Final Report: Curation of the American Museum of Natural History Hudson River Larval Fish Collection

Submitted to: John Cooper, Hudson River Foundation

Robert E. Schmidt
Hudsonia Limited
Bard College
Annandale, N.Y. 12504

C. Lavett Smith
Ichthyology Dept.
Amer. Mus. of Natural History
N.Y., N.Y. 10024

I The AMNH Hudson River larval fish collection.

The larval fish collection in the Ichthyology Department, American Museum of Natural History, is now established based on a large collection of Hudson River fishes. The specimens were originally collected as part of impact assessments of the nuclear and fossil fuel generating plants on the estuarine portion of the river. The specimens were donated to the AMNH by several contractors and power companies. Curation was supported primarily by the Hudson River Foundation (1984) and secondarily by the New York Council of the Arts (1983).

The collection consists of 23,481 lots of specimens. A lot is defined as one species from one place at one time. There are some (about 200) lots included here that are not part of the Hudson River studies but came into the museum during the grant period and were simply included at that time.

The specimens originated from near field impact assessment as well as river-wide surveys. Major studies included near field collections from Danskammer (1978-79), Roseton (1978-79), Bowline (1975-79), Lovett (1975-76), and Pollepell Island (1978). The Texas Instruments (TI) 1980 long river ichthyoplankton survey specimens were also included. The TI collections comprise about half the lots and certain specimens from the main river from the Tappan Zee Bridge to Albany. A 1977 collection received from the Power Authority (PASNY) had no locality data associated with the specimens and we could not locate any reports that indicated where the collections were made in the estuary. The Ichthyology Department has a policy that specimens without locality data are not catalogued and therefore this collection was not included. The specimens are still stored at the AMNH and could easily be integrated into the collection if locality data are found. There may be about 1000 lots in the PASNY collection.

There are 88 taxa included in the collection (See Appendices 1, 2 and 3). Representation in the collection ranges from a single specimen (e.g. Atlantic sturgeon) to thousands of specimens from all years and therefore the largest data sets are (not necessarily in order): bay anchovy, American shad, alewife, smelt, striped bass, white perch, and Atlantic tomcod.

IDENTIFICATION PROBLEMS

Among the taxa listed in Appendices 1, 2 and 3 are unidentified or partially identified categories. The "Unidentified" taxon is 99+% eggs that could not be readily distinguished. The eggs of the following are not included in the unidentified category: Atlantic tomcod, striped bass,

white perch, american shad, bay anchovy, and river herrings. The river herrings are listed as Alosa sp. because there is no known way to distinguish alewife and blueback herring eggs. There is also a "To be identified" category which includes a few lots of larvae that we could not name. They should be identifiable but we could not confidently place them. Other identification problems are discussed by family, below.

Clupeidae. - We are slightly disturbed on several points. Blueback herring are very abundant in the river and theoretically the larvae are distinguishable from all other clupeids in the river after dorsal fin formation. We did not find many bluebacks at all - certainly many fewer than our impression of the relative abundance of juveniles would suggest. It is possible that we overlooked some in the very large collections of herring larvae. To identify bluebacks, it is necessary to count myomeres between the dorsal fin and the anal fin and, although collections were scanned, we could not count many specimens. Still, even with the possibility of error, there seems to be too few specimens represented. Perhaps the blueback larvae are less likely to be collected (different distributions, different behaviors) or perhaps the criteria to distinguish between alewife and blueback herring are not valid for the Hudson River.

A second clupeid problem is that we have no specimens of Dorosoma (gizzard shad) larvae in the collections. They are distinguishable by the gut length and there may be a few specimens that slipped by us in the very large lots of Alosa larvae.

There are a number of specimens of American shad that caused difficulty. Some of the specimens did not clearly show the distinctive gut melanophore pattern that is typical of shad. This may be an artifact of prior preservation and storage.

There are some lots of Alosa mediocris included in the collections from the lower river, but some of the identifications are doubtful. Again, preservation may have obscured some melanophore patterns (especially on the tongue) and may have caused some confusion between hickory shad and American shad.

Engraulidae.- There may be some Anchoa hepsetus hidden in the massive collections of bay anchovy. A. hepsetus is distinguished by the relative placement of the dorsal and anal fins. We could not possibly examine all of the anchovy specimens and therefore some A. hepsetus may have escaped our notice.

Umbridae.- We have both Umbra limi and U. pygmaea in the Hudson River estuary (the only place in North America where the two species are sympatric) and there are no studies that adequately distinguish the larvae of the two species.

