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HISTORY AND STATUS OF THE VIMS FISH COLLECTION (1951-1992)

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SUMMARY

The fish collection housed at the Virginia Institute of Marine Science of the College of William and Mary provides an important resource for taxonomic, systematic and ecological investigations of freshwater, estuarine and marine fishes. The uniqueness of the collection is in part due to its historical significance as well as a close coupling with a strong graduate program in ichthyology. The collection has internationally recognized holdings of Chesapeake Bay, middle Atlantic Bight and deep-water marine fishes, as well as freshwater fishes of the southern Appalachians. These collections have provided the basis for numerous graduate research projects and investigations by systematists from many institutions. In addition, rapidly expanding collections of early life history stages of fishes from Chesapeake Bay, middle Atlantic Bight and Caribbean localities offer an important and unique source of material for ontogenetic studies.

I. INTRODUCTION AND HISTORICAL PERSPECTIVES

The Virginia Institute of Marine Science (VIMS) was founded in 1940 as the Virginia Fisheries Laboratory. From 1940 until 1959 the academic program of the Laboratory was conducted by the Department of Biology of the College of William and Mary. In 1959, the program became the Department of Marine Science, and in 1961 the Board of Visitors established the marine training program as the School of Marine Science (SMS). The General Assembly in 1962 reestablished the Virginia Fisheries Laboratory as the Virginia Institute of Marine Science, an independent research and service institution providing graduate education in marine sciences. In 1979 the General Assembly merged the Institute with the College of William and Mary.

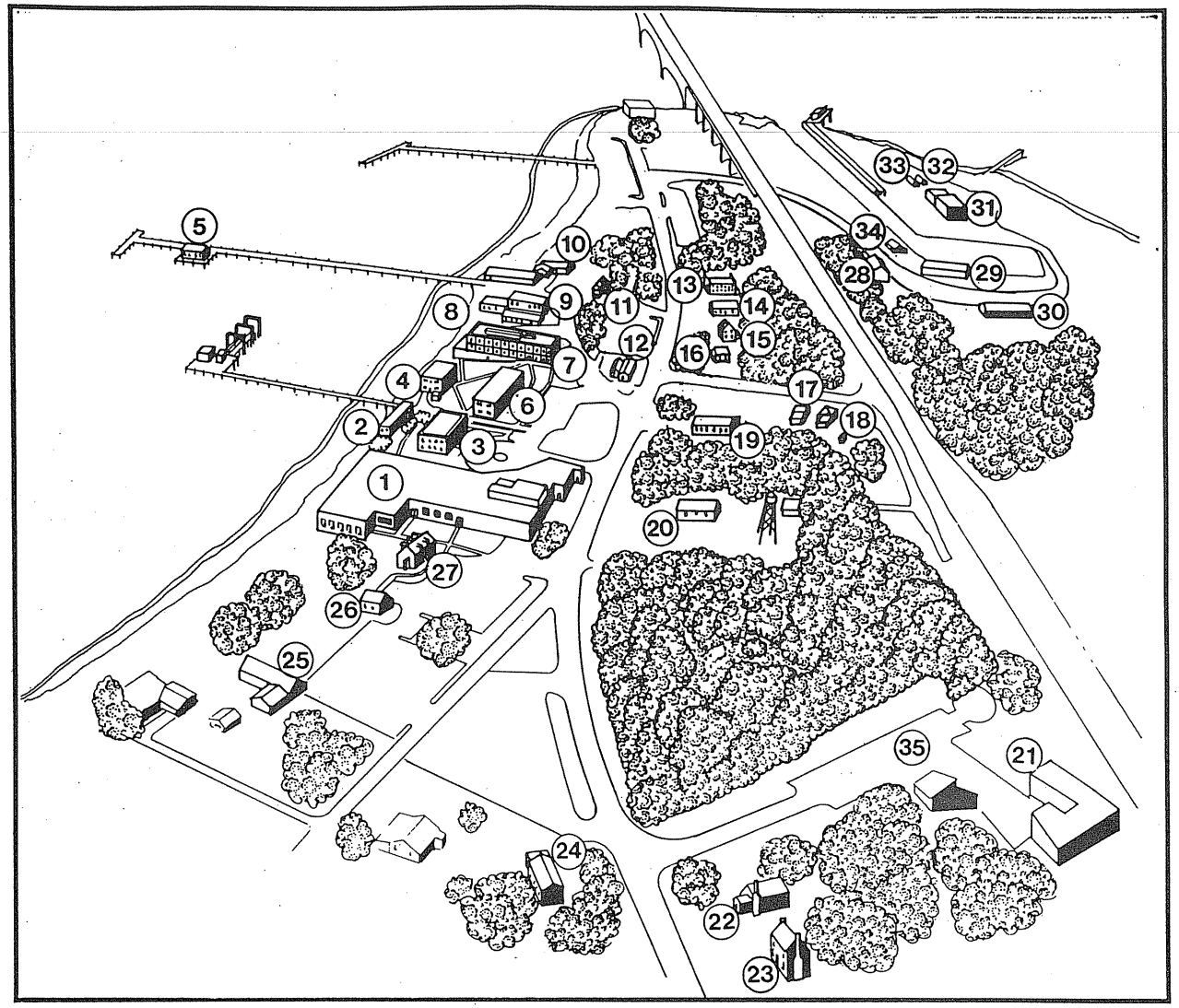
Laboratories of the Institute originally were on the main campus of the College of William and Mary at Williamsburg and at Yorktown. In 1950, the first permanent building was erected on the present campus at Gloucester Point. The school awarded its first master's degree in 1943 (to an ichthyology student), and in 1964 inaugurated a doctoral program in Marine Science. A total of 393 graduate degrees (270 M.A., 123 Ph.D.) have been awarded by the School of Marine Science through 1991.

VIMS is presently organized into five academic departments, including Biological Science, Physical Sciences, Fisheries Science, Environmental Sciences, and Marine Management and Policy. The total VIMS workforce of 320 includes 73 full-time faculty members. There are currently 129 students pursuing graduate degrees.

The Institute/School activities are supported by an annual budget of approximately $13 million per annum from the Commonwealth and approximately $5 million per annum via external grants and contracts.

II. PHYSICAL PLANT

The Virginia Institute of Marine Science/School of Marine Science is located at Gloucester Point, Virginia, on a thirty-three acre campus on the shores of the York River. The facilities at Gloucester Point are housed in thirty-three buildings (Fig. 1) serving research, education, administration, and public advisory functions. In addition, a field station is situated at



The Campus of

The College of William & Mary
Virginia Institute of Marine Science
School of Marine Science

1. WATERMEN'S HALL
2. MARINE CULTURE LAB
3. MAURY HALL
4. DAVIS HALL
5. FERRY PIER HOUSE
6. BROOKE HALL
7. BYRD HALL
8. SEDIMENT LAB
9. SERVICE CENTER & WET LAB
10. MAINTENANCE SHOP
11. REED HOUSE
12. MASEFIELD HOUSE
13. HOXTON HALL
14. HOLBEN HOUSE
15. WHITE HOUSE
16. STEVENSON HOUSE
17. MELVILLE HOUSE
18. CONRAD HOUSE
19. COASTAL INVENTORY FACILITY
20. RALEIGH HOUSE
21. JEFFERSON HALL
22. HALL HOUSE
23. BROWN HOUSE
24. WILLIAMS HOUSE
25. PAGE HOUSE
26. SAFETY OFFICE
27. CLAYTON HOUSE
28. FRANKLIN HALL
29. NEWPORT HALL
30. BOAT SHED
31. OYSTER HATCHERY
32. SAV GREENHOUSE
33. TURTLE GREENHOUSE
34. DIVE LOCKER
35. NUNNALLY HALL

Fig. 1. Map of VIMS Campus at Gloucester Point, Virginia

in Jefferson Hall to new, specially dedicated facilities in Nunnally Hall (Fig. 1).

VIMS has an extensive complement of modern scientific equipment including a mass spectrometer, scanning and transmission electron microscopes, epifluorescent microscope and a hydraulic flume. Six buildings have flow-through saltwater systems. In addition to traditional sampling gear, scientists employ a number of state-of-the-art remote sensing devices and oceanographic instrumentation including an in-situ silhouette plankton camera, Doppler current meter, side scan sonar system and an acoustic water-column profiler. The fisheries laboratories in Jefferson Hall are equipped with microcomputer-linked fish measuring boards and a Biosonics otolith and scale reading system.

A diverse fleet of research vessels supports a variety of sampling activities in the Chesapeake Bay and coastal Atlantic waters. These include the R/V Bay Eagle, a 65-ft. aluminum crew boat, the R/V Langley, a 44-ft. wooden Thompson Trawler, the R/V Fish Hawk, a 30-ft. fiberglass trawler and approximately 15 smaller boats ranging in size from 12 to 26 ft.

The central administrative offices of VIMS are located in Watermen's Hall, which also houses three fully-equipped teaching laboratories, three classrooms, a marine science library containing approximately 34,000 volumes and 1500 serial titles, a time-sharing PRIME 9955 model II computer (linked to INTERNET), a 273-seat auditorium and an exhibit area featuring five large aquaria stocked with Chesapeake Bay fishes, turtles and crustaceans.

III. ORGANIZATIONAL STRUCTURE

The primary fish collection is administered by J. A. Musick (Professor) and J. E. Olney (Assistant Professor) is in charge of the larval fish collection. Both are tenured members of the faculty of the School of Marine Science, College of William and Mary. Together, they presently serve as the major advisors to 20 students pursuing graduate research topics in ecology, taxonomy or systematics of fishes (Musick 14, Olney, 6) and regularly teach two graduate ichthyology courses. The fish collection is administered through the Department of Fisheries Science.

The Head of the Department of Fisheries Science is Roger Mann, who is directly responsible to Laboratory Director and Dean of the School of Marine Science, Dennis Taylor.

IV. DESCRIPTION OF THE FISH COLLECTION

History and Present Condition

The VIMS fish collection was established in the 1950's, largely through the collecting efforts of Drs. J. McHugh (third VIMS Director), E. Joseph, W. Davis and W. Massman. The first acquisition on record is a centrarchid collected in Mill Pond Creek, Gloucester County, in 1951, by William Massman. The collection was principally freshwater and estuarine until a 1960 collecting expedition to the Antarctic, initiated by Dr. W. Hargis (fourth VIMS Director) and supported by the National Science Foundation. Initially, the fish collection was small (< 2,000 lots), provincial and uncatalogued. In 1967, when J. A. Musick joined the faculty, the VIMS administration made a commitment to establish a permanent, cataloged collection. Under Musick's direction, the collection was moved from a small room (ca. 150 ft^2) in Brooke Hall to occupy most of the basement in Jefferson Hall (ca. 1,000 ft^2), a refurbished machine shop (Fig. 1). New fixed steel shelving was installed, and five stainless steel tanks were purchased to store specimens of moderate size. In the intervening years the fish collection in Jefferson Hall grew to 12,882 catalogued lots comprised of ca. 82,000 specimens in ca. 247 families (Appendix A). This material was stored in 50% isopropyl alcohol in ca. 12,000 glass jars (4 oz. to 5 gal.), 15 ceramic crocks (ca. 10 gal.), 20 medium-sized stainless steel tanks (35 gal.) and 3 large fiberglass coffins (ca. 600 gal.). The entire collection currently is being transferred to 70% ethanol. An estimated 1500 uncatalogued lots are stored in various places throughout the collection room in jars, buckets or tanks. In addition, an ichthyoplankton collection, consisting of ca. 22,000 lots of eggs, larvae and juveniles preserved in 5% formalin or 70% ethanol, is stored in small glass vials.

