



*The College of
William & Mary*

FISHERIES SCIENCE

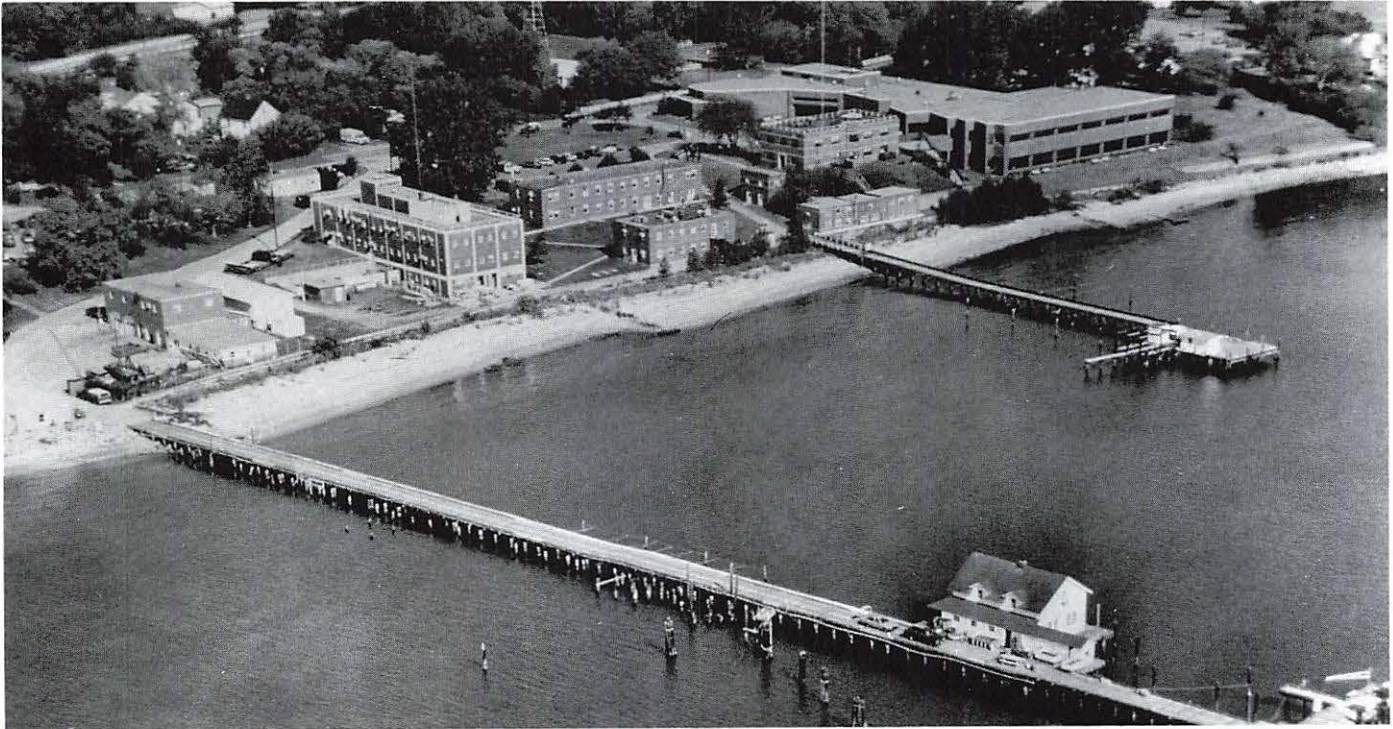
School of
Marine Science

Virginia Institute
of Marine Science



*The School of
Marine Science is
one of four professional
graduate schools of the
College of William & Mary.*

*The objective of the
educational program is
to provide a fertile and
stimulating learning
environment for students
preparing for careers in
marine science.*



The School of Marine Science/Virginia Institute of Marine Science occupies the site of Gloucester Town, a colonial settlement established in 1680. The remains of military fortifications from both the Revolutionary War and the Civil War reflect Gloucester Point's strategic location at the mouth of the York River.

Chartered in 1940, the School of Marine Science/Virginia Institute of Marine Science (SMS/VIMS) has a tripartite mission of research, education, and advisory service in marine science. This mandate established an institution that is uniquely prepared to educate the highly qualified researchers, resource managers, and educators needed for the future. Today, SMS/VIMS is the third largest marine research and education center in the country.

The School awards both Master of Arts and Doctor of Philosophy degrees. Graduate studies are offered in five areas:

- Biological Sciences**
- Environmental Sciences**
- Fisheries Science**
- Physical Sciences**
- Resource Management & Policy**

Academic programs are closely allied to the research and advisory programs of the Virginia Institute of Marine Science enabling students to participate in basic and applied science. Faculty scientists are involved in collaborative research with scientists from other institutes both nationally and internationally. In addition, researchers work closely with marine industries, policy makers, and regulatory agencies.

The Institute accommodates the interdisciplinary investigation that is essential to understanding and addressing the complex issues of

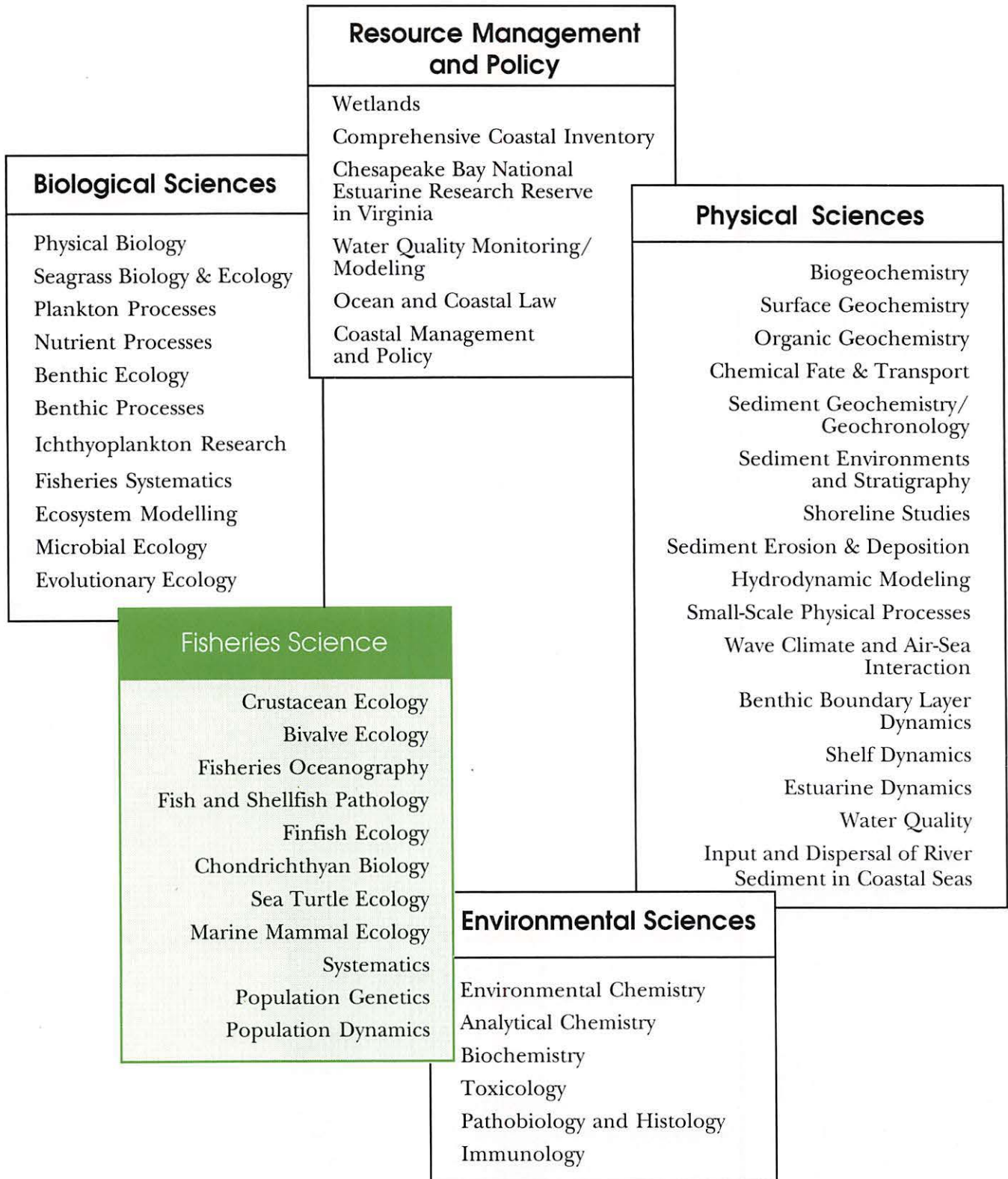
modern marine science. Faculty, researchers, and students maintain a primary affiliation in one of the five departments. However, programs and research within departments are often carried out in association with scientists from other departments. Students with specific interests in areas outside their department may arrange crossover study and research. This interactive approach enables students to work with various members of the diverse faculty and provides access to all facilities at the Institute.

