper behavior and obligations toward society and standards of the museum and scientific communities. Ethical behavior begins with a basic respect for and abidance of laws for all countries concerned. Because the use of natural history collections is fundamentally dependent on trusting the integrity of each specimen and its associated data, all aspects of managing and caring for collections are dependent on ethical behavior. Aspects affected include not only responsible collecting, proper preservation and record-keeping, and maintenance of specimen and data integrity, but interactions that affect decisions about health and safety concerns, accessibility to specimens and data, and collection use. Disciplines that have developed professional standards for personal conduct or practice to deal with many of these issues include the museum field (Museums & Galleries Commission, 1992a, b, c; American Association of Museums, 1991, 1988; International Council of Museums, 1990; American Association of Museums Registrars Committee, 1985; American Association of Museums Curators Committee, 1983; Barsook, 1982; Miller, 1980), conservation (American Institute for Conservation Committee on Ethics and Standards, 1993, 1985; IIC-CG and CAPC, 1989) and specific scientific disciplines (Association of Systematics Collections, 1993, 1991a, b; American Society of Ichthyologists and Herpetologists *et al.*, 1987; American Ornithologists' Union, 1975; American Society of Mammalogists, 1974; American Society of Mammalogists *ad hoc* Committee on Acceptable Field Methods, 1987).

Documentation.—Policies should identify standards for the extent and quality of documentation needed for managing and caring for natural history collections. The degree of completeness and level of accuracy are of particular importance. An accompanying concern, that should also be addressed in written policies, is that such documentation must be properly maintained, managed and cared for.

The need for documentation may seem so obvious that policies and standards seem unnecessary. For a variety of reasons, however, they have become essential. Standards describing the extent and quality of data collected in the field insure the usefulness of the specimens for research. Records documenting methods and materials used for preparing specimens also serve research purposes by making it possible to determine the potential specimens have for biochemical and molecular research; such documentation may also make it possible to understand the effectiveness of certain preservation practices or the effects of chemical pesticides on long-term preservation.

The importance of records documenting the legal collection and acquisition of specimens has long been recognized, but the quality of the records may be an issue. Discussions focusing on the quality and extent of documentation have arisen through professional museum and scientific societies (Alberta Museums Association, 1990; Pearce, 1990; Webster, 1990; Garrett, 1989; Fitzgerald, 1988; Lee *et al.,* 1982).

Of equal concern is the management and care of documentation materials. It is recognized that much of the value of a specimen is based on the associated data; thus, the loss of these data would have an adverse effect on the value of the specimen and ultimately, the collection as a whole. There is a need, therefore, to promote proper management and care of documentary material. Attention must be paid not only to the data directly associated with the specimen (labels, field notes, etc.), but additional forms such as catalogs, files, maps, film, magnetically stored data, libraries, and archives. A policy for the institutional archives is essential, but inasmuch as archives include more than material pertaining to the collections, the reader should refer directly to literature from the archives profession (e.g., Ogden, 1992; Deiss, 1984; Ritzenthaler, 1983).

Acquisition.—One of the most difficult yet most critical policies to construct deals with acquisition, or those actions taken to add permanently and to make accessible new specimens to collections, and to establish institutional control over these specimens. This policy provides an interpretation of the institution's mission relative to the addition of new specimens in such a way as to permit the institution to plan for the resources needed to accommodate specimen management and care. Priorities and criteria should be set forth that permit a rational evaluation of material offered to the collection, whether by field collection, salvage, purchase or donation. The policy must provide the institution with a way to reject offered material, based on a reasonable and appropriate set of criteria relative to the institution's mission and available resources. Ultimately a good acquisitions policy will emphasize priorities and establish a framework for planning. Useful references include Museums & Galleries Commission (1992a, b, c), Association of Systematics Collections (1991b), Alberta Museums Association (1990), National Park Service (1990), Garrett (1989), Fitzgerald (1988), Cato (1986), Brunton *et al.* (1985), Malaro (1985), Porter (1985), Lee *et al.* (1982), Phelan (1982), Dudley *et al.* (1979), and Williams *et al.* (1977).

Preventive conservation.—Preventive conservation involves actions taken to minimize or eliminate chemical, physical or biological deterioration in collections (Michalski, 1992; Williams and Hawks, 1992; Appelbaum, 1991; Rose, 1991; Garrett, 1989; Fitzgerald, 1988; Stolow, 1986; Thomson, 1986). Policies specifically addressing this issue are particularly relevant to natural history collections because much of the required care is based on preventive conservation. Policies specifically for preventive conservation have not generally been formalized in practice. However, planning, establishing priorities, and implementing solutions for issues such as collection environments, storage, handling, shipping, and documentation require an institution-wide commitment, not only in philosophy but of resources. Thus, at this stage, most museums need to make a philosophical commitment to preventive conservation through policy development to guide the institution towards more effective preservation practices.

Access.—This policy is essential to provide and promote appropriate access to and use of specimens and associated data. This logically involves security and authorization. However, the institution must balance access for use with preservation of specimens for the future; thus established criteria are needed for evaluating requests for collection access and use of specimens and their data. This type of policy may overlap loan policies, but it is more of an umbrella policy because it also serves as the basis for issues such as sampling, reproductions, photography, and use of electronic data (Appelbaum, 1991; Association of Systematics Collections, 1991a; Alberta Museums Association, 1990; McLaren, 1988; Malaro, 1985). To insure implementation of the policy, it is important that the institution establish procedural guidelines that promote the appropriate use of the specimens.

Loans—research, education, exhibitions.—Loans, whether within or outside the institution, constitute the primary method of access for the majority of specimens. Specimens are potentially at greater risk of loss or damage because control for management and care is relinquished to other individuals. Specimens used in educational programming, exhibits, and research projects can be exposed to new risks that may compromise specimen or data integrity. The institution must reduce the level of these risks by developing policies and procedures for approving loans and for specifying acceptable methods and materials during use to minimize deterioration (Merritt, 1992; American Association of Museums Registrars Committee, 1991; Alberta Museums Association, 1990; National Park Service, 1990; Malaro, 1989, 1985; Stolow, 1986; Dudley *et al.,* 1979).

Sampling.—Technological advances and changes in research techniques have recently begun to have a more direct impact on the physical and chemical integrity of some specimens. Increased demands to remove samples from specimens or even destroy entire specimens necessitate a policy that responsibly and ethically addresses the issue of sampling. It is to the institution's advantage to take the offensive and develop a policy that can provide guidance for approving sampling requests before they become a problem (Cato, 1993; Cato and Schmidly, 1991; Bohnert and Surovik-Bohnert, 1991).

Treatment.—Treatment involves physical and/or chemical actions applied to a specimen or a collection often for purposes of stabilization. This would include the introduction of preservatives or fumigants to specimens. For natural history collections, one of the greatest problems in understanding and providing appropriate care is the lack of available documentation on specimens and on collections needed to evaluate the nature or quality of preservation procedures. It is not possible at present to state unequivocally that one technique is superior to another because of the lack of adequate documentation and analysis. A treatment policy provides a framework for developing institutional procedures that will augment the baseline information available for evaluating the preservation value of procedures. It also provides a framework for making informed decisions about the appropriateness of particular procedures. The evolution of professional standards concerning treatment policies is likely to continue as the collection management and conservation professions develop (American Institute for Conservation Committee on Ethics and Standards, 1993; National Park Service, 1990; Webster, 1990; Garrett, 1989; Fitzgerald, 1988; IIC-CG and CAPC, 1989).

