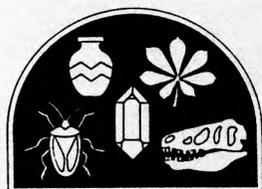


Collection Forum



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OBSERVATIONS OF TEMPERATURE AND RELATIVE HUMIDITY DURING THE COOLING AND WARMING¹ OF BOTANICAL SPECIMENS FOR INSECT PEST CONTROL

MICHAEL J. SHCHEPANEK

Botany Section, Canadian Museum of Nature, Ottawa, Ontario K1P 6P4, Canada

Abstract.—An experiment was conducted using a data logger recording temperature and relative humidity (RH) within boxes of herbarium sheets placed in a domestic type freezer. It was demonstrated that this freezer, currently in use at the Canadian Museum of Nature (CMN), is adequate for achieving and maintaining temperatures required to kill all life stages of insect pests. Times allowed for cooling and warming as well as the packaging of specimens are discussed. Eradication of insect pests with this low temperature technique is insured.

INTRODUCTION

Where an Integrated Pest Management (IPM) policy is not in place, insect infestation can be a great risk to vascular plant collections in herbaria. Insects are usually transmitted to herbaria via plant specimen loans, exchanges, and gifts from infested collections of other herbaria. The most destructive pests usually originate in tropical and semi-tropical environments. It is very important that all herbaria develop an IPM policy which includes screening and eradication processes to eliminate pests that might enter their collections. Although a number of effective controls are available (Bridson and Forman, 1992), one of the more popular methods is the low temperature technique. It is beneficial to use rapid cooling and slow warming procedures to insure 100% mortality (Florian, 1990). T. Strang (1992) assessed data for 46 known museum insect pests and recommends a minimum low temperature lethal boundary model at -30°C for four days (-20°C for 7 days should work as well but the lowest temperature possible should be used to insure success of this method). Domestic type freezers with a temperature capability of about -30°C have been available from retail outlets at a reasonable cost. A. Pinzl (1993) has suggested a modification that can upgrade freezers that do not attain and/or hold the required temperature.

An experiment was conducted at CMN using a domestic type freezer to determine if appropriate conditions could be obtained to eradicate insect pests in the Museum's botanical collections. This was done by:

1. monitoring the internal and external temperatures of boxes containing herbarium specimens placed inside a freezer.
2. recording the time required to lower the internal temperature of a plant parcel in the freezer to -30°C .

¹ The terminology "cooling and warming" is used here in place of what has commonly been termed "freezing and thawing." This is to avoid the connotation of a phase transition, as would be the case in water freezing to form ice and thawing to reform water. When dried and pressed botanical specimens and paper, equilibrated to a moderate relative humidity, are placed in a freezer at -30°C , there is no transformation from liquid to solid as occurs in freezing (Waller and Strang, 1995).

3. recording the time required for a plant parcel to reach room temperature (22°C) after removal from the freezer.

Relative humidity (RH) changes in the plant parcel while in the freezer and while returning to room temperature were also recorded. Visual monitoring of a plant parcel sealed in a polyethylene bag was carried out to determine possible condensation during the warming phase. Condensed moisture could accelerate the deterioration of the specimens, paper labels, and mounting materials by activating mold growth, causing stain migration, softening adhesives, etc. (Michalski, 1993).

METHODS AND MATERIALS

The experiments were conducted in July, 1992 when the average RH in the Botany Section building was the highest at 50–55% (midwinter average RH is 30–35%). The building is climatized so that the average temperature is 20–24°C throughout the year. A Thermor Hygrometer (calibrated against a Beckman Humi-chek model 5C) was used to monitor the building temperature and RH. A commercially available, 20 cu. ft., chest type freezer (Sears' Kenmore model # 47148) purchased in 1984 was used at its lowest temperature setting (rated at -33°C). Use of a non frost free model is recommended to minimize temperature fluctuations.

Plant parcels that consisted of an unsealed corrugated cardboard box measuring 48 cm (l) × 33 cm (w) × 20 cm (h) and that opened from both ends was filled with four bundles of vascular plant specimens. The bundles were wrapped in heavy paper folders (with open ends) that contained an unequal number of double newsprint sheets (total 100 in box) with each sheet holding an unmounted dried and pressed vascular plant specimen. The bundles were separated within the box by single corrugated cardboard sheets as would occur in shipping or storage.

An ACR Systems Inc. data logger (model XT-102) with a connected external probe (model EH-010) was used in the evaluation of the temperature and RH inside and at the edge of the plant parcel. The center of a 46 cm (l) × 30 cm (w) × 0.6 cm (h) sheet of corrugated cardboard was cut out (6 cm × 11 cm) to hold the logger and the probe was attached at one corner of the same cardboard (Fig. 1). The cardboard with logger and probe was placed in the center of the box between the bundles of plants. In this way, the logger would record temperature and RH at the center of the box of plants while the probe would record temperature and RH at the edge of the box. A single box was physically closed but not sealed with tape and was placed in the freezer by itself for seven days. After this period, the box was removed from the freezer and placed on a table where it was allowed to warm to room temperature for two days.

The experiment was conducted a second time with the plant box sealed in a polyethylene bag. On completion of the experiments, the data logger was sent to the Canadian Conservation Institute for downloading into a computer and graphs of temperature and RH versus time were produced for interpretation.

RESULTS

The graphs (Figs. 2, 2a) for the cooling of the unsealed box showed that the external probe (marked Temp ext and RH ext on the graphs) recorded six hours to reach the desired -30°C whereas the temperature of the center of the box documented by the logger (marked Temp int and RH int on the graphs) took 16 hours to reach the same temperature. Initially the RH reading on the external probe dropped from 53% to 15% in less than 0.5 hours but in four hours drifted back up to 25%. The internal logger dropped from 53% to 25% on a gradual curve over a seven hour period. Once leveling off at approximately 25% RH and reaching -30°C, both the logger and probe maintained these readings until the box was removed from the freezer.

During the warming process of the experiment (Figs. 3, 3a), the probe (edge of parcel) recorded seven hours to reach room temperature while the logger (center of parcel) documented a time span of 14 hours to reach the same temperature.

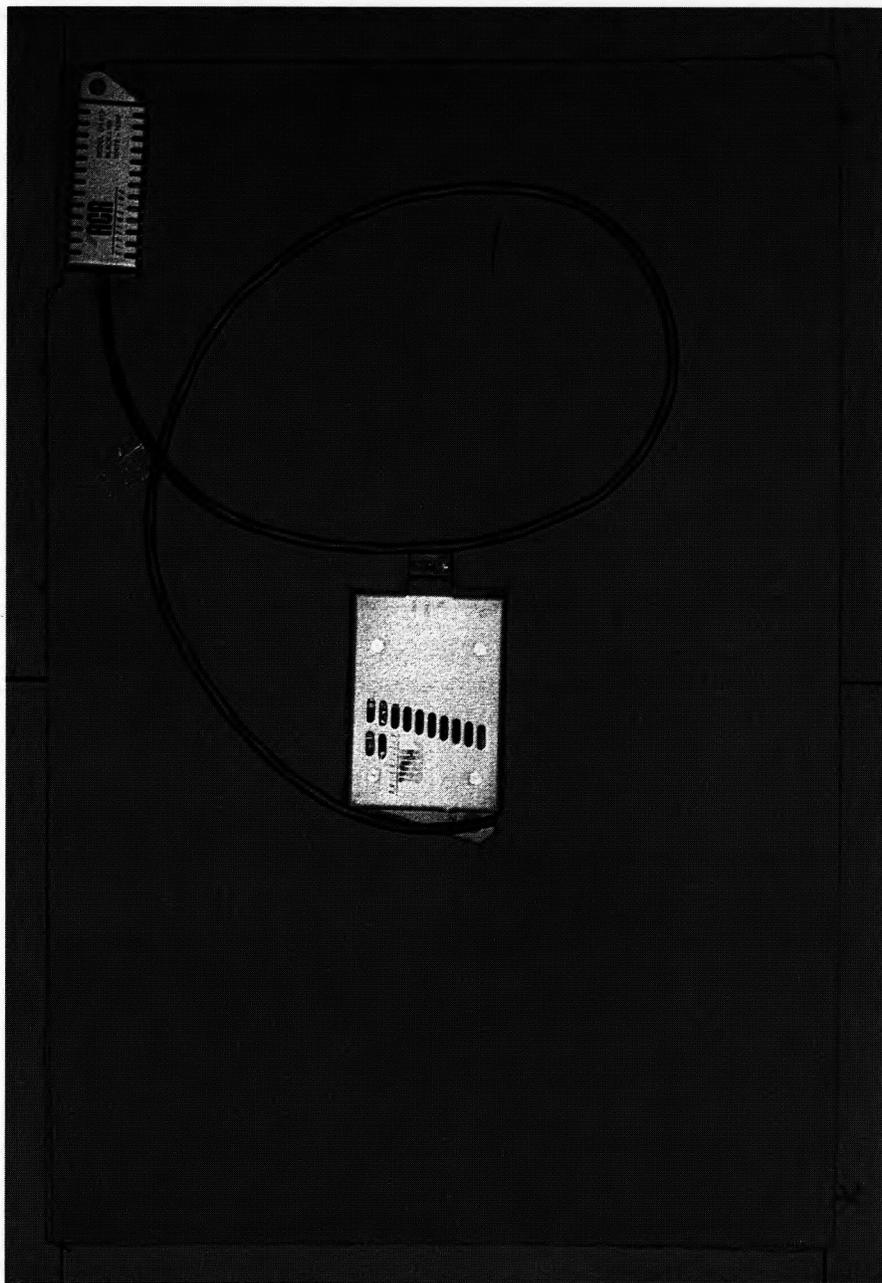


Figure 1. Data logger and probe inserted into corrugated cardboard sheet.

The probe measured a jump of RH from 25% to 45% in less than 0.5 hours then leveled off to approximately 55% over an eight hour period. The logger gradually moved from 25% to 55% over a 10 hour period. No frost buildup was observed on the outside of the parcel after removal from the freezer.

The experiment with the polyethylene bag resulted in temperature and RH

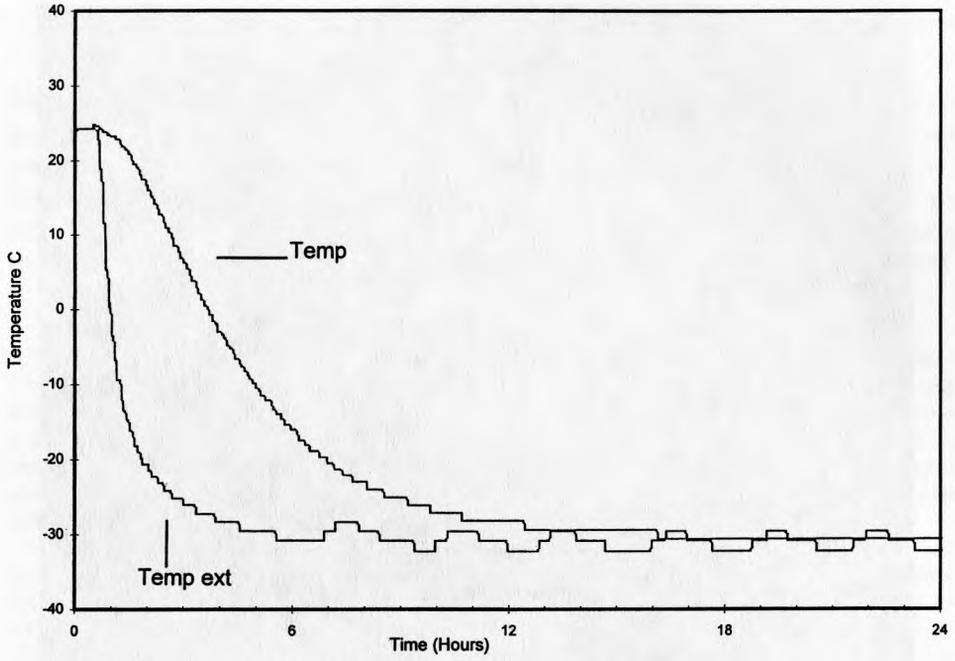


Figure 2. Plant box unsealed—cooling condition temperature.

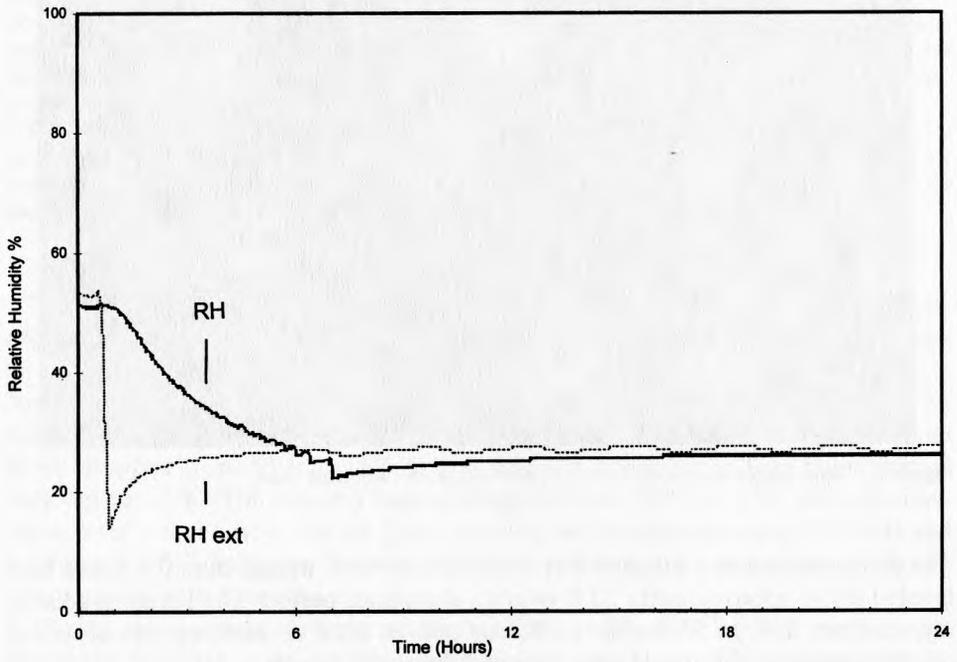


Figure 2a. Plant box unsealed—cooling condition RH.