*In a society
that is
increasing
its pressure on
the environment
and natural
resources,
the coastal,
estuarine,
and marine
environment
has become
an area of
critical
concern.*



Research at SMS/VIMS encompasses all elements—land, sea, and air—that affect marine ecosystems.

Major Programs



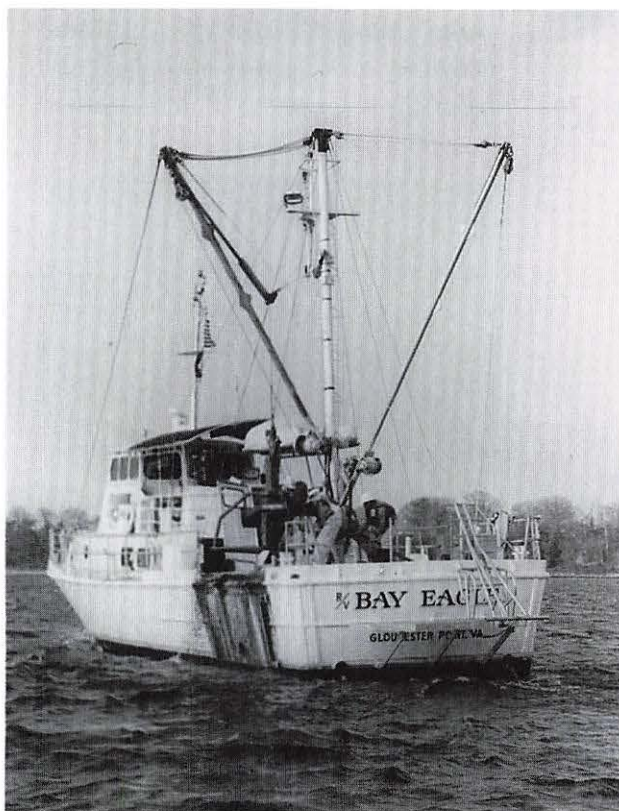
Located in Gloucester Point at the mouth of the York River, the campus has easy access to Virginia's estuaries, tidal and non-tidal wetlands as well as the Chesapeake Bay and Atlantic Ocean. The Wachapreague campus, on Virginia's Eastern Shore, is surrounded by embayments, salt marshes, barrier beaches, and coastal waters. Both locations provide ideal settings for research and teaching.

The thirty-five acre Gloucester Point campus houses six buildings with flow-through salt water systems and various laboratories that are well equipped for basic as well as specific project research. Equipment in-

cludes: a mass spectrometer, scanning and transmission electron microscopes, hydraulic flumes, an underwater video system, acoustic doppler current profilers, electromagnetic current meters, and a Geographic Information System.

A 60,000 square foot laboratory is scheduled for completion in the fall of 1995. The facility will house highly specialized labs for advanced research in chemistry, geochemistry, toxicology, pathobiology, microbiology, genetics, physiology, planktonology, nutrient cycling, and parasitology.

*The Institute
is the
largest marine
center in
the U.S. that
is focused
on coastal
and
estuarine
science.*



Institute scientists have monitored natural, commercial, and industrial effects on the Chesapeake Bay and its estuaries for more than fifty years.

EASTERN SHORE LABORATORY



Students from Virginia Polytechnic Institute & State University utilize facilities at the Eastern Shore Lab.

The VIMS Eastern Shore Laboratory, located in the seaside village of Wachapreague, serves as a field station for research, teaching, and advisory activities of SMS/VIMS.

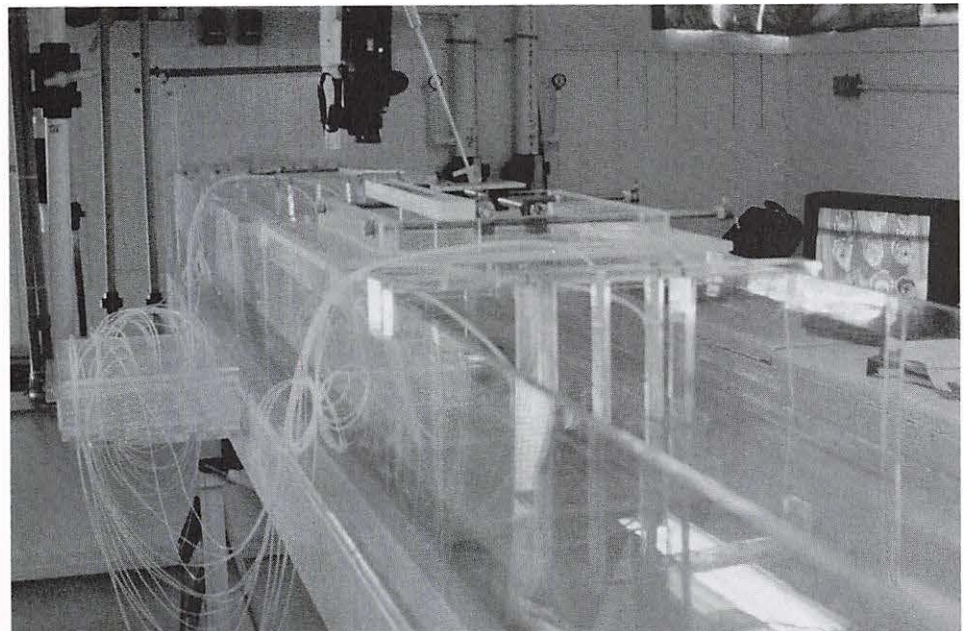
Along the approximately 100 km of its Atlantic shoreline, the Virginia Eastern Shore remains one of the least developed coastal regions in the United States, with essentially no development on its barrier islands. This pristine area is uniquely suited for field research into coastal processes. The location provides convenient access to the eastern portion of the Chesapeake Bay and the barrier island, salt marsh-lagoonal systems along Virginia's Atlantic shore.

Widely recognized for its contributions to research in bivalve aquaculture, the Lab also supports activities of scientists and students from the Gloucester Point campus

and other institutions. Recent research activities at the facility include: investigations into nitrogen cycling in salt marshes, disease transmission between mollusks, population dynamics of finfish and shellfish, chemical induction of settlement in invertebrates, and hydrodynamic characteristics of seagrass seeds.

Extensive wet laboratory facilities include running seawater tables and large holding tanks. A small hatchery for the culture of marine and estuarine organisms is especially well suited for mollusk culture. An on-site flume laboratory permits investigation of processes (hydrodynamic, sedimentological, and biological) in the benthic boundary layer.

Office and dry laboratory space are available to students and visiting investigators. An on-site dormitory can accommodate up to 28 visitors.



The seawater flume laboratory was designed and built by the Eastern Shore Lab faculty and staff.



More than 600 dives are logged annually by the 40-member dive team.

VESSELS CENTER

The vessels center maintains and operates a fleet of 40 vessels. The 65-foot *R/V Bay Eagle* is outfitted with a wet lab containing a flow-through seawater system, a dry lab housing electronics, and project-oriented equipment. Similarly outfitted is the 44-foot *R/V Langley*. Both vessels have Loran interface for downloading information to on board computers. In 1990, the 29-foot *R/V Fish Hawk* was specially designed and equipped to perform trawl surveys. A sizeable trailerable fleet supports estuarine and tributary research. Electronic systems can be transferred to these smaller boats, enabling precise scientific surveys to be conducted on board. A new diving facility includes a diver training room and classrooms to support the 40-member VIMS dive team. The VIMS diving program is an organizational member of the American Academy of Underwater Sciences.

LIBRARY

The library supports the Institute's mission by collecting and providing access to marine science literature, with emphasis on estuaries and the coastal zone. Currently the collection includes 521 journal subscriptions, 44,000 volumes and 19,200 titles in addition to topographic maps, nautical charts, and scientific archives. Access is provided through the card catalog as well as through the circulation terminal and personal computers. On-line networks provide access to marine science literature through *Aquatic Sciences and Fisheries Abstracts* and the *Chesapeake Bay Bibliography*, and Swem Library on the Main Campus in Williamsburg. The library workstation is networked to computers in the student User's Room.

MARINE ADVISORY SERVICES/SEA GRANT

Marine Advisory Services' (MAS) role is to be directly responsive to the needs of industry and the general public, and to provide information that will increase the public's awareness of the marine environment. MAS is associated with the Sea Grant Program, a state/federal program administered through the National Oceanic and Atmospheric Administration.

Specialists from MAS work closely with businesses, governmental agencies, educational organizations, and individuals to provide information and advice on a wide range of marine-related programs and activities.

The direction of MAS research is dictated by industry and government needs. Research has ranged from gear selectivity experiments and sea scallop biology, to technology for

soft crab shedding and clam relaying. MAS works extensively with the recreational fishery, marine trades, and the offshore pelagic fishery.

In the past few years, changing needs and opportunities—driven in part by enacted or pending regulatory measures—have presented new challenges to MAS in the areas of seafood processing, water quality, and mariculture development.

Students at MAS are generally associated with Fisheries Science or Resource Management departments. Their research has been diverse. Projects have included sea scallop biology, the socioeconomics of Virginia's recreational fishery, the food/feeding habits and trophic interaction of tuna species in Virginia's offshore waters, and the biology of recreational reefs.