Fundulidae.- We are not confidant in distinguishing Fundulus diaphanus from F. heteroclitus based on the distribution of melanophores. There may be regional differences that show up in the Hudson. For instance, F. heteroclitus populations in the Hudson are a different subspecies from the ones discussed in available keys.

Atherinidae.- The criteria to distinguish the three silversides do not seem to work in the Hudson River. We have Menidia menidia, M. beryllina and Membras martinica, supposedly differing in the number, size and arrangement of melanophores on the head. There appears to be a lot of ontogenetic variability in these patterns and we do not trust our identifications of these species in the Hudson.

Percichthyidae.- One of the major problems with assessing impact on Hudson River fishes has been separation of the two Morone species in collections. The differences are often subtle and at some sizes, ambiguous. Therefore we have a catagory of Morone sp. that may contain either specimens that are ambiguous and are best left without a specific name or large collections that contain both species which we did not have the time to sort.

If any of the above problems are solved in the future, our system allows for easy cataloging of new information as well as correcting errors.

SPECIMEN STORAGE

There is still considerable debate about proper storage of larval fish collections, especially which preservatives are appropriate. We elected to store our specimens in 70% ethanol (See appendix 4). Specimens were originally fixed in formalin and temporarily transferred to 50% ethanol before final storage.

The majority of specimens are housed in 20 ml scintillation vials with polyseal caps (recommended by D. Snyder, Colorado State Univ.). Each vial contains two labels, one with only the catalog number and the other with the catalog number, identity and locationa and date collected. The redundancy is to increase the chance that the lot can be identified if the labels fade. The scintillation vials are stored by taxa (phylogentically to family, alphabetically to species) on the shelves. Within each taxon, the vials are arranged sequentially by catalog number in wooden boxes. The contents of each box are indicated on the outside. The wooden boxes are standard containers used in the AMNH fish collections. We have placed an order for boxes better suited to the vials, but they have not yet arrived.

There were some specimens included in the collections that were by no means larvae. These specimens were sorted, identified and cataloged along with the larvae to retain the integrity of the collections, but these larger individuals could not be stored in 20 ml vials. These specimens are

stored in 8 or 16 oz jars (standard AMNH containers) and are labelled in the same manner as the larvae. Eventually these larger jars will be integrated into the museum's main fish collection. These specimens primarily consist of juvenile or adult Atlatic tomcod with lesser numbers of American eels, white perch and bay anchovies and a few other miscellaneous species. Although they are not physically integrated into the larval fish collection, the cataloging system allows integration of the specimens and the associated data if desired by using the field number assigned by the original collectors.

PH MONITORING

In order to monitor any pH changes occuring in the scintillation vials a sampling program has been designed in which repeated testing of both reference and ramdom samples will detect pH changes over time. The suggested sampling regime includes tri-monthly pH readings on one alcohol control vial (no specimens) and three vials each of nine chosen reference species. Within each reference species group catalog numbers were chosen to reflect specimens catalogued in early, mid, and late 1984. Reference vials were also chosen so that some contained relatively few specimens and others contained large numbers of specimens. Ten samples chosen randomly from the remaining species groups should also be tested on a tri-monthly basis.

An initial pH sampling program was done in December 1984. Twenty-seven reference samples and ten random samples were tested for pH. All but two samples were considered to be within an acceptable pH range (6.0 - 8.0). Those outside the acceptable pH range were transferred to fresh 70% ethanol.

ALCOHOL LEVELS

If tightly sealed there should be no alcohol evaporation from the scintillation vials. However, several factors have been found to contribute to alcohol evaporation including 1)loose fitting caps 2)nicks in the rim of the glass vials 3)jar labels interfering with the proper seal of the cap.

All vials containing larval fish specimens cataloged before January 1985 have been checked for proper alcohol levels. Since alcohol evaporation tends to progress very slowly it is recommended that alcohol levels be checked at 6-8 month intervals and defective vials replaced.

ASSOCIATED DATA SETS

We have printed data for all the studies included in the collection. This printed information is either a report by the consulting firm or a printout. The data consist of water quality measurements, weather observations, depths, flowmeter readings, etc. for each collection. These data can be correlated with the larval collections. Also, each lot is coded (see below) as to what kind(s) of associated data are available.