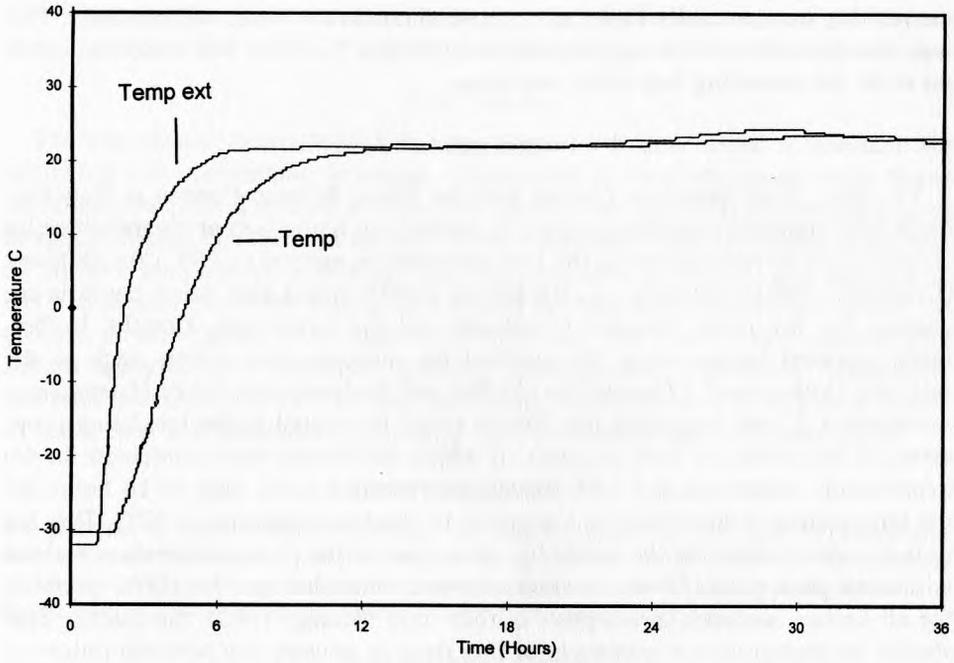


Figure 3. Plant box unsealed—warming condition temperature.

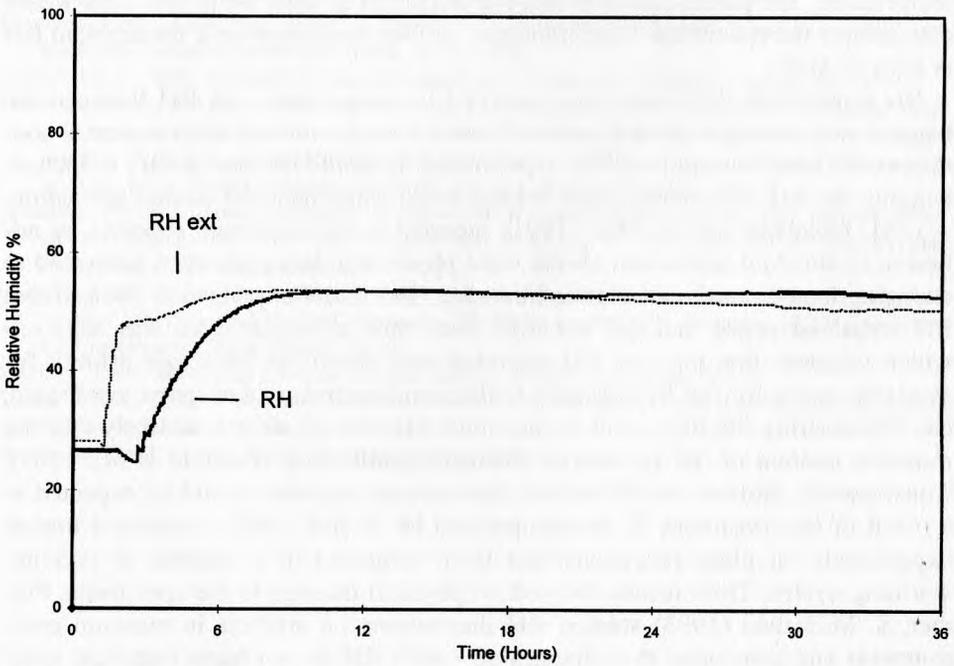


Figure 3a. Plant box unsealed—warming condition RH.

curves that were virtually identical to those obtained for boxes without bags. This was true for both the cooling and warming stages. No frost was observed either on or in the enclosing bag while warming.

DISCUSSION

The New York Botanical Garden and the Royal Botanic Garden at Kew herbaria have reported complete success in controlling herbarium or cigarette beetles (*Lasioderma serricorne*) using the low temperature method (-18°C) for 48 hours (Crisafulli, 1980); however, A. Brokerhof (1989) stated that some herbaria including the Inverness Museum (Scotland) and the Herbarium, Utrecht, Netherlands reported failure using this method for museum pest insects such as the webbing clothes moth (*Tineola bisselliella*) and the herbarium beetle (*Lasioderma serricorne*). It was suggested that failure could be related to the insulating properties of the materials such as paper in which the insects were contained. In the experiments conducted at CMN, the logger recorded a lag time of 16 hours for the temperature in the center of the parcel to reach the optimum -30°C . This lag time is a direct result of the insulating properties of the paper materials contained within the plant parcel. Since the minimum recommended time for 100% mortality for all known museum insect pests is four days (Strang, 1992), the freezer time should be increased to a minimum of five days to prevent any possible failure of this method.

The freezer maintained an acceptable external temperature (-30°C) and external RH (20%) during the cooling period. In the warming process, the logger indicated a time period of 14 hours for the center of the box to reach room temperature (22°C). To insure that the specimens will gradually return to room temperature, the parcel must remain unopened for at least 24 hours. This would also protect the specimens from transient, surface condensation if the ambient RH is high ($>60\%$).

No appreciable difference was recorded in temperature and RH between the bagged and unbagged plant parcels. Given the same ambient environmental conditions recorded during the CMN experiments, it should be unnecessary to include bagging for RH and condensation control when using this pest control procedure.

I. M. Egenberg and D. Moe (1991) reported plant specimens attached by adhesive to standard herbarium sheets were physically damaged when subjected to changing temperature and relative humidity. The CMN experiments showed that RH remained stable and did not drift once thermal equilibrium was achieved which suggests that the low RH recorded was due to an increased affinity for available water by the hygroscopic herbarium specimens, newsprint, cardboard, etc. Considering the high ratio of specimen material to air it is unlikely that the moisture content of the specimens changed significantly (Padfield *et al.*, 1984). Consequently, little or no RH related dimensional response would be expected as a result of this treatment. C. Messenger and M. Bolick (1993) conducted freezer experiments on plant specimens that were subjected to a number of cooling-warming cycles. Their results showed no physical damage to the specimens. Further, S. Michalski (1993) studied RH fluctuations on artifacts in museum environments and concluded that changes of -40% RH do not harm botanical specimens. The low temperature technique has been used at Botany Section of the

CMN for over ten years and at no time was any physical damage of plant specimens observed that could be attributed to fluctuations of RH and temperature.

CONCLUSION

The experiment demonstrated that the domestic freezer tested is adequate for achieving and maintaining temperatures required to eradicate insect pests. Some modifications related to time allowed for cooling and warming and the packaging of specimens, as discussed in the text, is recommended to insure complete success of the low temperature technique. The experiment also showed that changes in RH and moisture content among and around the herbarium sheets throughout the process do not appear to be significant concerns. The conclusions reached here should apply to most herbaria; however, environmental conditions, equipment, and materials used can vary so each herbarium should monitor their own situation to see if they are adequately protecting their collections against insect pests.

ACKNOWLEDGMENTS

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LITERATURE CITED

- Bridson, D., and L. Forman, eds. 1992. *The Herbarium Handbook*, revised edition. Royal Botanic Gardens, Kew, 303 pp.
- Brokerhof, A. W. 1989. *Control of Fungi and Insects in Objects and Collections of Cultural Value, a State of the Art*. Centraal Laboratorium voor Onderzoek van Voorwerpen van Kunst en Wetenschap, Amsterdam, 77 pp.
- Crisafulli, S. 1980. Herbarium insect control with a freezer. *Brittonia*, 32(2):224.
- Egenberg, I. M., and D. Moe. 1991. A "stop-press" announcement. Damage caused by a widely used herbarium mounting technique. *Taxon*, 40:601-604.
- Florian, M.-L. 1990. Freezing for museum insect pest eradication. *Collection Forum*, 6(1):1-7.
- Messenger, C. L., and M. R. Bolick. 1993. Freezing versus chemical fumigation as methods of insect pest control in herbaria: A response to Egenberg and Moe. Paper presented during the technical sessions of the 8th Annual Meeting of the Society for the Preservation of Natural History Collections. Royal British Columbia Museum, Victoria, British Columbia, Canada.
- Michalski, S. 1993. Relative humidity: A discussion of correct/incorrect values. 10th Triennial Meeting Washington, DC, USA 22-27 August 1993. Preprints. ICOM Committee for Conservation, Paris, France. Working Group, 17:624-629.
- Padfield, T., M. Burke, and D. Erhardt. 1984. A cooled display case for George Washington's commission. 7th Triennial Meeting Copenhagen 10-14 September 1984. Preprints. ICOM Committee for Conservation, Paris, France, 38-42.
- Pinzl, A. 1993. Modifying a freezer for pest control. *SPNHC Newsletter*, 7(2):4.
- Strang, T. J. K. 1992. A review of published temperatures for the control of pest insects in museums. *Collection Forum*, 8(2):41-67.
- Waller, R., and T. Strang. 1995. Personal communication.

CATEGORIES OF SPECIMENS: A COLLECTION MANAGEMENT TOOL

JUDITH C. PRICE AND GERALD R. FITZGERALD

Canadian Museum of Nature, Ottawa, Ontario, CANADA K1P 6P4

Abstract.—The Canadian Museum of Nature has defined five Categories of Specimens to be used as an aid in collection management. Levels reflect object value based on scientific, cultural, and monetary considerations and thus clarify the museum's intellectual and monetary investment in collections. Categories have multiple applications in collection management: as indicators of value they can assist in controlling specimen use; in conjunction with risk assessment they can guide allocation of limited resources.

INTRODUCTION

Museums the world over are learning the hard way that resources are finite; both money and staff continue to be severely limited by current economic conditions (Emery, 1993). As a result, the demands of collection management are being questioned by a new level of audit and accountancy (Doughty, 1993). Museums must, therefore, develop systems to prioritize curatorial functions to guide the allocation of resources (Danks, 1991; Howie, 1992; SPNHC, 1994). Categories of Specimens, used in concert with risk assessment (Waller, 1994), can provide an effective method to balance collection care priorities.

BACKGROUND

The idea of categorizing specimens is already accepted in principle: Type specimens are recognized as the most valuable specimens in a natural science museum's collection (Horie, 1993), a library provides specialized storage for rare books, and in fact the concept can be adopted for any type of collection. Levels of specimen or object value can be compared by considering factors such as Type or Voucher status, monetary, cultural and historic value, and the investment of time and scientific knowledge represented by properly prepared and identified specimens (Montero and Diéguez, 1993; SPNHC, 1994). For collection management purposes each category can be assigned an acceptable minimum level of care based on institutional values and can be associated with appropriate levels of authority for decisions regarding specimen use (Cato and Williams, 1993). Categories can thus codify the intellectual and monetary investment in specimens and hence facilitate collection management decisions.

Several value standards are already used in museums. The Netherlands Ministry of Welfare, Health and Cultural Affairs (1992a, b) established the *Delta Plan for the Preservation of Cultural Heritage* following a dismal report from the national General Audit Office on the state of their 17 national museums which concluded that "if nothing was done, before very long large numbers of works of art, monuments and documents would be irreparably damaged, or would even disappear altogether." The plan includes: an inventory and assessment of the collections and backlogs; assignment of value levels; and development of a work plan for registration and conservation. The Entomology Department of the United States National Museum implemented the *Smithsonian Curation Standards and Profiling System* (McGinley, 1989, 1993) which quantifies collections according to levels

Table 1. "Categories of Specimens" as applied to the natural science collection at the Canadian Museum of Nature, outlining category descriptors and permitted uses.

Category 1: Primary Types, Extinct Recent species

Description: The most valuable and irreplaceable specimens, must be preserved for posterity.

Destructive testing/sampling: Strictly regulated and rarely permitted.

Loans: Strictly regulated, short term.

Public Programming uses: Strictly regulated and rarely permitted: display only.

Category 2: Secondary Types, Historic Specimens, Rare or Endangered Recent species, High Market Value (>\$10,000)

Description: Specimens of great significance.

Destructive testing/sampling: Regulated.

Loans: Strictly regulated, normally short term.

Public Programming uses: Strictly regulated: display, travelling exhibit.

Category 3: Vouchers, Moderate Market Value (\$1,000–10,000)

Description: Specimens representing significant additions to the body of knowledge (e.g., specific specimens cited in publication.)

Destructive testing/sampling: Permitted with review.

Loans: Normal procedures.

Public Programming uses: Permitted: display, travelling exhibit.

Category 4: Identified specimens, Low Market Value (<\$1,000)

Description: Prepared and identified; may be duplicates; represent an investment in care and knowledge; accessioned and catalogued.

Destructive testing/sampling: Permitted.