Since 1969, the fish collection has been curated by a single, part-time (20 h per week) individual responsible not only for identifying, cataloging and curating specimens, but teaching the laboratory portion of the graduate ichthyology class and handling loans, acquisitions, tours of the collection and annual reports. These individuals were graduate students, supervised by J. A. Musick, pursuing a variety of topics in systematic ichthyology. In chronological succession, these students (and their present affiliation) were S. Leonard (Richardson),

deceased; J. D. McEachran, Texas A & M University; K. W. Abel, Rutgers University; L. N. Chao, Universidad do Amazonas; L. Mercer, North Carolina Division of Marine Fisheries; W. Raschi, Bucknell University; M. E. Anderson, J. L. B. Smith Institute of Ichthyology; H. J. Carter, University of New England; T. A. Munroe, NMFS Systematics Laboratory; C. C. Baldwin, present graduate assistant.

New Facility for Fish Collection - Nunnally Hall

VIMS recently constructed a 4,600 ft^2 Vertebrate Ecology and Systematics Laboratory, Nunnally Hall (Figs. 2,3). The construction of Nunnally Hall was funded by the State of Virginia, and the building was equipped through generous matching grants from the Moses P. Nunnally Foundation and the National Science Foundation. This building, provides space for the VIMS fish collection (which is in the process of being moved) and associated laboratories, including: a large, well-ventilated room for processing acquisitions, performing necropsies on large fishes, sea turtles and cetaceans and for storage of large coffins; two research and teaching laboratories available for use by students and visiting scientists; x-ray facilities; freezer storage room; and curator's office and library. A modern fire-protection system with ceiling sprinklers and remote alarms has been installed. Excluding an emergency exit, three conveniently located doors provide entrance into the collection. The collection room is spacious (1,320 ft^2), and has the planned potential for future expansion. Ample floor space provides easy access to medium-sized stainless steel tanks. The collection is housed, in a semi-isolated, temperature-controlled, light-regulated space.

Catalogue of Collection

The catalogue of the VIMS fish collection has been maintained on 3" x 5" file cards in two separate files since 1968. In the main file, each catalogued lot is represented by a card that contains the same information as the label that accompanies the lot. In the family file, each species in the collection is represented by a card on which the number of lots of that species is recorded. The main file is organized chronologically by catalogue number. The family file is arranged phylogenetically by order then alphabetically by family, genus and species. The family file was instituted to facilitate appraisals of collection contents.

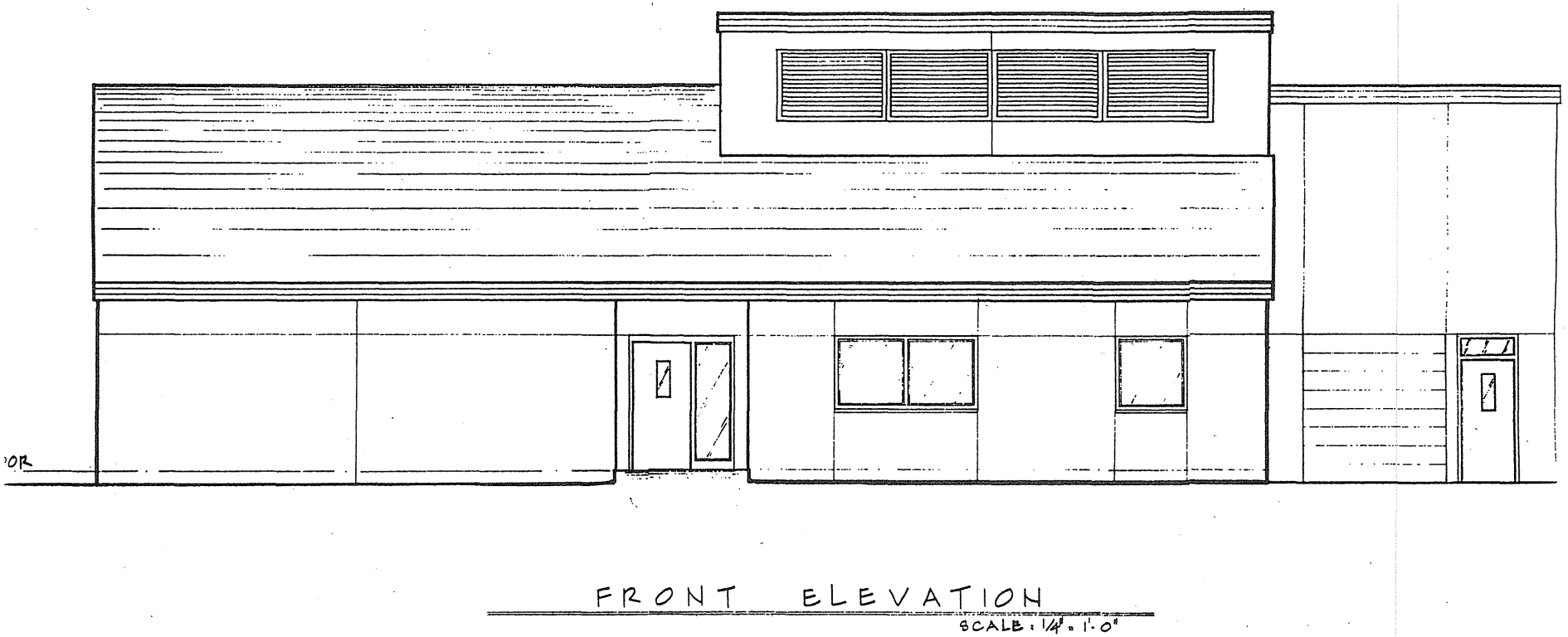


Figure 2. Front Elevation of New Vertebrate Ecology and Systematics Facility

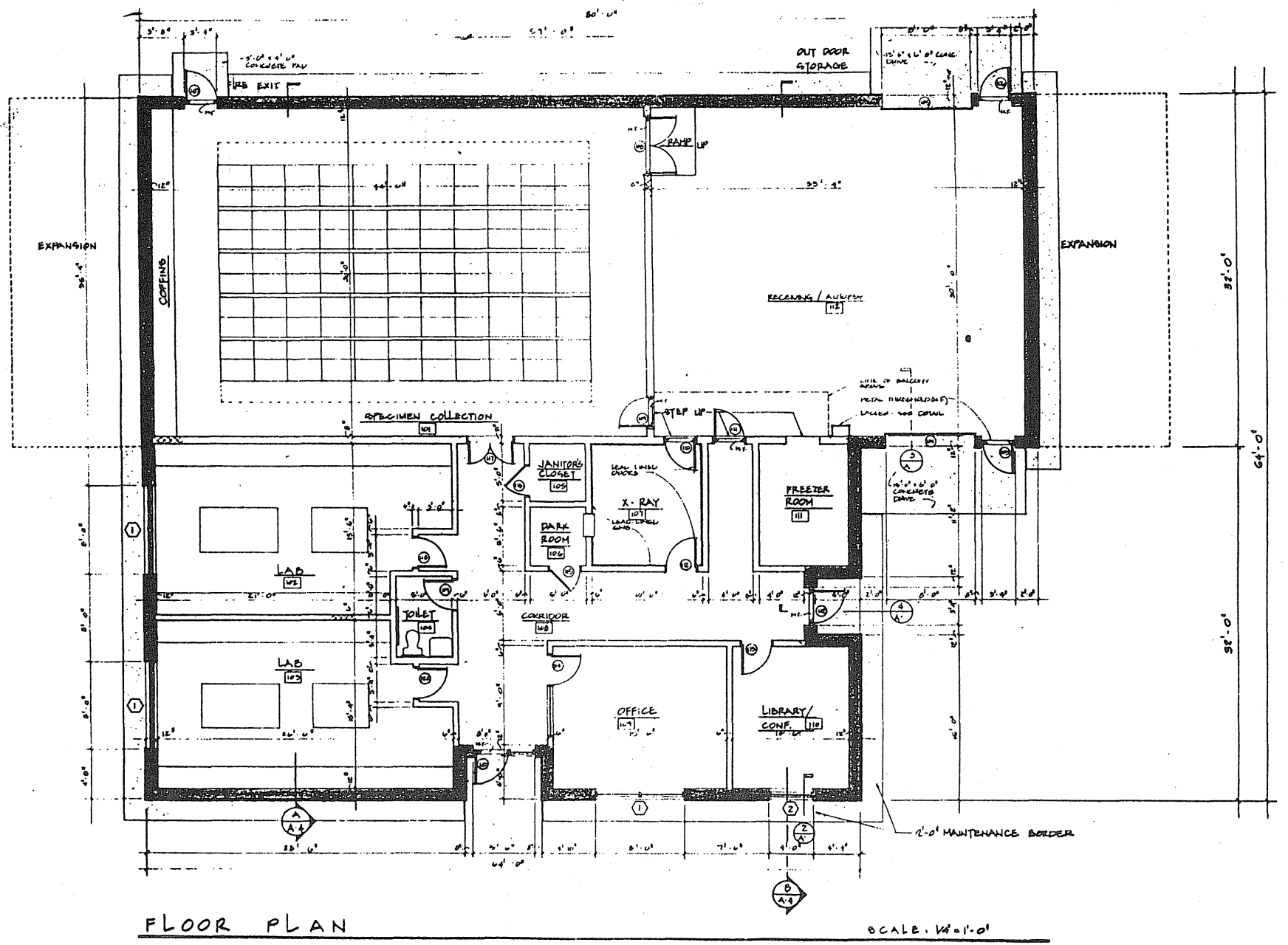


Figure 3. Floor Plan of New Vertebrate Ecology and Systematics Facility

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FLOOR PLAN

VIMS – SCIENTIFIC STORAGE

A - 1

The catalogue currently is being computerized on a microcomputer using DBASE III Plus (Ashton-Tate). Computer programs written by D. Catania for computerizing the fish collection of the California Academy of Sciences were made available to us and needed only slight modifications to meet the needs of our collection. Selected data from the main file (family, species, number of specimens and locality) have been entered into the "TOTCAT" database for ca. 8500 lots. Entry of data from the family file into the "FAMILY" database is now complete, most of the 12,882 lots catalogued in the main file are represented (Appendix A).

V. UNIQUENESS OF THE COLLECTION

The VIMS fish collection is a significant ichthyological resource for taxonomic, systematic and ecological investigations. Its principal components are: a large and historically important collection from the Chesapeake Bay and contiguous waters; deep-sea fishes from the continental slope and abyssal plain of the western North Atlantic; freshwater fishes of the southern Appalachians; and a growing collection of marine and estuarine ichthyoplankton from Chesapeake Bay, middle Atlantic Bight and Caribbean localities. The VIMS collection includes many published range records, particularly from the middle Atlantic Bight and Chesapeake Bay. A number of new taxa (at least 13) have been described from specimens in the VIMS fish collection, and primary types have been deposited in national museums (primarily USNM). A collection of eastern and western Atlantic elasmobranchs (ca. 500 lots in 20 families) as well as a specimen of the coelacanth, Latimeria chalumnae, contribute to its diversity and scope. The collection has been used extensively for graduate student research, and its uniqueness is in part derived from a close coupling with a strong graduate program in ichthyology. The collection houses voucher specimens from at least 43 VIMS theses and dissertations and numerous publications dealing with the systematics, morphology, or ecology of fishes (Appendices B and C).

VIMS has one of the largest and most diverse collections of marine and estuarine temperate zone fishes known from Nova Scotia to North Carolina (see "VI. Relationship to Other Similar Collections"). These holdings have been acquired primarily through long-term monitoring of teleosts and elasmobranchs in the Chesapeake Bay and contiguous waters, cooperative cruises with the NMFS, Northeast Fisheries Center at Woods Hole (RV Albatross IV, RV Delaware II) and Duke University Marine Laboratory (RV Eastward) and consolidations with neighboring institutions. VIMS became the repository for the fish collection of the

Chesapeake Biological Laboratory (Solomons, MD) in 1978. Resulting largely from the collecting efforts of Romeo Mansuetti, Frank Schwartz and Martin Wiley, this significant collection (ca. 4500 lots) consists primarily of freshwater and estuarine fishes of the upper Chesapeake and Delaware Bays. In addition, a smaller collection from Virginia Commonwealth University (Richmond, VA) was acquired in 1985, and recent agreements have been made with Dr. Ray S. Birdsong to incorporate parts of the fish collection of Old Dominion University (Norfolk, VA). As a result of these consolidations, VIMS is the primary regional repository for Chesapeake Bay fishes. The VIMS fish collection was used to compile an annotated checklist of fishes in the Bay by J. A. Musick in 1972, and will be an important reference collection for a new book on fishes of the Chesapeake Bay in preparation by R. S. Birdsong and E. Murdy (R. S. Birdsong, pers. comm., June 1991). The value of this collection will continue to grow as a documentary record of the diversity of fish in the middle-Atlantic coastal zone; an area of human overpopulation and attendent environmental degradation.