Pest control.—Pest control might logically be incorporated in a policy for preventive conservation, but the magnitude of the problem and variety of solutions often necessitates a separate policy. This policy addresses the framework needed to deal responsibly with the restriction or elimination of organisms from collection areas. It should incorporate an institution-wide approach and clarify appropriate levels of authority and responsibility, general prevention strategies, protocol for handling infestations, and documentation (Olkowski *et al.*, 1992; National Park Service, 1990; Jessup, 1989; Pinniger, 1989; Alpert and Alpert, 1988; Zycherman and Schrock, 1988; Stansfield, 1985; Peltz and Rossol, 1983).

Health and safety.—Health and safety policies are a mechanism to promote good health and safe conditions for individuals associated with collections. This insures the development of protocols for preventive measures as well as protocols in the event that preventive measures have failed. Necessary considerations include the recognition of hazards, hazard elimination or control, and identification of sources of assistance when hazards have compromised a safe environment. Health and safety policies must reflect and work within legal and ethical standards for providing suitable working conditions (National Fire Protection Association, 1991; ASIS Standing Committee on Museum, Library and Archive Security, 1990; National Park Service, 1990; Fenn, 1987; Howie, 1987a, b; Waddington and Fenn, 1986; Center for Occupational Hazards, 1985a, b; Brunton *et al.*, 1985; Peltz and Rossol, 1983).

Emergency preparedness.—Until efforts were initiated by the museum community to mitigate the effects of disasters, such as fires, floods, and weather extremes, the value of emergency preparedness policies was not recognized. However, it has been demonstrated that policies can be particularly useful in achieving desired action to reduce adverse effects to collections and/or personnel in the event of emergencies. This policy addresses issues such as risk assessment, as well as strategies for avoidance, mitigation, and recovery (Michalski, 1992; Ogden, 1992; American Institute for Conservation, 1991; Murray, 1990; National Institute for Conservation, 1990; Buchanan, 1988; Solley *et al.*, 1987; Center for Occupational Hazards, 1986; Jones, 1986).

Deaccessions.—When an institution needs to permanently remove specimens from the collections, there must be mechanisms for decision-making in place that address legal issues, ethical concerns and professional standards. Deaccessioning can be a sensitive activity and a sound deaccessions policy helps anticipate and address concerns (Besterman, 1992; Lewis, 1992; Association of Systematics Collections, 1991b; Weil, 1987; Malaro, 1985, 1988; Phelan, 1982; Dudley *et al.*, 1979).

Summary

The development of written policies for the management and care of natural history collections should begin with a clear understanding of the nature and objectives of the document to be produced. This will help define the working parameters, promoting conciseness and continuity within the document. A holistic approach will substantially improve the effectiveness of the document. The descriptions, objectives, issues and references provided in this paper should facilitate the development of useful collection policies. The development of policies should be regarded as an on-going process, changing with the needs of the institution; policies must be periodically reviewed to insure their usefulness for managing and caring for collections.

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Literature Cited

Alberta Museums Association. 1990. *Standard Practices Handbook for Museums.* Alberta Museums Association, Edmonton, 335 pp.

Alpert, G. D., and L. M. Alpert. 1988. Integrated pest management: A program for museum environments. Pp. 169–173 in *A Guide to Museum Pest Control* (L. A. Zycherman and J. R. Schrock, eds.). Association for Systematics Collections and American Institute for Conservation, Washington, D.C., 205 pp.

American Association of Museums. 1988. Policy regarding the repatriation of Native American ceremonial objects and human remains. Aviso, March 1988:4–5.

———. 1991. *Code of Ethics.* American Association of Museums, Washington, D.C., 4 pp.

American Association of Museums Curators Committee. 1983. Code of ethics for curators. Museum News, 61(3):38–40.

American Association of Museums Registrars Committee. 1985. Code of ethics for registrars. Museum News, 63(2):42–46.

———. 1991. Statement of practice for borrowing and lending. Registrar, 8(2):3–10.

American Institute for Conservation. 1991. Perspectives on Natural Disasters: Papers Presented at 1991 AIC Workshop. American Institute for Conservation of Historic and Artistic Works, Washington, D.C., 82 pp.

American Institute for Conservation Committee on Ethics and Standards. 1985. *Code of Ethics and Standards of Practice for Art Conservators.* American Institute for Conservation of Historic and Artistic Works, Washington, D.C., 7 pp.

———. 1993. *Code of Ethics and Guidelines for Practice,* draft. American Institute for Conservation of Historic and Artistic Works, Washington, D.C., 4 pp.

American Ornithologists' Union. 1975. Report of the *ad hoc* Committee on Scientific and Educational use of Wild Birds. Auk, 92(3):1A–27A.

American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and Society for the Study of Amphibians and Reptiles. 1987. *Guidelines for Use of Live Amphibians and Reptiles in Field Research,* 14 pp.

American Society of Mammalogists. 1974. Revised minimal standards for systematic collections of mammals. Journal of Mammalogy, 59(4):911–914.

American Society of Mammalogists *ad hoc* Committee on Acceptable Field Methods in Mammalogy. 1987. Acceptable field methods in mammalogy: Preliminary guidelines approved by the American Society of Mammalogists. Journal of Mammalogy, 68(4, suppl.):1–18.

Ames, P. 1985. Guiding museum values: Trustees, missions and plans. Museum News, 63(6): 48–54.

Appelbaum, B. 1991. *Guide to Environmental Protection of Collections.* Sound View Press, Madison, Connecticut, 270 pp.

Appelbaum, B., and P. Himmelstein. 1986. Planning for a conservation survey. Museum News, 64(3):5–14.

ASIS Standing Committee on Museum, Library and Archive Security. 1990. Suggested Guidelines in Museum Security. American Society for Industrial Security, Arlington, Virginia, 21 pp.

Association of Systematics Collections. 1991a. ASC position on collections use agreements. ASC Newsletter, 19(1):1–4.

———. 1991b. Guidelines: The ethics and responsibilities of museums with respect to acquisition and disposition of collection materials. ASC Newsletter, 19(6):77–79.

———. 1993. ASC guidelines on foreign field research and collecting. ASC Newsletter, 21(3): 35–36.

Barsook, B. 1982. A code of ethics for museum stores. Museum News, 60(3):50–52.

Beale, A. 1987. Long-range conservation planning for museums. Virginia Association of Museums Technical Information, Winter/Spring:1–2, 5.

Besterman, T. 1992. Disposals from museum collections: Ethics and practicalities. Museum Management and Curatorship, 11(1):29–44.

Bohnert, A. S., and M. Surovic-Bohnert. 1991. Destructive analysis of archaeological collections: Between Scylla and Chrybdis. Pp. 113–122 in *Natural History Museums: Directions for Growth* (P. S. Cato and C. Jones, eds.). Texas Tech University Press, Lubbock, Texas, 252 pp.

Boyd, W. L. 1991. Museum accountability: Laws, rules, ethics, and accreditation. Curator, 34(3): 165–177.

Brunton, C. H. C., T. P. Besterman, and J. A. Cooper (eds.). 1985. *Guidelines for the Curation of Geological Materials.* Miscellaneous Paper No. 17, Geological Society, London.