Loans: Normal procedures.

Public Programming uses: Permitted: display, travelling exhibit, hands on.

Category 5: Working Material

Description: All material entering the museum (e.g., field collections, unsorted acquisitions, research material, etc.) prior to evaluation for assignment to a higher category or for deaccession; not catalogued.

Destructive testing/sampling: Must be identified and catalogued to ensure preservation of data.

Loans: At discretion of collector and/or CMN staff.

Public Programming uses: Permitted: display, travelling exhibit, hands on.

of curation and provides a collection manager with a numeric "Collection Health Index."

DEVELOPMENT AND IMPLEMENTATION OF CATEGORIES OF SPECIMENS

The Canadian Museum of Nature (CMN) is a natural science museum holding broad collections in the areas of botany, zoology and earth sciences. The Collections Management Framework of the CMN tabled in 1994 proposed the establishment of a series of Categories of Specimens, applicable to all parts of the collection to "define the Permanent Collection while allowing researchers greater freedom to use Working Material before selected specimens are added to the Permanent Collection." Accordingly, a committee comprised of staff from Collection and Research Divisions was charged with the formulation of a system of categories defining the value of specimens within the CMN collection and recommending the authorities responsible for proper use of each category. The resulting draft document was approved in principle by the Collection Advisory Committee of the Museum for a one year trial and is currently being implemented.

Based on levels of scientific, historic, and cultural value, specimens may be assigned to categories as outlined in Table 1. This provides a gradation of value

from primary types through to the bulk field samples from which specimens for the collection might be selected. Assignment to a category is flexible and may be re-evaluated as a result of changes in specimen value. A specimen may have historic value to a museum, community, or field of science, and even natural science museums may hold objects of cultural significance such as gifts to government. As a secondary criterion, specimens may be assigned to Categories 2, 3 or 4 on the basis of their market value. This will apply only to selected objects that clearly have a commercial value to collectors on the open market, most commonly minerals and fossils. Use of monetary value in categorizing specimens is a recognition of the specimen as a corporate asset and that items representing significant investment must receive the appropriate care.

Category 1 is comprised of those unique objects in a collection which have the highest scientific, cultural, and historic importance. The Canadian Museum of Nature includes in Category 1 primary type specimens, and specimens of extinct Recent species. Access and use are most strictly regulated, as these are the specimens a museum is entrusted to preserve for posterity (IAPT, 1983; IUBS, 1985; Dunn and Mandarino, 1988; Bill C-12 Statutes of Canada 1990). These specimens are segregated to provide optimal security and specialized storage.

Category 2 includes secondary Types (e.g., Paratypes), historic specimens, specimens of Recent species which are rare or endangered, and specimens of high market value. Although of high scientific, cultural, or monetary value, these specimens do not share the irreplaceable quality of Category 1 material. Specimens in Category 2 may be segregated along with Category 1 material to provide optimal security and specialized storage.

Category 3 encompasses an interpretation of Voucher which has been broadened from the classical definition (Lee *et al.*, 1982) as a published citation of specific specimens. Unpublished range extensions or reductions, or specimens which have undergone extensive testing are examples of objects which, by virtue of their unique contribution to our body of knowledge, may be assigned to this category (SPNHC, 1994).

Category 4 represents the bulk of a museum reference collection. These are the identified and documented specimens used for comparative research, exhibition and, possibly, exchange.

Category 5 includes all material entering the museum (e.g., field collections, unsorted acquisitions, research material, etc.) prior to evaluation for assignment to a higher category or for deaccession. This category has been established to reduce regulation on research and educational use of specimens. Collaboration between scientists and institutions is often required to make full and efficient use of the large amount of material which can be collected on today's increasingly expensive expeditions. Specimens that are vouchers of research will be reviewed by the Collections Development Committee for assignment to a higher category to ensure the appropriate level of care.

The number of categories and the appropriate assignment of values may be interpreted in practice to arrive at a system of as few as three levels, combining "Types" (CMN's Categories 1 and 2), a "Reference Collection" (CMN Categories 3 and 4) and a bulk or backlog category (CMN Category 5). For the administration of collection care resources (e.g., physical storage) the CMN collection is considered to be composed of these three levels. For decisions regarding

access and use of the collection (e.g., requests for loans), all five categories are considered. Assessment of specimen category is made at the time of request for use and considers current value, as in reality the expenditure of resources required to assign static values to an entire collection is both impractical and wasteful.

At the CMN attempts were made to differentiate a "Permanent Collection" (Category 1 to 4) from "Working Material" (Category 5), but it was recognized that individual specimen values describe a continuum from primary types, the only specimens which must be, to the best of our ability, permanent holdings, to the almost transitory material used in some research projects. All specimens except primary types must be acknowledged to have a "working life" within which they might be consumed, rendering the phrase "Permanent Collection" virtually moot.

Categories of Specimens can be used in conjunction with risk assessment (Waller, 1994) to direct the allocation of resources for collection care, and those specimens judged most valuable must receive the highest possible standard of care. Assessment of risks to specimens involves calculation of the probability and extent of impact of various agents of deterioration to project a probable loss in value over time (Michalski, 1990; Waller, 1994). While we must recognize that deterioration is ongoing, and that we currently have few methods to completely measure loss in value, we can apply available technology to mitigate risks and thereby reduce deterioration. In applying these principles at the CMN, risk assessment indicated that a large percentage of the Type specimens (Categories 1 and 2) were subject to an unacceptable level of risk under existing storage conditions. Although other non-optimal situations existed, and some continue to exist, resources in the form of both salary and operational dollars, were directed to provide proper storage conditions for the Type specimens. This shows how risk assessment and categories of specimens may be used in concert to make collection management decisions.

In addition, Categories of Specimens provide a clear framework on which to base decisions regarding specimen use. The responsibility of a museum to make specimens available for ongoing research and exhibition must be balanced with the need to preserve specimens for future use (Compte-Sart, 1993; SPNHC, 1994). At the CMN a clear hierarchy of authority related to the levels of risk associated with potential uses of each category is being developed and will be tested as the use of categories is implemented. Responsibility for assignment of category levels lies with the Collection Manager in each section of the CMN collection, with delegation to experienced collection staff. Depending on the category, requests for use of CMN specimens may require the approval of the collector or Collection Manager, the Collection Development Committee (CDC) or the Collection Advisory Committee (CAC). The CDC is an internal committee, comprising staff of CMN Collection, Research and Public Programming Divisions, which reviews requests for consumptive specimen use and all acquisitions. Priorities for collection development, either through acquisition or deaccession, may be weighted by consideration of specimen category. The CAC, composed of external advisors, a member of the CMN Board of Trustees, managers and staff of the Collection and Research Divisions, provides guidance at the policy level and reviews major decisions regarding the CMN collection. Requests for access to the collection are evaluated in context to provide specimens of a category appropriate to the user's

requirements. These controls are intended to ensure the preservation of the most important scientific or heritage material, while allowing freer use of lower "valued" specimens.

SUMMARY

It can be difficult for a museum manager to balance the multiplicity of demands posed by the collection which is "the museum's 'soul' and *raison d'être*" (Alberch, 1993). Categories of Specimens are not intended to reflect or require a physical separation of specimens within a collection, except those judged most valuable, but to provide consistent and logical levels of commitment to protect specimens. This facilitates collection managers in making rational recommendations regarding the care and use of material under their purview.

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LITERATURE CITED

- Alberch, P. 1993. Museums, collections and biodiversity inventories. *Trends in Ecology and Evolution*, 8:372-375.
- Bill C-12, Statutes of Canada 1990, Chapter 3. An Act respecting Museums. Second Session, Thirty-fourth Parliament, 38 Elizabeth II, 1989-90, 29 pp.
- Cato, P. S., and S. L. Williams. 1993. Guidelines for developing policies for the management and care of natural history collections. *Collection Forum*, 9:84-107.
- Compte-Sart, A. 1993. La exhibición de ejemplares de museo excepcionales. *International Symposium and First World Congress on the Preservation and Conservation of Natural History Collections*, 1:157-164.
- Danks, H. V. 1991. Museum collections: Fundamental values and modern problems. *Collection Forum*, 7:95-111.
- Doughty, P. S. 1993. Collections assessments and long-range planning. *International Symposium and First World Congress on the Preservation and Conservation of Natural History Collections*, 3: 275-288.
- Dunn, P. J., and J. A. Mandarino. 1988. Formal definitions of type mineral specimens. *Mineralogical Record*, 19:227-228.
- Emery, A. R. 1993. Changing philosophies, roles and responsibilities. *International Symposium and First World Congress on the Preservation and Conservation of Natural History Collections*, 3: 111-126.
- Horie, C. V. 1993. Conservation in Europe. *International Symposium and First World Congress on the Preservation and Conservation of Natural History Collections*, 3:189-197.
- Howie, F. M. 1993. Natural science collections: Extent and scope of preservation problems. *International Symposium and First World Congress on the Preservation and Conservation of Natural History Collections*, 3:97-110.
- International Association of Plant Taxonomists. 1983. *International Code of Botanical Nomenclature*. Dr. W. Junk, Publishers, The Hague, 472 pp.
- International Union of Biological Sciences. 1985. *International Code of Zoological Nomenclature, Third Edition*. University of California Press, Berkeley and Los Angeles, 338 pp.
- 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.
- McGinley, R. J. 1989. Entomological collection management—Are we really managing? *Insect Collection News*, 2:19-24.
- McGinley, R. J. 1993. Where's the management in collections management? Planning for improved

- care, greater use, and growth of collections. International Symposium and First World Congress on the Preservation and Conservation of Natural History Collections, 3:309–333.
- Michalski, S. 1990. An overall framework for preventive conservation and remedial conservation. International Council of Museums, Committee for Conservation, Preprints of the 9th Triennial Meeting, Dresden, 26–31 August 1990, pp. 589–591.
- Montero, A., and C. Diéguez. 1993. Types of paleontological collections, interest: The case of the Museo Nacional de Ciencias Naturales (MNCN), Madrid, Spain. International Symposium and First World Congress on the Preservation and Conservation of Natural History Collections, 2: 221–227.
- Netherlands Ministry of Welfare, Health and Cultural Affairs. 1992a. *Deltaplan. Preservation of Cultural Heritage in the Netherlands*, 64 pp.
- Netherlands Ministry of Welfare, Health and Cultural Affairs. 1992b. Delta Plan for the preservation of cultural heritage. Fact Sheet C-11-E-1992, 10 pp.
- Society for the Preservation of Natural History Collections. 1994. Guidelines for the care of natural history collections. *Collection Forum*, 10:32–40.
- Waller, R. 1994. Risk management applied to preventive conservation. International Institute for Conservation of Historic and Artistic Works, Preprints of the 15th International Congress, 12–16 September 1994, pp. 12–16.

DISASTER PLANNING FOR A SCEPTICAL MUSEUM

JANE PICKERING

University Museum, Parks Road, Oxford OX1 3PW, UK

Abstract.—The Oxford University Museum contains the zoological and geological collections of the university which number over 4 million specimens. The museum has prepared a number of forward plans which will eventually become components of a full collection management plan. The impetus behind such planning has come from registration requirements. Disaster planning was part of this procedure and a museum disaster plan was produced last year. Apart from the disaster plan itself, there were a number of benefits which came out of the process of producing the plan. These benefits included raising staff awareness of associated issues, practical staff training, purchase of materials and tighter procedures for contacting staff out of hours. Such immediate benefits help to demonstrate to sceptical staff the usefulness of such planning.

DISASTER PLANNING FOR A SCEPTICAL MUSEUM

The University Museum is currently producing a series of documents which form elements of a full collection management plan as outlined in the local Museums Service document *Collection Management Plan Guidelines* (AMSSEE, 1992). The impetus behind such planning comes from the registration requirements of the Museums and Galleries Commission (MGC). The registration scheme was set up by the MGC in 1988 as a means of setting basic standards for museums (see Appendix). It is a minimum standards scheme which does not require a full collection management plan even in Phase II (began in 1995). However, some parts of a plan are required. Also, many other organizations now require plans as supporting documentation for grant applications. This means that time spent planning can be justified to even the most hardened sceptic. The museum has produced an acquisition and disposal policy, documentation and storage forward¹ plans, an education policy, parts of a forward plan for preventative conservation of specimens and a disaster plan. To complete the full collection management plan the museum will be looking at risk management, exhibitions, training and remedial conservation. It is the procedure adopted to prepare the disaster plan which is the subject of this paper.

CHALLENGES FOR DISASTER PLANNING

A disaster plan comprises written procedures for the protection and rescue of the collection in the event of emergencies such as fire, flood or other catastrophe. It has been demonstrated that plans are effective in helping to mitigate the effect of such disasters (Cato and Williams, 1993). Standards for disaster planning are included in *Standards in the Museum Care of Biological Collections* (MGC, 1992) which emphasizes the need for a plan, the necessity that the plan identify the scientifically most important specimens and provide for their priority rescue, and the requirement for regular staff training.

There are many challenges to producing a useful document. A disaster plan is not a novel idea but a synthesis of existing knowledge, both local (for example, about the building and collection details) and global (for example, the techniques

¹ A forward plan is roughly equivalent to what is termed a long-range plan in the U.S. and Canada.

for dealing with a damp book), which is contained in a format that can be easily and rapidly digested, possibly under conditions of extreme stress. The document should be concise, concentrating on procedures and lists of information. It should outline likely threats to specific individual museum buildings, building areas and types of collection, especially when these threats can be minimized. However, it should also be written so that it is "adaptable and capable of intelligent interpretation" in any disaster situation which might arise (Cackett, 1992). Useful advice is available from the many disaster plan guidelines in existence (e.g., EMMS, 1992; Jenkins, 1987; David, 1994).