Advisory scientists work closely with industry, in this case the operator of a blue crab shedding facility.



MAS maintains the aquarium that attracts more than 5,000 visitors each year.



CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE

Since 1987, Virginia Institute of Marine Science has been the lead agency for the Reserve System in Virginia. Reserve sites are preserved for estuarine research, monitoring, education, and conservation of key resources in relatively pristine settings. Establishment of four sites began a system that will include sites on the York, Pamunkey, Potomac, Rappahannock, and James rivers, the mainstem of the Bay and the Eastern Shore. Sites of activity today are the Goodwin Islands, the Catlett Islands, Taskinas Creek, and Sweet Hall Marsh. More than 20 research projects involving investigators from several colleges and universities are currently underway. The program provides study areas for numerous graduate research projects, "outdoor classrooms," and ecology presentations.



Taskinas Creek is one of the four Reserve Sites for estuarine research.

FISH COLLECTIONS

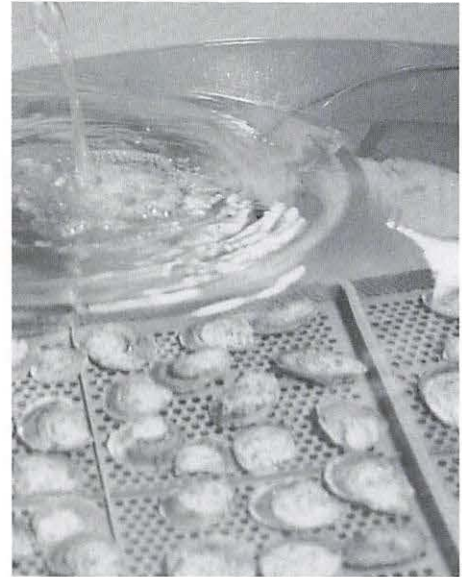
Nunnally Hall, completed in 1992, houses the extensive ichthyology collection that includes approximately 85,000 specimens in 247 families from Chesapeake Bay and contiguous waters, the continental slope and abyssal plain of the western Atlantic, and freshwater species of the southern Appalachians. More than 13,000 catalogued lots are stored on specially constructed shelving that provides access to the entire collection. The Institute also maintains a growing collection of marine and estuarine ichthyoplankton from Chesapeake Bay, Mid-Atlantic Bight, and Caribbean waters as well as a number of exotic species including a 5-foot female coelacanth from Comoros Island in the Indian Ocean. There are facilities for processing acquisitions, x-ray studies, and performing necropsies on large fishes, sea turtles and cetaceans.



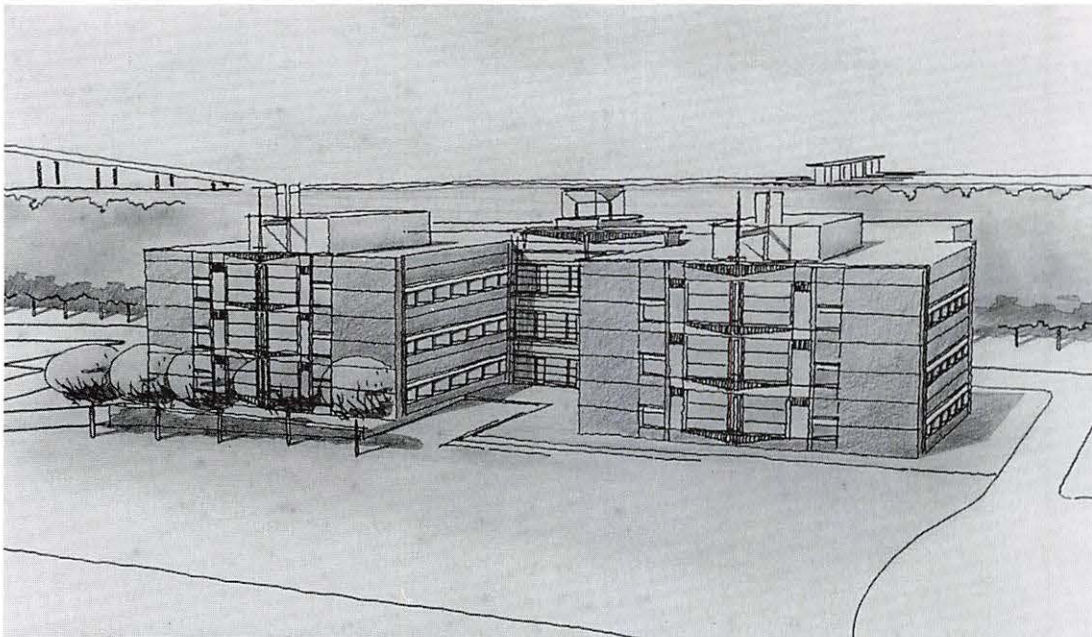
The Institute houses one of the most extensive fisheries collections on the East Coast.

OYSTER HATCHERY

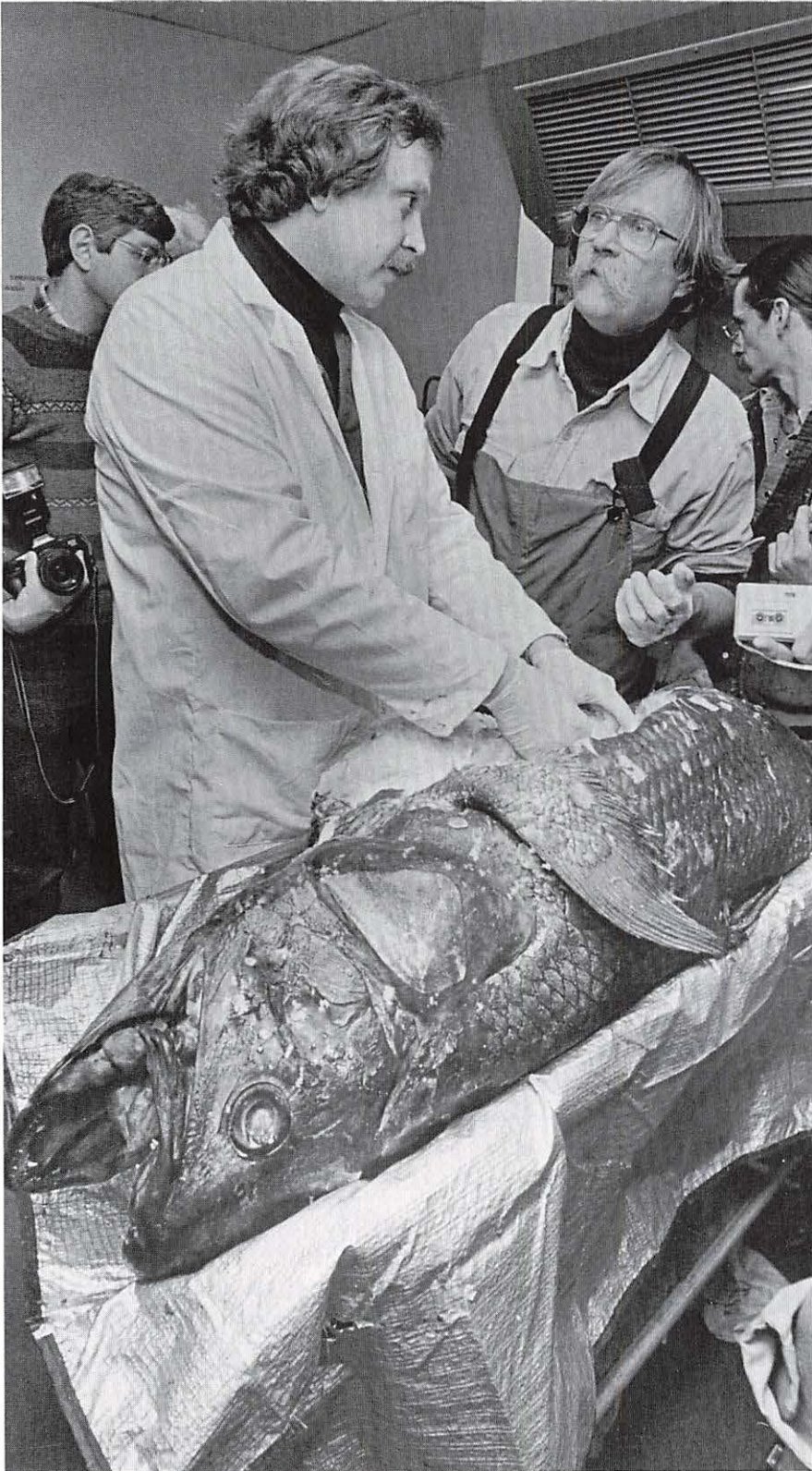
Established in 1985, the Oyster Hatchery provides breed stock (up to 2,000 at any given time) for research, conditioning, and selective breeding experiments. Specimens of any specified size are provided for class labs on a year-round basis. The hatchery is equipped with setting tanks for fertilization and a temperature controlled environment for development from larval to spat stage. Grow-out spats for oyster aquaculture are produced by the hatchery as well. In addition, the laboratory houses the largest algae culture lab on the East Coast. Four 1,000- gallon tanks, four 400- gallon tanks, state-of-the-art water temperature control and filtering systems enable the lab to produce vast quantities of virtually any kind of algae required for research or as a food source.