Buchanan, S. A. 1988. *Resource Materials for Disaster Planning in New York Institutions.* New York State Program for the Conservation and Preservation of Library Research Materials, Albany.

Cato, P. S. 1986. Guidelines for managing bird collections. Museology, Texas Tech University, 7:1–78.

———. 1990. Collection management and preservation. ASC Newsletter, 18(1):12–13.

———. 1993. Institution-wide policies for sampling. Collection Forum, 9(1):27–39.

Cato, P. S., and D. J. Schmidly. 1991. Policies concerning the use and management of ancillary preparations in vertebrate systematics collections. Pp. 91–104 in *Natural History Museums: Directions for Growth* (P. S. Cato and C. Jones, eds.). Texas Tech University Press, Lubbock, Texas, 252 pp.

Center for Occupational Hazards. 1985a. Fire Prevention in the Conservation Laboratory. Center for Occupational Hazards, New York, 5 pp.

———. 1985b. A Health and Safety Program for Conservation Laboratories. Center for Occupational Hazards, New York, 4 pp.

———. 1986. Emergency Plans for Museum Conservation Laboratories. Center for Occupational Hazards, New York, 5 pp.

Deiss, W. A. 1984. *Museum Archives: An Introduction.* Society of American Archivists, Chicago, 37 pp.

Dudley, D. H., I. B. Wilkinson, and others. 1979. *Museum Registration Methods* (3rd ed.). American Association of Museums, Washington, D.C., 437 pp.

Emery, A. R. 1990. Museum staff: Defining expectations. Museum Management and Curatorship, 9(3):265–272.

Fenn, J. 1987. Danger in the discovery room. Museum Quarterly: The Journal of the Ontario Museum Association, 16(2):8–11, 26.

Fitzgerald, G. R. 1988. Documentation guidelines for the preparation and conservation of paleontological and geological specimens. Collection Forum, 4(2):38–45.

Garrett, K. L. 1989. Documentation guidelines for the preparation and conservation of biological specimens. Collection Forum, 5(2):47–51.

Howie, F. 1987a. *Safety in Museums and Galleries.* Butterworths, London, xii + 184 pp.

———. 1987b. Safety considerations for the geological conservator. Pp. 379–401 in *The Conservation of Geological Material* (P. R. Crowther and C. J. Collins, eds.). Geological Curator, 4(7):375–475.

Hutchins, J. K. 1987. Conservation surveys. Virginia Association of Museums Technical Information. Winter/Spring:3–4.

International Council of Museums. 1990. Statutes and Code of Professional Ethics. International Council of Museums, Paris, 35 pp.

IIC-CG and CAPC. 1989. *Code of Ethics and Guidance for Practice for Those Involved in the Conservation of Cultural Property in Canada* (second edition). International Institute for Conservation—Canadian Group and Canadian Association of Professional Conservators, Ottawa, 20 pp.

Jessup, W. C. 1989. Pest management notes: Establishing a pest monitoring program for museums. MuseNews, 19(3):5–6. Oklahoma Museums Association and Oklahoma Historical Society.

Jones, B. G. 1986. *Protecting Historic Architecture and Museum Collections from Natural Disaster.* Butterworths, London, xi + 560 pp.

Kovach, C. 1989. Strategic management for museums. International Journal of Museum Management and Curatorship, 8(2):137–148.

Lee, W. L., B. M. Bell, and J. F. Sutton (eds.). 1982. *Guidelines for Acquisition and Management of Biological Specimens.* Association of Systematics Collections, Lawrence, 42 pp.

Lewis, G. 1992. Attitudes to disposal from museum collections. Museum Management and Curatorship, 11(1):19–28.

Malaro, M. C. 1985. *A Legal Primer on Managing Museum Collections.* Smithsonian Institution Press, Washington, D.C., xiii + 351 pp.

———. 1988. Deaccessioning, the importance of procedure. Museum News, 66(4):74–75.

———. 1989. How to protect yourself from not-so-permanent loans. Museum News, 68(5):22–25.

McGinley, R. J. 1990. Entomological collection management—Are we really managing? ASC Newsletter, 18(2):30–31.

McHugh, A. 1980. Strategic planning for museums. Museum News, 58(6):23–29.

McLaren, S. B. 1988. Guidelines for usage of computer-based collection data. Journal of Mammalogy, 69(1):217–218.

Merritt, E. 1992. Conditions on outgoing research loans. Collection Forum, 8(2):78–82.

Messenger, P. M., ed. 1989. *The Ethics of Collecting Cultural Property: Whose Culture? Whose Property?* University of New Mexico Press, Albuquerque, 266 pp.

Michalski, S. 1992. *A Systematic Approach to the Conservation (Care) of Museum Collections.* Canadian Conservation Institute, Ottawa, 15 pp. + appendices.

Miller, R. L. 1980. *Personnel Policies for Museums: A Handbook for Management.* American Association of Museums, Washington, D.C., 164 pp.

Murray, T. 1990. Basic Guidelines for Disaster Planning in Oklahoma. University of Tulsa Preservation Office, Tulsa, Oklahoma, 25 pp.

Museums & Galleries Commission. 1992a. *Standards in the Museum Care of Archeological Collections.* Museums & Galleries Commission, London, 59 pp.

———. 1992b. *Standards in the Museum Care of Biological Collections.* Museums & Galleries Commission, London, 55 pp.

———. 1992c. *Standards in the Museum Care of Geological Collections* (draft). Museums & Galleries Commission, London.

National Fire Protection Association. 1991. NFPA 911. Protection of Museums and Museum Collections, 1991 edition. National Fire Protection Association, Quincy, Massachusetts, 29 pp.

National Institute for Conservation. 1990. *Emergency Preparedness and Response: Materials Developed from the NIC Seminar.* National Institute for Conservation of Cultural Property, Washington, D.C., 47 pp.

National Park Service. 1990. *Museum Handbook. Part 1. Museum Collections.* National Park Service, Washington, D.C.

Ogden, S. (ed.). 1992. *Preservation of Library and Archival Materials: A Manual.* Northeast Documentation Center, Andover, Massachusetts.

Olkowski, W. S. Daar, and H. Olkowski. 1992. *Common-sense Pest Control.* Taunton Press, Newtown, Connecticut, 715 pp.

Pearce, S. 1990. *Archaeological Curatorship.* Smithsonian Institution Press, Washington, D.C., 223 pp.

Peltz, P., and M. Rossol. 1983. *Safe Pest Control Procedures for Museum Collections.* Center for Occupational Hazards, New York, 8 pp.

Phelan, M. 1982. *Museums and the Law.* American Association of State and Local History, Nashville, Tennessee, 287 pp.

Pinniger, D. 1989. Insect Pests in Museums. Institute of Archaeology Publications, London, 45 pp.

Porter, D. R. 1985. Current thought on collections policy: Producing the essential document for administering your collections. American Association of State and Local History, Technical Report 1:1–12.

Ritzenthaler, M. L. 1983. *Archives & Manuscripts: Conservation.* Society of American Archivists, Chicago, 151 pp.

Rose, C. L. 1991. Conservation of natural history collections: Addressing preservation concerns and maintaining the integrity of research specimens. Pp. 51–60 in *Natural History Museums: Directions for Growth* (P. S. Cato and C. Jones, eds.). Texas Tech University Press, Lubbock, Texas, 252 pp.

