Abbreviated version of Improvements to the Museum of Southwestern Biology Fish Collection, Phase I: Relocation and Reorganization.

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Project Summary:

The Museum of Southwestern Biology (MSB) Division of Fishes is a research and teaching facility housing a collection of over 2 million larval and adult fishes, primarily representing the imperiled ichthyofauna of the southwestern United States. Collections encompass a 60-year history and provide a detailed account of natural and anthropogenic disturbances on fish communities in the Rio Grande and Colorado River drainages.

Growth and use of the MSB fish collections has been limited due to a lack of space. The fish collection currently resides in an 84.5-m^2 room and exceeds capacity by over 20%. To alleviate space problems, renovation of the former UNM bookstore to a new MSB facility is underway and is scheduled for completion in summer 2000. The new facility is equipped with mobile shelving (compactors), providing 1,858 linear meters shelving of space dedicated to the fish collection, that is a five-fold increase in linear shelf space over the current facility.

We are requesting funds to relocate the MSB Fish Collection to the new facility and, following the move, to: (1) reorganize the collection and verify specimen records with the existing computer database, (2) check alcohol concentration and pH of fluids, (3) transfer specimens currently preserved in isopropranol to ethanol (4) curate our collection of large specimens currently stored in earthenware crocks. Reorganization will greatly increase the scientific value of the collection by providing more accurate and detailed specimen records and the first complete updating of the computer database. This request is the first of two-phase project designed to maximize the impact, significance, and use of the MSB fish collections. Following relocation and reorganization, phase two will be directed toward development of a relational database linking specimen information to geographical and environmental data. This database will incorporate ASC recommendations and be available via the World-Wide-Web.

1. Results from Prior NSF Support…

2. Collection Significance and Use

A Brief History of the MSB Division of Fishes

The Museum of Southwestern Biology, a division of the Department of Biology at the University of New Mexico, is an education and research facility dedicated to the study of natural history. The MSB maintains collections of mammals, birds, reptiles, amphibians, fishes, invertebrates, plants, cryogenically preserved tissues, and ancillary materials such as library materials and tape recordings. The MSB has a Director who reports to the Dean of Arts and Sciences, and six faculty members who have, in addition to teaching and research programs, curatorial responsibilities.

The Division of Fishes, the second oldest of the MSB collections (after plants), has grown from meager beginnings and negligible support into a large, well-supported facility housing important collections from aquatic habitats in the southwestern United States. Details of the history of the MSB Division of Fishes were chronicled in Platania (1993, 1997). In 1938 the fledgling Biology Department at the University of New Mexico hired a vertebrate biologist (William J. Koster) to complement its staff of three faculty botanists. Koster was charged with developing and teaching all courses pertinent to zoology. As there was almost no information on the fishes of the region, Koster formulated a plan to systematically sample the state's ichthyofauna. As he

approached retirement in 1974, Koster attempted to secure the future of the fish collection to which he had devoted 36 years. His concern for the 4,000 lots he had obtained throughout New Mexico was unyielding, and he intended to send the MSB fish collection to the U.S. National Museum if the University did not hire a curator of Fishes.

Manuel C. Molles arrived in 1975 to fill Koster's position and assumed the responsibilities as Curator of Fishes. Molles attended the MSB fish collection by maintaining alcohol levels and filling loan requests. However, the collection did not grow appreciably until 1986.

The MSB Division of Fishes experienced a period of rapid growth beginning in 1986 with the initiation of an ichthyological research program funded by state and federal resource agencies. One of the program's responsibilities was to upgrade the condition of the fish collection, incorporate uncataloged material that had accumulated since the 1970s, and deposit specimens taken during research projects into the MSB Division of Fishes. Curation costs were borne by the various research projects. Under this program, as many lots were taken and cataloged in the MSB Division of Fishes in five years as had been generated during the previous fifty years. The historic data collected by Koster during his tenure at UNM is now complemented by current studies. Upgrading all levels of the collection (jars, labels, tags, stainless steel tanks, computerization) remains a priority. Despite its humble beginnings, the MSB Division of Fishes has not only survived and flourished but has emerged as a prominent biological resource.

Current Holdings and Description of the MSB Fish Collection

The MSB Division of Fishes fills a unique and important role in documenting historical and present ichthyofauna and freshwater habitats of the arid southwestern United States (Table 1). The Division houses the largest university-based freshwater fish collection in New Mexico and the southwest. In addition, the MSB Division of Fishes maintains some of the largest collections of regionally rare and/or extirpated taxa. Historical collections (Koster collections 1938-1975) of New Mexico fishes (about 4,000 lots) was extensively used in the preparation of species accounts and distribution maps in *The Fishes Of New Mexico* (Sublette et al. 1990). In the last six years, computerization of collection records and localities (software = Paradox 4.5) has been accomplished, providing an invaluable data set for students and researchers in long term ecological studies of desert fishes and river systems.