In addition to these universal factors, there were particular challenges in making disaster planning successful in an academic setting. The University Museum is a sceptical institution; staff were suspicious of planning and viewed it as a necessary evil to back up grant applications, rather than being beneficial in its own right. This suspicion was common to many members of staff and is certainly not unique to the museum. Staff felt, for instance, that they had too much to do without also writing documents which no one would use and that the museum would lose future flexibility by being constrained by plans. Such attitudes are hard to change, particularly as they can be confirmed if planning documents are badly written. As well as general scepticism about planning, scepticism about the idea of disaster planning in particular was widespread. First, there was the somewhat trivial, but humorous response that planning a disaster seemed novel; the term "disaster" itself is a hindrance with its connotations of aeroplanes falling out of the sky, rather than the more mundane and likely occurrences seen in a museum context. Second, there was a feeling that much of disaster planning is actually common sense. Third, it was felt that the ability to cope with a disaster would depend largely on *who* was on the ground at the time and would have little to do with previous planning. Allied to this view was a strong belief amongst staff that during an emergency no one would have time to look at a disaster plan. They felt that the document itself would probably be verbose, unwieldy and of little practical use.

Many of these issues were directly confronted during the planning process. The plan itself did contain much which might be defined as common sense. It was also true, however, that not everything which might be so described was known by staff. An example would be that the Head of Technical Services knew how to turn off the water supply in the main museum building, but other staff on the call-out list did not. It was also recognized that parts of the plan did not fall into this category, particularly those parts dealing with individual collections. Within the museum even experienced staff who were extremely capable and knowledgeable knew surprisingly little about collections outside their own. It was recognized that whilst it was preferable for experienced members of staff to be at the scene of a disaster, this might not be possible. It was accepted that the plan had an important role in making sure that every member of staff would be sufficiently informed to cope, even if there was nobody present at the "disaster" with a specialist's knowledge. Finally, the fact that the working party produced a concise document helped to reassure staff that this was a practical plan which could be assimilated by anybody.

Apart from scepticism, there were other challenges inherent in disaster planning for the University Museum. The museum is also an academic department with

24-hour access for all keyholders. Consequently there can be people in the building at all hours. Most keyholders are staff but can also include selected post-graduate students and visiting academics. Keyholders who are not staff often have limited knowledge of the site but are often the only people who are in the building out of normal working hours. Any system implemented for disaster planning had to include such people.

Other factors made disaster planning simpler. The museum already has emergency procedures for ensuring staff and visitor safety. There is a University Central Monitoring Station which is linked up to the fire and security alarm systems. It is staffed 24 hours a day and keeps a list of home telephone numbers for museum staff on the call-out list as well as details of emergency 24-hour services such as plumbers. There are good university-wide links with the Emergency Services (police, fire and ambulance); in particular the fire service pay regular visits and are aware of the need for caution and care in the university. One member of staff, the Head Porter,² lives on site, a hundred yards from the front door of the museum and other members of call-out staff are only a few minutes' journey away.

PRODUCING A PLAN

The museum's managing committee of curatorial staff set up a working party to produce a draft disaster plan for the committee to consider. The committee decided that this working party would be chaired by the author, as a member of the curatorial staff, and would comprise another two members of the curatorial staff (including the Principal Curator), the Head of Technical Services, the Head Porter, the Museum Administrator and the Museum Librarian. The members of the working party (particularly long-serving members of staff) had, as part of their job experience, much of the necessary information to produce the plan.

The working party's charge was to produce a draft plan for consideration by the managing committee meeting in six months time. It was also asked to propose any associated recommendations for action, such as appropriate staff training. An initial paper, produced by the Chair of the working party, was then circulated to all members of the working party. This paper comprised two parts: an introduction to disaster planning and its benefits; and a summary of the contents of an "ideal" disaster plan as outlined in the East Midlands Museums Service (EMMS) *Museums and Records Office Emergency Manual* (1992).

At its first meeting, the working party decided that the plan outlined in the EMMS document was a good starting point for the University Museum plan, although it would require some modification for the particular circumstances of our institution. The working party also decided that the planning process would include procedures both for a major disaster and also for smaller incidents, such as a leaking radiator, which are much more likely to happen but can also cause considerable local damage.

It is worth noting at this point that the University Museum has ongoing "minor disasters" caused by regular leaks in the glass roof above the main display area. This glass roof is made up of overlapping glass slates (12 inches × 12 inches)

² The Head Porter is the Chief Museum Attendant and supervises the other museum attendants and the janitors.

screwed onto a grid of timber battening which is supported by timber beams and cast iron ribs. Details of its construction can be found in Haward (1989). The roof has always leaked occasionally, but the number of leaks has increased considerably in recent years since the installation of shatter-proof and UV-proof film to each pane of glass. This film was applied because of safety considerations, and has also greatly reduced light damage to exhibited specimens. However, the process of applying the film was combined with the replacement of the old mastic sealing between the glass slates with a modern silicon seal. The disturbance of the glass slates for the filming, combined with the manner of replacing the seal, has meant that there are now small leaks virtually every time it rains; if conditions are particularly windy, more serious leaks occur. The only solution to this problem is deemed to be the complete replacement of the roof, which would be a major capital project and currently beyond university resources. Considering ways of coping with this ongoing problem was a goal for the working party.

THE PLAN

The working party had three meetings over the six-month period to discuss and create the plan and make recommendations. It was notable that, as it became obvious that the plan would be short and practical, the attitude towards it became more positive. The plan was divided into five parts; a description of each follows.

1. *Staff response to an emergency out of normal hours.*—The museum already had evacuation procedures and chains of command for an emergency during normal hours, when most staff would be present. However, there was a problem making sure all keyholders knew what to do if they were alone in the building when an emergency happened. This section contains primary contact telephone numbers of call-out staff, instructions for action in event of a minor fire, a major fire or water leaks, and details of the new Emergency Point. The Emergency Point consists of the following equipment, which is located in an unlocked cupboard underneath the counter outside the Porters' Lodge, the museum's main reception area:

- plastic sheeting
- plastic trays
- safety helmets
- gloves
- rechargeable flashlight
- scissors
- rope and string
- list of telephone numbers

This equipment is primarily for use after hours and for dealing with water leaks, particularly from the roof. Staff are assigned to ensure stocks do not run out. The Emergency Point was an immediate practical benefit of the planning process which was used almost as soon as it had been set up.

2. *Salvage materials.*—This is a list of standard materials (such as polythene sheets and tie-on labels) held in a central store in the museum, accessible to all keyholders. It contains a wider range of equipment than that at the Emergency Point and is seen as a second-line defense. A useful list of materials for natural

history museums can be found in the United Kingdom Institute of Conservation (UKIC) *Disasters Manual* (Andrew, in press).

3. *Services.*—Emergency Services, including 24 hour services such as plumbing, are all reached through the University Central Monitoring Station (see above). There has never been a problem with the response through this university service; its efficiency has greatly improved over the last few years. There are lists of more specialized services not available within the university, for example, large freeze-drying facilities and natural history conservators. Emergency salvage areas are also identified, in agreement with other university departments.

4. *Maps showing fire and water points and priority salvage in certain collection areas.*—Fire points, which contain fire-fighting equipment such as fire blankets and extinguishers, are marked onto maps together with the locations of the main water taps. These maps also show certain areas within collection storerooms which contain material identified for priority salvage.

The categories of material which should be considered a priority for salvage are identified in the MGC's "Standards" documents (MGC, 1992, 1993). The identification of the most important specimens caused much discussion: some collections, like mineralogy, believed that such identification would compromise their security. However, in the biological collections the most scientifically valuable specimens, the types, are not necessarily the most valuable commercially. This point is noted, but not discussed, in the disaster planning standard for geological collections (MGC, 1993), and perhaps deserves more discussion within the profession. The working party decided that individual curators should decide whether they wished to identify specimens for priority salvage. This means that the system of labelling such collections is the same across the museum, but not all collection areas are so labelled. Those cabinets too large or awkward to be easily moved without damaging their contents have specially sized fire blankets and polythene sheets nearby.

5. *Procedure for updating the disaster plan.*—Different staff are allocated parts of the plan to keep up-to-date. In particular, telephone numbers must be updated and stocks of salvage materials maintained. The Museum Administrator is responsible for keeping contact telephone numbers up-to-date and stocks are monitored by the Head Porter and Head of Technical Services.

The document produced by the working party was agreed for adoption as the museum's disaster plan by the museum's managing committee. The other principal recommendation which the working party made to the committee was that the document would only be effective if it went alongside appropriate staff training. There is a great deal of truth in the previously expressed view that reaction to a disaster, particularly in the first crucial hours, will depend largely on the person concerned knowing how to cope with a situation. This was accepted and the first two parts of the plan were sent out to all keyholders on a bright pink sheet to be placed in their "Oxford University Museum Statement of Safety Organization" together with maps showing fire points and water taps in their areas.

The managing committee agreed to the working party's recommendation that staff training initially take two forms. First, both disaster planning and personal safety in event of a disaster were discussed at one of the monthly staff meetings to which all staff are invited to attend. This enabled the author to explain the purpose of disaster planning to staff, answer questions and lead discussion on

appropriate reactions to disasters. Second, there were a series of mandatory departmental meetings for all keyholders to look at fire and water points in particular areas and, once again, to discuss responses to an emergency. The response to these training events was positive, particularly to the practical training on dealing with fire and water emergencies. People who had been in the building for over 20 years commented on how they finally knew where the water taps were. There is no doubt that involving all staff helped to eliminate doubts about the usefulness of the planning.

At the time of writing, the museum is being reviewed by the university as part of the university's ongoing departmental reviews; this procedure happens every 20 years or so. The terms of reference for the Review Committee are to review organization, staffing and management; to look at the museum's relationships with other bodies and its obligations to its local, national and international public; and to look at its roles in teaching, curation and research (Oxford University, 1995). The findings and recommendations of the committee will guide future planning, although it is expected that effects on disaster planning will be minimal.

CONCLUSIONS

Disaster plans can very easily become pieces of paper (or even books) which are of little use in the event of a real disaster. Properly thought-out, brief documents are essential. Working in a sceptical environment helped ensure that the museum's plan fulfilled these criteria. The plan's great strength is that it is short, to the point, and tailored to the museum's situation. Its brevity does mean that detailed instructions on coping with individual collections are not included, but the author hopes to back up the plan with the natural history section of the forthcoming UKIC Disasters Manual (Andrew, in press). Disaster plans are essential to set in place preventative measures against disasters and ensure on-going staff training. It is these factors which greatly helped to dispel much staff scepticism. The immediate benefits from the more easily attained goals of the planning process, such as setting up proper stocks of salvage materials, also helped form more positive attitudes. Since the plan was implemented, minor water leaks, particularly from the roof, are now dealt with much more efficiently. The museum has had one other substantial leak from the heating system during working hours. Staff dealt with the leak with easily available equipment. The use of the plan in the case of a huge disaster will hopefully never be tested.

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LITERATURE CITED

- Andrew, K. J. In press. Natural history collections in a disaster. In *United Kingdom Institute of Conservation Manual on Disaster Planning*. UKIC.
- Area Museums Service for South Eastern England (AMSSEE). 1992. *Collection Management Plan Guidelines*. AMSSEE, London, U.K., 14 pp.
- Cackett, S. 1992. Disaster planning. Pp. 487-90 in *Manual of Curatorship* (J. M. A. Thompson, ed.). Butterworth-Heinemann/Museums Association. Oxford, U.K., 756 pp.
- Cato, P. S., and S. L. Williams. 1993. Guidelines for developing policies for the management and care of natural history collections. *Collection Forum*, 9(2):84-107.

- David, J. 1994. Disaster planning. *Historic House Magazine*, 18(3):17-34.
- East Midlands Museums Service (EMMS). 1992. *Museums and Records Office Emergency Manual*. East Midlands Museums Service, Nottingham, U.K., 40 pp.
- Haward, B. 1989. Oxford University Museum. *Architects Journal*, 190(13):40-63.
- Jenkins, I. A. 1987. *Disaster Planning and Preparedness: An Outline Disaster Control Plan*. British Library, London, 49 pp.
- Museums & Galleries Commission (MGC). 1992. *Standards in the Museum Care of Biological Collections*. Museums & Galleries Commission, London, U.K., 55 pp.
- Museums & Galleries Commission (MGC). 1993. *Standards in the Museum Care of Geological Collections*. Museums & Galleries Commission, London, U.K., 57 pp.
- Oxford University. 1995. Review of the University Museum. *Oxford University Gazette*, 4373, p. 12.
- Thompson, J. M. A. 1992. *Manual of Curatorship*. Butterworth-Heinemann/Museums Association, Oxford, U.K., 756 pp.

APPENDIX

Museums & Galleries Commission (MGC).—The MGC, founded in 1931, is a national government executive agency which exists to help the development of museums in the UK. Amongst its many activities it advises government on matters relating to museums, monitors the work of all the Area Museum Councils (AMCs) and provides revenue funding for the English AMCs and administers the UK's registration scheme.

Registration Scheme.—The registration scheme was set up by the MGC in 1988 as a means of setting basic standards for museums. Only registered museums are eligible for grant-aid from the MGC and AMCs and also a variety of other grant-giving bodies. The key requirements of registration are accordance with a definition of a museum, an acceptable constitution and a sound financial basis, publication of an acceptable statement of collection management policy, provision of a range of public services and access to professional curatorial advice.

Area Museum Services.—There are nine AMCs in the UK, seven in England, including SEMS (South Eastern Museums Service) and EMMS (East Midlands Museum Service); one in Scotland; and one in Wales. Their funding base is 50% grant on gross expenditure with the rest being made up from income from services and member museum subscriptions. They have a coordinating role in their region, working not only with museums but with other funding agencies and those responsible for regional planning. They provide services to members such as publications, advice and training, as well as grant funding for the less glamorous side of museum activity such as documentation, conservation and storage.

For further information on all these bodies see Thompson (1992).