The Chesapeake Bay is the largest estuary in North America and one of the largest in the world, encompassing 2,500 square nautical miles and bordered by large metropolitan populations exceeding eight million people (White, 1989). The diversity of the fish fauna is considerable. Musick (1972) listed 287 species of marine, freshwater and estuarine species that have been reported to occur in the Chesapeake drainage below the fall line. In recent years, the estuary has been identified as potentially and dangerously stressed by toxic discharges, episodic anoxia and discharges of municipal waste. This stress is believed to be a factor in the dramatic decline in landings of important fin-fish and shellfish resources, and may be linked in the future to declines in biodiversity. Detection of such trends will require a long-term documented record of Chesapeake Bay ichthyofauna. The studies and collections of Samuel F. Hildebrand (specimens now deposited at the USNM) coupled with the VIMS collection provides the only source of this historical data for the Bay.

The large collection (ca. 3,065 lots) of deep-sea demersal fishes is internationally recognized and unique in composition because of its significant holdings of alepocephalid, chlorophthalmid, gonostomatid, gadid, halosaurid, macrourid, melamphaid, morid, myctophid, nemichthyid, ophidioid, sternoptychid, synaphobranchid and zoarcid fishes. These specimens have been accruing from the studies of J. A. Musick and his students on community ecology and systematics of deep-sea fishes. This research was supported by N.S.F. (Biological Oceanography) from 1973 to 1981 and has resulted in at least 43 publications (Appendix C). The material and archival data, largely collected from the continental slope and abyssal plain

off Virginia and in the Bahamas, are still being studied by scientists and students. Furthermore, acquisitions of mesopelagic and deep-sea demersal fishes continue through grant- and contract-supported expeditions, such as recent trawling in Deep Water Dump Site No. 106 off New York.

Another major component of the VIMS fish collection is comprised of over 2,125 lots of freshwater fishes from the southern Appalachians. The collection includes over 15,000 catalogued specimens of Cyprinidae, Catostomidae, Percidae and Centrarchidae. Additionally, historical collections contain several specimens of a number of newly listed endangered species (e.g., Percina rex, Noturus gilberti). Most of this material is the result of annual and continuing collecting trips within Virginia and surrounding areas by J. A. Musick and his graduate ichthyology class. These collections have provided important material for numerous publications, including the benchmark book, The Freshwater Fishes of Virginia by Jenkins and Burkhead (In Press).

The VIMS holdings also include a large and growing (but as yet uncatalogued) collection of egg, larval and juvenile stages of estuarine and marine fishes. A portion of this collection (Table 1) consisting of early life history stages of 96 families of fishes is used as a reference collection in J. E. Olney's graduate course entitled "Early Life History of Marine Fishes." This material initially resulted from studies in the 1970's by S. Leonard (Richardson) and J. E. Olney of the development and distribution of larval fishes in the Chesapeake Bay and middle Atlantic Bight. The scope of the ichthyoplankton collection has expanded (Table 2) to include oceanic and tropical ichthyoplankton acquired through collecting efforts in the south Atlantic Bight and Belize, as well as through donations from the Southwest Fisheries Center (La Jolla, CA), Huntsman Marine Lab (St. Andrews, New Brunswick) and South Carolina Marine Resources Research Institute (Charleston, SC).

A final component of the VIMS collection includes a number of exotic holdings from various geographical localities including the South Atlantic Bight, Caribbean Sea, Antarctica and the Indian Ocean. In 1987, Dr. Musick organized a research team of prominent scientists from around the U.S. to present a proposal to The Explorers Club to acquire two frozen specimens of coelacanths (Latimeria chalumnae) collected by Club members in the Comoros Islands. The specimens initially were donated to VIMS where the team gathered in January 1988 to perform partial (visceral) dissections. After removing pertinent tissues, both specimens were preserved and catalogued. Tissues were subsequently analyzed in the course of physiological and

TABLE 1. Alphabetical List of the Families in VIMS Ichthyoplankton Reference Collection

FAMILY	CODE	FAMILY	CODE
ACANTHURIDAE	412	HOLOCENTRIDAE	243
AMMODYTIDAE	402	IDIACANTHIDAE	95
ANARHICHADIDAE	396	ISTIOPHORIDAE	419
ANGUILLIDAE	49	LABRIDAE	262
ANTENNARIIDAE	192	LOPHIIDAE	190
ARIOMMIDAE	423	LUTJANIDAE	323
APOGONIDAE	304	MELANOSTOMIATIDAE	93
ARGENTINIDAE	83	MEGALOPIDAE	47
ASTRONESTHIDAE	92	MOLIDAE	450
ATHERINIDAE	218	MORONIDAE	288A
BALISTIDAE	445	MONACANTHIDAE	445
BATHYLAGIDAE	84	MUGILIDAE	359
BELONIDAE	207	MURAENIDAE	56
BLENNIIDAE	392	MYCTOPHIDAE	167
BOTHIDAE	439	NEMICHTHYIDAE	52
BRAMIDAE	319	NOMEIDAE	422
BRANCHIOSTEGIDAE	308	OPHICHTHIDAE	66
BREGMACEROTIDAE	182	OPHIDIIDAE	186
CALLIONYMIDAE	435	OSMERIDAE	80
CARAPIDAE	187	OSTRACIIDAE	446
CARANGIDAE	314	PARALEPIDIDAE	169
CAULOPHRYNIDAE	195	PERCIDAE	396
CENTRARCHIDAE	302	PHOLIDAE	395
CHAETODONTIDAE	343	PLEURONECTIDAE	395
CICHLIDAE	349	POMACENTRIDAE	350
CLUPEIDAE	43	POMATOMIDAE	311
CONGRIDAE	62	PRIACANTHIDAE	303
CORYPHAENIDAE	315	SALMONIDAE	76
CRYPTACANTHODIDAE	394	SCARIDAE	364
CYCLOPTERIDAE	284	SCIAENIDAE	331
CYNOGLOSSIDAE	442	SERRANIDAE	289
CYPRINIDAE	122	SCOMBERESOCIDAE	208
CYPRINODONTIDAE	212	SCOPELOSAURIDAE	166
DACTYLOPTERIDAE	285	SCORPAENIDAE	264
DYSOMMIDAE	59	SPHYRAENIDAE	360
ELOPIDAE	46	SOLEIDAE	441
ENGRAULIDAE	44	STERNOPTYCHIDAE	89
ESOCIDAE	74	STICHAEIDAE	393
EVERMANELLIDAE	74	STOMIIDAE	91
EXOCOETIDAE	173	STROMATEIDAE	425
GADIDAE	206	SYNGNATHIDAE	258
GASTEROSTEIDAE	183	SYNODONTIDAE	160
GEMPYLIDAE	414	TETRAGONURIDAE	424
GERREIDAE	326	TETRAODONTIDAE	424
GOBIESOCIDAE	434	TRACHIPTERIDAE	225
GOBIIDAE	405	TRICHIURIDAE	415
GONOSTOMATIDAE	326	TRIGLIDAE	266
HEMIRAMPHIDAE	88	URANOSCOPIDAE	378

Table 2. Summary of Ichthyoplankton Material to be Catalogued in VIMS Fish Collection

SOURCE	LOCALITY	APPROXIMATE NUMBER OF LOTS
Reference/Teaching	(Varies)	295
Nassau Grouper Project	Belize, C.A.	1,165
NSF Ches. Bay Plume Project	Chesapeake Bay	5,000
Croaker Cruises	Middle and South Atlantic Bights	12,000
BLM Cruises	Middle Atlantic Bight	2,500
Black Drum/Striped Bass Spawning Assessment	Chesapeake Bay and Tributaries	1,040
TOTAL		ca. 22,000 lots

genetic studies by more than fifty researchers around the world. One of the preserved Latimeria specimens was subsequently sent to the University of Kansas on permanent loan, to support the active coelacanth research program there. Tissues from Latimeria are still being maintained frozen at VIMS for future use by qualified researchers.

VI. RELATIONSHIP TO OTHER SIMILAR COLLECTIONS

Chesapeake Bay

The collection of fishes that constituted Samuel F. Hildebrand's treatment of Fishes of the Chesapeake Bay (Hildebrand and Schroeder, 1928) was deposited at USNM, but it is difficult to obtain an estimate of the size of this collection because the enormous holdings of fishes at USNM are not completely computerized (J. T. Williams, pers. comm.). We expect that Hildebrand's collection is not large, however, because a large portion of his data was compiled from commercial fish catches. Since that significant study, the Chesapeake Biological Laboratory, Virginia Fisheries Laboratory (now VIMS) and Old Dominion University have been the primary institutions continuing ichthyological research efforts in the Chesapeake Bay. Because the USNM does not actively seek acquisitions from the Chesapeake Bay (G. D. Johnson, Pers. Comm., July 1991), and because the fish collections of CBL and ODU have been (or will be) consolidated with those of VIMS, the VIMS collection is the only active repository for Chesapeake Bay Fishes.

Freshwater Fishes

Likewise, VIMS is a major repository for freshwater fishes of the southern Appalachians. Dr. Robert Jenkins, Professor of Biology at Roanoke College, has relied heavily on the VIMS collection for the book, Freshwater Fishes of Virginia, that is currently in press (Jenkins and Burkhead). The VIMS collection contains samples from the James, Roanoke, New and Tennessee River Drainages collected annually for the past 21 years; thus, the collection provides an historical record of the fauna of this area that is not duplicated at any other institution.

Deep Sea Fishes

Our holdings of demersal and midwater fishes of the western Atlantic continental slope and abyssal plain constitute approximately 30% of the total catalogued lots, an unusual attribute for a relatively small and otherwise regional collection. Our collection of deep-sea fishes is unique because it represents intensive sampling over a period of years of the Norfolk Canyon and surrounding areas off the coast of Virginia. Additional collections have been made off the Bahamas and New York, the latter still being sampled regularly in efforts to evaluate the faunal diversity of Deep Water Dump Site No. 106. Although a number of fish collections in the eastern United States have large holdings of deep sea fishes (e.g., USNM, MCZ), only that of the University of Miami is similar to ours in composition because of regular sampling in the deep waters off the Bahamas.

Ichthyoplankton

Permanent ichthyoplankton collections (curated and catalogued) are rare in the U.S. The largest and most significant collection on the east coast is at the Museum of Comparative Zoology (Harvard University), but it is primarily oceanic in composition (North and South Atlantic) and resulted largely from collecting efforts by personnel of Woods Hole Oceanographic Institute. Smaller collections are housed at the South Carolina Marine Resources Research Institute in Charleston, SC, and Florida Department of Natural Resources in St. Petersburg, FL, but these are primarily subtropical in composition. Our collection of estuarine and coastal ichthyoplankton from the middle Atlantic Bight is unique. The collection most similar to ours in size and content (NMFS - Sandy Hook Laboratory) was destroyed by fire.

VII. CURRENT SYSTEMATIC RESEARCH AND GRADUATE TRAINING IN ICHTHYOLOGY

The Fisheries Science Department of the School of Marine Science (SMS) has a strong commitment to train graduate students in ichthyology. This subfaculty comprises 17 full time faculty members and advises ca. 50% of the total SMS graduate student body. Faculty expertise includes population dynamics and biometrics, fisheries biology, trophic ecology, population genetics, parisitology, aquaculture, vertebrate ontogeny and morphology, and systematics. The curriculum consists of ten graduate courses, presently including two courses dealing with taxonomy and systematics of fishes.