Oyster research ranges from cell cultures of the Perkinsus protozoan, to developing disease-resistant hybrids and oyster aquaculture.



The Marine Chemistry and Toxicology building will house specialized laboratories designed for biological and chemical research to examine the fate and effects of organic pollutants.



*The diverse faculty
is the cornerstone
of the Institute's
nationally and
internationally
recognized
education
and research
programs.*



School of Marine Science

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Virginia Institute of Marine Science

All School of Marine Science faculty are also Virginia Institute of Marine Science faculty.

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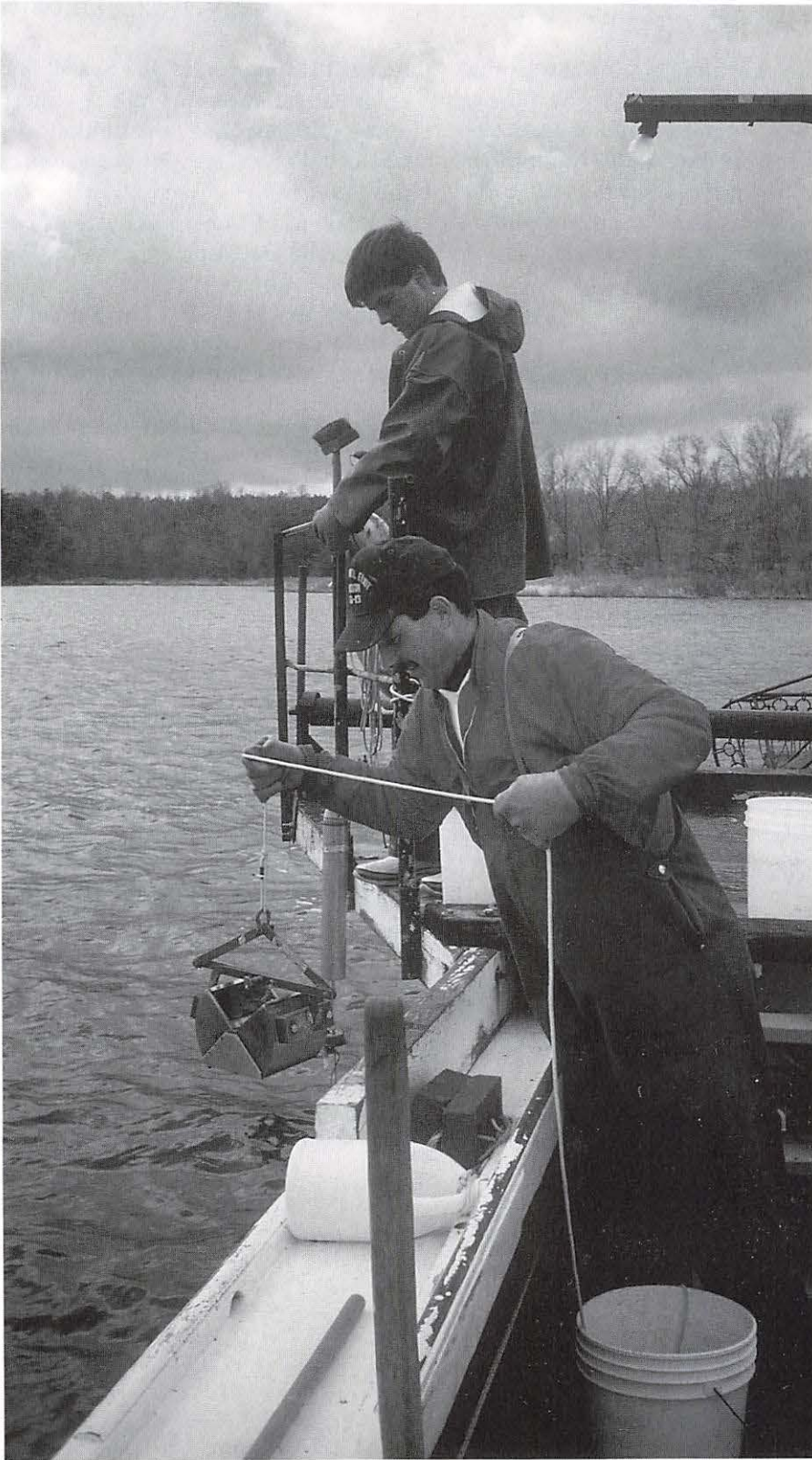
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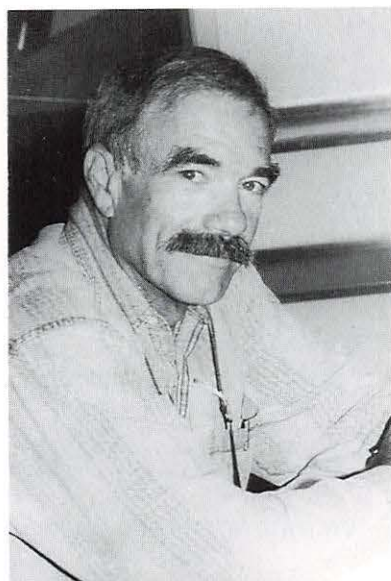
The specially equipped DeHavilland-Beaver aircraft logged 300 hours in 1993 to support various research projects.





The Department of Fisheries Science includes studies in ecology, population and molecular biology, pathology and genetics. Continuing programs focus on: life history and stock assessment of commercially valuable fish; crab and mollusc species; and sea turtle and marine mammal biology. The fishery genetics program investigates regional and global problems, while the development of DNA probes complement established methods and provide new avenues for research on diseases that continue to decimate regional oyster populations.

The Department of Fisheries Science



Herbert M. Austin

Professor of
Marine Science

B.S., Grove City College;
M.S., University of Puerto Rico;
Ph.D., Florida State University;
A.A., Thomas Nelson Community
College

RESEARCH INTERESTS

My research interests fall into two broad categories: the effects of the physical environment on recruitment processes (climate) and the early life history of the bluefish, *Pomatomus saltatrix*, and striped bass, *Morone saxatilis*, growth and recruitment.

CURRENT PROJECTS

- Annual monitoring of young-of-the-year bluefish and striped bass recruitment to Virginia's waters. Studies include looking at significant physical environmental factors controlling recruitment, and relationship of recruitment indices to later abundance.
- Annual monitoring of juvenile fin-fish recruitment (trawl survey) to Virginia's waters of the Chesapeake Bay and tributaries.
- The effects of annual fires on a coastal marsh ecosystem.
- Retroactive time series analysis of oyster, *Crassostrea virginica*, spatfall patterns in Chesapeake Bay.

CURRENT STUDENTS

Richard Holmquist, M.A. - Spatial and temporal variation in Virginia Eastern Shore surf-zone fish communities

Clifford Wagner, M.A. - Investigation of long-frequency periodicities in populations of Chesapeake Bay striped bass and the development of short-term predictive models.

Thomas Mosca, Ph.D. - Environmental control of recruitment in the Virginia tributary of Chesapeake Bay: a unification theory.

Geoffrey G. White, M.A. - Determination of batch fecundity and spawning frequency to estimate annual fecundity of tautog *Tautoga onitis*.

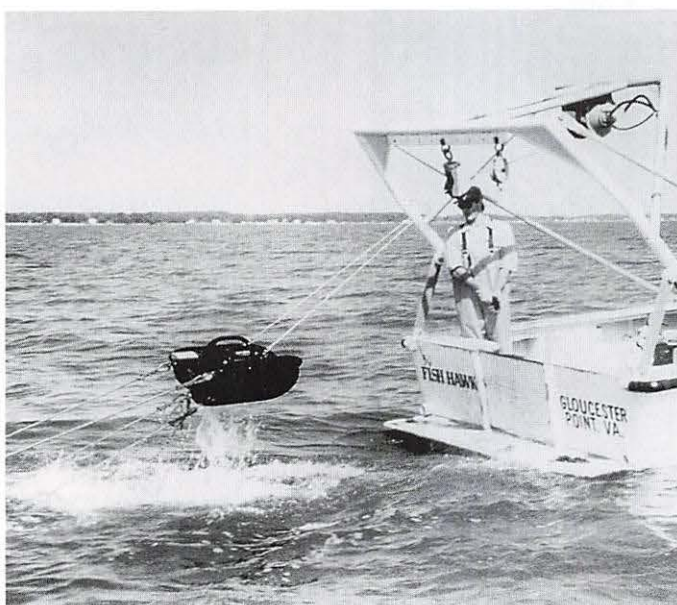
SELECTED PUBLICATIONS

Austin, H., D. Haven, and M. S. Moustafa. 1993. The relationship between trends in condition index of the American oyster, *Crassostrea virginica*, and environmental parameters in three Virginia, U.S.A. estuaries. *Estuaries*, 16(2):362-374.

Richkus, W. A., S.J. Nelson, and H. M. Austin. 1992. Fisheries assessment and management synthesis: Lessons for Chesapeake Bay, perspectives. In: Perspectives on Chesapeake Bay, 1992: Advances in Estuarine Science. STAC/CPB, pp. 75-114.