USE OF COLLECTION TO DATE

Several people have requested specimens to support their research. Dr. Gareth Nelson, AMNH has a series of cleared and stained bay anchovy larvae. Dr. Donn Rosen, AMNH has taken a series of smelt larvae for clearing and staining. John Waldman (Ph.D. student, AMNH) has a series of white perch and striped bass for clearing and staining. Darryl Siebert (Ph.D. student, AMNH) requested a series of goldfish and golden shiners for clearing and staining. Chan-Hwa Chang (Ph.D. student, AMNH) has a series of pumpkinseed sunfish for clearing and staining. All of these requests were to support systematic research.

Darryl Snyder, Colorado State Univ. borrowed our single larval Atlantic sturgeon as part of his studies on sturgeon morphology. Steven Leipertz, Univ. of Washington borrowed a series of hogchoker larvae as part of his doctoral research into flatfish development and relationships. Dr. Faber, national Museum of Canada visited the collection and we discussed curation strategies. D. Snyder has also indicated an interest in developing a key to Hudson River fish larvae using our collection as a base.

II. Using the Collection.

As described in Part I, ready and immediate access to the specimens is available through the phylogenetic and alphabetic arrangement of the vials within taxa. The computerized cataloging system we used also allows other approaches to accessing the data base.

When specimens are catalogued, an arbitrary sequential catalog number is assigned to each lot. The catalog numbers and the following data are then entered into the data base on the AMNH Wang microprocessor (See appendix 5):

Collection date
Time of day
Country
State
Drainage
Specific locality (including river mile)
Field collection number
Gear
Code for associated data avilability
Collector
Initials of person doing identification
Species code
Code for stage of development
Count or estimate of numbers of specimens
Museum accession number

All of this information for a specific catalog number can be viewed on one screen and can be altered easily if errors are discovered or new, more complete information becomes

available. From this data base, we generate a printed catalog and labels for the vials and we can generate data sets on request that can be printed and mailed or sent over the telephone to other computers.

CATALOG

The printed catalog is an alternate method of accessing the data. The catalog is printed in catalog number order and lists of abstract of the information for each lot (See appendix 6 for an example of a catalog page).

Note the field number that is included for each lot. The field number is a unique number (in the Hudson River studies) assigned by the collectors to each sample. This number is useful and important in two respects. The field number allows us to easily associate all lots taken at the same locality at the same time. This is important because one should not assume that all associated lots are sequential in the catalog. There are a number of reasons why associated lots could get out of order. The easiest way to check is to call up field numbers through the Wang keyboard (explained in section III) which will then display all the lots with the same field number and therefore from the same collection.

The field number also allows us to look up associated water quality and other data that was not computerized in our data base but is available in reports and printouts. These data are roughly arranged by field number in the various reports.

We view the catalog as a notebook that is changed as mistakes are corrected and new information is added. Interim changes are inked in the catalog and eventually new pages are printed (described in section III) and added in. It is not necessary to print the whole catalog (about 2000 pages) each time changes occur. Single pages or sets of pages can be selected and printed at will.

LABELS

The labels we are using are a compromise among information that is useful to have in the vials, the small size of the labels necessary so they fit in the vials, and limitations of the computer program. The Wang system only allows for three lines of information and a maximum of five variables per label. We can get around the latter constraint by concatenating variables but our labels are limited to three lines (which is fine for our purposes because four lines would make the label too large for the vials).

The labels contain the following: AMNH catalog number, genus and species, specific locality, drainage, state and date. The labels are printed with 12 pitch type but some long species names make the labels too large for the vials and then the labels must be coiled in the vials (not a real problem other than it is a time-consuming process).

Labels are manufactured from the data base via a special program (described in section III) and are printed on Resistall linen paper. The paper is very resistant to liquid preservatives. The ink used is partially soluble in alcohol,

so labels are pre-soaked before placement in the vials. We do not know how long these labels will last, but new labels can be made for any part of the collection at any time.

The format of the labels can be changed as well. They can be made to include other variables, to eliminate variables, to add constants (we have "AMNH" printed before each catalog number), and to rearrange the sequence of variables.

TELECOMMUNICATIONS

We consider this data base to be dynamic in that changes will continue to be made in the data already stored and also additional data will continue to be added as the collection expands. Backup copies of the entire data base are automatically made at least twice a week so there is always a safety margin available besides the printed catalog. Because of the continual additions and modifications of the data base and because of its sheer volume, we do not anticipate much demand for copies of the entire set.

The AMNH Wang system does have telecommunications capabilities and all or part of the data can be sent over the phone lines to any user equipped to receive. We have established sucessful communications and have transferred files between the Wang microprocessor and 1) an IBM PC at Hudsonia Limited, 2) an Apple IIe at Simon's Rock College, and 3) a Columbia PC at the AMNH Ichthyology Department. All of these communications have been done through Hayes modems using standard Hayes Smartcom software. The Wang is an "origin only" system which means it cannot answer the telephone, so someone in the museum needs to initiate the call (which anyone can do at any workstation). Therefore the easiest way we envision data sharing is for a user to request a data set and the museum personnel can send the data over the telephone once it is gathered. The Wang default options for telecommunications are listed in Appendix 7.