APPLYING MCGINLEY'S MODEL FOR COLLECTION ASSESSMENT TO COLLECTIONS OF RECENT VERTEBRATES

STEPHEN L. WILLIAMS,¹ R. RICHARD MONK,²
AND JOAQUIN ARROYO-CABRALES

¹*Strecker Museum Complex and Department of Museum Studies, Baylor University,
P.O. Box 97154, Waco, Texas 76798-7154*

²*Natural Science Research Laboratory, Museum of Texas Tech University,
Box 43191, Lubbock, Texas 79409-3191*

³*INAH, Subdireccion de Laboratorios y Apoyo Academico; Laboratorio de Paleozoologia,
Moneda #16, Col. Centro, 06060 Mexico, D.F.*

Abstract.—Assessment strategies have been proposed for insect collections. However, inherent procedural differences have limited the usefulness of such strategies for Recent vertebrate collections. By starting with methods used for insect collections, and applying modifications derived from trial and error, a system for assessing the condition of vertebrate collections was developed. This assessment system was tested with collections of fish, amphibians and reptiles, birds, and mammals. Assessment data were computerized in a spreadsheet format to facilitate a summarization of each collection status as well as task management of collection activities. General concepts and approaches used in the project have broad application, and they support previous contentions that this management tool is a viable mechanism for assessing, describing, and addressing collection needs.

In many ways “collection management” has been a misnomer, possibly originating from a title for an advanced collection support position long before it was ever considered as a holistic approach and function for collections (Simmons, 1993; Williams and Cato, 1995). In typical organizational settings, “management” is an important, long-term process involving considerable study, practice, standardization, and refinement. However, in operations of natural history collections, true management has been lacking and has been more appropriately described as “collection ad-hocing” (McGinley, 1989). More recently, McGinley (1992) has justifiably raised the question, “where is the management in collection management?”

In practice, true management is a continuously evolving process which is primarily based on simple concepts, such as goal-setting, strategic planning, and leadership. It is standard practice for strategic planning to involve assessment analysis, problem identification, prioritization, solution development, and resource management for solution implementation. The successful implementation of these activities is predicated on the availability of appropriate quantifiable documentation.

The Entomology Collections Committee of the Smithsonian Institution was the first to methodically quantify “condition” of entire natural history collections by identifying curation standards, assessing conditions within appropriate storage segments, developing collection profiles, and ultimately calculating a “collection health index” for evaluation and comparison (McGinley, 1989). The final product was a useful management tool that facilitated strategic planning and resource management for insect collections. We have referred to this approach as “McGinley’s model” for collection assessment in recognition of its significance and

because of McGinley's effort to share this information with the museum community through multiple presentations and publications (McGinley, 1989, 1990, 1992).

Considering some of the inadequacies of traditional approaches for "managing collections," McGinley's contributions are innovative, timely, and consistent with management schemes that have been successfully implemented in other disciplines. It is noteworthy that in recent years, similar management schemes have been a primary focus of many assessment programs in the museum community (Dixon, 1987; Hutchins, 1987; Wolf, 1993; Wolf Green *et al.*, 1990).

While McGinley's model for collection assessment is an invaluable contribution to collection management practices, its application has been restricted to insect collections. This may be partially attributed to the fact that management and utilization of such collections differ significantly from that of many other natural science collections. For example, insect collections typically contain greater numbers of specimens including many from taxonomic groups that may be poorly understood; vertebrate collections may have considerably fewer specimens and include specimens which can usually be identified to species level with reasonable expertise, effort, and literary resources. These differences and others directly affect how the staff manages and utilizes the collections. These differences also raise questions about the compatibility of McGinley's model of assessment with other kinds of natural science collections.

To address concerns of compatibility, a project was designed to incorporate a derivation of McGinley's model for collection assessment for documenting the condition of collections of fish, amphibians and reptiles, birds, and mammals. While there is clear support for the basic concepts and approaches of McGinley's model, the current project resulted in some procedural differences in the process and its application as well as proposing some new and useful concepts.

METHODS AND MATERIALS

This project was conducted in 1994, in the collections of the Natural Science Research Laboratory of the Museum of Texas Tech University. The objectives of the project were to develop a method to help describe the status of entire collections or their parts to administrators, as well as to facilitate task management for collection support staff and volunteers. However, as different strategies evolved through a "trial and error" process, the objectives of accuracy and consistency also influenced the final method used.

The final method used for assessing collections in the current study (Appendix I) utilized only seven levels, but addressed many of the same issues as McGinley (1989, 1990, 1992). Titles and arrangements were modified to be more consistent with typical processing stages of vertebrate collections.

Level 1 involves gaining physical control of acquisitions, but may involve any situation where there is a risk of losing specimens, specimen parts, or associated data. As in McGinley's model, level 1 represents the highest priority in the management process. Level 2 involves activities for "stabilization," such as applying appropriate preservation measures, associating specimens and data, and providing at least temporary storage for protection. Level 3 involves actual collection registration with number assignment and labelling of specimens, thus making the specimens of vertebrates provisionally available for use. Level 4 addresses the need for some vertebrate collections to have supplementary processing of specimens to facilitate their utilization (e.g., osteological processing). This level also addresses subsequent reassociation and containment (e.g., boxes or vials) of specimen parts. Level 5 involves curatorial procedures that facilitate organization and retrievability of specimens in the permanent collection. Level 6 addresses quality of storage materials and space allocation for existing and future specimens. Level 7 involves collection maintenance with respect to updating specimen information (e.g., taxonomic revisions), pest control activities, and dealing with specimens for purposes of

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
421	CASE 30																								
422	DR01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
423	DR02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
424	DR03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
425	DR04	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
426	DR05	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
427	DR06	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	
428	CASE 31																								
429	DR01	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
430	DR02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
431	DR03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
432	DR04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
433	DR05	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
434	DR06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
435	DR07	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
436	DR08	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	
437	DR09	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
438	CASE 32																								
439	DR01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
440	DR02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	

MAIN

Figure 1. A "print-screen" copy of a spreadsheet showing computerized methods used for tallying and summarizing assessment data.

utilization (e.g., loans). For the sake of utility and convenience, titles given to the levels are as follows: 1, acquisition; 2, stabilization; 3, registration; 4, processing; 5, curation; 6, storage; and 7, maintenance.

At one point during the "trial and error" process an eighth level had been included for "state-of-the-art" philosophies and practices (e.g., emergency preparedness, broader information management systems, integrated pest management, condition reporting). Often these issues were more holistic in their application, and thus inappropriate to evaluate on a drawer-by-drawer or shelf-by-shelf basis. However, such needs are important to document. The current study used a generic check-off system for each data-sheet to document such needs (Appendix II).

Within each of the seven levels utilized, specific criteria had to be met to satisfy completion of that particular level (Appendix I). To achieve the desired results, criteria were presented so that the conditions would be noted as either acceptable or unacceptable. For example, it is equally important to indicate whether there *was* or *was not* a pest issue observed. Also, conditions were stated in a manner such that if there was a deficiency, a specific "action" was required to address the issue, thus "action oriented" responses were incorporated. For instance, it was not helpful to state that space was good, fair, or poor; instead, it was more helpful to state that individual specimens did or did not have adequate storage space *and* that there was or was not adequate space for future collection expansion and growth.

A form with instructions for completion was designed for documenting conditions of each drawer or shelf of a storage unit (Appendix II), thus, specific storage units were identified by number and general contents. The form identifies management levels and specific criteria for each level. To avoid confusion and documentation errors, each criterion was assigned a unique alphabetic character. It was easier to associate a condition with a specific letter, such as *P*, *Q*, or *R*, than it was to try to consistently differentiate the letter *A*, *B*, or *C* with levels 4, 5, or 6.

To expedite the documentation process, two individuals worked together; one individual conducted the examination while the other recorded information. Also, documentation consistency and quality were enhanced with prior preparation of forms for storage units to be examined. Generic and known information (e.g., case number, contents, number of shelves or drawers, and status of specimens stabilized, specimens cataloged, etc.) were entered on the form before the contents of the storage unit were examined. This procedure allowed the workers to focus on the issues that required greater attention. The use of two individuals and prior preparation of forms allowed reliable assessments to be completed at a rate of less than five minutes for a storage unit containing no more than 12 drawers or shelves.

When the collection assessments were completed, information from the forms was entered into a Lotus 1-2-3® spreadsheet. Rows were used to document conditions observed for an individual drawer or shelf. One column served as a counter (e.g., column C of Fig. 1) to tally the total number of observations (e.g., drawers and shelves); other columns were used to document responses of the assessment issues (e.g., columns D–W of Fig. 1).

Depending on whether a criterion was met or not, the category was scored "1" or "0" (Fig. 1),

Table 1. Tabulation of percent work completed based on management evaluations described in text.

Collection	Number of observations	Level						
		1 ACQ	2 STAB	3 REG	4 PROC	5 CUR	6 STOR	7 MNT
Fish	27	33.3	100.0	0.0	46.1	0.0	56.8	84.6
Amphibians & reptiles	106	99.4	93.4	81.6	67.8	31.8	71.4	49.5
Bird (Dry)	197	100.0	100.0	92.9	87.6	89.6	67.3	52.5
Bird (Wet)	13	100.0	100.0	100.0	83.3	0.0	63.3	50.0
Mammal (Dry)	1,763	100.0	99.1	97.0	63.6	76.1	73.8	69.0
Mammal (Wet)	92	100.0	100.0	100.0	50.5	61.2	59.6	74.5

respectively. Data entry was facilitated by copying series of lines as if all criteria for each drawer or shelf were met ("1"). This was followed by simply changing the exceptions ("0"). Using spreadsheet options and the tally column, the percentage of drawers or shelves found to be satisfactory were determined for each criterion. Each management level was quantified by taking the percentage of all positive responses in relation to the total possible responses for all associated criteria.

As collections were examined, unused drawers, shelves, or space were documented on the forms, but not included with the tallies used for collection assessments. To do so would incorporate errors with other assessment issues and inflate the magnitude of "problem" values.

Once the collection assessment data were computerized, the information was used to produce several products. These products illustrated condition comparisons between and within collections, changes resulting from management activities, and collection patterns for purposes of strategic planning and resource management.

RESULTS

The collections examined involved recognized physical differences such as size, activity, and quality of management and care. Before the project, the management and condition of the collections (except for numbers of cataloged specimens) could only be explained qualitatively.

The fish collection included several thousand specimens, many of which normally would be registered in lots (batch-units). While this collection is important because of its association with arid and semi-arid habitats, it is in the greatest need of attention because major parts have not been cataloged, adequately labeled, or organized (Table 1; Fig. 2).

The collection of amphibians and reptiles, consisting of 11,500 specimens or lots, also is important because of its association with arid and semi-arid habitats, and because of disappearing populations, both regionally and globally (Blaustein and Wake, 1990; Wake, 1991). This collection is mostly cataloged, but in need of curation. It has a slow growth rate with a small backlog requiring some level of processing (Table 1; Fig. 2).

The bird collection is cataloged and reasonably well-curated. However, the collection of about 4,250 specimens has a slow growth rate due to wildlife protection laws and limited use. Inactivity has resulted in the need for maintenance, particularly an updating of taxonomy (Table 1; Fig. 2).

The mammal collection, consisting of almost 70,000 cataloged specimens, is the largest and most active of all of the institution's Recent vertebrate collections. Although large portions are cataloged, the quantity of backlogged specimens varies depending on the research activities of the five university mammalogists and their associated students. The level of management given to the collection fluctuates.

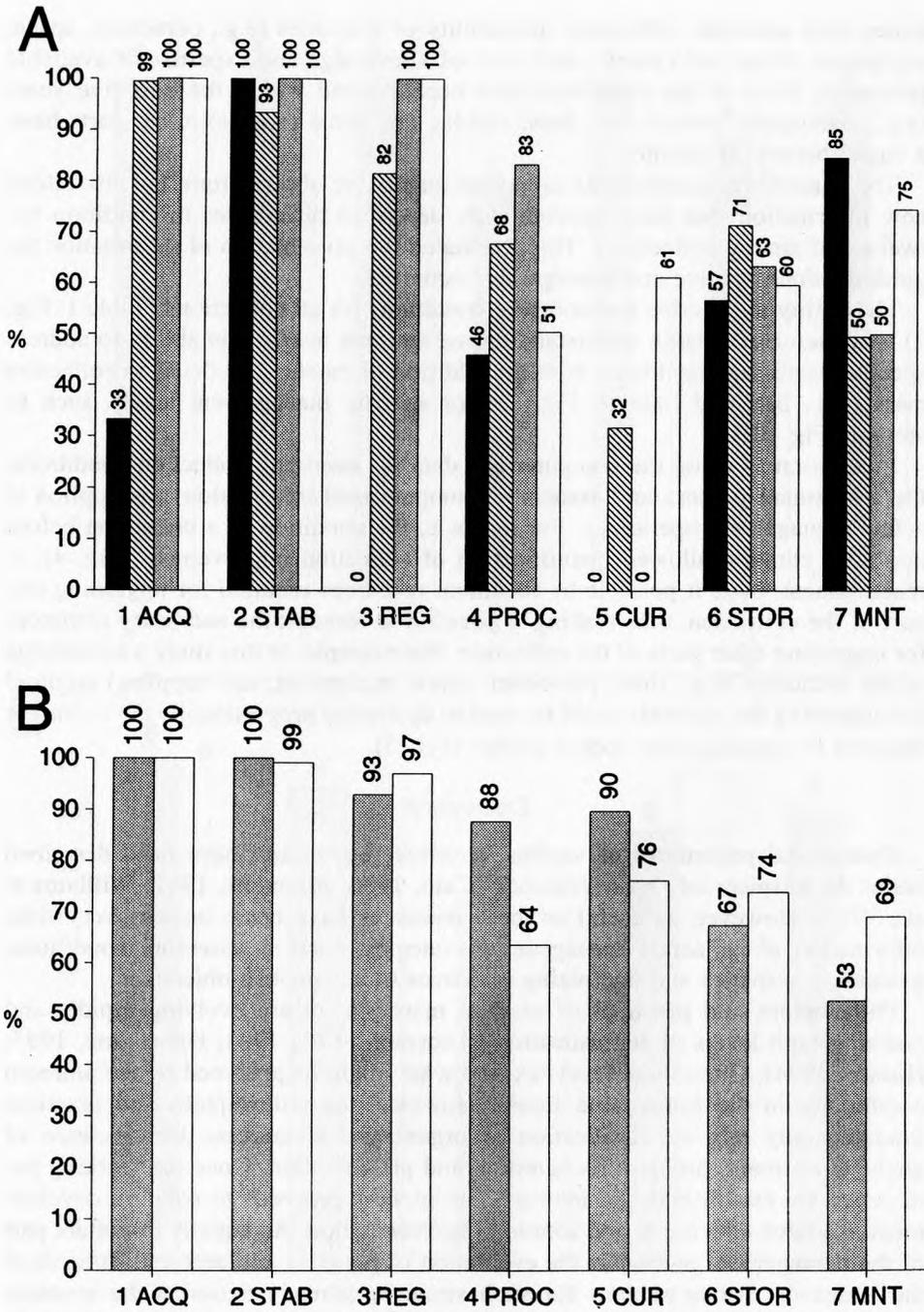


Figure 2. General management profile (based on Table 1) of wet (A) and dry (B) vertebrate collections, showing percent of work completed for the management levels described in the text (solid bar = fish; slashed bar = amphibians and reptiles; stippled bar = birds; open bar = mammals). The number of observations for each group is as follows: A. *wet collections*—fish, 27; amphibians and reptiles, 106; birds, 13; mammals, 92; B. *dry collections*—birds, 197; mammals, 1,763. Respective percentage values are given above each column.