The VIMS fish collection is an integral part of this curriculum, and has served as the basis of numerous theses and dissertations (Appendix B). Principally through the mentorship of J. A. Musick, the SMS has graduated an impressive list of systematic ichthyologists, most of whom presently hold teaching and research positions in universities or museums (Table 3). Since the early 1970's, the graduate program in ichthyology at VIMS has benefitted substantially from a close association with the National Museum of Natural History (Smithsonian Institution) and the National Marine Fisheries Service (NMFS) Systematics Laboratory in nearby Washington, D.C. Smithsonian curators and NMFS personnel who serve (or have served) as co-advisors or committee members of SMS graduate students include Drs. B. B. Collette, D. M. Cohen, R. G. Gibbs, V. G. Springer, G. D. Johnson, S. Weitzman, M. Vechionne and T. A. Munroe.

An active systematic research program at VIMS augments the curriculum and provides opportunities for students to interact and often collaborate with the research staff. A number of recently completed, ongoing and planned studies by VIMS faculty and students of the Departments of Fisheries Science helps to characterize this program. An NSF award from the Systematic Biology Program in 1981 (J. E. Olney and D. F. Markle, DEB-8117185) recently culminated in a monographic revision of the ophidiiform family Carapidae (Markle and Olney, 1991), and resulted in 6 papers on ontogeny, taxonomy and systematics of the pearlfishes. More recently, two VIMS scientists were invited contributors to a symposium entitled "Phylogeny of the Percomorpha," convened at the 1990 annual meetings of the American Society of Ichthyologists and Herpetologists in Charleston, SC. Olney, VIMS graduate student C. C. Baldwin and VIMS Associate Faculty Member G. D. Johnson (USNM) presented a paper on the monophyly and relationships of the large oceanic fishes of the order Lampridiformes; and Baldwin discussed inter- and intrarelationships of the seabass subfamily Anthiinae. These works will appear in Bulletin of Marine Science in the proceedings of the symposium. Continuing studies on shark systematics have resulted in an article in press in Copeia on the

Table 3. Systematic Ichthyologists Graduated From or Enrolled in VIMS/SMS and Their Present Affiliation

STUDENT	YEAR GRADUATED	PRESENT AFFILIATION
K. W. Able	1974	Rutgers University
M. E. Anderson	1984	J.L.B. Smith Institute of Ichthyology
C. C. Baldwin	1992	U.S.N.M.-Smithsonian Institute
H. M. Banford	(Presently enrolled)	
B. B. Bowen	1987	University of Florida
H. J. Carter	1984	University of New England
M. R. Cavalluzzi	MA 1992; (Presently enrolled in Ph.D. program)	
L. N. Chao	1976	Universidad do Amazonas
R. E. Crabtree	1984	Florida Department of Natural Resources
J. V. Gartner	1984	Florida Department of Natural Resources
E. D. Grogan	(Presently enrolled)	
D. N. Hata	(Presently enrolled)	
E. J. Heist	(Presently enrolled)	
S. Leonard (Richardson)	1971	Deceased
J. Lyczkowski (Schultz)	1971	National Marine Fisheries Service
E. D. Maddox	1992	Florida Institute of Technology
J. D. McEachran	1973	Texas A&M University
D. F. Markle	1976	Oregon State University
L. W. Morgan	1992	Univ. of Wisconsin, School of Vet. Medicine
T. A. Munroe	1986	NMFS Systematics Laboratory (USNM)
J. E. Olney	1978	VIMS
W. G. Raschi	1984	Bucknell University
R. S. Rosa	1985	Universidade Federal de Paraiba
D. R. Scoles	(Presently enrolled)	
G. R. Sedberry	1980	S.C. Marine Resources Research Institute
C. R. Tabit	(Presently enrolled)	
C. A. Wenner	1978	S.C. Marine Resources Research Institute

taxonomy of Pseudotriakus by K. Yano and J. A. Musick. The acquisition of the two coelacanth specimens at VIMS provided unique opportunities for systematic research. "The Biology of Latimeria chalumnae and the Evolution of Coelacanths," edited by J. A. Musick, M. Bruton and E. K. Balon has just been published as a special volume of Environmental Biology of Fishes and as a separate book by Kluwer Press. This work provides a comprehensive treatment of the relationships of the coelacanth based on morphological and molecular data sets. Finally, a genetic analysis of Atlantic and Pacific blue marlin recently was completed by Dr. J. E. Graves and will be submitted to Fishery Bulletin. Plans for future studies that involve collaboration between morphological systematists and Dr. Graves are in progress (e.g., Phylogeny of the Epinephelinae - C. C. Baldwin, G. D. Johnson and J. E. Graves).

In the past, systematic ichthyology at VIMS largely comprised traditional studies of morphology and morphometrics of adult fishes. When J. E. Olney initiated the graduate course "Early Life History of Marine Fishes" in 1982, students at VIMS were (and continue to be) provided with a rare opportunity to be trained formally in the identification of ichthyoplankton and to learn its significance in studies of ecology and phylogeny of fishes. Furthermore, recognizing the value of biochemical techniques in studies of population biology and systematics, the VIMS administration made a commitment in 1989 to create a tenure-track position for a biochemical systematist. The position was nationally advertised, and John E. Graves joined the faculty in 1990. In addition to conducting a strong research program (protein electrophoresis and restriction fragment length polymorphism analysis of mitochondrial DNA), Dr. Graves annually offers a graduate course in population genetics. Thus, a broadened faculty expertise has resulted in a considerably stronger and more diverse graduate systematic ichthyology program at VIMS.

Several students have recently completed or presently are pursuing graduate research at VIMS in taxonomy, systematics or functional morphology of fishes (Table 3). Topics of research (student's name and degree sought in parentheses) include taxonomy of larval blennioid fishes from Belize (M. R. Cavalluzzi, M.A.); larval morphology and relationships of epinepheline serranids (C. C. Baldwin, Ph.D.); morphology and population genetics of halfbeaks (H. M. Banford, Ph.D.), scombrids (D. R. Scoles, Ph.D.), sharks (E. J. Heist, Ph.D.) and billfishes (L. W. Morgan, M.A.); phylogenetic patterns of immune systems in holocephalans (E. D. Grogan, Ph.D.); functional morphology of body morphometrics and placoid denticles in squaloids (C. R. Tabit, Ph.D.) and functional morphology of gills in galeoid sharks (D. N. Hata, Ph.D).

VIII. ACQUISITION POLICY

The VIMS fish collection will continue to serve as the regional repository for estuarine and marine fishes of the Chesapeake Bay and the middle Atlantic Bight, and will continue to expand its holdings of deep-sea, freshwater and exotic fishes as well as early life history stages of marine fishes. Although considerable effort was expended between 1970 and 1980 to increase exotic holdings from outside sources (primarily for teaching purposes), in recent years this activity has been kept to a minimum because of the ever increasing space constraints on the collection. Upon completion of relocation to the new Vertebrate Ecology and Systematics Facility in Nunnally Hall, we envision new opportunities and renewed efforts to increase the size and scope of the fish collection.

A number of on-going investigations, long-term monitoring efforts, and planned projects will provide excellent opportunities for continuing acquisition of material. These include (but are not limited to):

1. VIMS Lower Bay Finfish Monitoring (supported by State of Virginia, $300,000 per year) - These monthly spring and summer surveys of the lower Chesapeake Bay monitor juvenile fish recruitment to important commercial fisheries interests of the Commonwealth.

2. VIMS Anadromous Fish Surveys (supported by NOAA, NMFS, $110,000 per year) - Annual spring monitoring of juvenile clupeiform fishes by bow-mounted pushnet is conducted weekly during spring and early summer periods of recruitment.

3. VIMS Seine Surveys (supported by U.S. Fish and Wildlife Service, Wallop Breaux Fund, $60,000 per year) - Weekly seine collections in oligohaline portions of the James, York and Rappahannock rivers monitor recruitment of striped bass.

4. VIMS Longline Surveys (supported by U.S. Fish and Wildlife Service, Wallop Breaux Fund, $207,000 per year) - Regular spring, summer and fall sets of baited longlines monitor historical trends in the abundance and define distributions of sharks from Cape Henlopen, Delaware to Cape Hatteras, North Carolina.

5. Spawning Assessment Surveys (supported by State of Virginia and various agencies, ca. $100,000 per year) - Regular ichthyoplankton cruises designed to estimate stock size and monitor spawning activity of striped bass, sciaenids and anchovies are conducted during spring, summer and fall months in the lower Chesapeake Bay and contiguous waters. These surveys yield abundant egg, larval and juvenile material.

6. Deep-sea Demersal Fish Study (supported by NOAA, $80,000 per year) - Periodic trawl expeditions to define historical trends in community structure of demersal, bathyal fishes from 200 to 3000 m off the middle Atlantic Bight.

7. Belize Ichthyoplankton Surveys - Collections of early life history stages of Belize fishes began in 1985 in a study of grouper spawning ecology and recruitment in cooperation with the New York Zoological Society and the Smithsonian Institution. These collections continue intermittently and are providing an important source of poorly-known larval material.

8. St. Eustatius Collections - Cooperative agreements between the government of St. Eustatius (Caribbean Sea) and the College of William and Mary have provided collecting opportunities in recent years. We plan future collecting trips.

9. "Roanoke Round-up" - Annual collecting trip of ichthyology class to Roanoke, VA and surrounding areas to sample freshwater fishes of the southern Appalachians.

10. Brazil - Cooperative agreements with Brazilian investigators (Dr. Cassiano Monteiro-Neto and Dr. Labbish Chao) will provide opportunities for acquisition of material from the Amazon Basin and northern coastal Brazil.

Furthermore, we will continue to exchange material well represented in the VIMS fish collection for exotic taxa at other ichthyological resource centers. We maintain close association with regional universities and will continue to acquire material collected in independent projects. Finally, we benefit from public awareness of this collection and will continue to accept unusual specimens from commercial and recreational fishing interests as well as the general public.

Our policy regarding type material is in keeping with that outlined by Collette and Lachner (1976). All primary types will be deposited at the National Museum of Natural History, Smithsonian Institution, but paratypes may be maintained in the VIMS collection. VIMS will not accept illegally-collected or acquired material.

IX. LOAN POLICY

The VIMS fish collection is available to education centers and scientists throughout the United States and abroad. Our policy is to lend, donate and exchange material freely. Each request is reviewed to determine the qualifications of the investigator, the condition of the material requested and the nature of the request (for example, permission to dissect or clear and stain). Loans are generally six to 12 months in duration. All costs of processing and shipping specimens are covered by VIMS, and detailed records of all transactions are maintained. In keeping with common protocol, we return the container, from which the loan specimens have been removed, to its proper place in the collection. The original labels, borrower's name and date allows others to see the disposition of the material.

X. USER CHARGES

VIMS has no user charges for services associated with the fish collection with the exception of expenses incurred by extensive use of the planned x-ray facility.

XI. UTILIZATION

Visitors

Although the VIMS fish collection attracts modest numbers of scientific visitors (ca. eight per year), such activities vary widely from year-to-year. Many prominant ichthyologists from the U.S. and abroad have worked in the collection over the years (Fig. 4). Once the collection is fully relocated to our new facility, we look forward to increased numbers of scientific guests and public tours, and will maintain logs of these visits. Scientific visitors have access to living quarters at VIMS at Clayton House (see Fig. 1).

Public Education

The VIMS fish collection is frequently used in demonstrations of fish biology and morphological diversity to public school classes in Virginia, private organizations, undergraduate classes and gifted student programs. In addition, state fisheries management officials request regular training workshops for law enforcement personnel on identification of commercially important taxa. In the past, these activities have been led by the graduate assistant in charge of the collection.