DATA SORTING

The current label program can be used (either as now set up or modified for the user's needs) to sort and list data. These data could then be sent over the telephone or could be mailed as a paper copy. The program allows sorting on up to 10 variables simultaneously with a large capacity for specifications within each variable (using logical connectors like OR, AND, LESS THAN, etc.). The program now presents data in ascending order of catalog number but this can be changed as well (see Appendix 8 and 9).

We tested the Wang's capacity by asking for several combinations and permutations of data to be displayed in the current label format. We used three variables at once (e.g. list all the lots of smelt from August of 1979 and 1980). The Wang sorted through all 23,000+ data sets in about 12-15 minutes and presented the list ready to be copied or sent on the phone. Therefore we feel that the current capabilities of the computer system are adequate to supply information about the collection to most interested parties.

EXAMINING SPECIMENS

We suggest that any time anyone examines specimens from the collection that they follow certain rules. The main concern we have is that the specimens retain their shape and melanophore patterns as long as possible. Anyone examining specimens should therefore keep the specimens in 70% ethanol if at all possible. Transferring back and forth between alcohol and water will eventually damage the specimens.

Also we suggest that investigators should help us improve the data base. If identifications or life history stage data are incomplete or incorrect, indicate so and they will be changed. Accurate specimen counts were not taken on all lots and this information could be easily added to the data base. Measurements were not taken and these data would be useful to have on the computer. Labels should be coiled in the vials if they are not already.

USE OF THE COLLECTION IN HUDSON RIVER RESEARCH

We are positive that much useful information could be derived from the specimens in the AMNH collection . The following are a few projects that occurred to us and we would be interested in any other ideas that occur in the future:

- An atlas of Hudson River larval fish
- Investigations of food habits/competition of specific fishes
- Community structure of Hudson River fish larvae
- Growth rates and cohort identification of certain species
- Temporal and spatial dynamics of populations

III. A manual for using the AMNH Wang Microprocessor in cataloging and data retrieval in the larval fish collection is provided as Appendix 5. Topics covered in the manual include:

- data entry and alteration
- printing and modifying the catalog
- making labels
- sorting with multiple fields in the label program
- converting to word processing documents
- sending files over the telephone
- species coding system

SUGGESTIONS FOR EXPANDING/ALTERING DATA BASE

Additional alteration that would improve the system a little would be establishing a variable for river mile (we should have done this at the beginning). The river mile is indicated for each lot but it is difficult (not impossible) to sort using river mile as a variable at present.

APPENDIX 1

Family list - larval fish

Family: Petromyzontidae
104 Petromyzon marinus
204 Lampetra appendix

Family: Acipenseridae
107 Acipenser oxyrhynchus

Family: Anguillidae
108 Anguilla rostrata

Family: Ophichthidae
208 Myrophis punctatus

Family: Clupeidae
109 Alosa pseudoharengus
209 Alosa sapadissima
309 Alosa sp.
409 Alosa aestivalis
609 Alosa mediocris
709 Clupea harengus
809 Brevoortia tyrannus

Family: Engraulidae
509 Anchoa mitchilli

Family: Osmeridae
111 Osmerus mordax

Family: Umbridae
112 Umbra sp.

Family: Synodontidae
113 Trachinocephalus myops
213 Synodus foetens

Family: Cyprinidae
116 Notropis hudsonius
216 Carasius auratus
316 Hybognathus regius
416 Cyprinidae, unidentified
516 Cyprinus carpio
616 Notemigonus crysoleucas
816 Rhinichthys atratulus
1316 Campostoma anomalum
1416 Semotilus atromaculatus
1516 Pimephales notatus
1616 Notropis spilopterus

Family: Catostomidae
716 Catostomus commersoni
916 Hypentelium nigricans
1016 Carpiodes cyprinus
1116 Moxostoma sp.
1216 Catostomidae

Family: Ictaluridae
117 Ictalurus nebulosus
217 Ictalurus catus

Family: Percopsidae
118 Percopsis omiscomaycus

Family: Gadidae
121 Microgadus tomcod
221 Pollachius virens

Family: Belonidae
123 Strongylura marina

Family: Cyprinodontidae
124 Fundulus diaphanus
224 Fundulus heteroclitus

Family: Atherinidae
125 Menidia beryllina
225 Menidia menidia
325 Membras martinica

Family: Syngnathidae
128 Syngnathus fuscus

Family: Gasterosteidae
228 Apeltes quadracus
328 Gasterosteidae
428 Culaea inconstans

Family: Cottidae
130 Myoxocephalus aenaeus
330 Cottus cognatus
430 Cottus bairdi

Family: Triglidae
230 Prionotus evolens

Family: Percihthyidae
131 Morone americana
231 Morone saxatilis
331 Morone sp.