tuates with academic schedules, availability of resources (e.g., personnel, space, equipment, time, and money), and level of knowledge and expertise of available personnel. Parts of the collection have been curated within the past five years (e.g., marsupials, insectivores, bats, rabbits, and some rodents); other parts have a vague history of curation.

The quantitative assessments supported qualitative observations, but also added new information that more appropriately described differences in condition between and among collections. This facilitated the presentation of information for guiding administrative and management activities.

The ability to describe and compare conditions for all collections (Table 1; Fig. 2) was useful in broadly understanding institutional needs. The ability to address specific needs was facilitated with the addition of meaningful detail to collection parts (e.g., bats and rodents; Fig. 3A) or specific management levels, such as storage (Fig. 3B).

In addition to using the computerized data for assessing collection conditions, the assessment process and associated computerized information was applied to actual management operations. For instance, the condition of a collection before and after curation allowed quantification of collection improvement (Fig. 4). A reassessment made it possible to document resources required for upgrading one part of the collection, thus making it possible to forecast the necessary resources for upgrading other parts of the collection. For example, in this study a knowledge of the resources (e.g., time, personnel, space, equipment, and supplies) required for upgrading the squirrels could be used to determine proportionally the resources required to upgrade other rodent groups (Fig. 5).

DISCUSSION

Operational procedures of various vertebrate collections have been described under the auspices of "management" (Cato, 1986; Simmons, 1987; Williams et al., 1977). However, as useful as these resources have been, there is very little information about actual management strategies, such as assessing conditions, evaluating activities and organizing resources to accomplish objectives.

Philosophies and practices of modern management are evolving rapidly and reaching high levels of sophistication (Anderson *et al.*, 1994; Harrington, 1995; Hussey, 1994). Often these levels exceed what might be practiced by the museum community in the foreseeable future. However, the philosophies and practices fundamentally rely on clarification of organizational mission, identification of goals, assessment, problem recognition, and prioritization. Once the working parameters are established, the management process proceeds to solution development, resource allocation, and solution implementation. An equally important part of the management process is the evaluation of progress and accomplishments of the endeavor. Strong support for such strategies already exists in the museum community as indicated by the number of museum projects that receive federal funds for conducting assessments. Such assessments may involve different levels of management, such as general assessments, collection assessments, or object assessments (Hutchins, 1987).

McGinley's contributions (1989, 1990, 1992) and the current project provide mechanisms for assessing the condition of natural science collections. In the past,

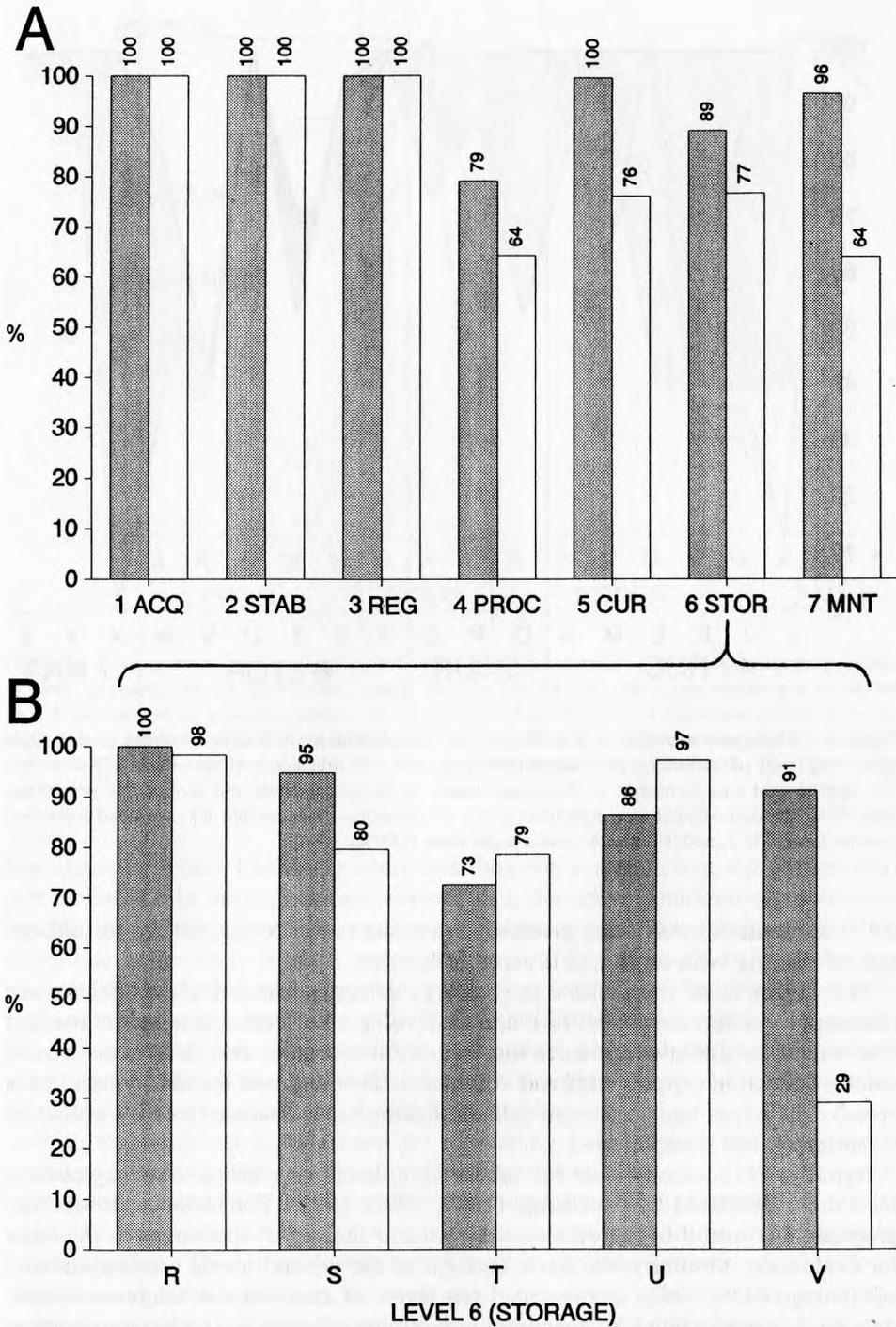


Figure 3. Detailed management profile for specific taxonomic groups within a collection (A) and corresponding specific management level (B; level 6—storage) as described in Appendix I. The stippled bars represent bats ($N = 329$ drawers) and the open bars represent rodents ($N = 1,065$ drawers) for both figures. Respective percentage values are given above each column.

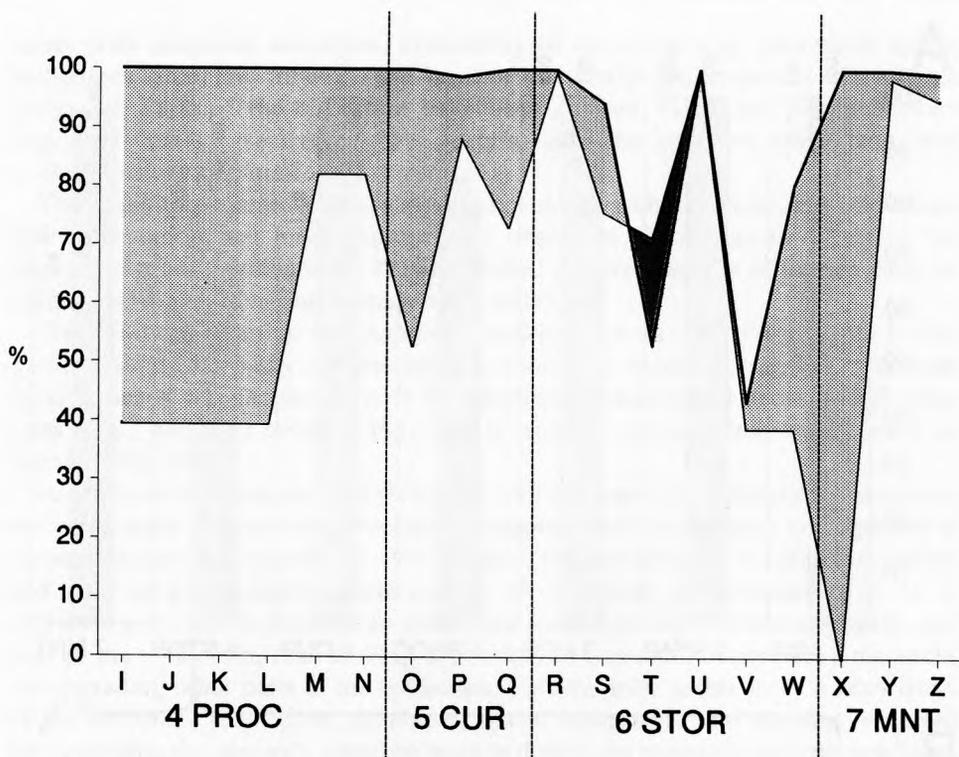


Figure 4. Management profile of a collection subsection (Family Sciuridae) showing change after addressing many of the management needs (pre-curation = 157 drawers; post-curation = 175 drawers). The light-shaded area represents a 23% improvement in the management and care of that part of the collection. The dark-shaded area represents a loss of expansion space needed for continued collection growth. Levels 1, 2, and 3 for each case are the same (100%).

such assessments rarely were given much consideration because of the formidable task of dealing with large and diverse collections.

The objective of the current project was to apply McGinley's model for assessment to vertebrate collections, and to develop an effective assessment method that would facilitate communication with administrators and task management among collection support staff and volunteers. This required the ability to address broadly all issues and to present reliable information, characterized by accuracy, consistency, and completeness.

Initially, the methods used for assessing collections were in close agreement with those proposed by McGinley (1989, 1990, 1992). For instance, it was appropriate and useful to incorporate drawers and shelves of specimens as the basis for evaluation. Similarly, the basic concept of the general levels was maintained. McGinley (1989, 1992) incorporated ten levels of curation that addressed materials conservation (level 1), specimen accessibility (levels 2-4), physical curation (levels 5-6), data capture (levels 7-9), and scientific voucher material (level 10). However, inherent operational differences between insect collections and vertebrate collections (e.g., preservation methods, level of identification, special processing, use of computerization, and storage methods), resulted in modifications.

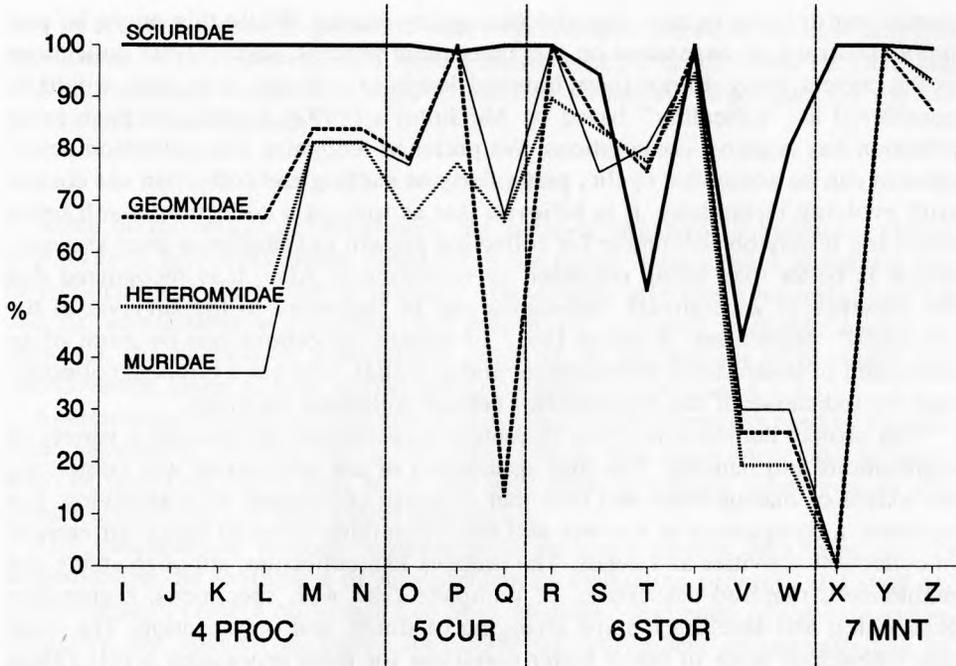


Figure 5. Management profile of several collection parts (four families of rodents) comparing percent of work completed for the management levels described in the text. The management goal would be to at least improve all groups of rodents to the same level as Sciuridae. Differences observed can be explained by group sizes, taxonomic complexity, and time lapsed since group was fully curated (Sciuridae = 175 drawers; Geomyidae = 211 drawers; Heteromyidae = 165 drawers; Muridae = 487 drawers).