Austin, H. M. 1988. Fire at Sea, *Comm. Fish. Newsletter*, 7(4):8-9.

Norcross, B. L. and H. M. Austin. 1988. Middle Atlantic Bight meridional wind component effect on bottom water temperatures and spawning distribution of Atlantic croaker. *Cont. Shelf Res.*, 8(1):69-88.



Trawl survey personnel retrieve otter trawl on York River.

RESEARCH INTERESTS

My broad interests are the biology and ecology of protozoan parasites of marine fish and shellfish and their effect on host recruitment and population dynamics. Current emphasis is on oyster pathogens and fish blood protozoa. Presently, my research focuses on environmental control of the distribution and abundance of oyster pathogens, the life cycles and transmission dynamics of oyster pathogens and on ways to mitigate the effects of these pathogens on the oyster industry of Chesapeake Bay. I am also interested in the taxonomy and systematics of marine leeches and their role as vectors for fish blood protozoa.

CURRENT PROJECTS

- Role of winter temperature and spring salinity in the abundance of *Perkinsus marinus*.
- Effect of long-term climate variability on the distribution and abundance of *Perkinsus marinus*.
- Selective breeding program to develop disease resistant oysters.
- Review of the Australian marine leeches with a key to the species.
- Revision of the Class Hirudinea.
- Use of DNA probes and PCR primers to solve the life cycle of *Haplosporidium nelsoni* (MSX disease).
- Molecular phylogeny of the Haplosporidia.
- Effect of pollutants on development of oyster diseases.

CURRENT STUDENTS

Caroline O'Farrell, M.A. - Salinity tolerance of cultured cells of *Perkinsus marinus* acclimated to various salinities.
Brenda Sandy Flores, M.A. - Small subunit rRNA gene sequence of *Haplosporidium louisiana* and its implications for molecular phylogeny of the Haplosporidia.

SELECTED PUBLICATIONS

Burreson, E. M., L. M. Ragone Calvo, J. F. La Peyre, F. Counts and K. T. Paynter, Jr. 1994. Acute osmotic tolerance of cultured cells of the oyster pathogen *Perkinsus marinus* (Apicomplexa: Perkinsida). *Comp. Biochem. Physiol.* **109A**:575-582.

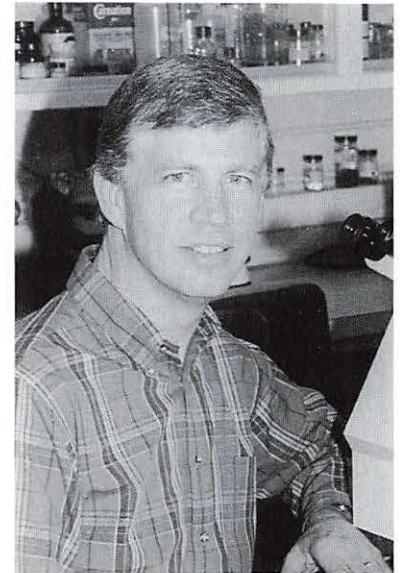
Burreson, E. M., V. Vidal-Martinez, R. Sima-Alvarez and L. Aguirre-Macedo. 1994. *Perkinsus marinus* (Apicomplexa) as a potential source of oysters (*Crassostrea virginica*) mortality in coastal lagoons of Tabasco, México. *Dis. Aquat. Org.* **20**(1):77-82.

Siddall, M. E., and E. M. Burreson. 1994. The development of a hemogregarine of *Lycodes varidens* from Alaska in its definitive leech host. *J. Parasitol.* **80**(4):569-575.

Ragone Calvo, L. M. and E. M. Burreson. 1994. Characterization of overwintering infections of *Perkinsus marinus* (Apicomplexa) in Chesapeake Bay oysters. *J. Shellfish Res.* **13**(1):123-130.

Burreson, E. M. 1994. Phylum Annelida: Hirudinea as vectors and pathogens of fish. *In: Parasitic Diseases of Fish- Protozoan and Metazoan Infections*, P. T. K. Woo, (ed.). CAB International.

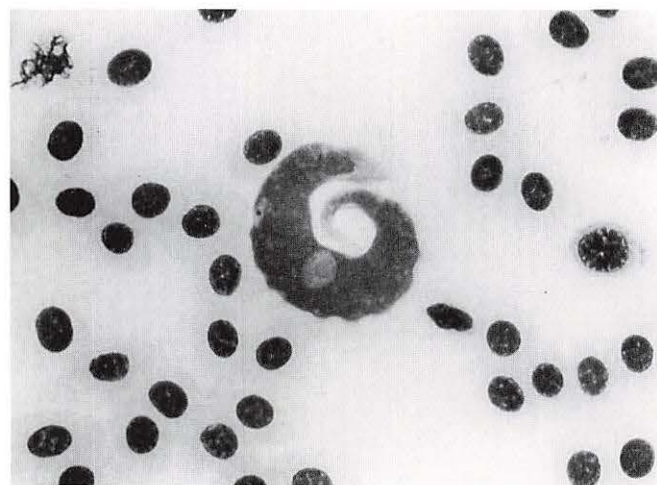
La Peyre, J. F., M. Faisal and E. M. Burreson. 1993. In vitro propagation of the protozoan *Perkinsus marinus*, a pathogen of the eastern oyster, *Crassostrea virginica*. *J. Eukar. Microbiol.* **40**(3): 304-310.



Eugene M. Burreson

*Professor of
Marine Science*

*B.S., Eastern Oregon
State College;
M.S., Ph.D., Oregon
State University*



*Blood smear from the epaulette shark *Hemiscyllium ocellatum* showing a large parasite, *Trypanosoma mackerrasi*, among the red blood cells.*



Mark E. Chittenden, Jr.

Professor of
Marine Science

B.A., Hobart College;
M.S., Ph.D., Rutgers University

RESEARCH INTERESTS

My broad research interests are in the functional ecology and dynamics of fish populations and communities in the Gulf of Mexico and Atlantic Ocean. These interests are expressed in the following specific research areas: composition, movements, and spatial/temporal distribution of fishes and fish communities; mechanisms of community formation and population regulation; life histories and population dynamics including recruitment, reproductive biology, age and growth, and mortality estimation; role of zoogeography in setting population dynamics; stock identification; yield-modeling and simulations of the effects of harvesting fishes.

CURRENT PROJECTS

- Life histories and population dynamics of Chesapeake Bay fishes.
- Functional ecology of Gulf of Mexico demersal fish communities.

SELECTED PUBLICATIONS

Chittenden, M. E., Jr., L. R. Barbieri and C. M. Jones. 1993. Fluctuations in abundance of Spanish mackerel in Chesapeake Bay and the Middle Atlantic Region. *N. Amer. J. Fish. Mgmt.* **13**:450-458.

Chittenden, M. E., Jr., L. R. Barbieri and C. M. Jones. 1993. Spatial and temporal occurrence of Spanish mackerel, *Scomberomorus maculatus*, in Chesapeake Bay. *Fish. Bull., U.S.* **91**:151-158.

Chittenden, M. E., Jr. 1991. Operational procedures and data interception points in the Chesapeake Bay pound net fishery. *Fisheries* **16**(5):22-27.

Murphy, M. D. and M. E. Chittenden, Jr. 1991. Reproduction, movements, and population dynamics of the Gulf butterfish, *Peprilus burti*. *Fish. Bull., U.S.* **89**:101-116.

Dentzau, M. D. and M. E. Chittenden, Jr. 1990. Reproduction, movements, and population dynamics of the Atlantic threadfin, *Polydactylus octonemus*. *Fish Bull., U.S.* **88**:439-462.

Chittenden, M. E., Jr. 1989. Sources of variation in Chesapeake Bay pound net and haul seine catch compositions. *N. Amer. J. Fish. Mgmt.* **9**:367-371.

RESEARCH INTERESTS

Commercial fisheries and aquaculture development are my broad areas of interest. Related research includes fishing gear selectivity and bycatch; management and regulatory strategies for commercial fisheries; seafood production and utilization. Additionally, I am interested in applicable technology and information transfer.

CURRENT PROJECTS

- Selectivity of sea scallop dredges constructed with 3, 3.25 and 3.50 inch rings.

CURRENT STUDENTS

Jeffrey Brust, M.A. - An assessment of a 3.5 inch ring sea scallop dredge on a resource dominated by a single year class.

Ryan Carnegie, M.A. - Size specific fecundity of the sea scallop (*Placopecten magellanicus*).



Conducting size selectivity studies of scallop dredges aboard commercial fishing vessel.

SELECTED PUBLICATIONS

Kirkley, James E. and William D. DuPaul. 1993. Technical efficiency, biological conditions, and management of the sea scallop fishery. *Canadian J. Fish. and Aquatic Sci.*, (in press).