Family: Centrarchidae
132 Lepomis gibbosus
432 Lepomis sp.
532 Lepomis macrochirus
632 Micropterus salmoides
732 Lepomis auritus
932 Ambloplites rupestris
1032 Micropterus dolomieui

Family: Percidae
132 Etheostoma olmstedi
232 Perca flavescens
832 Stizostedion vitreum
1132 Percina sp.
1232 Etheostoma flabellare
1332 Etheostoma caeruleum
1432 Percina caprodes
1532 Percidae
1632 Percina maculata
1732 Pomoxis sp.
1832 Etheostoma nigrum

Family: Pomatomidae
135 Pomatomus saltatrix

Family: Scianidae
139 Cynoscion regalis
239 Menticirrhus saxatilis
339 Bairdiella chrysoura

Family: Labridae
146 Tautoga onitis

Family: Ammodytidae
149 Ammodytes americanus

Family: Gobiidae
150 Gobiosoma bosci
250 Gobiosoma ginsburgi
350 Gobiosoma sp.

Family: Soleidae
154 Trinectes maculatus

Family: Pleuronectidae
254 Pseudopleuronectes americanus

Family: Bothidae
354 Paralichthys dentatus
454 Scophthalmus aquosus

APPENDIX 2

LIST OF LARVAL FISH

ALPHABETICAL LISTING

Acipenser oxyrhynchus	107
Alosa aestivalis	409
Alosa mediocris	609
Alosa pseudoharengus	109
Alosa sapidissima	209
Alosa sp.	309
Ambloplites rupestris	932
Ammodytes americanus	149
Anchoa mitchilli	509
Anguilla rostrata	108
Apeltes quadracus	228
Bairdiella chrysoura	339
Brevoortia tyrannus	809
Campostoma anomalum	1316
Carassius auratus	216
Carpiodes cyprinus	1016
Catostomidae	1216
Catostomus commersoni	716
Clupea harengus	709
Cottus bairdi	430
Cottus cognatus	330
Culaea inconstans	428
Cynoscion regalis	139
Cyprinidae, unidentified	416
Cyprinus carpio	516
Etheostoma caeruleum	1332
Etheostoma flabellare	1232
Etheostoma nigrum	1832
Etheostoma olmstedi	132
Fundulus diaphanus	124
Fundulus heteroclitus	224
Gasterosteidae	328
Gobiosoma bosci	150
Gobiosoma ginsburgi	250
Gobiosoma sp.	350
Hybognathus regius	316
Hypentelium nigricans	816
Ictalurus nebulosus	117
Ictalurus catus	217
Lampetra appendix	204
Lepomis auritus	732
Lepomis gibbosus	332
Lepomis macrochirus	532
Lepomis sp.	432
Membras martinica	325
Menidia beryllina	125
Menidia menidia	225
Menticirrhus saxatilis	239
Microgadus tomcod	121

Micropterus dolomieui	1032
Micropterus salmoides	632
Morone americana	131
Morone saxatilis	231
Morone sp.	331
Moxostoma sp.	1116
Myoxocephalus aenaeus	130
Myrophis punctatus	208
Notemigonus crysoleucas	616
Notropis hudsonius	116
Notropis spilopterus	1616
Osmerus mordax	111
Paralichthys dentatus	354
Perca flavescens	232
Percidae	1532
Percina caprodes	1432
Percina maculata	1632
Percina sp.	1132
Percopsis omiscomaycus	118
Petromyzon marinus	104
Pimephales notatus	1516
Pollachius virens	221
Pomatomus saltatrix	135
Pomoxis sp.	1732
Priontus evolans	230
Pseudopleuronectes americanus	254
Rhinichthys atratulus	816
Scophthalmus aquosus	454
Semotilus atromaculatus	1416
Stizostedion vitreum	832
Strongylura marina	123
Syngnathus fuscus	128
Synodus foetens	213
Tautoga onitis	146
To be identified	999
Trachinocephalus myops	113
Trinectes maculatus	154
Umbra sp.	112
Unidentified	100