TABLE 1. A SUMMARY OF HOLDINGS IN THE MSB DIVISION OF FISHES BY PERCENTAGE OF THE COLLECTION IN TAXONOMIC, POLITICAL AND RIVER DRAINAGE CATEGORIES.

Taxonomic					
Cypriniformes	Cyprinidontiformes	Siluriformes	Perciformes	Salmoniformes	Atheriniformes
86.4%	10.1%	1.2%	0.9%	0.6%	0.6%
Political					
New Mexico	Southwestern USA	Other US States and Canada		Latin America	
73.7%	25.2%	0.6%		0.5%	
Drainages					
San Juan River	42 %				
Rio Grande	29 %				
Pecos River	25 %				
Gila River	1 %				
Canadian River	0.8 %				
Tularosa Basin	0.1 %				
Zuni River	0.1%				
Other drainages	2%				

The collection (as of 1999) has 42,925 cataloged lots of fishes or 2,135,565 specimens, representing 58 families, 154 genera and 289 species. Early life history stages of fishes from the Rio Grande, San Juan and Pecos Rivers are well represented in the collection with 3,459 lots of eggs and 2,486 lots of identified larvae. Fluid collections are maintained in specimen jars (8 and16 oz. flint Paragon with polypropylene lids, 1-liter, 2-liter and 3-liter Le Parfait captive lid jars with N-buna white gaskets), arranged by family (Nelson 1984) and alphabetically at genus and species levels. A vial jar system is used for eggs, larvae, and single or small lots of adult fishes. Vial jars (6 and 8 dram) are stored in 3-liter Le Parfait jars. Each 3-liter jar holds up to 40 vials, and contains lots collected from the same species and drainage. Sixty-three percent of the collection is stored in this system (676 jars containing a total of 27,040 catalogued lots). Fluid collections are maintained in 70% ethanol, except for 4000 lots from 1986 to 1989 that are in 55% isopropranol. The majority of the large historic specimens are stored in earthenware crocks (circa 1930s) or 5-gallon plastic buckets. Specimens held in crocks are wrapped in cheesecloth (with original labels) and maintained in fluid-filled, 4-mil plastic bags. Specimens have been transferred to 8 or 15-gallon plastic barrels with gasket tops as time and funds permit. These containers serve as temporary storage until stainless steel specimen tanks can be purchased. Fifty-six crocks, averaging of seven specimens per container await curation. The fish skeleton collection is stored in four locked cabinets in the hallway. About 350 fish skeletons with original labels are maintained in cardboard cigar or shoeboxes. Proper storage of skeletal material requires that it be transferred to acid free, paper-wrapped boxes with telescoping lids. A small fossil collection and archeological midden remains are stored with the skeleton collection in the four locked cabinets.

Growth

The MSB Fish Collection is among the top-ten fastest growing collections in the United States (based on comparisons to Poss and Collette 1995). The greatest period of growth (1986 to present) corresponds to an extremely active fish research programs in New Mexico (Table 2). The Division of Fishes serves as the primary repository for specimens derived from projects by U. S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and the New Mexico Department of Game and Fish. Biologists from these agencies have archived voucher collections and their field data with the Division of Fishes since 1986.

TABLE 2. SUMMARY STATISTICS GROWTH AND CATALOGING ACTIVITY OF THE PAST 5 YEARS (JULY 1994 TO JULY 1999).

Fiscal Year	Cumulative Lots	Cumulative Specimens	Cataloged Lots	Catalogued Specimens	Lots %Increase	Specimens % Increase
94/95	28,915	1,299,305	6,093	280,027	27	28
95/96	35,008	1,526,823	762	7,925	3	1
96/97	35,770	1,749,484	6,637	227,282	19	15
97/98	42,407	2,034,500	518	11,505	1	1
98/99	42,925	2,135,565	2,422	101,515	6	5
Mean Annual Values			3,280/ year	125,651/ year	**11%**	**10%**

Access to these specimens has been greatly facilitated, and duplication of research effort has been reduced, by centralizing and organizing these projects through MSB Division of Fishes. Because some of these projects focused on systematic monitoring of major river drainages, the collection represents one of the most comprehensive ichthyofaunal databases available in the southwestern United States. Given the overall demise of native fish diversity in the southwest, the importance of this collection for assessing declines of fish species (and the mechanisms that drive such events) will continue.

The fish skeleton collection has grown more gradually than fluid collections at a rate of nearly 1% per year. These collections are used extensively by anthropologists and archaeologists to identify fish bones from human-settlement middens.