Simerly, R. 1982. Strategic long-range planning. Museum News, 60(6):28–31.

Simmons, J. E. 1987. *Herpetological Collecting and Collections Management.* Society for the Study of Amphibians and Reptiles, 70 pp.

———. 1991. University of Kansas working paper on collections management policy. Association of Systematics Newsletter, 19(2):25–26.

———. 1993. Natural history collections management in North America. Journal of Biological Curation, 1(3/4):1–17.

Solley, T. T., J. Williams, and L. Baden. 1987. *Planning for Emergencies: A Guide for Museums.* Association of Art Museum Directors, American Association of Museums, Washington, D.C., 72 pp.

Stansfield, G. 1985. Pest control—a collection management problem. Museum Journal, 85(2): 97–99.

Stolow, N. 1986. *Conservation and Exhibitions: Packing, Transport, Storage, and Environmental Considerations.* Butterworths, London, 266 pp.

Thomson, G. 1986. *The Museum Environment* (second edition). Butterworths, London, 293 pp.

Waddington, J., and J. Fenn. 1986. Health and safety in natural history museums: An annotated reading list. Pp. 117–121 in *Proceedings of the 1985 Workshop on Care and Maintenance of Natural History Collections* (J. Waddington and D. M. Rudkin, eds.). Royal Ontario Museum, Life Sciences Miscellaneous Publications, v + 121 pp.

Webster, L. 1990. Altered states: Documenting changes in anthropology museum objects. Curator, 33/2:130–160.

Weil, S. 1987. Deaccession practices in American museums. Museum News, 65(3):44–49.

Williams, S. L., and C. A. Hawks. 1992. The condition of type specimens of *Peromyscus.* Journal of Mammalogy, 73(4):731–743.

Williams, S. L., R. Laubach, and H. H. Genoways. 1977. A guide to the management of recent mammal collections. Special Publication, Carnegie Museum of Natural History, 4:1–105.

Wolf, S. J., ed. 1990. *The Conservation Assessment: A Tool for Planning, Implementing, and Fund-raising.* Getty Conservation Institute and the National Institute for the Conservation of Cultural Property, Los Angeles, 50 pp.

Yang, M. 1989. Manuals for museum policy and procedures. Curator, 32(4):269–274.

Zycherman, L. A., and J. R. Schrock (eds.). 1988. Recommended institutional policies. Pp. 3–4 in *A Guide to Museum Pest Control.* Association of Systematics Collections and American Institute for Conservation, Washington, D.C., 205 pp.

APPENDIX I. Guidelines for developing written policies for the management and care of natural history collections.

Ethics Policy

General description.—Basis for establishing a set of principles to insure proper behavior and obligations toward society and with respect to standards established by the museum and scientific communities.

Objective.—Develop a framework that reflects the institution's and collection's commitment to professional standards and values for the acquisition, care, management, use, and disposal of collections.

Issues to be addressed.—

1) Service by the institution and collection to society and for benefit of the public.
    a) Preservation of natural heritage for posterity.
    b) Personal conduct of trustees, staff, and volunteers.
    c) Relevance of collections to mission of institution and individual department.
    d) Accountability for collections by staff and trustees to institution and public.
2) Legal issues.
    a) Liability of governing body.
    b) Personal conduct of trustees, staff, and volunteers.
    c) Acquisitions.
    d) Accessibility of collections and programs.
    e) Deaccessioning.
3) Loyalty and conflict of interest.
    a) Personal conduct of trustees, staff, and volunteers.
    b) Personal collections.
4) Management and care of collections.
    a) Standards and guidelines set by professional societies.
    b) Need for responsible evaluation and planning (short and long-range).
        1) Prioritization of needs.
        2) Allocation of resources (personnel, space, equipment, time, etc.).
5) Professional Society Codes of Ethics.
    a) Museum and conservation societies.
    b) Scientific societies.

Documentation Policy

General description.—Basis for insuring that the extent and quality of information pertaining to the specimens and collections, including all associated parts and transactions, are thorough, accurate, and meet professional standards, and that all such documentation is properly maintained, managed, and cared for.

Objectives.—To establish standards for the nature and quality of both the data collected for specimens and the information maintained as part of the collection record; to establish standards for the management and care of all documentation, including libraries and archives.

Issues to be addressed.—

1) Institutional commitment.
    a) Quality and extent of documentation.
    b) Management and care of documentation.
2) Professional standards.
    a) Scientific disciplines.
    b) Museum specialties (registration, conservation, collection management, etc.).
3) Collection information.
    a) Accessions.
    b) Catalogs.
    c) History of use (loans, sampling, etc.).
    d) Treatment (fumigations, standard processing procedures, etc.).
    e) Magnetically stored data.
    f) Data generated from research use of collection.
4) Specimen information.
    a) Data.
        1) Specimen labels.
        2) Field records.
    b) Condition of specimen.
    c) Treatment (preservation methods, etc.).
    d) History of use.
5) Library.
6) Archives.
7) Film, slides, videos, recordings.

Acquisition Policy

General description.—Basis for adding new specimens permanently to the collections, and to establish institutional control over the specimens.

Objectives.—Develop responsible and ethical guidelines for adding specimens to the permanent collection of the institution; protect credibility of the institution and collection.

Issues to be addressed.—

1) Clarify the scope of the collections.
    a) Define ownership.
    b) Purpose of collections relative to mission of institution.
    c) Disciplinary scope of collections.
    d) Taxonomic scope of collections.
    e) Geographical scope of collections.
2) Identify acceptable methods for acquisition.
3) Establish criteria for evaluation of potential donations.
    a) Collection priorities.
    b) Uniqueness of specimen or collection of specimens.
    c) Legality.
    d) Ethical considerations.
    e) Documentation (extent and degree of accuracy).
    f) Physical integrity.
    g) Institution's ability to provide adequate protection and care.
    h) Impact on existing institution and collection resources.
    i) Encumbrances or conditions of donation.
    j) Appraisals.
4) Establish authority and responsibility for evaluation process.
    a) Individual(s).
    b) Committee.
    c) Governing body.
5) Level of documentation required.
    a) Information to permit evaluation.
    b) Information to substantiate result of evaluation.
    c) Deed of gift and transfer of title.
    d) Accessioning process.

PREVENTIVE CONSERVATION POLICY

General description.—Basis for developing procedures to minimize or eliminate chemical, physical, or biological deterioration.

Objectives.—To recognize the agents of deterioration and to control them appropriately for maximum long-term preservation of the collection; develop parameters for activities involving the collections so as to minimize the effects of chemical, biological, and physical deterioration or damage.

Issues to be addressed.—

1) Establish institutional commitment to preservation.
    a) Role of preventive conservation.
    b) Importance of stable environment.
    c) Importance of appropriate storage.
    d) Importance of appropriate handling and exhibition techniques.
    e) Importance of adequate documentation.
2) Establish authority and responsibility of appropriate staff.
    a) Museum-wide.
    b) Department level.
    c) Individual(s).
3) Level of documentation required.
    a) Environment.
    b) Storage.
    c) Handling and shipping.
    d) Condition reporting.
4) Procedures to meet professional standards.
    a) Environmental conditions.
    b) Storage.
    c) Exhibition.
    d) Handling and shipping.