For example, where McGinley addressed data entry specifically, the current project included it in the registration section; also, the active deterioration mentioned by McGinley tends to be an issue more common with incoming material for vertebrate collections. In the current project, it also was useful to incorporate a sequential perspective and terminology that was logical and familiar to the staff. For example, levels such as acquisitions, stabilization, and registration clearly identify stages of processing vertebrate collections. Although the project involved some customizing of the assessment strategy, the general categories used are applicable for most assessments of vertebrate collections.

With regard to the criteria used for evaluating individual levels, we found it useful to be sufficiently specific to initiate appropriate "action." However, it was acknowledged that such detail can cause assessments to vary with different times and collections. For example, it was once a common practice to staple multiple labels together. This is no longer considered acceptable because of the risk of abrasion and metal corrosion, both of which can damage labels and specimens; furthermore, there are descriptions of preferred methods (Hawks and Williams, 1986). Once the situation was corrected, it would not be an issue with future assessments.

McGinley (1992) stated that a bimodal bar-graph is an indication of a healthy collection, one that is actively being curated (primary mode) and one that is

continuing to bring in new material (secondary mode). While this might be partially construed as dependent on the assessment process, some of the collections in the current study do not show bimodal levels of curation, thus, they would be considered as "unhealthy" based on McGinley's (1992) criteria. Such an interpretation has negative connotations. We prefer to recognize that collection development can be somewhat cyclic, particularly as staffing and collection use change with evolving technology. It is believed that as long as a collection is still being cared for, it may be acceptable for collection growth to stabilize or even stagnate, which is better than being orphaned or warehoused. Also, it is recognized that the presence of zero-growth collections can be important to the survival of the "bimodal" collections. A broad range of related collections can be more of an indication of institutional commitment and potential, whereas a bimodal collection may be indicative of the personalities behind collection activities.

This project demonstrated that collection assessments can provide a variety of applications and benefits. The first application of the assessment was comparing the extent of management and care that different collections were receiving. For instance, a comparison of the wet and dry collections revealed major differences in collection activities and needs. The inactive fish collection, although stable and maintained, required association of complete data with specimens, registration (cataloging and labelling), some changing of fluids, and organization. The other wet collections were in much better condition for most processing levels (Table 1; Fig. 2). Similarly, the dry collections revealed differences in the amount of acquisition and management activity. For instance, the strong institutional interest in mammals was evident with a larger backlog of incoming material waiting to be processed and curated. Also, the same collection had received more new storage equipment as well as closer attention to taxonomic updates and other maintenance issues (Fig. 2B).

Reassessments facilitated other applications. In this project, they allowed quantification and summarization of the curation of the squirrel collection—it was possible to estimate a 23% improvement in its management and care (Fig. 4). Perhaps a more useful application of the reassessment process was the ability to forecast resource needs for future activities. In this project, a knowledge of the resources required for curating the collection of squirrels made it possible to forecast resources needed for curating other groups of rodents (Fig. 5).

One of the immediate benefits realized from the project was increased awareness and concern by personnel involved with the assessment. Also, it was beneficial for staff to become aware of collection needs that previously had been assumed to be under control. For example, the amount of backlog in the amphibian and reptile collection was not appreciated fully until the assessment was completed.

Another benefit of the assessment process was learning about problems affecting collection care. For instance, the initial assessment of the collection of squirrels documented crowding and unprocessed materials. However, the post-curation reassessment revealed that drawer movement was displacing specimens and that objects were damaging one another. The solution was to provide a means of preventing box and vial movement when the drawer was moved.

Task management, a major benefit of the assessment process, was facilitated by printing specific sections of the spread-sheet. Such print-outs allowed individ-

uals to recognize specific problems that required their attention during curatorial operations. With respect to task management, specific needs could be identified and appropriately assigned to support staff or volunteers depending on the expertise and time required.

SUMMARY

Based on the results of this project, the methods proposed by McGinley (1989, 1990, 1992) have tremendous potential in the future management of natural history collections. The ability to quantify assessments provides a powerful tool for making administrative decisions and effectively utilizing available resources. However, the success of assessments is based on the amount of planning and consideration given to how results are to be presented and used.

Assessments of ancillary collections (e.g., tissues and libraries) need to be evaluated separately, possibly using different criteria. The assessment and management of such collections may be as different from vertebrate collections as vertebrate collections are from insect collections.

Any management strategy requires periodic reassessment. McGinley (1992) demonstrated the usefulness of reassessment in evaluating progress and staff accomplishment. Once a collection has been evaluated and parts of the assessment document are updated as issues are addressed, subsequent assessments can be easier to accomplish.

The contributions of McGinley (1989, 1990, 1992) and this project are consistent with the philosophies and practices of the museum community (Hutchins, 1987). Although assessments can be used effectively for justifying new resources from external parties, it is important to remember that the real value of collection assessments is their application for "true management" of collections.

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LITERATURE CITED

- Anderson, D. R., D. J. Sweeney, and T. A. Williams. 1994. *An Introduction to Management Science. Quantitative Approaches to Decision Making*. 7th Edition. West Publishing Co., New York, xxii + 814 + 56 + 9 pp.
- Blaustein, A. R., and D. B. Wake. 1990. Declining amphibian populations: A global phenomenon? *Trends in Ecology and Evolution*, 5:203-204.
- Cato, P. S. 1986. Guidelines for managing bird collections. *Museology*, 7:1-78.
- Dixon, B. 1987. Conservation management: Possible or necessary? Pp. 1-8 in *Conservation Management*, Queen's University, Kingston, Ontario, 72 pp.
- Harrington, H. J. 1995. *Total Improvement Management*. McGraw-Hill, Inc., New York, xviii + 488 pp.
- Hawks, C. A., and S. L. Williams. 1986. Care of specimen labels in vertebrate research collections. Pp. 105-108 in *Proceeding of the 1985 Workshop on Care and Maintenance of Natural History Collections* (J. Waddington and D. M. Rudkin, ed.). Royal Ontario Museum, Life Sciences Miscellaneous Publications, unnumbered series: vi + 1-121.
- Hussey, D. E. 1994. *Strategic Management. Theory and Practice*. 3rd Edition. Alden Press, Oxford, U.K., xii + 625 pp.
- Hutchins, J. K. 1987. Conservation surveys. *Virginia Association of Museums, Technical Information*, (Winter/Spring):3-4.

- McGinley, R. J. 1989. Entomological collection management—Are we really managing? *Insect Collection News*, 2(2):19–24.
- McGinley, R. J. 1990. Entomological collection management—Are we really managing. *ASC Newsletter*, 18(2):30–31.
- McGinley, R. J. 1992. Where's the management in collection management? Pp. 309–333 in *Current Issues, Initiatives, and Future Directions for the Preservation and Conservation of Natural History Collections* (C. L. Rose, S. L. Williams, and J. Gisbert, eds.), Ministerio de Cultura, Madrid, Spain, 3:xxviii + 1–439.
- Simmons, J. E. 1987. Herpetological collecting and collections management. *Society for the Study of Amphibians and Reptiles, Herpetological Circular*, 16:ii + 1–70.
- Simmons, J. E. 1993. Natural history collections management in North America. *Journal of Biological Curation*, 1(3/4):1–17.
- Wake, D. B. 1991. Declining amphibian populations. *Science*, 253(5022):860.
- Williams, S. L., and P. S. Cato. 1994. Interaction of research, management, and conservation for serving the long-term interests of natural history collections. *Collection Forum*, 11(1):16–27.
- 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. 1993. Conservation assessments and long-range planning. Pp. 289–307 in *Current Issues, Initiatives, and Future Directions for the Preservation and Conservation of Natural History Collections* (C. L. Rose, S. L. Williams, and J. Gisbert, eds.), Ministerio de Cultura, Madrid, Spain, 3:xxviii + 1–439.
- Wolf Green, S. J., D. Brown, J. H. Chambers, and C. Gould (eds.). 1990. *The Conservation Assessment: A Tool for Planning, Implementing, and Fundraising*. National Institute for Conservation of Cultural Property, Washington, D.C., 50 pp.

Appendix I. Descriptive information for evaluating and standardizing management information.

Collection evaluation criteria

Level 1—acquisition.

Potential exists for loss of specimens, specimen parts, and/or associated data.—This applies to the need for:

- A) addressing missing or disassociated data,
- B) appropriately preserving materials regarded as unstable or at risk to mechanical, chemical, and/or biological damage,
- C) addressing legal ownership and gaining control of the accession as a whole.

Level 2—stabilization.

Basic preservation processing, compilation and organization of records, and protection.—This applies to the need for:

- D) correcting or completing data to be associated with individual specimens,
- E) eliminating or replacing inappropriate materials (e.g., packing or improper fluids),
- F) providing basic protection to mitigate risks with mechanical, chemical, and/or biological deterioration.

Level 3—registration.

Cataloged and labeled (provisionally available for use).—This applies to the need for:

- G) specimens to be cataloged as part of the permanent collection,
- H) associated parts of specimens (e.g., specimen labels), to be marked with the collection acronym and catalog number.

Level 4—processing.

Supplementary processing.—This applies to the need for:

- I) processing specimen parts to facilitate their utility,
- J) properly containing specimen parts (e.g., standardized boxes or vials),
- K) reassociating specimen parts,
- L) removing extraneous materials (e.g., string, debris, staples, etc.).

Supplementary labelling.—This applies to the need for:

- M) properly labelling specimen parts (e.g., use of collection-specific labels, attachment of tags on specimens, bones labelled with collection acronym and catalog number),
- N) properly labelling storage containers (e.g., boxes, vials, and jars).

Level 5—curation.

General organization.—This applies to the need for:

- O) specimens to be positioned in the permanent collection according to written procedures that at least meet disciplinary standards (e.g., phylogenetic arrangement).

Retrievability.—This applies to the need for:

- P) organizing and arranging of specimens in a specific, predictable, and accessible location in the collection,
- Q) appropriately labelling storage units and associated parts to expedite retrieval and minimize unnecessary handling.

Level 6—storage.

Permanent storage.—This applies to the need for:

- R) storing specimens in protective storage units in the permanent collection in the vicinity where common taxa occur.

Space.—This applies to the need for:

- S) providing sufficient space for specimens to avoid physical damage caused by crowding of individual specimens by materials in drawer or by overlying drawers.
-

Appendix I. Continued.

Collection evaluation criteria

Collection growth.—This applies to the need for:

- T) providing sufficient unused space (e.g., >20%) to allow expansion for future collection growth.

Storage unit.—This applies to the need for:

- U) improving the quality of storage units because of structural integrity or the existence of reactive materials.

Associated materials.—This applies to the need for:

- V) replacing associated storage materials (e.g., defective supplies, inappropriate containers, corks on vials, acidic papers, and any undesirable material that is in contact with specimens and increasing the risk of mechanical or chemical damage),
- W) correcting inappropriate use of storage materials (e.g., controlling movement or positioning of containers, particularly when there is a risk of specimen damage, such as trays lying on specimen parts).

Level 7—maintenance.

Record quality and cross-referencing.—This applies to the need for:

- X) updating specimen information and appropriately cross-referencing changes in the collection records (e.g., species identification, taxonomic update).

Pest control.—This applies to the need for:

- Y) corrective action to address pests, pesticides, or evidence of their presence.

Loan transactions.—This applies to the need for:

- Z) corrective action to address overdue loans.
-

Appendix II. Form with instructions used for evaluating collections.

Instructions for evaluation

1. Use a soft-lead pencil to document collection conditions so that future updating will be possible, if desired.
 2. The physical basis for evaluation will be each drawer or shelf of each storage unit. Taxonomic information should be appropriately included on the form because the final assessment is referenced to major taxonomic groups.
 3. When all criteria are satisfied for a level, a check (✓) is used to indicate completion of that entire level.
 4. For levels that have been partially completed, simply cross out the subdivisions that have been satisfied and leave the others unchecked. Unchecked letters should be written in the appropriate square to call attention to needed management activities.
 5. For any level or subdivision, if there is a question about the accuracy of information include a question mark (?) with the appropriate code.
 6. Leave the level blank if it is inappropriate to evaluate the group because levels are not yet expected or attempted.
-

COLLECTION MANAGEMENT EVALUATION FORM

EVALUATOR'S NAME _____ DATE _____

CASE DESCRIPTION _____ NO. DRAWERS _____

CONTENTS IN NEED OF: INTEGRATED PEST MANAGEMENT COMPUTERIZATION
 HEALTH AND SAFETY ATTENTION INVENTORY
 EMERGENCY PREPAREDNESS PLAN DATA VERIFICATION
 CARE OF SUPPLEMENTARY RECORDS OTHER (_____)

DRAWER	1 ACQ	2 STAB	3 CAT	4 PROC	5 CURAT	6 STORE	7 MAINT	DRAWER CONTENTS	COMMENTS
01	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
02	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
03	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
04	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
05	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
06	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
07	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
08	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
09	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
10	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
11	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
12	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
13	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
14	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
15	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
16	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
17	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			
18	A 9 C	D E F	G H	I J K L M N	O P Q	R S T U V W X Y Z			

BOOK REVIEWS

STANDARDS IN THE MUSEUM CARE OF ARCHAEOLOGICAL COLLECTIONS, 1992, Crispin Paine, ed. (Museums & Galleries Commission, London, UK, 59 pp.) Let's say you are a curator in a financially strapped institution that has archeological collections, and expects to receive more. You have a feeling that the collections are not in proper order and you want to apply for a grant for money to put them right. How do you figure out what conditions and procedures you should try to implement?