Loans and Exchanges

A list of loans, gifts and exchanges of material from 1986 to present is provided in Appendix D. This list of 47 transactions (average eight per year) does not include extensive and historical utilization of the collection by ichthyology students and faculty in Jefferson Hall, probably the greatest body of users of the collection thus far (see "VII. Current Systematic Research and Graduate Training in Ichthyology"). This utilization rate by outside scientists appears to be similar to that of collections comparable in size (T. Pietch, pers. comm.), but we

Figure 4. Copy of Photograph of Dr. and Mrs. Carl Hubbs and Dr. Robert R. Miller During Their Visit to VIMS in 1953

anticipate an increase in annual loan number and future exchanges following our complete relocation to the new facility and advertisement of the scientific community.

XII. PUBLICATIONS

Lists of publications, theses and dissertations in which VIMS specimens were investigated are given in Appendices B and C. The list of publications likely is incomplete because detailed records have not been maintained; nevertheless, it clearly demonstrates the use of the four major components of the collection (Chesapeake Bay, deep-sea and freshwater fishes as well as early life history stages of fishes) by VIMS faculty and students, other U.S. scientists and international colleagues.

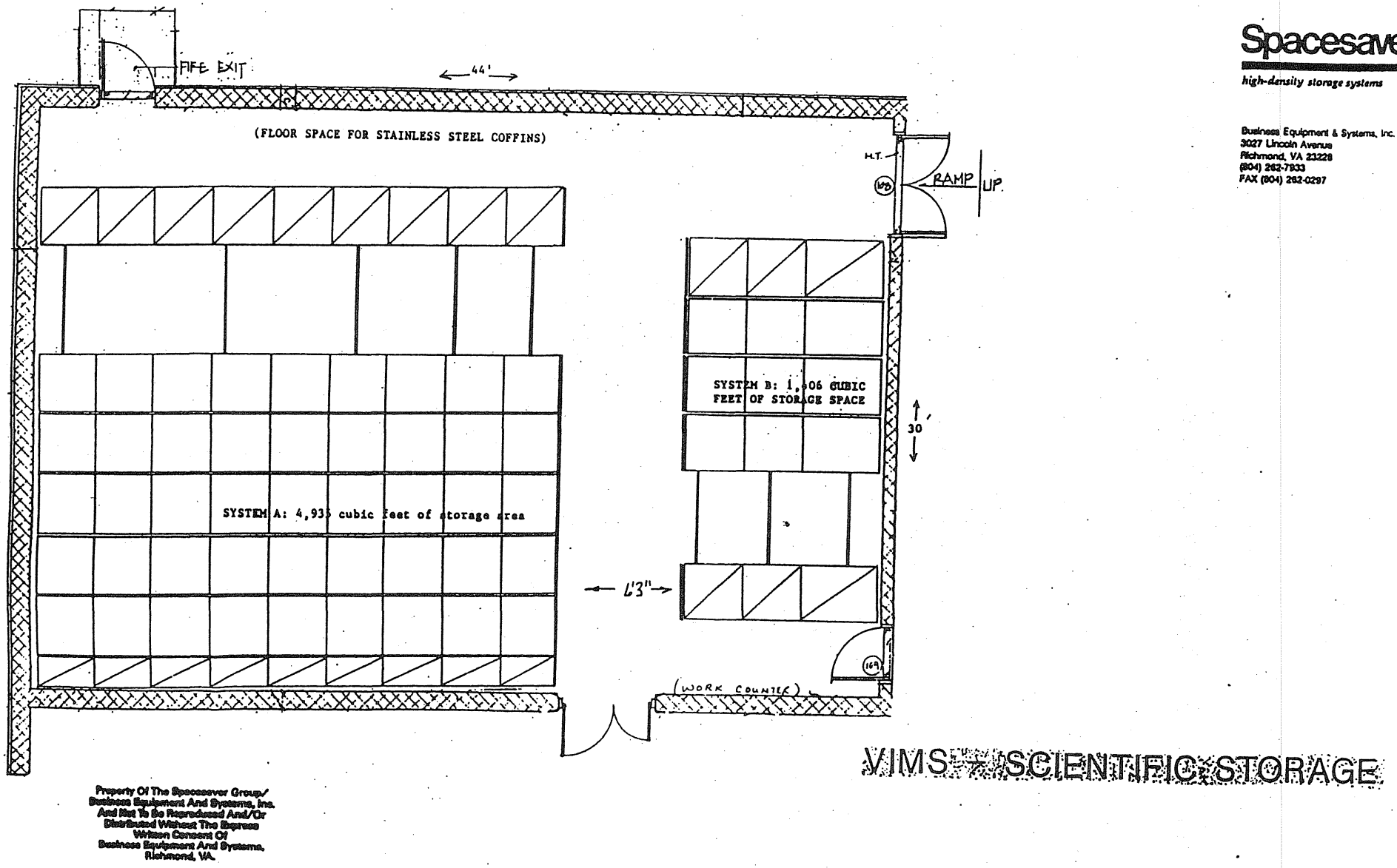
XIII. FUTURE GOALS

Relocation and Curation of Collection

The principal immediate goals for the VIMS fish collection are to complete the computerization of the catalogue, transfer the entire collection to ethanol, recap or rebottle all those lots that are in substandard containers and complete moving the collection from the crowded quarters in Jefferson Hall to the new facility in Nunnally. Using our newly computerized catalogue, this relocation will facilitate an inventory of catalogued and uncatalogued holdings, confirmation of outstanding loans, detection of duplicated, skipped or erroneous catalogue numbers, and removal of improperly curated material if it exists.

We are presently installing the Spacesaver High Density Mobile Storage System in the fish collection. This system is space-efficient, yet economical, because it converts non-productive aisles to valuable storage space. In consideration of cost, however, the system initially will occupy only a portion of the collection room (Fig. 5, System A), but tracks for future expansion of the system (Fig. 5, System B) will be installed in the remainder of the room. The mobile shelving system, combined with several rows of stationary shelves, can accommodate the present collection and also provide additional space for years to come.

Historically, the VIMS fish collection has been stored in 50% isopropyl alcohol. Recently, it has been shown that long-term storage of fishes in isopropyl may lead to severe damage (Lavenberg et al., 1984; Taylor, 1984). Following the protocol recommended by the American



Spacesaver
high-density storage systems

Business Equipment & Systems, Inc.
3027 Lincoln Avenue
Richmond, VA 23228
(804) 262-7933
FAX (804) 262-0297

Figure 5. Proposed Design of New Collection Room Showing Location of SPACESAVER Mobile Storage Systems

Society of Ichthyologists and Herpetologists (ASIH) Ichthyological Collection Committee, we are currently converting to 75% ethanol.

All existing glassware (except one- and five-gallon jars) in the fish collection is capped with bakelite lids lined with waxed cardboard. These lids crack when tightened, and the seals often fail as the wax liners deteriorate with age and exposure to alcohol. We are replacing all of these with polypropylene lids and polyethylene liners, following the recommendation of the ASIH Ichthyological Collection Committee. Additionally, several hundred jars presently on collection shelves are miscellaneous supermarket varieties that we to replacing with standard-size jars so that proper lids can be applied.

We are adding 10 new 35-gallon capacity stainless steel coffins to store specimens of intermediate size (0.5-1.0 m in length). These containers are needed for future acquisitions and to replace 15 ceramic crocks (originally from Smithsonian Institution) that are about 100 years old. The old crocks do not close tightly, thus preservatives evaporate, and collections are difficult to maintain.

At present the larval fish collection is uncatalogued and stored in 1-dram shell vials or 20--ml clear glass, scintillation vials. The teaching and reference collection is housed in a portable air-tight cabinet. The remaining collections (see Description of Collection) are miscellaneously stored in various localities on campus, usually as collections of vials submersed in preservative in a larger jar. The status of identification of this material is variable, but the majority is identified to family, genus or species. We plan to consolidate and catalogue these collections, and follow a double-vial storage system, such as described by Lavenberg et al. (1984). In this system, the fragile specimens are separated from catalogue labels and thus protected from damage. In the future we plan to purchase additional storage cabinets to house the entire collection.

All collection labels and catalogue cards presently are printed by hand in india ink. Completion of the computerization of the card catalogue will enable us to produce labels more efficiently. A laser printer is available in Jefferson Hall for this purpose, and we are purchasing both a microcomputer and laser printer for use in the fish collection in the new facility.

Additionally, in the future, we plan to exhibit special collections. For example, the coelacanth specimen will be placed in a custom-made, light-controlled exhibit chamber and located for public viewing.

Acquisitions

We plan to continue cataloguing material accruing from our many research projects (see Acquisition Policy), and to renew our acquisition (through exchanges) of additional exotic collections. Recognizing the increasing importance of ontogeny in studies of phylogeny, we Win focus in the future on expanding the holdings of early life history stages of teleost fishes. Our goal is to provide researchers at VIMS and other institutions an easily accessed collection of identified egg and larval material in developmental series that can be used as a source of ontogenetic characters, a means of assessing homology and as a tool in identifying heterochrony. One of us (JEO) has extensive experience in the collection, maintenance and identification of eggs and larvae, in ecological studies of teleost reproduction, a-nd in using ontogenetic data in phylogenetic reconstruction. Thus, we are well prepared to handle the special problems associated with the curation of the ichthyoplankton collection.

Graduate Training in Ichthyology

The commitment of VIMS to training systematic ichthyologists has remained strong for 25 years, and we believe that the new facilities can only strengthen this commitment in the future. With the relocation of the collection, we plan to renew efforts to recruit new systematic ichthyology students through advertisement of facility, fish collection and faculty. These students will be supported by funds from this award as well as institutional stipends. We hope to expand our ichthyology curriculum with the addition of a new course, entitled "Phylogenetic Relationships of Acanthomorph Fishes." Additionally, Dr. G. D. Johnson, USNM and Associate member of the SMS Faculty, has expressed interest in continuing and expanding his involvement in MS 630, "The Early Life History of Marine Fishes." Finally, the recent addition of a population geneticist (Dr. J. E. Graves) on the SMS faculty will provide opportunities for joint research on morphology and genetics. As future opportunities to enhance our faculty occur, we will continue to strengthen our graduate program in ichthyology.

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XXV. APPENDICES

APPENDIX A. Catalogue by Family of Fishes in VIMS Collection

(Tabulated from Data in "FAMILY" Database -- see Table 2)

FAMILY	SPECIES	LOTS	SPECIMENS	%OF TOTAL LOTS
ACANTHURIDAE	9	9	12	0.08
ACIPENSERIDAE	1	7	8	0.06
AGONIDAE	5	16		0.15
ALBULIDAE	2	4	6	0.04
ALEPISAURIDAE	1	2	2	0.02
ALEPOCEPHALIDAE	18	65	109	0.60
ALOPIIDAE	2	2	2	0.02
AMBLYOPSIDAE	1	4	6	0.04
AMIIDAE	1	4	4	0.04
AMMODYTIDAE	3	14	179	0.13
ANABANTIDAE	3	3	16	0.03
ANARHICHADIDAE	4	15	24	0.14
ANGUILLIDAE	1	57	335	0.52
ANOPLOGASTERIDAE	2	8	8	0.07
ANOTOPTERIDAE	1	1	1	0.01
ANTENNARIIDAE	3	14	67	0.13
APHREDODERIDAE	1	20	71	0.18
APHYONIDAE	8	18	21	0.16
APOGONIDAE	14	87	402	0.80
ARGENTINIDAE	2	14	46	0.13
ARIIDAE	4	9	12	0.08
ASPREDINIDAE	1	1	6	0.01
ASTRONESTHIDAE	6	12	14	0.11
ATHERINIDAE	8	191	7226	1.75
AULOPIDAE	1	1	10	0.01
BALISTIDAE	15	90	169	0.82
BATHYDRACONIDAE	1	1	1	0.01
BATHYLAGIDAE	5	30	39	0.27
BATHYMASTERIDAE	1	1	1	0.01
BATHYPTEROIDAE	1	1	2	0.01
BATHYSAURIDAE	1	13	18	0.12
BATRACHOIDIDAE	4	48	127	0.44
BELONIDAE	7	59	436	0.54
BLENNIIDAE	11	88	150	0.81
BOTHIDAE	25	210	1175	1.92
BRAMIDAE	1	3	3	0.03
BRANCHIOSTEGIDAE	3	5	8	0.05
BRANCHIOSTOMIDAE	1	3	3	0.03
BREGMACEROTIDAE	4	8	15	0.07
BROTULIDAE	1	1	1	0.01
BYTHITIDAE	2	2	3	0.02
CALLICHTHYIDAE	4	4	9	0.04
CALLIONYMIDAE	2	2	4	0.02

(Appendix A, Cont.)