APPENDIX 3

LIST OF LARVAL FISH

SPECIES CODE	
100	Unidentified
104	Petromyzon marinus
107	Acipenser oxyrhynchus
108	Anguilla rostrata
109	Alosa pseudoharengus
111	Osmerus mordax
112	Umbra sp.
113	Trachinocephalus myops
116	Notropis hudsonius
117	Ictalurus nebulosus
118	Percopsis omiscomaycus
121	Microgadus tomcod
123	Strongylura marina
124	Fundulus diaphanus
125	Menidia beryllina
128	Syngnathus fuscus
130	Myoxocephalus aenaeus
131	Morone americana
132	Etheostoma olmstedi
135	Pomatomus saltatrix
139	Cynoscion regalis
146	Tautoga onitis
149	Ammodytes americanus
150	Gobiosoma bosci
154	Trinectes maculatus
204	Lampetra appendix
208	Myrophis punctatus
209	Alosa sapidissima
213	Synodus foetens
216	Carassius auratus
217	Ictalurus catus
221	Pollachius virens
224	Fundulus heteroclitus
225	Menidia menidia
228	Apeltes quadracus
230	Prionotus evolans
231	Morone saxatilis
232	Perca flavescens
239	Menticirrhus saxatilis
250	Gobiosoma ginsburgi
254	Pseudopleuronectes americanus
309	Alosa sp.
316	Hybognathus regius
325	Membras martinica
328	Gasterosteidae

330	Cottus cognatus
331	Morone sp.
332	Lepomis gibbosus
339	Bairdiella chrysoura
350	Gobiosoma sp.
354	Paralichthys dentatus
409	Alosa aestivalis
416	Cyprinidae, unidentified
428	Culaea inconstans
430	Cottus bairdi
432	Lepomis sp.
454	Scophthalmus aquosus
509	Anchoa mitchilli
516	Cyprinus carpio
532	Lepomis macrochirus
609	Alosa mediocris
616	Notemigonus crysoleucas
632	Micropterus salmoides
709	Clupea harengus
716	Catostomus commersoni
732	Lepomis auritus
809	Brevoortia tyrannus
816	Rhinichthys atratulus
832	Stizostedion vitreum
916	Hypentelium nigricans
932	Ambloplites rupestris
999	To be identified
1016	Carpiodes cyprinus
1032	Micropterus dolomieui
1116	Moxostoma sp.
1132	Percina sp.
1216	Catostomidae
1232	Etheostoma flabellare
1316	Campostoma anomalum
1332	Etheostoma caeruleum
1416	Semotilus atromaculatus
1432	Percina caprodes
1516	Pimephales notatus
1532	Percidae
1616	Notropis spilopterus
1632	Percina maculata
1732	Pomoxis sp.
1832	Etheostoma nigrum

APPENDIX 4

SUMMARY OF PRESERVATION TECHNIQUES FOR LARVAL FISHES

The state of the art of ichthyoplankton preservation is still very primitive. Our current interest was stimulated by the fairly recent collections by the numerous contract research firms and the need to establish repositories for these collections. Therefore we have very little history that can be applied to designing long-term storage systems.

Formalin preservation- Standard procedure for ichthyolpankton (Smith and Richardson. 1977. Fao Fish. Tech. Pap. 175) is to fix in 5% formalin and to store the specimens in 3% formalin. Formalin solutions are acidic, however, and tend to decalcify skeletal tissue at or below pH 6.4 (Taylor. 1977. Proc. Biol. Soc. Wash. 90) and therefore are frequently buffered. Sodium borate raises the pH rather high and can cause tissue clearing at or above pH 7.0 (Taylor, Ibid; Dingerkus. 1982. ASIH Curation Newsletter No. 5). Limestone and/or marble chips may be a better buffer since the pH is lower in these solutions but Markle (In press. Copeia) found that tha pH varies considerably depending on the lot of formaldehyde used and how long the preservation and buffer were mixed before adding specimens. Markle (Ibid.) suggested using a phosphate buffering system (.013 M sodium phosphate monobasic and anhydrous sodium phosphate dibasic in equal quantities) at pH 6.8.

The number and distribution of melanophores on the body of larval fishes is frequently taxonomically important. Melanin is water soluble and eventually will dissolve in low concentration preservative (D. Johnson, South Carolina Marine Fisheries Dept., pers. comm.). Thus, larval fishes preserved in 3% formalin (97% water) may eventually lose some of their distinguishing characteristics.