The Division of Fishes serves as repository for ongoing research in the Department of Biology, and state and federal agencies. Studies in systematics, ecology, evolution, conservation of southwestern fishes, long-term examinations of geographical range and abundance patterns (and the ecological factors that drive patterns), and longterm studies of genetic variation of rare and threatened species are being conducted by Division of Fishes personnel. For the first time in almost 25 years, a faculty-curator with a strong interest in southwestern fishes and building the MSB Fish Collection has been hired to lead the Division of Fishes. This position ushers in a new period of growth for the Division by increasing undergraduate and graduate students directly involved in research projects that build or use the MSB Fish Collection. In addition, the faculty-curator's research interests in conservation genetics combined with ongoing ecological research in the Division will lead to increased growth of the collection and increased research productivity and support for the collection.

Once the collection is moved into the new facility and organized, the MSB Division of Fishes will be able to accept orphaned collections. The Division will soon receive the fish collection from the Ft. Collins Biological Survey Fish Collections (BSFC) in Colorado (at no cost to the project). This collection of pre-impoundment Colorado River fishes includes about 800 oversized specimens of catostomid and cyprinid fishes.

Education

The University of New Mexico Biology Department has a long and distinguished history of educational programs in organismal biology. Currently, the department's organismal focus remains firmly intact, despite trends at other institutions to emphasize molecular and cellular biology. The MSB continues to play a pivotal

role in this education mission. The MSB Division of Fishes maintains a teaching collection (separate from the research collection) of over 200 specimens in 79 families. This resource is an integral part of Ichthyology (20 students/year) and General Vertebrate
Zoology (100 students/year) courses. Specimens are used in the laboratory components of both courses to illustrate the unique natural history of the southwestern United States by providing materials documenting biodiversity, for comparative morphology, and taxonomy and systematics. In addition, undergraduate and graduate students use the research and teaching collections as tools for studies in biological diversity, conservation biology, parasitology, comparative vertebrate zoology, and animal behavior. The MSB Division of Fishes employs at least two undergraduate students per semester as museum assistants, providing training in curatorial procedures and care of natural history collections. The College of Arts and Sciences provides a graduate teaching assistantship annually for advanced training in curatorial procedures and systematic ichthyology.

Research and Education Impact (Past Five Years)
Table 3 summarizes the degree and range of use, and impact in research, education, and other activities over the past 5 years as evidenced in numbers of visitors, loans, data requests, and published works using the MSB fish collection.

TABLE 3. A SUMMARY OF THE DEGREE AND RANGE OF USE OF THE MSB FISH COLLECTION OVER THE PAST FIVE YEARS. FIVE REPRESENTATIVE PUBLICATIONS BASED ON MSB FISH SPECIMENS FOLLOW.

Research/Education Activity	FY 94/95	FY 95/96	FY 96/97	FY 97/98	FY 98/99	TOTALS
VISITORS						
Professional	11	17	6	5	2	41
Student	10	17	6	8	2	43
						84
LOANS/GIFTS OUT						
Professional	10	20	16	19	10	75
Student	11	7	13	15	8	54
						129
INFORMATION/DATA REQUESTS						
Professional	8	4	3	4	6	25
Student	6	8	5	10	6	35
						60
PUBLICATIONS						
Professional	2	1	1	3	2	9
Student	1	2	1	0	1	5
						14

FIVE REPRESENTATIVE EXAMPLES OF PUBLICATIONS BASED ON SPECIMENS FROM THE MSB DIVISION OF FISHES.

Anderson, A. and D. A. Hendrickson. 1994. Geographic variation in morphology of spikedace, *Meda fulgida*, in Arizona and New Mexico. The Southwestern Naturalist 39(2):148-155.

Bestgen, K.R. and D. L. Propst. 1996. Redescription, geographic variation, and taxonomic status of Rio Grande silvery minnow, *Hybognathus amarus* (Girard, 1856). Copeia 1996 (1):41-55.

Echelle, A. A., C.W. Hoagstrom, A. F. Echelle, and J. E. Brooks. 1997. Expanded occurrence of genetically introgressed pupfish (Cyprinodontidae: *Cyprinodon pecosensis* X *variegatus*) in New Mexico. The Southwestern Naturalist 42(3):336-339.

Platania, S. P. and C. S. Altenbach. 1998. Reproductive strategies and egg types of seven Rio Grande basin cyprinids. Copeia 1998(3):559-569.

Gido, K. B. and D. L. Propst. 1999. Habitat use and association of native and nonnative fishes in the San Juan River, New Mexico and Utah. Copeia 1999 (2):321-332.

Description of current facilities

The MSB Division of Fishes is currently housed in a 84.5 m^2 room in the basement of Castetter Hall on the UNM campus (see floor plan in **Special Information and Supplementary Materials**). The collection is archived on 371.2 m stationary shelving that occupies 32.5 m^2 floor space in the room (including 0.75 m aisles). Shelves have been filled since 1997; consequently all newly catalogued lots are now stored in boxes that are labeled with species name and drainage. Workers and equipment occupy the remaining space. The current facility is poorly ventilated, inadequately lit, and has no emergency sprinkler system. Conditions in the Division of Fishes were an important catalyst for relocating to new facilities.