FAMILY	SPECIES	LOTS	SPECIMENS	%OF TOTAL
CAPROIDAE	3	13	29	0.12
CARANGIDAE	33	230	686	2.11
CARAPIDAE	2	4	4	0.04
CARCHARHINIDAE	14	49	139	0.45
CATOSTOMIDAE	19	225	508	2.06
CENTRARCHIDAE	27	453	1007	4.15
CENTRISCIDAE	2	16	40	0.15
CERATIIDAE	2	6	6	0.05
CETOMIMIDAE	2	2	2	0.02
CHAETODONTIDAE	17	30	42	0.27
CHAMPSODONTIDAE	1	1	2	0.01
CHANIDAE	1	1	1	0.01
CHANNICHTHYIDAE	2	2	2	0.02
CHANNIDAE	1	1	3	0.01
CHARACIDAE	4	4	12	0.04
CHAULIODONTIDAE	2	53	112	0.49
CHAUNACIDAE	3	15	25	0.14
CHIASMODONTIDAE	5	16	19	0.15
CHIMAERIDAE	4	22	26	0.20
CHLOROPHTHALMIDAE	17	307	1657	2.81
CICHLIDAE	1	1	1	0.01
CLINIDAE	6	6	8	0.05
CLUPEIDAE	24	377	11795	3.45
COBITIDAE	3	3	18	0.03
CONGRIDAE	7	31	48	0.28
CORYPHAENIDAE	2	7	16	0.06
COTTIDAE	16	128	507	1.17
CYCLOPTERIDAE	11	137	365	1.26
CYNOGLOSSIDAE	9	48	166	0.44
CYPRINIDAE	91	872	12453	7.99
CYPRINODONTIDAE	23	299	9758	2.74
DACTYLOPTERIDAE	2	6	6	0.05
DACTYLOSCOPIDAE	1	1	1	0.01
DASYATIDAE	6	21	38	0.19
DERICHTHYIDAE	1	27	31	0.25
DICERATIIDAE	1	2	2	0.02
DIODONTIDAE	3	32	38	0.29
DIRETMIDAE	2	3	3	0.03
DORADIDAE	1	1	2	0.01
ECHENEIDIDAE	5	33	49	0.30
ELEOTRIDAE	2	3	4	0.03
ELOPIDAE	1	10	40	0.09
EMBIOTOCIDAE	3	3	16	0.03
ENGRAULIDAE	6	108	3061	0.99
EPHIPPIDIDAE	3	22	34	0.20
ESOCIDAE	5	72	509	0.66
EURYPHARYNGIDAE	1	16	18	0.15
EVERMANNELLIDAE	2	3	6	0.03
EXOCOETIDAE	12	37	69	0.34
FISTULARIIDAE	2	8	12	0.07

(Appendix A, Cont.)

FAMILY	SPECIES	LOTS	SPECIMENS	%OF TOTAL
GADIDAE	21	197	1288	1.80
GASTEROPELECIDAE	1	1	4	0.01
GASTEROSTEIDAE	4	26	483	0.24
GEMPYLIDAE	7	17	19	0.16
GERREIDAE	10	27	90	0.25
GIGANTACTINIDAE	1	1	1	0.01
GIGANTURIDAE	2	2	3	0.02
GOBIESOCIDAE	3	38	80	0.35
GOBIIDAE	11	72	322	0.66
GONOSTOMATIDAE	18	154	707	1.41
GRAMMICOLEPIDAE	2	5	5	0.05
HAEMULIDAE	15	62	156	0.57
HALOSAURIDAE	9	129	515	1.18
HEMIRHAMPHIDAE	7	23	137	0.21
HEXAGRAMMIDAE	4	5	15	0.05
HEXANCHIDAE	1	2	2	0.02
HIMANTOLOPHIDAE	1	1	1	0.01
HOLOCENTRIDAE	5	8	9	0.07
ICTALURIDAE	13	166	955	1.52
IDIACANTHIDAE	1	3	3	0.03
ISTIOPHORIDAE	1	2	4	0.02
KUHLIIDAE	1	1	2	0.01
KYPHOSIDAE	1	2	2	0.02
LABRIDAE	17	43	68	0.39
LABRISOMIDAE	2	2	3	0.02
LACTARIIDAE	1	1	1	0.01
LAMNIDAE	2	6	6	0.05
LATIMERIIDAE	1	2	2	0.02
LEIOGNATHIDAE	4	5	7	0.05
LEPISOSTEIDAE	2	9	17	0.08
LINOPHRYNIDAE	1	1	1	0.01
LIPOGENYIDAE	1	7	7	0.06
LOBOTIDAE	1	5	5	0.05
LOPHIIDAE	2	25	54	1.23
LUTJANIDAE	11	31	63	0.28
MACRORHAMPHOSIDAE	1	7	25	0.06
MACROURIDAE	35	231	1486	2.12
MACROUROCYTTIDAE	1	3	4	0.03
MALACOSTEIDAE	3	28	29	0.26
MASTACEMBELIDAE	1	1	1	0.01
MELAMPHAIDAE	15	95	180	0.87
MELANOCETIDAE	2	15	16	0.14
MELANONIDAE	1	3	4	0.03
MELANOSTOMIATIDAE	16	33	34	0.30
MENIDAE	1	1	2	0.01
MERLUCIIDAE	1	7	7	0.06
MOCHOKIDAE	1	1	1	0.01
MOLIDAE	1	1	1	0.01
MORIDAE	5	76	230	0.70

(Appendix A, Cont.)

FAMILY	SPECIES	LOTS	SPECIMENS	%OF TOTAL
MORONIDAE	4	282	991	2.58
MUGILIDAE	3	34	253	0.31
MUGILOIDIDAE	1	1	2	0.01
MULLIDAE	7	20	40	0.18
MURAENIDAE	5	6	9	0.05
MURAENOSOCIDAE	1	1	2	0.01
MYCTOPHIDAE	49	273	1210	2.50
MYLIOBATIDAE	3	21	34	0.19
MYXINIDAE	2	19	137	0.17
NEMICHTHYIDAE	2	51	348	0.47
NEMIPTERIDAE	2	8	8	0.07
NEOSCOPELIDAE	2	6	11	0.05
NESSORHAMPHIDAE	1	32	38	0.29
NETTASTOMATIDAE	2	16	23	0.15
NOTACANTHIDAE	4	56	116	0.51
NOTOPTERIDAE	1	1	1	0.01
NOTOTHENIIDAE	7	11	43	0.10
ODONTASPIDIDAE	1	3	8	0.03
OGCOCEPHALIDAE	10	54	255	0.49
OMOSUDIDAE	1	3	4	0.03
ONEIRODIDAE	5	7	7	0.06
OPHICHTHYIDAE	6	53	167	0.49
OPHIDIIDAE	41	290	1322	2.66
OPISTHOPROCTIDAE	1	1	1	0.01
ORECTOLOBIDAE	1	1	1	0.01
OREOSOMATIDAE	1	1	1	0.01
OSMERIDAE	2	4	33	0.04
OSTRACIIDAE	3	18	38	0.16
PANGASIIDAE	1	1	2	0.01
PANTODONTIDAE	1	1	1	0.01
PARALEPIDIDAE	5	14	73	0.13
PERCIDAE	37	301	840	2.76
PERCOPHIDIDAE	2	3	3	0.03
PETROMYZONTIDAE	6	49	196	0.45
PHOLIDICHTHYIDAE	1	1	3	0.01
PHOLIDIDAE	6	12	41	0.11
PIMELODIDAE	2	2	9	0.02
PLATYCEPHALIDAE	2	3	7	0.03
PLEURONECTIDAE	10	79	488	0.72
PLOTOSIDAE	1	1	3	0.01
POECILIIDAE	3	29	282	0.27
POLYMIXIIDAE	3	18	27	0.16
POLYNEMIDAE	3	9	329	0.08
POLYPTERIDAE	2	2	2	0.02
POMACENTRIDAE	12	15	51	0.14
POMATOMIDAE	1	28	50	0.26
POTAMOTRYGONIDAE	1	1	2	0.01
PRIACANTHIDAE	5	19	27	0.17
PSETTODIDAE	1	1	1	0.01

(Appendix A, Cont.)

FAMILY	SPECIES	LOTS	SPECIMENS	%OF TOTAL
RACHYCENTRIDAE	1	5	5	0.05
RAJIDAE	19	158	321	1.45
RETROPINNIDAE	1	1	1	0.01
RHAMPHICHTHYIDAE	1	1	2	0.01
RHINOBATIDAE	1	1	1	0.01
RHINOCHIMAERIDAE	3	13	15	0.12
RONDELETIIDAE	2	2	2	0.02
SACCOPHARYNGIDAE	1	1	1	0.01
SALMONIDAE	7	31	79	0.28
SCARIDAE	6	9	22	0.08
SCHILBEIDAE	1	1	1	0.01
SCIAENIDAE	45	364	2106	3.33
SCOMBEROSOCIDAE	1	3	4	0.03
SCOMBRIDAE	11	29	54	0.27
SCOPELARCHIDAE	3	4	4	0.04
SCOPHTHALMIDAE	1	23	58	0.21
SCORPAENIDAE	19	58	200	0.53
SCYLIORHINIDAE	5	23	55	0.21
SEARSIIDAE	5	8	8	0.07
SERRANIDAE	26	113	233	1.04
SERRIVOMERIDAE	2	61	144	0.56
SIGANIDAE	1	1	2	0.01
SILLAGINIDAE	1	1	4	0.01
SIMENCHELYIDAE	1	41	92	0.38
SOLEIDAE	6	71	96	0.65
SPARIDAE	15	71	297	0.65
SPHYRAENIDAE	4	20	63	0.18
SPHYRNIDAE	3	8	12	0.07
SQUALIDAE	13	87	159	0.80
SQUATINIDAE	1	7	9	0.06
STEINDACHNERIIDAE	1	1	2	0.01
STEPHAENOBERYCIDAE	3	14	26	0.13
STERNOPTYCHIDAE	8	114	163	1.04
STICHAEIDAE	12	58	242	0.53
STOMIATIDAE	4	58	149	0.53
STROMATEIDAE	12	91	448	0.83
SYNAPHOBRANCHIDAE	6	119	986	1.09
SYNBRANCHIDAE	1	1	2	0.01
SYNGNATHIDAE	12	102	2126	0.93
SYNODONTIDAE	13	104	204	0.95
TETRAODONTIDAE	11	68	137	0.62
THAUMATICHTHYIDAE	1	4	4	0.04
THERAPONIDAE	2	3	3	0.03
TORPEDINIDAE	2	2	2	0.02
TRACHICHTHYIDAE	4	30	59	0.27
TRIACANTHODIDAE	1	1	1	0.01
TRICHIURIDAE	6	27	54	0.25
TRICHODONTIDAE	1	1	3	0.01
TRIGLIDAE	23	154	590	1.41

(Appendix A, Cont.)

FAMILY	SPECIES	LOTS	SPECIMENS	%OF TOTAL
TRIPTERYGIIDAE	1	1	2	0.01
UMBRIDAE	3	23	182	0.21
URANOSCOPIDAE	4	25	25	0.23
UROLOPHIDAE	1	2	2	0.02
ZANIOLEPIDIDAE	1	1	1	0.01
ZEIDAE	2	12	21	0.11
ZOARCIDAE	46	324	1702	2.97
*** Total ***	1533	10915	79968	100.05

APPENDIX B. College of William and Mary, School of Marine Science Theses and Dissertations Resulting from Study of Material in VIMS Fish Collection

I. MASTER'S THESES:

Armstrong, Michael P. 1987. Life history of the goosefish, Lophius americanus.