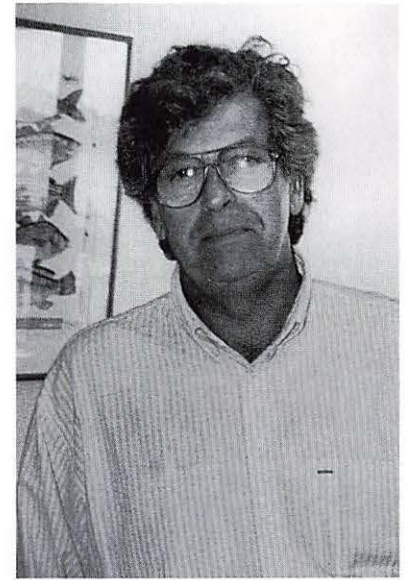
Kirkley, James E. and William D. DuPaul. 1993. Technical efficiency, biological conditions, and management of the sea scallop fishery. *J. Shellfish Res.*, (in review).

Fisher, Robert A., William D. DuPaul and Thomas E. Rippen. 1993. Nutritional, proximate, and bacteriological characteristics of processed sea scallops, *Placopecten magellanicus*. *J. Food Sci.*, (in review).

Oesterling, Michael J. and William D. DuPaul. 1993. Shallow water bay scallop (*Argopecten irradians*), culture in Virginia. *Canadian J. Fish. and Aquat. Sci.*, (in press).

DuPaul, William D., James E. Kirkley and Anne C. Schmitzer. 1989. Evidence of a semi-annual reproductive cycle for the sea scallop (*Placopecten magellanicus*) in the mid-Atlantic region. *J. Shellfish Research* 8(1).

DuPaul, William and James Kirkley. 1994. A report to the Sea Scallop Plan Development Team: preliminary assessment of 3.25" ring dredge. *VIMS Marine Resource Report No. 94-1*.



William D. DuPaul

*Associate Director for
Advisory Services*

*Coordinator, Virginia Sea Grant
Marine Advisory Program*

*Professor of
Marine Science*

*B.S., Bridgewater State College;
M.A., Ph.D., College of
William and Mary*



John E. Graves

Associate Professor of
Marine Science

B.A., University of California,
San Diego; Ph.D. Scripps
Institution of Oceanography

RESEARCH INTERESTS

My research interests are broadly focused on the processes of molecular evolution in the marine environment. In particular, my research program is directed toward 1) the use of molecular techniques to elucidate the population structure of marine organisms, with an emphasis on pelagic fishes; 2) the application of techniques in molecular biology to help resolve problems in fishery science; and 3) the investigation of the functional significance of molecular variation and its role in influencing the distribution of marine organisms.

CURRENT PROJECTS

- Population genetic analysis of the blue marlin using nuclear and mitochondrial DNA technologies.
- Genetic relationships among cultures of the apicomplexan parasite, *Perkinsus marinus*, obtained from different individuals of the American oyster, *Crassostrea virginica*.
- Global population structure of the sailfish, *Istiophorus platypterus*.
- Population genetic structure of the white marlin, *Tetrapturus albidus*, within the Atlantic Ocean.

CURRENT STUDENTS

Jan Cordes, Ph.D. - Population structure and birthdate distribution of recruiting juveniles of the Nassau grouper *Epinephelus striatus*, in the Caribbean.

David Carlini, Ph.D. - Molecular phylogeny of cephalopods.

David Plotner, Ph.D. - Larval dispersal and the population structure of the spiny lobster, *Panulirus argus*, in the Caribbean.

Vince Buonaccorsi, M.A. - The population structure of striped marlin, *Tetrapturus audax*, inferred from the analysis of anonymous nuclear DNA.

Jan McDowell, M.A. - The global population genetic structure of the sailfish, *Istiophorus platypterus*.

Jeff Norgarrd, M.A. - Stock composition of loggerhead turtles feeding in Chesapeake Bay.

Catherine O'Neil, M.A. - Genetic relationships among geographically isolated populations of the cosmopolitan bluefish, *Pomatomus saltatrix*.

SELECTED PUBLICATIONS

Heist, E. J., J. E. Graves and J. Musick. 1994. Population genetics of the sandbar shark (*Carcharhinus plumbeus*) in the Gulf of Mexico and Mid-Atlantic Bight. *Copeia* (in press).

Graves, J. E. and J. R. McDowell. 1994. Interocean genetic divergence of istiophorid billfishes. *Marine Biol.*, (in press).

Graves, J. E. and J. R. McDowell. 1994. Genetic analysis of striped marlin *Tetrapturus audax* population structure in the Pacific Ocean. *Can. J. Fish. Aquat. Sci.*, (in press).

Daniel, L. B. and J. E. Graves. 1994. Morphometric and genetic identification of eggs of spring-spawning sciaenids in lower Chesapeake Bay. *Fish. Bull.*, U.S., **92**:254-261.

Scoles, D. R. and J. E. Graves. 1993. Population genetic structure of yellowfin tuna, *Thunnus albacares*, from the Pacific Ocean. *Fish. Bull.*, U.S., **91**:690-698.

Graves, J. E., A. M. Beardsley, J. R. McDowell, and D. R. Scoles. 1993. Stock structure of the bluefish *Pomatomus saltatrix* along the mid-Atlantic coast. *Fish. Bull.*, U.S. **90**:703-710.

RESEARCH INTERESTS

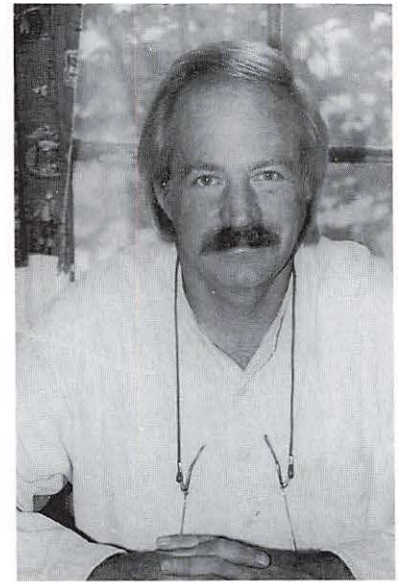
My primary interests include marine resource and environmental economics, resource management, statistics, game theory, risk and uncertainty, and operations research analysis. Additional research interests include gear conservation, by-catch, International trade, economic development, population dynamics, economics of recreational fishing, and economic impact analysis.

CURRENT PROJECTS

- Economic impacts and importance of commercial fishing and the seafood industry of Virginia.
- Economic impacts and importance of marine recreational fishing in Virginia.
- Assessment of benefits and costs of recreational fishing in Virginia.
- Gear conservation/engineering on scallop dredge: Assessing the technical and economic ramifications of gear regulations.

SELECTED PUBLICATIONS

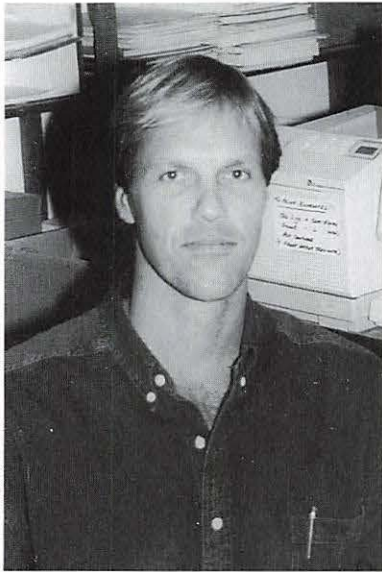
- Kirkley, James E. and W. D. DuPaul. 1994. Technical efficiency and regulating the sea scallop fishery. *Canadian J. Fish. and Aquatic Sci.*, (in press).
- Kirkley, James E. and W. D. DuPaul. 1994. Technical efficiency, biological conditions, and management of the sea scallop fishery. *J. Shellfish Res.* (in press), December.
- Kirkley, J., D. Squires, and I. Strand. 1994. Assessing technical efficiency in commercial fisheries. *Amer. J. Agri. and Res. Econ.*, (in review).
- Kirkley, J. and K. E. McConnell. 1994. Marine debris: Benefits, costs, and choices. Third International Conference on Marine Debris, Miami, Florida. May 8-12, (in press).
- Squires, D. and J. Kirkley. 1994. Individual transferable quota markets and investment decisions in the fixed gear sablefish industry. *J. Envir. Econ. Manag.*, 27:185-204.
- Squires, D. and J. Kirkley. 1994. Individual transferable quotas: A summary and overview of ITQs. *J. Fish. Review*, (in press).



James E. Kirkley

*Associate Professor of
Marine Science*

*B.A., M.A., Ph.D., University of
Maryland*



Romuald N. Lipcius

Associate Professor
of Marine Science

B.S., University of Rhode
Island; Ph.D., Florida State
University

RESEARCH INTERESTS

My research areas include ecology and fishery biology of the blue crab, Caribbean spiny lobster, queen conch and Nassau grouper; determinants of macrobenthic community structure.