Description of Renovated Facilities

The new MSB building will be a state-of-the-art facility, with office areas for staff, wet and dry laboratories equipped with sinks and fumehoods. In addition to MSB collections and staff, the new facility will house a Geographical Information Systems Laboratory (associated with Sevilleta LTER) facilitating linkage of museum specimens and geographical information. The building will be equipped with high-speed communications cables that will aid development of web-based information networks. Most importantly, the Division of fishes will realize a five-fold increase in linear shelf space (from 371 linear meters to 1858 linear meters) dedicated to the MSB Fish Collection. Fluid collections will be archived in a 473-m^2 room, maintained at 16^oC, and illuminated with halogen lighting (when lights are turned on). This room will have wet pipe emergency sprinklers, a floor drain and containment system, and 4-hour firewalls. Neither personnel nor equipment will be housed in this room, as it is strictly for storage of the collections.

Floor plans of the renovated MSB Fish Collection area are supplied in the **Special Information and Supplementary Materials** Section.

Comparisons of the MSB Division of Fishes to other collections based on survey information

In the most recent survey of fish collections in the United States and Canada (Poss and Collette, 1995), the MSB Division of Fishes (index 120) was ranked as one of the 71 "other collections." As defined by Collette and Lachner (1976), the "other" status indicates mostly university-based collections with local faunal representation. Unfortunately, data for the most recent survey (Poss and Collette 1995) were collected in 1990 limiting the utility of comparisons for rapidly growing collections like MSB Fish Collection. In an effort to quantitatively identify areas of improvement in the Division over the past ten years, we reviewed and answered

survey questionnaires from the 1976 and 1995 using current data (Table 4). Significant improvements have been made in the number of specimens and lots, and in staff size, training and education. The regional concentration of the MSB Fish Collection resulted in high index scores, and will continue to yield high scores in future. This is primarily due to the absence of primary type specimens, and low species diversity compared to neotropical and eastern temperate faunas. However, southwestern U.S. fishes are some of the most unique and endangered fishes on the continent.

TABLE 4. A COMPARISON OF INDEX SCORES BASED ON SURVEYS OF NORTH AMERICAN FISH COLLECTIONS BY COLLETTE AND LACHNER (1976) AND POSS AND COLLETTE (1995). DATES ON COLUMNS REFLECT LAG TIME FROM COLLECTION OF THE DATA TO PUBLICATION. THE 1999 COLUMN SCORES ARE BASED ON RESPONSES SURVEY QUESTIONNAIRES USING CURRENT (1999) DATA FOR THE MSB DIVISION OF FISHES. THE WEIGHT COLUMN REFERS TO A MULTIPLIER USED FOR SCORES AND INDICATES THE RELATIVE IMPORTANCE OF EACH ITEM IN THE OVERALL INDEX SCORE. **WHITE BOXES INDICATE AREAS THAT THE DIVISION HAS IMPROVED ITS SCORE. IN NO CASE DID SCORES DECREASE FROM 1990 TO 1999.**

Category	1973	1990	1999	weight
Total no. Specimens	**3**	**2**	**1**	2
Total no. Lots	**4**	**4**	**2**	3
No. Primary Types	4	4	4	3
No. Secondary Types	4	4	4	2
Geographical Coverage	4	4	4	2
North American Coverage	**4**	**3**	**3**	2
Regional Center	**4**	**4**	**3**	2
Permanence	**4**	**3**	**3**	2
Training and Education	**4**	**4**	**2**	1
Staff size, professional	**3**	**4**	**2**	1
Staff size, technical	**4**	**4**	**3**	1
Historical value	2	2	2	1
Exchange rate	**4**	**4**	**3**	1
Growth rate	**4**	**2**	**1**	1
Loan rate	**4**	**4**	**3**	2
Available facilities	**4**	**4**	**3**	1
Documentation	**1**	**2**	**1**	1
Osteological material	3	3	3	2
Number of families	4	4	4	2
Number of species	4	4	4	2
Index Score	**126**	**120**	**99**	

With over 42,000 cataloged lots, and over 2,000,000 specimens, the MSB Fish Collection is the largest university freshwater fish collection in the southwestern United States and maintains one of the strongest regional fish collections (based on information in Poss and Collette, 1995).