Formalin may be a significant health hazard to museum workers.

Alcohol preservation- Alcoholic preservation (after initial formalin or alcohol fixation) has not been considered by the majority of workers because of problems with shrinkage and distortion of small fishes. Shrinkage can be a very significant problem with larval fishes since identification depends, in part, on the size of the larvae correlated with ontogenetic events. Shrinkage may be more of a perceived problem rather than real, however D. Johnson (pers. comm.) said that old Caribbean collections at the ROM are preserved in isopropanol (% unknown) with little or no apparent shrinkage and specimens in 70% ethanol at Wood's Hole have had no obvious shrinkage. An additional benefit of high percentage alcohol is that melanin tends to be preserved much longer.

Few objective data exists on shrinkage of fish larvae in

alcohol. Laroche et al. (1982. NOAA Fish. Bull. 80) compared live vs preserved lengths in Parophys (Pleuronectidae) larvae fixed in both 80% ethanol and 10% formalin. After 4 months, the formalin fixed and preserved specimens shrank significantly more (P less than 0.01) than specimens fixed and preserved in ethanol. N was 15 in both solutions.

D. Johnson (pers. comm.) has seen shrinkage in the brain and neurocranium in alcohol unless the larvae had run through at least on step of lower concentration alcohol prior to final preservation.

Alcohol preserved specimens can have pH problems (Dingerkus. Ibid.) especially when the fishes are oily or fatty. In the larvae, the variation in numbers of larvae per vial may affect the pH in alcohol preservatives. Alcoholic specimens therefore should be monitored and the alcohol should be changed as often as necessary until all formalin, oil and fat is removed (Dingerkus, Ibid.).

Recommendations- The AMNH larval fish collection should be permanently stored in 70% ethanol. Specimens should be run through at least one step of lower concentration alcohol (50%) prior to final preservation. A monitoring program for pH changes should be established.

Caveats- The effect of alcohol on eggs has not been investigated. Much of the data discussed above related to marine larvae and essentially freshwater lavae may react differently. The variation in larval density in the vials in tha AMNH collection is very large and may have unforseen effects on the preservative. We do not really know the handling and preservation history of the specimens and therefore cannot really predict the results of any preservativation method.

APPENDIX 5

LARVAL FISH MANUAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

by RALPH EVANS

CURATORIAL ASSISTANT

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DEDICATION

This manual is dedicated to Ms. Loretta Stillman and Dr. Robert Schmidt, whose tireless work and effort made this volume possible, and hopefully will leave the world safe for larval fish everywhere.

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INTRODUCTION

The American Museum of Natural History (AMNH) larval fish collection was given a substantial start by funding from the Hudson River Foundation through a grant to Dr. Robert E. Schmidt (Hudsonia Limited) and Dr. C. Lavett Smith (AMNH). The vast majority of the fishes thus far catalogued are Hudson River specimens collected by various contractors studying power plant impacts from 1975-1980.

The collection consists of 23,481 lots of specimens (a lot is defined as one species from one place at one time). There are 88 taxa in the collection ranging from single specimens of uncommon species to thousands of specimens from all years and all localities in the estuary.

During the curation process we have tried to establish a system that allows easy access to the specimens and associated data for anyone using the collection. To this end, the collection was catalogued on the AMNH Wang microprocessor and most data are stored on disk as well as paper copies. The Wang system allows for rapid and easy searches and can print or send data files over the telephone to anyone with a modem. The accompanying manual, written by one of our assistants on

the project, Ralph Evans, is meant to be a guide so that the AMNH staff and anyone else with access to the AMNH system can search for data or do the more mundane tasks of adding/modifying data, printing labels, printing the catalog, etc.

Our hope is that these specimens will be used. We think this collection is a valuable resource and we have tried to make the use of this resource as easy as possible.

Robert E. Schmidt
Hudsonia Limited

CALL-UP PROCEDURE

After entering your I.D. and Password, press PF(1) RUN Program or Procedure. This will allow you to get to the various programs needed for the collection. The first program that you will run is called 'LARVAL', in the library 'RESPROGM' on volume 'VOL444'. Type these in in the spaces provided (VOL444 may already be in the third space), and hit the ENTER key.

The next screen that you see will give you the choice to: a) Enter new data, b) maintain old data, c) delete data, or d) exit from the program (any time that you want to stop, you may hit the HELP key and exit; follow directions carefully).