Access Policy

General description.—Basis for providing and promoting appropriate access to and use of specimens and their data.

Objectives.—Develop guidelines for permitting responsible and ethical access to collection areas, specimens, and associated data while insuring their security; develop procedural guidelines for access to specimens and data.

Issues to be addressed.—

1) Balance access for use with need to preserve.
2) Establish criteria for permitting use.
    a) Legitimate reason for using collections.
    b) Knowledge of techniques for handling specimens.
    c) Willingness to comply with institution's security precautions.
3) Establish authority and responsibility.
    a) Authority to approve requests.
    b) Responsibility for monitoring access.
4) Legislation.
    a) Freedom of Information Act and/or comparable legislation.
    b) Americans with Disabilities Act and/or comparable legislation.
    c) Issue of museums holding collections in the public trust.
5) Documentation.
    a) Requests, evaluation of requests.
    b) Record transactions, records of specimens used.
6) Minimal standards to accommodate physical presence of users in collection.
    a) Security at several levels of physical plant.
        1) Building (locks, keys, alarms, etc.).
        2) Room.
        3) Case.
        4) Human security.
    b) Security based on functional issues.
        1) Physical integrity of specimens.
        2) Procedural guidelines for handling specimens.
        3) Informational aids to assist visitors.
        4) Finding specimens in collection.
        5) Physical handling.
7) Issues subject to conditions set forth in access policy.
    a) Loans for research, educational programs, or exhibitions.
    b) Sampling.
    c) Use of specimen for reproductions and photography.
    d) Use of magnetically stored data.

Loan Policy

General description.—Basis for temporarily placing specimens in the care of others who are not directly associated with the collection for research, educational programs, or exhibits.

Objectives.—Develop guidelines for permitting responsible and ethical use of specimens and their data while insuring their physical and chemical integrity; develop parameters for use of specimens.

Issues to be addressed.—

1) Definition of loan.
2) Clarification of which specimens are available for loans; restrictions.
3) Establish authority and responsibility.
    a) Loan approvals.
    b) Loan processing and documentation.
4) Evaluation of requests to use specimens.
    a) Policy regarding accessibility.
    b) Purpose of loan.
    c) Description and quantity of material needed.
    d) Where and under whose authority specimens will be housed.
    e) Length of loan.
    f) Legal ramifications.
        1) National laws and permits.
        2) International laws and permits.
5) Establish guidelines for loan.
    a) Duration and request for extensions.
    b) Approvals for changing where specimens are housed and used.
    c) Approvals for sampling, testing, etc.
    d) Storage, handling, and shipping parameters (e.g., materials, environmental conditions).
    e) Costs associated with shipping and insurance.
    f) Credit for lending institution in publication.
6) Establish guidelines for processing loans.
    a) Documentation.
    b) Condition reports.
    c) Packing guidelines and use of appropriate materials.

Sampling Policy

General description.—Basis for responsible specimen use that may result in changing specimen integrity as the result of sampling.

Objectives.—Develop parameters for permitting responsible and ethical use of specimens, enhancing their research value while minimizing the effects of sampling and testing; develop parameters for determining procedures and documentation regarding specimen use for sampling purposes.

Issues to be addressed.—

1) Definition of terms.
    a) Testing, sampling.
    b) Destructive, non-destructive.
    c) Other commonly used terms (e.g., consumptive, invasive).
2) Clarification of which specimens are available for destructive sampling; restrictions.
    a) Type specimens.
    b) Endangered, threatened, or extinct species.
3) Establish authority and responsibility.
    a) Individual or committee approach for approvals.
    b) Perspectives of researcher, conservator, and collection manager.
    c) Processing and documenting request.
4) Evaluation of requests to use specimens.
    a) Policy regarding access.
    b) Purpose of loan request.
    c) Description and quantity of material needed.
    d) Description of techniques to be used and why they are appropriate.
    e) Name and qualifications of individual(s) associated with project.
    f) Legal ramification.
        1) National laws and permits.
        2) International laws and permits.
5) Establish parameters for sampling process.
    a) Disposition of usable samples and unused portion of specimens.
    b) Disposition of resulting analytical data or preparations.
    c) Documentation of methods.
    d) Costs associated with sampling, shipping, and insurance.
    e) Credit for institution in publications.
6) Establish parameters for processing requests.

Treatment Policy

General description.—Framework to permit responsible specimen treatment, that is, physical or chemical actions used to stabilize a specimen or collection.

Objectives.—To properly evaluate specimen treatment needs and potential risks based on scientific criteria; to perform needed treatment in a responsible manner according to knowledge, skills, and ability; to scientifically document treatment activities.

Issues to be addressed.—

1) Establish authority and responsibility based on expertise from perspectives of use, management and care.
    a) Evaluation.
    b) Decision-making.
    c) Conducting treatments.
2) Examination and documentation of specimen(s).
    a) Evaluation.
        1) Cause of damage.
        2) Type and extent of corrective action needed.
        3) Impact of corrective action.
    b) Condition reporting (pre-and post-treatment, including graphic documentation).
    c) Treatment proposal.
        1) Review of options.
        2) Risk assessment for each option.
        3) Recommendation and justification.
3) Conducting treatment.
    a) Individual qualified relative to type of treatment.
    b) Treatment documentation.
    c) Materials, methods.
    d) Treatment assessment.

Pest Control Policy

General description.—Framework to permit the institution to responsibly deal with the restriction or elimination of organisms that directly or indirectly pose a threat of biological degradation to specimens or collections.

Objectives.—Develop and maintain pest-free environments; develop responsible procedures for handling infestations.

Issues to be addressed.—

1) Commitment to prevention and institution-wide management approach.
   a) Recognize risk management process.
      1) Identify materials at risk; monitoring process.
      2) Identify areas requiring control.
      3) Identify likely pests.
      4) Prevention.
      5) Passive and active controls.
   b) Health and safety issues.
   c) Legal responsibilities.
2) Establish authority and responsibility.
   a) Museum-wide responsibility for prevention.
   b) Individual(s) and committee.
   c) Contracted services of certified pest control specialists.
3) Develop parameters for prevention.
   a) Inspection of collections, exhibits, related areas.
   b) Traps for monitoring.
   c) Proper storage.
   d) Work habits, housekeeping.
   e) Handling of loans.
   f) Handling of food items, institutional receptions, etc.
   g) Handling of living plants and animals.
   h) Storage and handling of field equipment.
4) Develop parameters for handling active pest problems.
   a) Isolation of problem specimen(s) or area.
   b) Problem assessment.
   c) Pest identification.
   d) Review and analysis of pest control treatment(s).
   e) Housekeeping treatment(s).
   f) Surveillance.
5) Documentation.
   a) Preventive measures.
   b) Active pest problems and treatments.

Health and Safety Policy

General description.—Basis for promoting good health and safe conditions for individuals associated with specimens and collections.

Objectives.—Provide conditions in collection areas that do not compromise the health and safety of staff, visitors, or other individuals; develop procedures for handling situations where the health and/or safety of an individual(s) has been compromised.