University Support for the Collection

Beginning in 1995, three important University-supported events have helped assure the permanence of the MSB Division of Fishes. First, based on pressing space needs, the University of New Mexico has contributed $3.9 million to renovation of a new facility for the Museum of Southwestern Biology in an effort to alleviate space needs and enhance collection care. A tenure-track position was created for a faculty-curator for the MSB Fish collection. In 1998, the administration of the MSB was reorganized as a distinct division of Biological Sciences, giving the MSB director budgetary control of operating funds from the College of Arts and Sciences. These actions demonstrate increased support for the Division of Fishes and the Museum of Southwestern Biology.

3. Normal Collection Operations

Table 5 lists primary positions associated with the MSB Division of Fishes, both University-funded and externally funded personnel. Thomas F. Turner, appointed by the Department of Biology as Curator of Fishes, has a nine-month joint (faculty) appointment in Biology. Steven P. Platania, Associate Curator, has served in this position for over 10 years, funding his position and staffing the collection with external grant funds. Three full-time externally funded staff members prepare and identify specimens under Platania and Snyder's direction.

TABLE 5. CURRENT STAFF OF MSB DIVISION OF FISHES AND PERCENTAGE OF ESTIMATED ALLOCATION OF THEIR TIME TO DAILY OPERATION OF THE COLLECTION. ALL POSITIONS ARE FUNDED THROUGH PERMANENT UNIVERSITY SUPPORT EXCEPT THE ASSOCIATE CURATOR.

Staff	Accessions	Specimen Prep & ID	Collection Care	Catalog,& Data Entry & Management	Loans, Data Requests	Visitor & Student Support	Other*
Turner Curator 0.33 FTE	5%	5%	5%	0%	5%	5%	75%
Platania Assoc. Curator *Externally Funded*	20%	5%	5%	10%	5%	5%	50%
Snyder Collections Manager 0.50 FTE	20%	5%	30%	30%	5%	10%	0%
Graduate Student 0.50 FTE	0%	0%	0%	80%	20%	0%	0%
Undergraduate Student 0.125 FTE	10%	0%	90%	0%	0%	0%	0%

*Research, Field Work, Grant Applications, Project Reports, Graduate Education, and Service

A 0.50 FTE Collection Manager (Snyder) position is a permanent staff line item funded by the College of Arts and Sciences. The duties of the Collection Manager are to supervise and coordinate normal collection operations (accessions, loans, catalog, processing specimens, data management, care and maintenance, and

management/training of graduate and undergraduate students). Contract employees conduct the bulk of specimen preparation and identification. A graduate curatorial/teaching assistant (TA) is assigned to the Division 20 hours per week during the academic year and 10 hours per week in summer. The primary responsibilities of the TA are to assist the collection manager in data entry, computer work, and curation. Currently, the Division is assigned undergraduate work-study student(s) for 10 to 15 hours per week (for the academic year). Their primary tasks include mixing preservative fluids, washing glassware and assisting the Collection Manager in maintenance of collection files. To perform the duties outlined in Table 5 requires about 4,800 person-hours per year (or 2.5 FTEs). The University funds 2,885 person-hours, with the balance provided by externally funded research projects. Our task analyses indicate that 2,586 additional person-hours per year are required to accomplish tasks associated with relocation and reorganization (see *Task Analysis* -- **Project Design and Management** section).

University Staff Support

To increase staffing for normal operations of the MSB Fish Collection, the College of Arts and Sciences has agreed to assume the cost of 0.5 FTE Project Manager (if this grant application is successful) at the end of the grant period (see support letter from Dean Michael Fischer, **Special Information and Supplementary Information** section). This action will result in a permanent, 1.0 FTE Collection Manager for the Division of Fishes. Thus, the total number of permanent, University-supported staff positions will be: 0.33 FTE Curator, 1.0 FTE Collection Manager, 0.5 FTE Graduate Teaching/Curatorial Assistant, 0.125 FTE Undergraduate Curatorial Assistant.

Following the grant period, a total of 3,840 university-funded person-hours per year will be devoted to the MSB Fish Collection.

4. Need for the Project

Introduction

Large rivers are among the most severely impacted ecosystems in the world. Restoration efforts of large rivers and the recovery of individual species are hampered because of uncertainty about the composition of the historical (pre-impacted) community, and whether individual species in the community have declined or increased as a result of environmental change. How then do we provide a picture of the historical community to serve as a template and goals for restoration efforts? Previous efforts have relied on identifying relatively pristine rivers in close proximity to the impacted river, but this is often difficult because most large river systems in the U.S. have been altered in some way (Benke 1990).

Another approach is to tap the enormous resources provided by natural history collections to reconstruct historical patterns of community diversity and function. As global biodiversity decreases, natural history collections have provided a baseline to document extinctions (Bestgen and Platania 1991) and declines in species' ranges (Shaffer et al. 1998). Examination of fish species' distributional patterns can be used to identify constituent members of the historical community, and patterns of decline or increase. The appearance and dynamics of exotic species can also be documented in this fashion. These data can be evaluated in terms of environmental changes like reductions in river flow (compiled by the United States Geological Service) or increased human populations.