Banford, Heidi M. In Prep. A morphometric and meristic study of the halfbeak, Hyporhamphus fasciatus (Pisces: Hemiramphidae) from the western Atantic and eastern Pacific.

Barans, Charles A. 1969. Distribution, growth and behavior of the spotted hake in the Chesapeake Bight.

Benner, David A. 1980. An analysis of parasite communities of the Atlantic croaker, Micropogonias undulatus (Linnaeus), within the Chesapeake Bay.

Byrne, Donald M. 1976. Life history of the spotfin killifish, Fundulus luciae (Pisces: Cyprinodontidae), in Fox Creek Marsh, Virginia.

Cavalluzzi, Martin R. In Prep. Taxonomy of larval Blennioidei of Belize, Central America.

Chambers, James R. 1969. Methods of distinguishing larval alewife (Alosa pseudoharengus) from larval blueback herring (A. aestivalis).

Comyns, Bruce H. 1987. Identification and distribution of Urophycis (Gill) and Phycis (Artedi) larvae and pelagic juveniles in the middle Atlantic Bight.

Desfosse, Joseph C. 1989. Meristic and morphometric comparisons of three juvenile Alosa species: blueback herring, A. aestivalis; alewife, A. pseudoharengus; and American shad, A. sapidissima.

Delaney, Glenn R. 1986. Morphometric and meristic stock identification of summer flounder (Paralichthys dentatus).

Gartner, John V. 1984 Aspects of vertical distribution and ecology of the dominant meso- and bathypelagic fishes from the Norfolk Canyon region.

Hedgepeth, Marion Y. 1983. Age, growth and reproduction of American eels, Anguilla rostrata (Lesueur), from the Chesapeake Bay area.

Hill, Gary L. 1985. Ontogeny of the sexually dimorphic sonic muscle in three sciaenid species.

Johnson, James R. 1952. Morphology and development of hatchery cultured American shad (Alosa sapidissima Wilson), with a comparison between field sampled and cultured specimens.

Kavanaugh, Kathryn D. In Prep. Natural history and ecology of the black triggerfish, Melichthys niger.

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Ladd, Ernest C. 1958. A comparative study of meristic variation in the American eel (Anguilla rostrata) and Atlantic anchovy (Anchoa mitchilli).

Lawler, Edward F., Jr. 1976. The biology of the sandbar shark Carcharhinus plumbeus (Nardo, 1827) in the lower Chesapeake Bay and adjacent waters.

Lyczkowski, Joanne M. 1971. Age and growth of the northern puffer, Sphoeroides maculatus (Bloch and Schneider).

McEachran, John D. 1968. Age and growth of the striped searobin.

Maddox, Elizabeth In Prep. Taxonomy of larval Gobiidae of Belize, Central America.

Markle, Douglas F. 1972. Benthic fish associations on the continental slope of the Middle Atlantic Bight.

Middleton, Robert W. 1979. The abundance, distribution and bionomics of the family Macrouridae in the Norfolk Canyon area.

Nammack, Marta F. 1982. Life history and management of spiny dogfish, Squalus acanthius, off the northeastern United States.

Rhodes, Scott, F. 1971. Age and growth of the silver perch (Bairdiella chrysura).

Ross, Jeffrey L. 1978. Life history aspects of the gray tilefish, Caulolatilus microps (Goode and Bean, 1878).

Scoles, Daniel 1990. Stock identification of weakfish, Cynoscion regalis, by function analysis of morphometric characters.

Sedberry, George R. 1975. Food habits of some demersal fishes of the continental slope and rise.

Sminkey, Thomas R. 1986. A morphological study of the pharyngeal sac of two species of stromateid fishes, Peprilus triacanthus and P. paru.

Smith, Joseph W. 1980. The life history of the cownose ray, Rhinoptera bonasus (mitchill 1815), in lower Chesapeake Bay, with notes on the management of the species.

Smith, Stephen M. 1986. Reproductive ecology, population dynamics and seasonal movements of the hogchoker (Trinectes maculatus), in the Elizabeth River, Virginia.

Wenner, Charles A. 1972. Aspects of the biology and systematics of the American eel, Anguilla rostrata (Lesueur).

Wong, Robert S. P. 1968. Age and growth of the northern searobin Prionotus carolinus (Linneaus).

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II. DISSERTATIONS:

Able, Kenneth. 1974. Life history, ecology and behavior of two new Liparis (Pisces: Cyclopteridae) from the western North Atlantic.

Anderson, Michael E. 1984. On the anatomy and phylogeny of the Zoarcidae (Teleostei: Perciformes).

Baldwin, Carole C. In Prep. Phylogeny of the Epinephelinae (Teleostei: Serranidae) with descriptions of larvae of four genera and a discussion of heterochrony.

Carter, H. Jacque. 1984. Feeding strategies and functional morphology of demersal deep-sea ophidiid fishes.

Chao, Labbish N. 1976. Aspects of systematics, morphology, life history and feeding of western Atlantic Sciaenidae (Pisces: Perciformes).

Colvocoresses, James A. Abundance, seasonality and community structure of fishes on the Mid-Atlantic Bight continental shelf.

Crabtree, Roy E. Food habits and body composition of some dominant deep-sea fishes from temperate and tropical regions of the western North Atlantic.

Hata, David In Prep. Gill surface area and metabolism in galeoid sharks.

Heist, Edward In Prep. Population genetics of selected galeoid sharks in the northwest Atlantic.

Govoni, John J. 1980. Morphological, histological, and physiological aspects of assimilation in larval spot, Leiostomus xanthurus Lacepede.

Grogan, Eileen D. In Prep. Phylogenetic patterns and evolution of the immune system in chondrichthyans.

Leonard, Sarah B. 1971. Larvae and young of the western North Atlantic bothid flatfishes Etropus microstomus (Gill) and Citharichthys arctifrons Goode in the Chesapeake Bight.

Luo, Jiangang In Prep. Daily growth and reproductive biology in the bay anchovy.

Markle, Douglas F. 1976. Preliminary studies on the systematics of deep-sea Alepocephaloidea (Pisces: Salmoniformes).

McEachran, John D. 1973. Biology of seven species of skates (Pisces: Rajidae).

Middleton, Robert W. 1986. The seasonal and diel use by juvenile and adult finfishes of a menhaden intertidal creek on the York River, Virginia.

Monteiro-Neto, Cassiano 1990. Comparative structure of surf zone fish communities in the northern and southern hemispheres of the western Atlantic.

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Munroe, Thomas A. 1987. A systematic revision of Atlantic tonguefishes (Symphurus: Cynoglossidae: Pleuronectiformes) with a preliminary hypothesis of species group relationships.

Raschi, William. 1984. Anatomical observations on the Ampullae of Lorenzini from selected skates and galeoid sharks of the western North Atlantic.

Sedberry, George R. 1980. Food habits, prey selectivity and food resource partitioning on a community of fishes on the outer continental shelf.

Sminkey, Thomas In Prep. Historical trends in abundance in galeoid sharks off Virginia.

Tabit, Christopher R. In Prep. Functional morphology of placoid scales in squaloid sharks.

Thoney, Dennis A. 1989. Comparative ecology of the parasites of the spot, Leiostomus xanthurus Lacepede, and the Atlantic croaker, Micropogonias undulatus Linnaeus (Sciaenidae), in the Cape Hatteras region.

Vieira, Joao P. In Prep. Comparative community structure of fishes from the Lagoan Dos Patos (32°) and York River (37°) estuaries.

Wenner, Charles A. 1978. Making a living on the continental slope and in the deep-sea: Life history of some dominant fishes of the Norfolk Canyon area.

APPENDIX C. - Publications Resulting from Study of Material in VIMS Fish Collection
(An Asterisk Indicates Paper Resulting From N.S.F.-Supported Research on
Community Ecology and Systematics of Deep-Sea Fishes or N.S.F.-Supported Study
On the Systematics of Pearlfishes)

Able, K. W. 1973. A new cyclopterid fish, Liparis inquilinus, associated with the sea scallop, Plactopecten magellanicus, in the western North Atlantic, with notes on the Liparis liparis complex. Copeia 1973:787-794.

Able, K. W. 1976. A new cyclopterid fish Liparis coheni from the western North Atlantic with notes on life history. Copeia 1976:515-521.

Able, K. W. (In Press) Taxonomy of the Liparis liparis complex in Arctic waters. Copeia.

Able, K. W. and J. D. Felley. 1986. Geographical variation in Fundulus heteroclitus: Tests for concordance between egg and adult morphologies. American Zoologist 26:145-157.

Able, K. W. and J. A. Musick. 1973. Life history, ecology, and behavior of Liparis inquilinus (Pisces: Cyclopteridae) from the western North Atlantic. U.S. Fishery Bulletin 74:409-521.

*Anderson, M. E. 1982. Revision of the fish genera Gymnelus Reinhardt and Gymnelopsis Soldatov (Zoarcidae), with two new species and comparative osteology of Gymnelus viridis. National Museum of Canada, Publications in Zoology 17, 76 p.

Anderson, M. E. 1988. Eucryphycus, a new genus of California eelpout (Zoarcidae) based on Maynea californica Starks and Mann, 1911. Proceedings of the California Academy of Sciences 45:89-96.

*Anderson, M. E., R. E. Crabtree, H. J. Carter, K. J. Sulak and M. D. Richardson. 1985. Distribution of demersal fishes of the Caribbean Sea found below 2000 meters. Bulletin of Marine Science 37:794-802.

Anderson, M. E. and C. L. Hubbs. 1981. Redescription and osteology of the northeastern Pacific fish Derepodichthys alepidotus (Zoarcidae). Copeia 1981:341-352.

Baldwin, C. C. 1990. Morphology of the larvae of American Anthiinae (Teleostei: Serranidae), with comments on relationships within the subfamily. Copeia 1990:913-955.

Baldwin, C. C., G. D. Johnson and P. L. Colin. 1991. Larvae of Diploprion bifasciatum, Belonoperca chabanaudi and Grammistes sexlineatus (Serranidae: Epinephelinae) with a comparison of known larvae of other epinephelines. Bulletin of Marine Science 48:67-93.

Burkhead, N. M., R. E. Jenkins and E. G. Maurakis. 1980. New records, distribution and diagnostic characters of Virginia ictalurid catfishes with an adnexed adipose fin. Brimleyana 4:75-93.

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*Campbell, R. A. and J. V. Gartner, Jr. 1982. Pistana eurypharyngis gen. et. sp. n. (Cestoda: Pseudophyllicea) from the bathypelagic gulper eel, Eurypharynx pelecanoides Vaillant, 1882, with comments on host and parasite ecology. Proceedings of the Helminthological Society of Washington, 49:218-225.

*Carter, H. J. 1983. Apagesoma edentatum, a new genus and species of ophidiid fish from the western North Atlantic. Bulletin of Marine Science 33:94-101.

*Carter, H. J. and D. Cohen. 1985. Monomitopus magnus, a new species of deep-sea fish (Ophidiidae) from the western North Atlantic. Bulletin of Marine Science 36:86-95.

*Carter, H. J. and J. A. Musick. 1985. Sexual dimorphism in the deep-sea fish Barathrodemus manatinus (Ophidiidae). Copeia 1985:69-73.

*Carter, H. J. and K. J. Sulak. 1984. A new species and a review of the deep-sea fish genus Porogadus (Ophidiidae) from the western North Atlantic. Bulletin of Marine Science 34:358-379.

Chambers, J. R., J. A. Musick and J. Davis. 1976. Methods of distinguishing larval alewife from larval blueback herring (Pisces, Clupeidae) Chesapeake Science 17:93-100.

Chao, L. N. 1978. A basis for classifying western Atlantic Sciaenidae (Teleostei: Perciformes). NOAA Tech. Rep. NMFS Circ. 415, 64 p.