Issues to be addressed.—

1) Institutional commitment for safe environment.
2) Establish authority and responsibility.
    a) Individual (Health and Safety Officer).
    b) Committee.
3) Legal and ethical responsibilities.
    a) Institutional.
    b) Supervisor.
    c) Individual.
4) Develop parameters for recognizing and eliminating or controlling hazards.
    a) Hazard recognition (chronic vs. acute risks).
        1) Health (chemical and electromagnetic exposure).
        2) Safety.
            a) Physical threats.
            b) Fire.
            c) Utilities.
    b) Hazard elimination or control.
        1) Legal and ethical protection.
        2) Safety equipment and supplies.
            a) Monitoring and detection devices.
            b) First aid equipment.
            c) Fire equipment.
            d) Clean-up equipment.
            e) Protective clothing and equipment.
    c) Personnel.
        1) Training.
        2) Testing.
        3) Monitoring illnesses and injuries.
    d) Identify sources of assistance.
        1) Advice.
        2) Control.
        3) Medical.

Emergency Preparedness Policy

General description.—Basis for reducing the adverse effects to collections and/or personnel in the event of an emergency.

Objectives.—Provide a level of preparedness for emergencies to reduce the adverse effects to collections and personnel.

Issues to be addressed.—

1) Establish authority and responsibility (committee, individuals, etc.).
2) Identify potential disasters.
    a) Fire (flame, heat, smoke).
    b) Flooding.
    c) Power failure.
    d) Earthquake.
    e) Weather damage.
    f) Human factor.
        1) Vandalism/theft.
        2) War.
3) Identify specific areas of risk.
    a) Materials (e.g., flammable materials and fluids).
    b) Location (e.g., windows and poor drainage areas).
    c) Storage designs (e.g., shelves vs. cases).
    d) Sensitive collections (e.g., frozen tissues).
    e) Valuable specimens (e.g., types, endangered species, ivory, gems, precious metals).
    f) Data.
4) Establish avoidance strategies.
    a) Preferred location of building, specimens inside building, etc.
    b) Disaster resistant facilities and equipment.
5) Develop mitigation strategies.
    a) Establish authority and responsibility for specific tasks.
    b) Personnel training and testing of procedures.
    c) Familiarity of location and operation of utilities.
    d) Identification of available resources.
        1) Expertise.
        2) Alternative storage sites.
        3) Supplies and equipment.
        4) Special services (e.g., medical, fire, security).
    e) Insurance.
6) Develop recovery strategies.
    a) Establish authority and responsibility.
        1) Specific tasks.
        2) Management of immediate recovery process.
        3) Management of long-term recovery process.
    b) Parameters for securing area.
    c) Parameters for assessment of damage.
        1) Primary—immediate.
        2) Secondary—immediate.
        3) Long-term.

EMERGENCY PREPAREDNESS POLICY—CONTINUED

d) Resource management (volunteers, staff, supplies, equipment, etc.).
e) Documentation.

Deaccessioning Policy

General description.—Basis for allowing institutions to permanently remove specimens from collections by responsible methods.

Objectives.—Develop responsible and ethical parameters for permanently removing specimens from the ownership of the institution/collection; enhance protection of the institution/collection from public or political scrutiny.

Issues to be addressed.—

1) Establish responsibility and authority.
    a) Committee.
    b) Administrative body.
2) Reasons for deaccessioning.
    a) Object does not relate to institution's or collection's mission.
    b) Object is a duplication of material.
    c) Object is a health or safety hazard.
    d) Object is damaged beyond utilization.
    e) Object is part of an exchange agreement.
    f) New issues regarding legality or ownership.
    g) Repatriation.
    h) Institution or collection is unable to provide proper care.
3) General protocol.
    a) Confirm clear and unrestricted title.
    b) Obtain proper approval for deaccessioning.
    c) Notify donor of deaccession if appropriate.
    d) Document all deaccession transactions.
    e) Clarify use of any returns in the event of exchange or sale.
    f) Provide proper disposal.
4) Methods of disposal.
    a) Exchange.
    b) Donation or transfer.
    c) Sales.
    d) Destructive analyses for research/documentation.
    e) Destroy and discard.

SANDBLASTED PLASTIC BOXES FOR PROCESSING SPECIMENS IN DERMESTID COLONIES

FREDERICK J. JANNETT, JR. AND JOHN G. DAVIES

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The usual procedure for processing skulls and skeletal material through a dermestid beetle colony is to place each specimen in a separate tray. Small skulls, such as those of mice, are most commonly distributed in cardboard or styrofoam egg cartons as suggested by, for example, Hildebrand (1968) and Williams (1992). A carton has an array of 2 × 6 units or 5 × 6 units. The advantages of these cartons are that they have cells of an appropriate size and are usually free.

There are, however, several major disadvantages of the cartons for processing small skulls. Skulls can be damaged if cartons are stacked, a problem that may be partially alleviated with the larger cartons which can be placed perpendicular to one another. Another disadvantage is that larvae accumulate on the undersides of the cartons, resulting in a loss of larvae if the cartons containing skeletal material are fumigated before larvae are removed. In addition, cartons that have been fumigated may not be suitable for reuse in the dermestid colony. Other problems include fouled specimens due to chewed cardboard and styrofoam, allergic reaction by the worker to accumulated debris, difficulty in seeing small teeth or bone fragments in the cells, and movement of small skulls from one cell to another by exuberant larvae.

As an alternative to cartons, we have adapted for use high-density polystyrene (grade 202, High E crystal) boxes with fixed partitions. A different modification and use of the same box for degreasing skulls was described by Jannett and Davies (1989). Figure 1 shows the bottom view of the modified box. The lid of the box is removed and discarded. A 20 × 30 mm piece of ⅜-inch plexiglass is glued with methylene chloride to each outside bottom corner of the box so that it protrudes about 4 mm from each vertical side. These act as dividers between stacked boxes to provide access for beetles and larvae. Another piece of ⅛-inch plexiglass, 11 × 21 mm, is glued to the bottom of the first, so that, when the boxes are stacked, these lower pieces nest in the respective cells below to prevent the boxes from sliding. Lastly, all surfaces are sandblasted to roughen them to facilitate easier movements of larvae. We used a conventional sandblasting machine in a table-top abrasive chamber, a piece of equipment commonly used in museum paleontology laboratories for the removal of matrix from fossils. The boxes are placed in aquaria lined with cardboard to provide the necessary harborage for beetles.

The boxes have none of the disadvantages of egg cartons discussed above, and have some additional advantages. The box we have chosen for small mammal skulls is 180 × 250 × 40 mm (O.D.) and has 36 cells. It is smaller in length and width than the carton of 30 cells and so is more easily accommodated in the dermestid colony aquaria. A stack of five boxes containing 180 skulls requires 37% less space than in a stack of six 30-cell cartons.