The MSB Fish Collection is a very rapidly growing collection focusing on the ichthyofauna of the southwestern United States. The collection is uniquely suited to address the consequences of natural and human associated disturbances in the Southwest. Large pre- and post-disturbance collections, spanning a 60-year history, are held for Rio Grande and, to a lesser extent, Colorado River Basins, permitting evaluation of historical changes of the

fish fauna, and geographical ranges of its constituents. There are 50 specimens per lot on average, which provides sufficient information for cursory studies of life history changes in the face of long-term disturbance. However, the value of any research collection depends on its completeness, accuracy and accessibility to the scientific community. Our collection, though extremely valuable in its completeness, needs improvements in accuracy and accessibility. Our proposal seeks to meet those needs. Research use of the MSB fish collection has been severely hampered by inadequate space and facilities. Currently, collections' space is so limited that over 20% of holdings are stored in cardboard boxes and virtually inaccessible to researchers. In addition, there are no facilities for visiting researchers. Despite inadequate space, the MSB Fish Collection is very well curated. The vast majority (93%) of lots is cataloged into an electronic database. The utility of this database is questionable however, because computerized records have yet to be verified and cross-referenced. The trend toward computer-driven syntheses of large data sets makes the accuracy of individual databases of paramount importance.

Description of the Project

Accessibility of the MSB Fish Collection will be markedly improved by relocating the collection to a new, larger facility. Prior to, and following relocation, we will accomplish a series of tasks aimed at improving the organization of specimens and accuracy of associated labels and records. Specimens currently stored in cardboard boxes will be incorporated in an updated, phylogenetically based organizational system (after Nelson 1994). Our tank specimen collection will be curated in a stainless-steel tank system. Electronically captured specimen records will be reconciled with specimens on the shelves, and the computerized database updated. The historical collections of W.J. Koster will be reexamined and updated to reflect recent changes in taxonomy. These tasks will vastly improve accuracy and accessibility of the MSB Fish Collection. These improvements are a critical first step in implementing a complete, accurate, and widely available electronic database.

Request from NSF

To accomplish relocation and reorganization in the safest, most cost-effective manner we are requesting two years of funding for salaries, moving expenses, and collection upgrade supplies. Two half-time positions are requested to plan, coordinate, and implement this project. Moving expenses from a professional, licensed and bonded moving company are also requested. Finally, upgrade supplies including stainless-steel tanks, dollies, and other curatorial supplies are requested. All salaries and supplies are directed specifically toward project goals and does not include items for normal curatorial operations.

Long-range plans

Our five-year plan for MSB Division of Fishes is directed toward increasing the accuracy, accessibility, and visibility of the collections. Relocation and reorganization will accomplish the first phase of this plan by providing much-needed space for growth, and more importantly, the opportunity to adequately organize and verify our collection against electronic specimen records. In addition, laboratory and office space for in-house and visiting researchers will be available. Once reorganization and verification are complete, the second phase is to electronically capture vast ecological data (physicochemical, temporal, habitat, and current flow data) associated with each lot from field notes and other electronically available sources (e.g., USGS flow data). In addition, locality information will be supplied using Geographical Information System maps. These data will be linked to specimen records in relational database format (e.g. Microsoft Access™) and made available to researchers via the world-wide-web. This plan will allow the vast resources of our collection to be used to their fullest potential to address a wide variety of issues regarding the ecology, conservation, and management of fishes in the southwestern United States.

5. Project design and management

Goals

This project aims to relocate and upgrade the MSB Fish Collection to alleviate severe overcrowding thereby increasing accessibility of the collection. Upgrades are specifically designed to improve the quality of the specimens and their storage, and to improve the accuracy of electronically captured specimen records. Specific goals and the timeline of the project are outlined below:

1. Hire one half-time Project Manager and one half-time Project Assistant (**March through May 2000**)
2. Plan, coordinate pre-move curatorial activities (**March through May 2000**)
3. Execute pre-move curation activities, curate and transfer specimens in crocks to stainless steel tanks (**March through June 2000**)
4. Pack, move, and reshelve the collection using phylogenetic system, state, and drainage (**July and August 2000**)
5. Inventory (verification with computerized records) and upgrade 12,695 jars (**September 2000 through March 2002**)
6. Alcohol transfer 50% isopropanol to 70% ethanol for 2,500 jars (**January 2001 to May 2001**)
7. Verify and upgrade skeleton collection (**July 2001 through August 2001**)
8. Verify and update the W.J. Koster collection (4000 lots) **(March 2001 through March 2002**)

Curatorial Steps and Task analyses

1. *Advertise and hire two half-time positions for curation and relocation of collection: no time and no supplies charged to the project*

Curatorial Steps: In accordance with UNM Human Resources, these positions must be advertised (1 to 2 weeks), interviews conducted (1 to 2 weeks), and UNM Human Resources Compensation paperwork processed (1 month to 4 months).