Chao, L. N. and R. V. Miller. 1975. Two new species of sciaenid fishes (Tribe: Sciaenini) from the Caribbean Sea and adjacent waters. Bulletin of Marine Science 25:259-271.

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Cloutier, R., H.-P. Schultze, E. O. Wiley, J. A. Musick, J. C. Daimter, M. A. Brown, S. J. Dwyer, III, L. T. Cook and P. L. Laws. 1988. Recent radiologic imaging techniques for morphological studies of Latimeria chalumnae. Environmental Biology of Fishes 23:281-282.

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*Cohen, D. M. and J. L. Russo. 1979. Variation in the fourbeard rockling, Enchelyopus cimbrus, a North Atlantic gadid fish, with comments on the genera of rocklings. Fishery Bulletin 77.

Colvocoresses, J. A. and J. A. Musick. 1984. Species association and community structure of middle Atlantic Bight continental shelf demersal fishes. Fish. Bull. 82(2):295-313.

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*Crabtree, R. E. and K. J. Sulak. 1986. A contribution to the life history and distribution of Atlantic species of the deep-sea fish genus Conocara (Alepocephalidae). Deep-Sea Research 33:1183-1201.

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*Markle, D. F. 1980. A new species and a review of the deep-sea fish genus Asquamiceps (Salmoniformes: Alepocephalidae). Bulletin of Marine Science 30:45-53.

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*Markle, D. F. and J. E. Olney. 1991. Systematics of the pearlfishes (Pisces, Ophidiiformes). Bulletin of Marine Science 47(2).

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*Munroe, T. A., R. A. Campbell and D. E. Zwerner. 1981. Diclidophora nezumiae sp. n. (Monogenea: Diclidophoridae) and its ecological relationships with the macrourid fish Nezumia bairdii (Goode and Bean, 1877). Biological Bulletin 161:281-290.

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APPENDIX D. Loans/Gifts/Exchanges (1986 to Present)

LOAN NO.	RECIPIENT	TAXON	LOTS	SPECIMENS
86-1	Dr. Robert Jenkins, Roanoke College	Esox americanus	1	1
86-2	Dr. Sally Richardson, Museum of Comparative Zoology	Anoplogaster cornuta	5	5
86-3	Dr. Douglas Markle, Oregon State University	Symphurus diomedianus	1	1
86-4	Dr. John Govoni, NOAA, NMFS, Beaufort Laboratory	Leiostomus xanthurus	1	2
86-5	Dr. Christine Karrer, University of Hamburg	Hyperoglyphe bythites	1	1
86-6	Ms. Jennifer Carver, Peninsula Nature Center	Chilomycterus schoepfi	1	1
		Pogonias cromis	1	1
		Monocanthus hispidus	1	1
		Hemirhamphus	1	3
		Uranoscopus	1	1
		Paralichthys dentatus	1	4
		Raja laevis	1	1
		Ictalurus catus	1	1
		Noturus insignis	1	5
86-7	Ms. Cinder Stanton, Thomas Jefferson Mem. Foundation	Alosa aestivalis	1	2
86-8	Mr. George Mathews, Peninsula Nature Center	Strongylura marina	1	1
		Pogonias cromis	1	1
		Pomatomus saltatrix	1	1
		Brevoortia tyrannus	1	10
		Acipenser oxyrhynchus	1	2

87-1	Dr. Thomas J. Koob, The University of Mexico	Scyliorhinus retifer	1	4
		Raja senta	1	2
		Raja radiata	2	5
		Raja eglanteria	1	1
		Raja erinacea	1	13
		Raja garmani	1	12
		Raja ocellata	1	1
87-2	Dr. Jeffrey M. Boltz, Pennsylvania State University	Aphredoderus sayanus	5	47
87-3	Dr. Robert K. Johnson, Field Museum of Natural History	Bathyleptus gracilis	1	1
		Gigantura vorax	1	2
87-4	Exchange with Dr. Kazumi Hosoya, Kyoto University	Catostomus discobolus	1	8
		Catostomus latipinnis	1	2
		Hypentelium roanokense	1	6
		Hypentelium nigricans	1	9
		Moxostoma anisurum	1	6
		Moxostoma ariommum	1	1
		Moxostoma aureolum	1	1
		Moxostoma cervinum	1	13
		Moxostoma macrolepidotum	1	1
		Moxostoma pappillosum	1	1
		Moxostoma rhoethoecum	1	7
88-1	Dr. Eric Anderson, California Academy of Sciences	Coryphaenoides macrocephalus	1	1
88-2	Dr. Kenneth J. Sulak, Huntsman Marine Laboratory	Lycodes esmarkii	5	8
		Lycodes atlanticus	1	3
		Thaumatichthys binghami	1	1

88-3	Exchange with Huntsman Marine Laboratory	Trinectes maculatus	1	4
		Notropis coccogenis	1	5
		Lycodes atlanticus	1	1
		Bathypterois viridensis	1	2
		Fundulus majalis	1	3
		Leiostomus xanthurus	1	2
		Porichthys porissimus	1	1
		Semotilus atromaculatus	1	9
		Bathypterois longipes	1	1
		Aphredoderus sayanus	1	4
		Synaphobranchus brevidorsalis	1	2
		Bathyonus pectoralis	1	1
		Dorosoma cepedianum	1	1
		Exoglossum maxillingua	1	6
		Gobiosoma bosci	1	6
		Notropis analostanus	1	6
		Notropis photogenis	1	7
		Hypentelium nigricans	1	2
		Etheostoma rufilineatum	1	6
		Nocomis leptocephalus	1	8
		Hybognathus nuchalis	1	9
		Campostoma anomalum	1	4
		Pimephales notatus	1	4
		Lepomis gibbosus	1	4
		Enneacanthus gloriosus	1	1
		Etheostoma olmsteadi	1	6
		Aldrovandia gracilis	1	1
		Amboplites rupestris	1	1
		Mugil cephalus	1	2
		Synagrops bella	1	1
88-4	Dr. H. Ishihara, University of Tokyo	Raja senta	1	1
		Raja ocellata	1	1
		Raja garmani	1	1
		Raja erinacea	1	1
88-5	Permanent loan to University of Kansas	Latimeria chalumnae	1	1

88-6	Dr. John D. McEachran, Texas A & M University	Raja bigelowi	3	5
88-7	Exchange with Oregon State University	Enchelyopus cimbrius	1	9
		Phycis chesteri	2	3
		Urophycis regia	1	2
88-8	Dr. Jacque Carter, Bucknell University	Parabassogigas grandis	4	4
88-9	Gift to Dr. Richard C. Herold, University of Penn.	Latimeria chalumnae teeth	1	2
89-1	Dr. Jorgen G. Nielsen, Zoological Museum	Bathymicrops regis	5	14
89-2	Mr. Charlie Barr, Student, College of William & Mary	Ammodytes americanus	1	11
		Peprilus triacanthus	2	35
		Peprilus alepidotus	1	3
		Peprilus burti	1	13
		Trichiurus lepturus	1	2
89-3	Ms. Sue Mauger, Technician, VIMS	Lucania parva	1	11
		Microgobius thalassinus	1	2
		Gobiosoma ginsburgi	1	2
		Fundulus heteroclitus	1	8
89-4	Dr. Robert Jenkins, Roanoke College	Notropis bifrenatus	13	118
89-5	Gift to Dr. R. Chapman, The Johns Hopkins University	Acipenser gill epithelium	1	-
		Lepisosteus gill epithelium	1	-
		Amia calva gill epithelium	1	-
89-6	Roberto C. Melendez, Student, Oregon State University	Laemonema barbatulum	4	89
		Porogadus miles	1	1
89-7	Dr. John McEachran, Texas A & M University	Prionotus alatus	1	1
89-8	Mr. Louis Daniel, Student, College of William & Mary	Pogonias cromis	1	20

89-9	Ms. Linda Stehlik, Sandy Hook Marine Laboratory	Hypsoblennius hentzi	1	2
		Chasmodes bosquianus	1	2
89-10	Ms. Gail Keenum, Student, Hollins College	Cottus bairdi eggs/larvae	1	20
89-11	Dr. John McEachran, Texas A & M University	Raja laevis	1	1
89-12	Dr. Mark M. Leiby, Florida Dept. Natural Resources	Bothus ocellatus	6	13
89-13	Mr. Christopher P. Buzzelli, Teaching Assistant, VIMS	Centropristis striata	1	1
		Morone saxatilis	1	1
		Fundulus heteroclitus	1	5
		Pomatomus saltatrix	1	2
		Micropogon undulatus	1	1
		Menidia menidia	1	15
		Syngnathus fuscus	1	2
		Gambusia affinis	1	3
		Cynoscion nebulosus	1	1
		Hypsoblennius hentzi	1	2
89-14	Dr. T. Abe, University Museum, University of Tokyo	Cypselurus melanurus	1	3
		Cypselurus furcatus	3	3
90-1	Dr. John Paxton, Australian Museum	Rondeletia loricata	1	1
90-2	Mr. John E. Olney, VIMS	Apeltes guadracus	1	33
		Aphredoderus sayanus	1	1
		Antigonia combatia	1	1
		Cyttopsis roseus	1	1
		Dactylopterus volitans	1	1
		Polymixia lowei	1	1
		Scopelogadus mizolepis	1	1
		Hoplostethus sp.	1	1
90-3	Gift to Dr. Marchalonis, University of Arizona	Latimeria chalumnae (Frozen Liver Tissue)		

90-4	Mr. Dick St. Pierre, U.S. Fish & Wildlife Service	Alosa sapidissima	1	10
		Alosa mediocris	1	10
		Alosa pseudoharengus	1	20
		Alosa aestivalis	2	42
90-5	Ms. Martha Nizinski, NOAA, NMFS Systematics Lab.	Stenotomus chrysops	7	75
		Lagodon rhomboides	1	2
90-6	Mr. Michael P. Fahay, Sandy Hook Laboratory	Ophidion grayi	2	7
		Lepophidium sp.	1	3
		Otophidium sp.	1	1
		Rissola marginata	1	1
91-1	Dr. Roy Crabtree, Florida Dept. of Natural Resources	Porogadus catena	1	1
		Porogadus silus	2	9
		Porogadus miles	7	10
91-2	Ms. Rochelle Seitz, Teaching Assistant, VIMS	Argyropelecus aculeatus	1	1
		Bathypterois viridensis	1	1
		Chiasmodon niger	1	1
		Eurypharnx pelecanoides	1	1
		Chauliodus sloani	1	1
		Melanostomias spilorynchus	1	1
		Pomatomus saltatrix	1	1
		Melanocetus johnsoni	1	1
		Micropogonias undulatus	1	1
		Brevoortia tyrannus	1	1
		Cynoscion regalis	1	1
		Opsanus tau	1	1
		Anchoa mitchilli	1	1
		Centropristis striata	1	1
		Menidia menidia	1	1
		Trinectes maculatus	1	1
		Paralichthys dentatus	1	1
		Symphurus plagiusa	1	1
		Morone saxatilis	1	1
		Euthynnus alletteratus	1	1

91-3	Gift to Fisheries Aquarium, NOAA, NMFS, Woods Hole	Argyropelecus aculeatus	1	1
		Chauliodus sloani	1	1
		Aldrovandia affinis	1	1
		Aldrovandia phalacra	1	1
		Aldrovandia oleosa	1	1
		Parabassogigas crassus	1	1
		Antimora rostrata	1	1
		Nezumia bairdi	1	1
		Synaphobranchus kaupi	1	1
		Synaphobranchus parasitica	1	1
		Porogadus miles	1	1
		Ilyophis brunneus	1	1
91-4	Dr. Jim Tyler, Smithsonian Institution	Carapus bermudensis (w/ host)	1	1
91-5	Dr. Brian A. Jacob, Boys Town National Research Hospit.	Raja radiata	4	8
91-6	Dr. Robert Jenkins, Roanoke College	Carpiodes cyprinus	2	2