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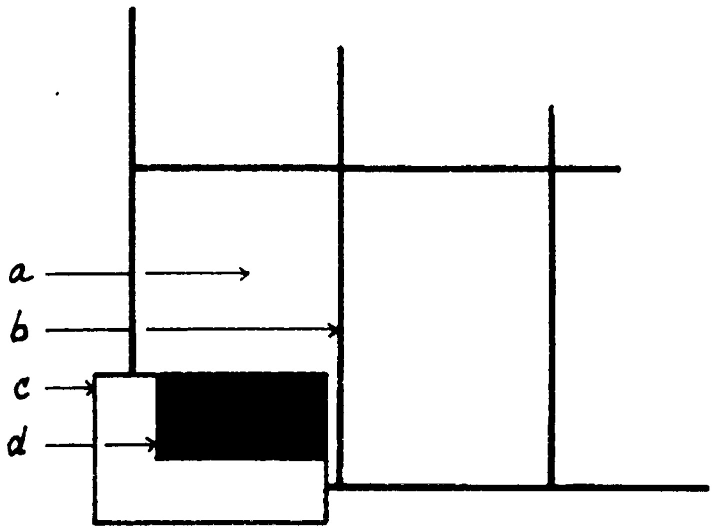

Figure 1. a = bottom of the box; b = bottom of an internal partition; c = block glued to bottom of box, d = block glued to bottom of first block.

A box the size described above can be sandblasted in approximately four minutes. We have successfully processed more than 8,000 skulls in these boxes. The boxes are not subjected to any fumigant, and use with a fumigant should be undertaken only after investigation of possible reactivity of the plastic with the intended fumigant. Boxes of various sizes are available commercially.[1]

Literature Cited

Hildebrand, M. 1968. *Anatomical Preparations.* University of California Press, Berkeley, 100 pp.

Jannett, F. J., Jr., and J. G. Davies. 1989. An inexpensive apparatus for degreasing skulls. Curator, 32:88–90.

Williams, S. L. 1992. Methods of processing osteological material for research value and long-term stability. Collection Forum, 8:15–21.

[1] Cargille Laboratories, Inc., 55 Commerce Road, Cedar Grove, NJ 07009.

BOOK REVIEWS

GUIDELINES AND STANDARDS FOR FOSSIL VERTEBRATE DATABASES, 1991, Stanley D. Blum, ed. (Society of Vertebrate Paleontology, U.S.A., 129 pp.) This publication summarizes the results of the Society of Vertebrate Paleontology Workshop on Computerization held November 1–4, 1989, in Austin, Texas, which was attended by 27 participants from a wide range of institutions, and represents considerable additional work by the working group formed after the workshop. Both the workshop and the working group efforts were supported by the National Science Foundation. The guidelines and background presented are relevant to and will be tremendously and practically useful for establishment of any museum collection database, regardless of the discipline or kind of object to be cataloged.

Chapter 1, the Introduction, by Michael J. Novacek, Stanley D. Blum, and Leslie F. Marcus, gives a brief background on the workshop and working group. It also presents the results of a survey on collection trends and use of computers in vertebrate paleontology. For each institution that responded, information is given on how many specimens are held, how many records have been computerized, and what kind of software and hardware were used.

In Logistics and Planning for Computerization, Samuel A. McLeod and Melissa C. Winans give simple, straightforward, realistic advice on what must be considered at each phase of developing a computerized database system. The issues range from the need to evaluate the status of records and objects to the need to plan for long-term data and equipment maintenance, staff training, and upgrades. Even though the authors point out that they are just touching the surface of this topic, any curator beginning to plan for computerization should follow this chapter carefully, step-by-step, and take each statement very seriously. McLeod and Winans give *excellent* advice about the process and following that advice could well save substantial time, energy, and frustration in the long run.

Chapter 3, Computerization Fields for Vertebrate Paleontology, by Samuel A. McLeod, uncovers a number of issues related to how biologists capture and think about their data. Although this chapter is more specific to paleontological issues, similar questions and controversies are likely to arise in any discipline. Although this is not mentioned, one presumes that data fields used throughout paleontology follow standards established for the broader discipline. Efforts are underway to establish data standards for systematics collections generally, coordinated by the Association of Systematics Collections, and these will no doubt be linked to the vertebrate zoology standards as well.

In Trends in Computing, John Damuth gives a brief overview of the directions computing is taking in academic and museum institutions. He discusses the pros and cons of centralized versus dispersed databases and the use of various kinds of networks. Stanley D. Blum, in Exchanging Collection Data, brings together the ideas presented in the previous two chapters, discussing the ethical issues raised by increased data sharing opportunities, the practical considerations of using data from more than one collection, and data exchange formats and procedures. This is a more technical chapter, and for those curators who are less computer-literate it will be a useful tool for communicating with their computer support staff.

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Blum presents An Information Model for a Vertebrate Paleontology Collection in Chapter 6. A data model forms the heart of any successful computerization project. It is a codified way of expressing what information is to be gathered, how each piece relates to any other piece, and how the information will be used. Biologists do this kind of thinking all the time, but in fitting ideas and concepts into a data model, one is forced to be much more disciplined and precise than usual. As Blum points out, there often is controversy about what the data elements are or how they relate. These differences of opinion are not based on questions of computer science, they are real issues about how biological information is interpreted and used, and the exercise of arguing them through can be very enlightening. This chapter is also rather technical, but it will help those curators who are working with computer specialists to explain what the relationships are among their data elements.

The three appendices will also be very useful. Appendix 1, compiled by J. Howard Hutchison, gives a list of acronyms, institutional names, and acronymic synonyms. Appendix 2, Element Names and Modifiers: A Vocabulary for Describing Vertebrate Fossils, by J. Howard Hutchison, will be very important for facilitating data exchange. Appendix 3, Using Bitnet, by Stanley D. Blum, gives step-by-step instructions on using this network.

This is an excellent, carefully thought out, and extremely useful report. It can be obtained at no cost from Dr. Michael Novacek, Department of Vertebrate Paleontology, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024-5192.—*Nancy R. Morin, Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166.*

GUIDE TO THE CURATION OF ARCHAEOZOOLOGICAL COLLECTIONS, 1991, Erin Henry, ed. (Florida Museum of Natural History, Gainesville, Florida, 105 pp.) This publication contains the proceedings of the Curation Workshop held in conjunction with the Sixth International Conference of the International Council of Archaeozoology at the Smithsonian Institution, Washington, D.C., in May, 1990. The stated intent of the publication is "to serve as the basis for a working document to be revised and added to as new methods and curatorial products become available."

The guide is organized around five general topics, following the organization of the workshop itself. These are 1) accession procedures, 2) preparation and conservation, 3) cataloguing, 4) storage, and 5) accessibility. Altogether, nineteen papers cover one or more aspects of these general topics.

Thirteen appendices include bibliographies of accessions policies and procedures, acquisition and collection policies and procedures, laws, regulations and ethics regarding comparative collections, a list of organizations and publications of interest to zooarchaeologists, standards for modern osteological collections, standards for curation of zooarchaeological collections and modern comparative collections, conservation of zooarchaeological collections and a list of organizations for museum data standards/computerization. Finally, there is a selected bibliography from *Curator.* This volume brings together in one place a wealth of information useful to those who are involved in preparing and curating collections, either of zoological materials from archaeological sites, or modern zoological materials used for comparison with archaeozoological specimens. A note of thanks is due to the organizers of the workshop, Elizabeth S. Wing, Florida Museum of Natural History, Gainesville, and Melinda Zeder, Smithsonian Institution, Washington, D.C.