CURRENT PROJECTS

- Recruitment dynamics and settlement processes of blue crab postlarvae and early-stage juveniles that emphasizes the food web dynamics of similar ecosystems in Chesapeake Bay and the Kattegat Sea bounded by Denmark and Sweden.
- Quantifying bay-wide abundance, distribution and mortality rates of the blue crab in Chesapeake Bay and the historical trawl-survey abundance of the blue crab in Chesapeake Bay tributaries.
- Investigations on Caribbean spiny lobster, queen conch and Nassau grouper in Florida and the Caribbean that include: experiments to test the feasibility of enhancing spiny lobster and finfish production with artificial shelters; field studies on the recruitment and metapopulation dynamics of spiny lobster and Nassau grouper; and field experiments on factors regulating the survival of queen conch in nursery habitats.
- Examining the potential for biological control of the zebra mussel by the blue crab and other natural predators.

CURRENT STUDENTS

Rochelle Seitz, Ph.D. - Regulation of macrobenthic community structure in Chesapeake Bay by predation and environmental stress.

Martha Nizinski, Ph.D. - Impact of disturbance and shelter-associated predators upon the macrobenthos of Florida Bay and the Bahamas.

David Plotner, Ph.D. - Genetic structure and stock identity of the Caribbean spiny lobster.

Lance Garrison, Ph.D. - Effects of nutritional stress and predation upon larvae of crab species with differing recruitment strategies.

Larry Boles, M.A. - Abundance, natural mortality and potential for biological control of the zebra mussel.

Don Gibbs, M.A. - Pheromonal communication and mating behavior of the blue crab.

Luis Coba-Cetina, M.A. - Effects of habitat and conspecific density upon survival of spiny lobster postlarvae and young juveniles.

Jessica Schulman, M.A. - Metapopulation dynamics of macrobenthos in Chesapeake Bay.

SELECTED PUBLICATIONS

Lipcius, R. and J. S. Cobb. 1994. Ecology and fishery biology of spiny lobsters. *In: Spiny Lobster Management: Current Situation and Perspectives*, B. Phillips, J. S. Cobb and J. Kittaka (eds.), *Fishing News Books*, Oxford, UK.

Eggleston, D. and R. Lipcius. 1992. Shelter selection by spiny lobster under variable predation risk, social conditions, and shelter size. *Ecology*, **73**:992-1011.

Mansour, R. and R. Lipcius. 1991. Density-dependent foraging and mutual interference in blue crabs preying upon infaunal clams. *Marine Ecology Progress Series*, **72**:239-246.

Lipcius, R., E. Olmi and J. van Montfrans. 1990. Planktonic availability, molt stage and settlement of blue crab megalopae. *Marine Ecology Progress Series*, **58**:235-242.

Lipcius, R. and W. Van Engel. 1990. Blue crab population dynamics in Chesapeake Bay: variation in abundance (York River, 1972-1988) and stock-recruit functions. *Bulletin of Marine Science*, **46**:180-194.

RESEARCH INTERESTS

My primary interests are the assessment of the striped bass and *Alosa* (American shad, alewife, and blueback herring) stocks. These studies include vital biological statistics (age, size, and sex structure) and stock assessment statistics (abundance, recruitment, exploitation, and commercial and recreational fishing mortality rates). Mark-recapture studies of striped bass are being conducted to evaluate the degree of striped bass exploitation within and outside the Chesapeake Bay region, to assess the coastal migratory pattern of Virginia striped bass, and to assess the degree of fidelity to the river of capture in subsequent spawning seasons. Annual juvenile indexes of abundance for the *Alosa* species are determined; these indexes have been found to be highly correlated to adult recruitment.

CURRENT PROJECTS

- Evaluation of striped bass stocks in Virginia: Tagging and monitoring studies.
- Study of *Alosa* stock composition in Virginia's Commercial inshore fisheries.
- Development of an *Alosa* juvenile index of abundance.



CURRENT STUDENT

Douglas A. Dixon - Investigation of diel periodicity and variations in annual abundance of anadromous juvenile *Alosa* species.

SELECTED PUBLICATIONS

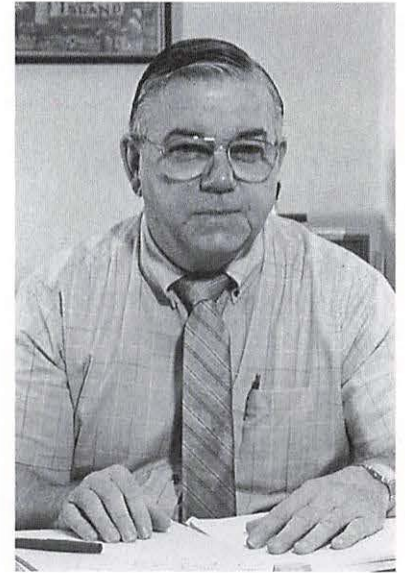
Loesch, J. G. and S. M. Atran. 1994. History of *Alosa* management: Virginia, a case example. J. E. Cooper, R. T. Eades, R. J. Klauda, and J. G. Loesch (eds.). Proceedings of the Anadromous *Alosa* Symposium, American Fisheries Society, Bethesda, MD. pp. 1-6.

Loesch, J. G. and D. A. Evans. 1994. Quantifying seasonal variation in somatic tissue: Surfclam - A Case Study. *J. Shellfish Research* 13(2):425-432.

Loesch, J. G. 1987. Overview of life history aspects of anadromous alewife and blueback herring in freshwater habitats. *In: Common strategies of anadromous and catadromous fishes*, M. J. Dadswell, R. J. Klauda, C. M. Moffitt, and R. L. Saunders, (eds.), American Fisheries Society Symposium 1, pp. 89-103.

Johnson, J. R. and J. G. Loesch. 1983. Morphology and development of hatchery cultured American shad, *Alosa sapidissima* (Wilson). *Fish. Bull. U.S.*, 81(2):323-339.

Loesch, J. G., W. H. Kriete, Jr. and E. J. Foell. 1982. Effects of light intensity on the catchability of juvenile anadromous *Alosa* species. *Trans. Amer. Fish. Soc.*, 111(1):41-44.



Joseph G. Loesch

*Professor of
Marine Science*

*B.S., University of
Rhode Island;
M.S., Ph.D., University of
Connecticut*

Striped bass, Alosa sapidissima



Roger Mann

Chair of Department

Professor of
Marine Science

B.S., University of East Anglia;
Ph.D. University of Wales

RESEARCH INTERESTS

My interests are physiological ecology of marine molluscs; larval dispersal and settlement processes in estuarine and shallow water systems and fisheries and aquaculture of marine molluscs.

CURRENT PROJECTS

- Population models of the Chesapeake oyster resources.
- Physiological and ecological studies of bivalve mollusc larvae in the field.
- Dispersal processes in estuarine systems.
- Resource stock assessment by fishery dependent and fishery independent methods.
- Recruitment and early life history in relation to intertidal exposure processes.

CURRENT STUDENTS

Ian Bartol, M.A. - Recruitment processes on intertidal reefs.

Sandra Brooke, M.A. - In situ studies of molluscan larval growth and physiology.

Julia Harding, Ph.D. - Predator-prey interactions of larval fish and larval molluscs.

SELECTED PUBLICATIONS

Castell, L. L. and R. Mann. 1994. Optimal staining of lipids in bivalve larvae with Nile Red. *Aquaculture* **199**:89-100.

Baker, S. M. and R. Mann. 1994. Description of metamorphic phases in the oyster *Crassostrea virginica* and effects of hypoxia on metamorphosis. *Marine Ecology Progress Series* **104**:91-99.

Barber, B. J. and R. Mann. 1994. Growth and mortality of eastern oysters, *Crassostrea virginica* (Gmelin, 1791), and pacific oysters, *Crassostrea gigas* (Thunberg 1793) under challenge from the parasite, *Perkinsus marinus*. *J. Shellfish Research* **13**(1):109-114.

Mann, R., R. Morales-Alamo and J. S. Ranier. 1994. Reproductive activity of oysters, *Crassostrea virginica* Gmelin, in the James River, Virginia, during 1987-1988. *J. Shellfish Res.* **13**(1):157-164.

Rosenfield, A. and R. Mann. 1992. *Dispersal of Living Organisms into Aquatic Systems*. Maryland Sea Grant College Press, 436 pp.

Shpigel, M., B. J. Barber, and R. Mann. 1992. The effects of elevated temperature on growth, gametogenesis, physiology, and biochemical composition of diploid and triploid juvenile *Crassostrea gigas* Thunberg. *J. Exp. Mar. Biol. Ecol.* **161**:15-25.

RESEARCH INTERESTS

My vertebrate ecology and systematics programs include several diverse research areas which deal with various aspects of the ecology systematics, and morphology of marine vertebrates.

CURRENT PROJECTS

- To determine species composition, age, size structure, sex ratio, reproductive biology, food habits and population dynamics of shark populations in the Chesapeake Bight.
- Ecology, distribution, abundance, and behavior of sea turtles in Western Atlantic.
- Fish systematics program based on the Scientific VIMS Fish Collection (18,000 catalogued lots and 100,000 specimens of preserved fishes).
- Comparative ecological studies of finfishes such as flounders, anchovies and pipefishes and comparative studies of fish community structure from estuaries to the deep sea.