ENTERING NEW DATA

Press PF(3) ADD ENTRIES TO THE FILE. You are now ready to enter data from the data sheets. Enter the AMNH#, SPECIES code, larval STAGE, and COUNT (number of specimens) on the first line. Then enter the DATE (yr/mo/da), TIME (hr/mn), COUNTRY (of origin), STATE, DRAINAGE, ACCESSION #, SPECIFIC LOCALITY, FIELD COLLECTION #, GEAR (used), COLLECTOR (the company or person that did the collecting), WATER QUALITY DATA

(usually abbreviated to initials: S = salinity, D = depth, T = temperature, and X = any additional data) and IDENTIFIED BY (the initials of the person who did the identification).

After all data has been entered, check to see if it is correct, then hit ENTER. The screen will blink briefly and the return, but only the first line will be blank. This is so you will not have to retype all the data if it comes from the same (field) collection. To make any other changes not on the first line, simply type over the old data, then hit ENTER. When all data has been entered, and you wish to leave this part of the program, hit PF(16) after you have made your last entry.

NOTES:

1) Once an AMNH# has been assigned, it may not be used again, if so the line 'ENTRY ALREADY EXISTS' will appear in the lower left corner of the screen. This helps to avoid duplicate numbers in the collection. The Larval Fish Collection starts with the number 100001, and no lower number should be assigned.

2) The AMNH#, SPECIES, DATE, and TIME must be entered as numbers. No letters or other characters will be accepted. If the case arises, that no DATE (or any part thereof) or TIME is available, we have entered 99/99/99 or 99/99 (respectively) since the computer will not accept a blank field. All other fields may be left blank by TABbing past the field.

3) The FIELD COLLECTION NUMBER is important in the printing of the catalog. (see PRINTING, page 11) It is important that this number is different for each field collection, otherwise the catalog may print out as one long collection. If the collector has not assigned his collection a number, we have assigned a number starting with 9999__. This helps to avoid this problem, and makes it easy to find later. Any number may be assigned, but each field number (consecutively) must have a different number.

4) Each collection (or donation from a particular collector) is given an Accession number. See Ms. Norma Feinberg, senior scientific assistant, who is in charge of assigning these numbers. NOTE: this number is not the same as the Field collection number.

MAINTAINING OLD DATA

NOTE:

EXTREME CARE MUST BE TAKEN WHEN VIEWING OR CORRECTING OLD DATA. Hitting any other key besides those specified may forever lose data that may be very important.

If you are just reviewing old data, hit only the PFKeys that are necessary. Once you are through, exit by hitting

PF(16). If any other key is accidently hit, press PF(16), and continue your search as before (of course you will have to start at the beginning of your search as the program will not pick up where you left off).

To view or correct old data, hit PF(4) MAINTAIN ENTRIES IN THE FILE after you enter the LARVAL program. This will allow you to make any changes, or search existing data. There are five ways of locating data:

1) CATALOG NUMBER. This is the AMNH#. Type in the number of the record that you wish to see and hit PF(1). Any number less than or equal to 100000 will give you the first entry (100001), any number greater than the last number assigned will give you 'END OF FILE REACHED' on the bottom of the screen. To see the very next catalog number, hit PF(2). This can be done until the last record is met, then 'END OF FILE REACHED' will appear. Hitting PF(2) will only allow you to go forward; to see a previous entry, you must hit PF(3), and enter a new catalog number. Also you may not skip around easily, but must restart your search to advance to a record that is too far away to reach by hitting PF(2) continuously.

2) SPECIES CODE. This is a three to five digit number assigned to each species, as designated by the museum. The last two digits are a key to group name, the first (one to three) digit(s) is the order in which that species was

identified. For example, species 109 would be the first species identified in the group 09, 209 would be the second, etc. To search for a species, TAB to the second line, type in the species code for that species, and hit PF(2). This will give you the first occurrence of that species. Continuously hitting PF(2) will then show you all the records of the species that you have requested. Once you have passed the last entry of that species, the next highest species number will appear (unless you have passed the highest species code number in which case, END OF FILE REACHED will appear on the screen as before). To find out the species that corresponds to the code, or to enter a new species code, you must run the program SPLIST (see page 9).

3) DATE. This is the date that the specimen was collected in the field. The order in which you search for the date is YR/MO/DA. TAB to this (the third) field and enter the date that you wish to find. Hit PF(3) to find the first entry for that date. If you do not know the exact date, you can type in the YR, and/or YR/MO. There are many collections where the date is incomplete or not given at all. In those cases 99 has been substituted for the missing information (99/99/99 would therefore mean no information is available, etc).

4) FIELD NUMBER. This is the number a collector has assigned in the field, to a particular lot of fish. TAB to the