One way would be to pore over collections-care literature such as Pearce's *Archaeological Curatorship*, Thompson's *Manual of Curatorship*, or the U.S. National Park Service's *Museum Handbook, Pt 1*. The problem, though, is that the information you want needs to be extracted from sometimes long grey paragraphs, buried like flecks of gold in masses of quartz. What is needed is a kind of primer, an executive summary, to introduce the terms and overall conceptual structure of the problems and solutions in the care of archeological collections. I believe that the Museums & Galleries Commission in London has come up with just such a creature in their *Standards*.

This thin, spiral-bound, A-4 sized publication consists of a series of numbered *standards* to which one is encouraged to aspire, followed by a series of numbered *guidelines* and *notes*, which amplify and present ways to achieve the recommendations of the standards, followed by a list of *sources* of advice and help. The *standards* are usually limited to a well-phrased sentence or two, while the *guidelines* rarely go beyond a paragraph of five sentences. The aim is clarity and succinctness.

Topically, the publication is divided into two parts: *Managing Collections*, and *Protecting Collections*. The first part covers collecting, the preparation and transfer of finds and records, curation and conservation generally, access, loans, documentation, research, and the records of sites and monuments. The second part covers the specific threats of theft, fire, flood, physical damage, poor construction or maintenance of buildings/furnishings/fittings, damage by poor environmental condition, the protection of primary records, and disaster planning. At the end are three tables covering recommendations for temperature, relative humidity, light, and UV for various kinds of artifacts and records.

Note that the recommendations cover both the finds (the artifacts and samples) and the records of the excavation. This they call the *archaeological archive*: "all the finds and records, in whatever form, generated by an archaeological excavation or other fieldwork programme." That the task of preservation of collections consists of more than just boxing up artifacts and sticking them in the back room is often not immediately apparent to the non-museum people who often must have a grasp of this fact: managers and boards, volunteer staff, architects, and so on. This publication provides an easy-to-digest way to convey this information to such people.

An example of a *standard* from part one is this from the section on access: "4.1 Every museum must make publicly known the existence of its archaeological study collections." From the same section, an example of a *guideline*: "4.12 The museum will need to balance the good aim of encouraging access to its collections

with the requirement of conservation and of security. . . . Enquirers who need to handle objects should be advised on how to do so safely; some objects may be too fragile to handle at all. . . .”

From part two, section 14, on protecting collections from poor environment, after referring the reader to the chart on maximum light levels, *standard 14.7* states: “The period of exposure to light must be kept to a minimum as damage by light is cumulative.” *Guideline 14.23* goes on to further make the subtle point that “Length of exposure is as important as the level of illumination when assessing the possible damage caused by light. Measuring exposure in lux-hours using an integrating light-meter provides a more accurate record of total exposure. Total exposure (lux-hours) = time (hours) × illuminance (lux).”

Of course things are simplified, maybe oversimplified. But that's the point: to get to the point. This work represents a “growing consensus” and was derived from an “expert group” of 15. It is meant to be a starting point, to be modified for local conditions as necessary, but not meant to be a single stand-alone contains-everything-in-detail encyclopedia. It supplements, condenses, and refers to more complete works.

However, the references to all publications are limited to those published in the UK only. This limits its usefulness as a guide to further reading, though many of the references contain more broadly based bibliographies.

This publication is one of a series with similar structure setting out standards in various aspects of museum work. The other works cover care of biological, geological, musical instrument, and industrial collections.—*Dan Riss, National Park Service Conservation Labs, PO Box 50, Harpers Ferry, West Virginia 25425.*

STANDARDS IN THE MUSEUM CARE OF GEOLOGICAL COLLECTIONS, 1993. (Museums & Galleries Commission, London, UK, 57 pp.) This is the third in a series of four publications devoted to standards for collection care. The other three numbers cover archaeological, biological and industrial collections. The Commission assembled a panel of 20 experts (and consulted with an additional 48 museum professionals) to codify current thought in the management and care of geological materials. Although this book is directed toward institutions in the UK, it is equally relevant to institutions, large or small, worldwide.

The book is divided into two main parts: "Managing Collections" and "Protecting Collections." The managing section, with standards for collecting, specimen disposal, curation, conservation, access, loans, documentation, research and site recording, deals with establishing policies to preserve the integrity and value of the collection. The protecting section emphasizes the more physical aspects of the museum, under topics covering theft, fire, flood, disaster planning, primary documents, "protecting people from specimens," and physical damage, including damage due to poor environmental controls and construction or maintenance of the building and furnishings. Three one-page tables: "Relative humidity and temperature for the display and storage of geological specimens;" "Maximum levels of illuminance and ultraviolet radiation for geological materials;" and "Relative humidity and temperature for the display and storage of geological records" summarize practical environmental information, and complete the volume.

For each topic, a three-part format is consistently maintained. The standards are presented in a few succinct statements followed by "Guidelines and notes," an extensive section in which the standards are explained, terms are defined, and practices are elaborated. The guidelines suggest subtopics for inclusion in the policy and explain appropriate conservation and curatorial principles that apply to setting the standards. Each of the guidelines sections contains a vast amount of information that enables users to shape individual, collection-specific policies while conforming to the standards. The final part, "Sources of advice and help," refers the user to pertinent publications and professional groups or government agencies.

Consult this book! Compare your current collection management policy, practices and documentation with the described standards. I seriously doubt that any collection will conform to every standard. As the Commission acknowledges in the introduction most institutions are "aspiring" to conform. Where your policies do conform, smile with satisfaction. Where yours fall short, examine them closely, consider the Commission's recommendations, and amend accordingly. The book is thorough. However, references to Museums & Galleries Commission standard policies or publications are obviously not applicable to all museums. For direction with these aspects, a collection will rely on its own institutional guidelines, or those recommended by professional societies.

As the book constantly reminds us, policy is not static, it must be reviewed frequently. With the publication of this book, the task of evaluating policy becomes easier. The clear and concise style makes this an essential reference book for anyone concerned with managing and caring for geological collections. The affordable price (£6 UK, £10 outside UK, including postage) is an added attraction. The layout and typeface of this slim, spiral-bound volume are simple and pleasing. The pages are cleverly protected by a sturdy, coated-paper cover which

enwraps the book and folds out to reveal the table of contents. The Standards may be purchased from The Museums & Galleries Commission, 16 Queen Anne's Gate, London, SW1H 9AA UK.—*Julia Golden, Department of Geology, University of Iowa, Iowa City, Iowa 52242.*

SYSTEMATICS AGENDA 2000: CHARTING THE BIOSPHERE, 1994, and **SYSTEMATICS AGENDA 2000: CHARTING THE BIOSPHERE: TECHNICAL REPORT, 1994**. (Systematics Agenda 2000, a consortium of the American Society of Plant Taxonomists, the Society of Systematic Biologists, and the Willi Hennig Society, in cooperation with the Association of Systematics Collections, 20 pp. and 34 pp. respectively.) The profound implications of our impending, tremendous loss in biodiversity is well understood by most people working in the natural sciences, but is not well-known or well-understood among either the professional members of other disciplines or the members of the general public. Systematic biology projects tend to be underfunded in favor of other biological disciplines; countries with the greatest biodiversity have the least ability to house and care for natural history collections. Further, there is a serious shortage of taxonomically trained scientists to study biodiversity. In an attempt to remedy these situations, this project, the Systematics Agenda 2000, described in these two booklets, was initiated by the organizations listed above. It is a proposal originating from within the systematics community itself.

The two booklets are each meant to stand alone; they do not complement each other, but are different versions of the same proposal. The first booklet (without a subtitle) is apparently intended as a popular report. It gives a brief introduction to the problem of the loss of the biological diversity, defines systematics, and describes the proposed project—to chart the biosphere—in terms of three mission statements. This booklet is very slick in appearance, containing many color photographs (non-glossy because they are printed on recycled paper). The photographs are not captioned, which is unfortunate. Labelled photographs, some of which are intriguing images, would have contributed to the presentation. The information is well-organized and the text is augmented with sidebars containing appropriate quotations, examples of case studies, and additional information on various aspects of the project.

The second booklet, the technical report, contains much the same basic information as the popular report, but it is fleshed out in considerably greater detail. As such, it is probably of greater interest to the scientific community. There is more discussion, couched primarily in economic terms, concerning the value of systematic knowledge and of biodiversity. Greater detail is given concerning the mission statements and the plans for implementation of the Agenda. There are no color photographs in this technical report, but there is considerable use of “boxes” for additional examples, definitions of concepts, and discussions of several topics brought up in the report. Unlike the first booklet, there is both an excellent bibliography and a glossary of terms.

The crux of both booklets and the heart of the Agenda project are contained in the three missions statements: Mission 1: To discover, describe, and inventory global species diversity; Mission 2: To analyze and synthesize the information derived from this global discovery effort into a predictive classification system that reflects the history of life; Mission 3: To organize the information from this global program into an efficiently retrievable form that best meets the needs of science and society.

Inextricably connected to the implementation of these missions is the promotion of new and enhancement of existing systematics collections and research centers. If this proposal meets with approval and obtains the support that is needed from

the many and various governmental and nongovernmental agencies involved with funding such projects, the effects on the systematics community and on natural history museums could be profound.

However, it is beyond the ken of this reviewer to pass judgement on the value of this project as it is proposed or what chances it has of being implemented. It is also unclear to me to whom the booklets are addressed—it is never stated. My impression is that they are intended as tools for lobbyists to gain influence among the policy makers of national and international governments and agencies. While these booklets are not useful in the day-to-day management of natural history collections, their clear statements describing the value of systematic research and the powerful case they make for this approach in dealing with the biodiversity crisis, make them interesting and hopeful reading.—*Maria E. Rutzmoser, Museum of Comparative Zoology, Harvard University, 26 Oxford Street, Cambridge, Massachusetts 02138.*

CONSERVATION OF GEOLOGICAL COLLECTIONS, 1994, R. E. Child, ed. (Archetype Publications Ltd, 31-34 Gordon Square, London, WC1H 0PY, 65 pp., £7.50.) This publication represents the proceedings of a conference of the same name held at the Welsh Folk Museum, National Museum of Wales on 4 November 1993. Indeed, all of the contributors are employees of the National Museum of Wales and recognized as well qualified conservators.

The book addresses the many problems of decay associated with the storage and maintenance of geological specimens in museum collections, materials which even today, are widely regarded by the uninitiated as generally stable under normal conditions. Geological curators, geologists, and paleontologists know differently. It goes on to discuss the forms of conservation, damage control, and amelioration available to the geological curator. The inclusion of 8 colour photographs provides useful examples of the types of specimen problems typically encountered.

The book is organised into several sections covering a range of curatorial concerns and procedures. For instance, individual chapters deal with the common problems of pyrite decay (C. J. Buttler), detrimental effects of the museum environment (R. E. Child), shale degradation (D. Dollery), and mineral salt efflorescence. The latter chapter includes a welcome note of caution towards the chemical, specifically acid, preparation of fossils and their matrices. Perhaps less obvious matters, such as previous conservation treatment problems (D. Dollery) and the use of proper collection survey and record keeping techniques (C. J. Buttler) are also knowledgeably reviewed.

The issue of good storage practices, which one might think to be self-evident, is in my experience all too frequently overlooked or ignored by museums with geological collections. Granted, this is frequently due to the inheritance of numerous pre-existing problems in historical collections, or of large scale problems that overwhelm inadequate resources, but all too often small museum curators are not fully appraised of current procedural recommendations. A selection of writings by Child, Dollery, and Buttler combine to cover this important topic.

Perhaps the most interesting and useful sections, by virtue of their novelty, are those on light (visible and otherwise) induced changes in mineral specimens (J. Horák), and the storage of hazardous specimens such as those which are poisonous or radioactive (M. Lambert). The hazards of lifting and securing extremely heavy rocks/bones are excluded from consideration, by the way!

I can recommend this book as a concise general overview of geological specimen care, but not, I am afraid, as an in depth guide to conservation. It nicely reviews the issues that should be of concern to the experienced geological curator, but sadly, it does not provide an adequate knowledge of the detailed techniques required for practical conservation in today's museums, and which is especially necessary for those curators whose experience is not strictly geological. In this respect, it is not very helpful in the area where it stood to make its most significant contribution. For example, Child's review of museum environmental problems is extremely brief and where, in a separate section, he discusses storage materials, he provides few specific recommendations. Indeed, many of the chapters rely heavily upon reference to previous reviews. Even here, the individual reference lists are restricted in scope and several works in press are ill-advisedly included.

The book is, not surprisingly, of greater use to the British curator as the few

addresses given are for UK suppliers, while occasional references are also made to UK safety regulations, especially those regarding potential radiation hazards. The book is apparently not meant for a wider audience, but unfortunately, limits its appeal by this parochial emphasis. It includes the occasional awkward phrase/grammatical error and could have benefited also by more rigorous editing.

Conservation of Geological Collections no doubt reflects and well summarizes the content of the National Museum of Wales 1993 conference and may act as a useful reference source for its attendees. Unfortunately, it is unlikely to become a standard reference work for others anxious to learn and apply good conservation practices to geological collections because of its limited scope.—*Glenn W. Storrs, Cincinnati Museum of Natural History, Geier Collections and Research Center, 1720 Gilbert Avenue, Cincinnati, Ohio 45202-1401 USA and University of Bristol, Department of Geology, Wills Memorial Building, Queens Road, Bristol, BS8 1RJ UK.*

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.

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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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