2. *Planning and developing protocol for move: 520 person-hours and no supplies charged to the project.*

Curatorial Steps: The Project Manager, in consultation with Curators, will prioritize premove tasks, determine packing and moving needs. Project Manager and Collection Manager will train and supervise student assistants and the Curatorial Assistant in premove tasks.

Task Analysis: Based on experience that one of us (Snyder) has had planning the move of a similar-sized fish collection (University of Washington Fish Collection). Eight hours will be required to map the old collection for changes in organization. An additional eight hours will be devoted to prioritizing the pre-move curation tasks (outlined below). Training and supervision of new personnel will occupy approximately 440 hours, while ordering supplies and involvement in museum-wide planning and coordination will occupy 24 hours.

3. *Pre-move curation of 18,367 shelved jars and 66 earthenware crocks and 5-gallon plastic buckets: 620 person-hours and $23,523 for supplies charged to the project*

Curatorial Steps: Jars on existing shelves will be checked for alcohol level and closure seal (caps and gaskets). All jars and shelves will be washed and dried by hand, eliminating accumulated grit and dust. Each shelf (464 total) will be assigned a temporary label showing new family number designations (Nelson 1994). Jars will be reshelved in the new organization by family (Nelson 1994), genus, species, state, drainage. Specimens

contained in both earthenware crocks and 5 gallon plastic buckets will be removed and original labels checked against the catalog record. Original labels will be rolled and inserted into a 4-dram vial and carefully inserted in to a deep body cavity of the specimen. Standard lengths will be measured and entered into the database, at which time the specimens will also be verified against the catalog record. A MSB prenumbered catalog tag will be sewn through the lower jaw of the specimen. These specimens will be transferred to stainless steel FST or SST specimen tanks.

Task analysis: Based on real, timed trials using undergraduate curatorial assistants and/or the collection manager as subjects. Curatorial tasks include retrieving, rinsing, drying jars at a rate of 30 minutes per 40 jars for a total of 230 person-hours for 18,367 jars. After removing jars, they will be placed on carts, which will require 20 minutes per cart x 397 carts totaling 133 person-hours. Once jars are removed, the shelves will be washed and dried requiring 1 minute per shelf x 464 shelves totaling 8 person-hours. All jars will be replaced on clean, dry shelves by taxon and geography (as above) requiring 20 minutes of time per cart x 397 carts totaling 133 person-hours. Temporary labels will be placed on each shelf requiring 5 minutes per shelf x 464 shelves totaling to 39 person-hours. Verification of specimens contained in earthenware crocks and 5 gallon plastic buckets requires 20 minutes for 7 specimens (the average number of specimens per container) X 66 crocks/buckets equals 22 person-hours. Measuring standard lengths, recording the information, transferring original labels into 4 dram vials, and inserting vials in the specimens requires 15 minutes for 7 specimens X 66 containers equals 16.5 person-hours. Sewing new MSB tags on each specimen requires 20 minutes for 7 specimens X 66 containers equals 22 person-hours. Placing specimens into stainless steel tanks, by phylogenetic order and within drainage requires 15 minutes per 7 specimens totaling 16.5 person-hours. Supply costs are for masking tape (temporary shelf labeling), wooden dollies, and stainless steel tanks.

4. Packing, moving, and reshelving fluid collections: $10,722 to hire a professional mover and $806 supplies charged to the project.

Curatorial Steps: We will simultaneously pack, move and unpack the collection every working day for two weeks. Moving the collection in this manner will allow for inspection of each jar after delivery to the new facility; any broken jar can be curated immediately. The contents of each jar will be contained in a plastic sleeve, and an entire dolly full of jars will be shrink-wrapped to prevent accidental breakage. The decision to hire a professional mover is based on Snyder's experience conducting a move of the University of Washington Fish Collection with professional moving staff, and Platania and Snyder's experience moving the MSB Fish Collection without professional movers. Hiring professional movers will insure maximum safety for the collection and staff, and to avoid excessive delays in normal collection activities. Student assistants will remove the shrink-wrap and jar wrapping and hand the jars to the Project Manager/Collection Manager. The Project/Collection Manager will be responsible for inspecting and placing the jars on the shelves.

Task Analysis: Task analysis in this section is based on an estimate provided by Benton Allied Moving Company of Albuquerque, NM, a licensed, bonded, and insured company under a negotiated, competitive contract to UNM. Labor (6 persons at 80 hours), dollies, tote cartons, plastic sleeves, shrink-wrap, and a delivery van totaled $10,722. An additional $806 will be used to purchase magnetic shelf label holders for compactor shelves.