Erin Henry has attempted to include every workshop participant's contribution. Thirteen authors submitted documents while six of the papers are the result of transcription by Henry, who states in the introduction, that, in the interest of time, the transcribed papers are printed without review by the authors. Henry's transcription represents a great amount of effort and time and is largely successful. However, unhappily, there are a great many spelling errors which could have been eliminated with a spell-checking program. Also, in one paper (Kehoe), the references mentioned were not provided and references were incomplete in another (Crockford). The guide is a modest publication, bound simply with a plastic spiral binding, containing the cost to an affordable $9.00, including postage and handling. The guide may be ordered from Elizabeth S. Wing, Florida Museum of Natural History, Gainesville, Florida 32611.—*Tonya Baroody Largy, Zooarchaeology Laboratory of the Peabody Museum, Harvard University, 11 Divinity Avenue, Cambridge, Massachusetts 02138.*

CONTROLLED WILDLIFE VOLUME I: FEDERAL PERMIT PROCEDURES SECOND EDITION, 1993, Revised and Updated by Richard Littell. (The Association of Systematics Collections, Washington, D.C., 271 pp.) Ten years ago the Association of Systematics Collections (ASC) began publication of its Controlled Wildlife Series, intended to make information about wildlife laws and permit procedures accessible and understandable to professional biologists and the general public. The primary purpose for the series, according to ASC, is to facilitate compliance with these regulations. It was further hoped that an overview of regulatory superstructure might foster changes and improvements in wildlife lawmaking and enforcement. Since the series was first published (1983–85) many changes have indeed occurred in wildlife law; the second edition incorporates these changes. Volume I renders the often complex regulations regarding wildlife permits comprehensible and easily accessed. Federal statutes that control the use of wildlife are summarized in concise, easily read outline format, as are application procedures for all Federal wildlife permits.

The book's total number of pages had to be computed for this review because the volume is divided into A and B sections, each of which is separately paginated. Section A is comprised of 169 pages and deals with the laws themselves (e.g., Endangered Species Act, Migratory Bird Treaty Act, etc.), explaining in detail all controlled activities as well as exemptions, special cases, and permit application information. The latter very conveniently includes current fees and full addresses of Federal offices responsible for each type of permit. Throughout this section the reader is directed through the text by following a "dichotomous key" kind of format. By answering "yes" or "no" to graphically blocked questions, the reader can conveniently learn if a proposed activity requires a permit, and if so, exactly which one, and to which page to turn for information.

Section B totals 94 pages and can best be described as an appendix or series of appendices. It reproduces all permit application forms and their instructions for use precisely as the U.S. Fish and Wildlife Service issues them. These are actual photo reproductions of government forms which invariably had to be reduced to fit the book's 7″ × 10″ format, rendering some of the text difficult (if not impossible) to read.

ASC is to be commended for publishing what will serve as a handbook for many of us who deal with biological collection materials regulated by Federal wildlife laws. It should help dissipate much of the confusion that often clouds matters concerning wildlife collecting regulations and thus help reduce widespread, albeit innocent, non-compliant practices among working professionals. My suggestions for future printings or later editions are purely technical: paginating consecutively the entire volume even if the A and B section format is retained, inclusion of an index (in addition to the highly detailed Table of Contents), and correcting the problem of illegibility of photo-reduced documents, perhaps by enlarging the book's size. This volume belongs in the reference library of every wildlife biologist and biological collections manager.—*Marilyn R. Massaro, Museum of Natural History, Roger Williams Park, Providence, Rhode Island 02905.*

Preparation of Manuscripts

General.—It is strongly recommended that, before submitting a paper, the author ask qualified persons to appraise it. The author should submit three copies of the manuscript either typewritten or printed on letter quality printers. **All parts of the manuscript must be double spaced** with pica or elite type on 8½ × 11 inch (21.6 by 27.9 cm) or A4 paper and at least one inch (2.5 cm) margins on all sides. Manuscripts should not be right justified, and manuscripts produced on low-quality dot matrix printers are not acceptable.

Each page of the manuscript should be numbered. Do not hyphenate words at the right-hand margin. Each table and figure should be on a separate page. The ratio of tables plus figures to text pages should generally not exceed 1:2.

The first page includes the title of the article, names of authors, affiliations and addresses of authors, and the abstract if present. In the top left-hand corner of the first page, indicate the name and mailing address for the author to whom correspondence and proofs should be addressed. All subsequent pages should have the last names of the authors in the upper left-hand corner.

The preferred language for manuscripts is English, but a summary in another language can precede the literature cited, if appropriate. Manuscripts written in other languages will be considered if the language uses the Roman alphabet, an English summary is provided, and reviewers are available for the language in question.

Abstract.—An abstract summarizing in concrete terms the methods, findings and implications discussed in the paper must accompany a feature article. The abstract should be completely self-explanatory and should not exceed 200 words in length.

Style and abbreviations.—Symbols, units, and nomenclature should conform to international usage. Cite all references in the text by the author and date, in parentheses. Footnotes should be avoided. For general matters of style authors should consult the "Chicago Manual of Style," 13th ed., University of Chicago Press, 1982.

Literature cited.—This section includes only references cited in the manuscript and should be typed double spaced. References are listed alphabetically by authors' names and take these forms:

Jones, E. M., and R. D. Owen. 1987. Fluid preservation of specimens. Pp. 51–64 in *Mammal Collection Management* (H. H. Genoways, C. Jones, and O. L. Rossolimo, eds.). Texas Tech University Press, Lubbock, 219 pp.

Sarasan, L. 1987. What to look for in an automated collections management system. Museum Studies Journal, 3:82–93.

Thomson, G. 1986. *The Museum Environment*, 2nd ed. Butterworths, London, 293 pp.

Tables and illustrations.—Tables and illustrations should not repeat data contained in the text. Each table should be numbered with arabic numerals, include a short legend, and be referred to in the text. Column headings and descriptive matter in tables should be brief. Vertical rules should not be used. Tables should be placed one to a page, after the references.

All figures must be of professional quality as they will not be redrawn by the editorial staff. They may include line drawings, graphs or black and white photographs. All figures should be of sufficient size and clarity to permit reduction to an appropriate size; ordinarily they should be no more than twice the size of intended reductions and whenever possible should be no greater than a manuscript page size for ease of handling.

Photographs must be printed on glossy paper, with sharp focus and high contrast essential for good reproduction. Photos should be trimmed to show only essential features.

Each figure should be numbered with arabic numerals and be referred to in the text. Legends for figures should be typed on a separate sheet of paper at the end of the manuscript. Magnification scale, if used, should be indicated in the figure by a scale bar, not in the caption. Notations identifying the author and figure number must be made in pencil on the back of each illustration. All illustrations must be submitted as an original and two copies. Note placement of tables and illustrations in the margins of the manuscript.

Evaluation of a manuscript.—Authors should be aware that the following points are among those considered by the editorial staff when evaluating manuscripts: 1) Is the content appropriate to the purpose of the journal and society? 2) Are the contents clearly and logically presented and the paper well organized? 3) Is the methodology technically and logically sound? 4) Does the paper contribute to the body of knowledge and literature? 5) Is the study integrated with existing knowledge and literature? Is the literature cited appropriate for the study? 6) Are the conclusions supported by sufficient data? 7) Does the title reflect the thrust and limitations of the study? 8) Are the tables and figures clearly presented? Are they necessary to support the text?

Submission Procedure

Manuscripts intended either as feature articles or general notes should be submitted in triplicate (original and two copies) to the Managing Editor. Letters to the Editor and correspondence relating to manuscripts should be directed to the Managing Editor. Books for review should be sent to the Associate Editor for Book Reviews.

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