5. Inventory and upgrade 12,695 jars (not including the vial jars and isopropanol preserved collections): 3,175 person-hours and $59 supplies charged to the project.

Curatorial Steps: Specimens cataloged before 1993 (when the collection was computerized and a new protocol for labeling jars was started) must be verified against the computer database and relabeled. Old labels will be maintained in jars and new labels printed on Resistal paper with an impact printer and permanent ink. New labels will be inserted along with the permanent MSB catalog tag. Total counts and standard lengths for the smallest and largest individuals will be taken for each jar and entered into the database. This information is very important in responding to queries for life history studies. Alcohol concentrations and pH will be verified before reshelving the jars. Jar lids will be replace as needed.

Task Analysis: Based on timed trials with undergraduate curatorial assistants or the collection manager as subjects. On a per jar basis, verification of specimen jar against the record (0.5 min), count and measures (8 min), printing and inserting new labels and tags (6 min), and testing alcohol concentration and pH (0.5 min) x 12,695 jars totals to 3,175 person-hours committed to this task. Supply charges are for a pH meter.

6. Alcohol transfer from 55% isopropanol to 70% ethanol for 2500 jars: 793 person hours and $536 for supplies charged to the project.

Curatorial Steps: Prior to fluid transfer, all jars will be verified, counted and measured as in *Task 5*. We have identified four required steps for transferring specimens in 55% (or less) isopropanol to 70% ethanol. Isopropanol will be replaced with distilled water in the first step, followed by 3 steps of a graded series of ethanol (30%, 50% and 70%), used to minimized shrinkage of specimens and stabilize ethanol concentration to within 3% of the desired 70% solution (Laframboise et al.1993).

Task analysis: Based on timed trials with an undergraduate curatorial assistant as subject. On a per jar basis, and a total of 15 minutes to accomplish the series of tasks in *5,* multiplied by 2,500 jars, totals to 625 person-hours committed to this task. Fluid change requires 1 minute per jar by four steps, multiplied by 2,500 jars, totaling to 168 person-hours. Ninety-seven gallons of 95% ethanol will be required to accomplish this task.

7. Skeleton collections (approx. 350) cataloged and organized: 64 person-hours and $893 for supplies.

Curatorial Steps: The skeleton collection will be verified in the catalog and assigned new catalog numbers if not part of a split lot (i.e. fluid examples already exist on the shelves). Acid free labels will be produced on Permalife paper and glued to the box tops. MSB tag will be inserted into box and the specimens filed in cabinets.

Task analysis: Task analysis is based on timed trials with the collection manager as a subject. Locating, determining whether the specimen is a split-lot (5 minutes/specimen), cataloging and printing labels (0.5 minutes/specimen) will require a total of 32 person-hours for 350 skeletons. Transferring each specimen to a new box and affixing the new label will require 5.5 minutes/specimen x 350 totaling to 32 person-hours. Required supplies are 350 acid-free skeleton boxes, 1000 sheets of Permalife paper, and one bottle of white neutral-pH adhesive.

8. Inventory of update of W.J. Koster Collection (1938 to 1975) of approx. 4,000 lots: no salary or supplies charged to the project

Curatorial Steps**:** The Koster collection of historically important specimens will be curated along with the other jars in Task *5*. However, this collection has long required verification of identifications. The curators will seek

assistance in verification for representative specimens from outside experts in cyprinids, especially *Gila* spp., Catostomidae, Fundulidae, and Cyprinodontidae. Researchers will be invited to visit the collection (at no cost to the project) to examine representative specimens or specimens will be made available by loans.

6. Impact of the Project

Relocating the MSB Fish Collection to the new facility will alleviate space shortfalls, allowing us to reorganize and shelve the entire collection, and permit about 20 years of sustained growth. Increased space will greatly enhance research opportunities by providing office and laboratory space for visiting researchers. The proposed upgrades to the collection will improve storage conditions, make collections more accessible, and most importantly, provide an accurate electronic database. The latter is a critical first step to implementing the second phase of improvements to the collection. A verified, accurate relational database including specimen records, environmental, and
geographical data will be made available to the scientific community via the world-wide web. As management and conservation issues become increasingly more pressing, this database will be an invaluable resource to assess historical conditions and patterns of change in the fish fauna of the southwestern United States.

7. Dissemination of Results

If funded, announcements of the project, specific improvements, and the timetable of the project will be published in *Copeia* (the Journal of the American Society of Ichthyologists and Herpetologists-ASIH), *The Newsletter of Systematic Ichthyology*, *The Southwestern Naturalist*, *Conservation Biology*, and the *ASIH Curatorial Newsletter.* Similar announcements will be posted on the Division of Fishes world-wide-web page. The PI and co-PIs are active participants at annual ASIH meetings including the Collections' Committee thereby insuring that ASIH members are informed of progress with improvements to the MSB Fish Collection.

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