CURRENT STUDENTS

William Jones, M.A. - Effect of nest temperatures on sex ratio of juvenile loggerhead turtle hatchlings in Virginia.
Soraya Moein, Ph.D. - Auditory capabilities of the loggerhead sea turtle.
James Gelsleichter, Ph.D. - Calcium physiology and deposition of annual growth rings in elasmobranchs.
Lisa Ayers, M.A. - Seasonal fish community structure of an intertidal salt marsh in Virginia.
Thomas Orrell, M.A. - Systematics of selected perciform fishes.
Mark Terwilliger, M.A. - Autecology of the tongue fish, *Symphurus plagiosa*.

William Coles, Ph.D. - Electromagnetic cues and migration behavior of loggerhead sea turtles.

Joseph Desfosse, Ph.D. - Age, growth, population dynamics and migratory behavior of summer flounder.

Rogério Teixeira, Ph.D. - Reproductive biology and trophic ecology of selected pipefishes and seahorses in the western Atlantic.

Louis Daniel, Ph.D. - Early life history and reproduction of the black drum in Chesapeake Bay.

Heidi Banford, Ph.D. - Phylogenetic systematics and zoogeography of selected marine fishes in the neotropics.

Deane Grubb, M.A. - Life history studies of selected shark species.

Jennifer Newton, Ph.D. - Behavior and ecology of the loggerhead sea turtle in the Western North Atlantic.

SELECTED PUBLICATIONS

Musick, J. A., J. C. Desfosse, S. Wilk, D. McMillan and E. Grogan. Comparative structure of demersal fish communities near a deep-sea disposal site in the western North Atlantic. *J. Mar. Environ. Eng.* (in press).

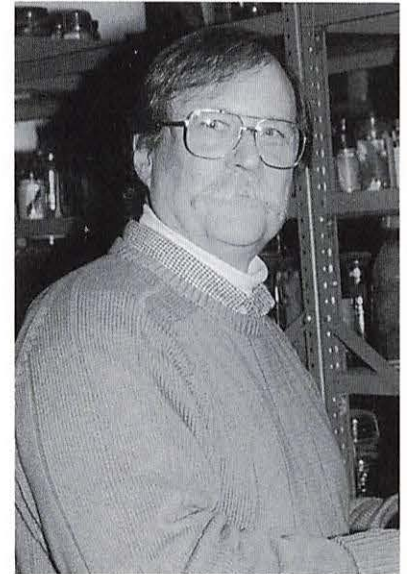
Musick, J. A., R. D. Jenkins and N. Burkhead. 1994. The sturgeons (Acipenseridae). In: The Freshwater fisheries of Virginia, R. E. Jenkins, et al. (eds.). American Fisheries Soc. Spec. Publ., Washington D.C., pp. 183-195.

Klinger, R. C. and J. A. Musick. Age and growth of loggerhead turtles (*Caretta caretta*) from Chesapeake Bay. *Copeia* 4: (in press).

Musick, J. A., S. Branstetter and J. A. Colvocoresses. 1993. Trends in shark abundance from 1974-1991 for the Chesapeake Bight of the U.S. Mid-Atlantic Coast. NOAA Tech. Rep. NMFS 115:1-18.

Keinath, J. A. and J. A. Musick. 1993. Internesting movements and behavior of a leatherback turtle, *Dermochelys coriacea*. *Copeia* 4:1010-1017.

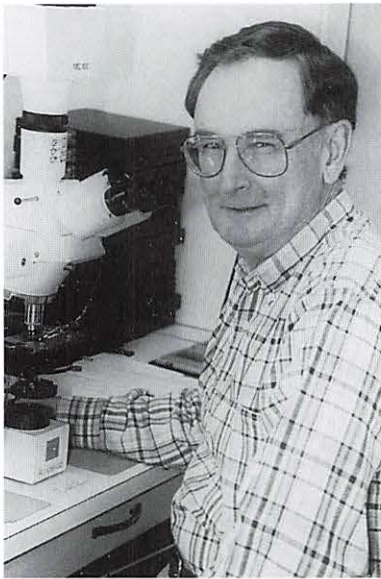
Musick, J. A., M. Bruton and E. Balon (ed.). 1991. The biology of *Latimeria chalumnae* and the evolution of coelacanth. Kluwer Acad. Publ., Boston, 466 pp.



John A. Musick

Professor of
Marine Science

A.B., Rutgers University;
M.A., Ph.D., Harvard University



Frank O. Perkins

Professor of
Marine Science

B.A., University of Virginia;
M.S., Ph.D., Florida State
University

RESEARCH INTERESTS

My research involves the studies of cell biology, life cycles and phylogeny of protists.

CURRENT PROJECTS

- Determination of the host specificity of *Perkinsus marinus* within the Mollusca.
- Determination of the species identity of *Perkinsus* spp. found in *Macoma balthica*, *M. mitchelli*, and *Bankia gouldi*.

SELECTED PUBLICATIONS

Perkins, F. O. 1993. Infectious diseases of molluscs. *In: Pathobiology of Marine and Estuarine Organisms*, J. A. Couch, and J. Fournie (eds.). CRC Press, Boca Raton, pp. 255-287.

Bricelj, V. M., S. E. Ford, F. J. Borrero, F. O. Perkins, G. Rivara, R. E. Hillman, R. A. Elston, and J. Chang 1992. Unexplained mortalities of hatchery-reared, juvenile oysters, *Crassostrea virginica* (Gmelin). *J. Shell-fish Research*, 11:331-348.

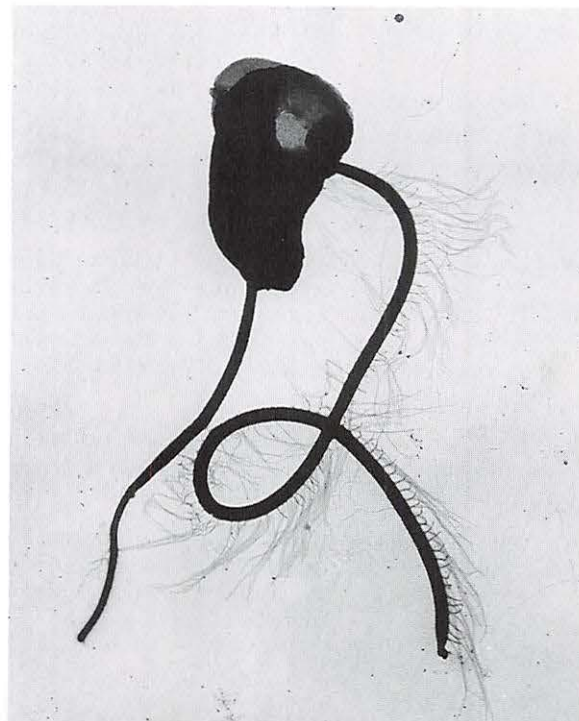
Perkins, F. O., and T. C. Cheng (editors). 1990. *Pathology in Marine Science*. Academic Press, San Diego, 538 pp.

Perkins, F. O. 1990. Sporozoa. *In: Microscopic Anatomy of Invertebrates, Volume I: Protozoa*, F. W. Harrison and J. O. Corliss (eds.), Wiley-Liss., New York, pp. 261-331

Perkins, F. O. 1990. Haplosporidia. *In: Handbook of Protoctista*, L. Margulis, J. O. Corliss, M. Melkonian, and D. J. Chapman (eds.), Jones and Bartlett Publ., Inc., pp. 19-29.

Desportes, I., and F. O. Perkins. 1990. Paramyxea. *In: Handbook of Protoctista*, L. Margulis, J. O. Corliss, M. Melkonian, and D. J. Chapman (eds.), Jones and Bartlett Publ., Inc., pp. 30-35.

Perkins, F. O. 1988. Structure of protistan parasites found in bivalve molluscs. *In: Disease Processes in Marine Bivalve Molluscs*, W. S. Fisher (ed.), American Fisheries Society Special Publ. 18, Bethesda, pp. 93-111.



Transmission electron micrograph of a zoospore of the oyster pathogen, *Perkinus marinus*.



ADMISSION POLICY

Applicants are encouraged to visit the campus and contact faculty members about specific research interests, funding opportunities, and program information. Admission to the School of Marine Science is highly competitive, and admissions procedures are designed to provide adequate information for objective evaluation by the faculty.

Applicants are required to submit:

- 1) One copy of the completed application form;
- 2) A non-refundable processing fee of \$20. This fee is not credited to the student's account;
- 3) Three letters of recommendation;
- 4) Official transcripts of all college work. Final degree transcripts are required of admitted students before they matriculate;
- 5) Official scores of the Verbal and

Quantitative sections of the Graduate Record Examination (GRE); and

- 6) International students whose primary language is not English are required to submit GRE-TOFEL scores.

Requests for application forms as well as additional information should be directed to:

**Dean of Graduate Studies
School of Marine Science
Virginia Institute of Marine Science
College of William & Mary
P.O. Box 1346
Gloucester Point, VA 23062
(804) 642-7105
Fax (804) 642-7097**

GENERAL INFORMATION

Located in historic Tidewater Virginia, Gloucester Point is within 20 minutes of Williamsburg and Hampton/Newport News, Virginia. Major metropolitan areas of Norfolk, Virginia Beach, and Richmond are within easy driving distance. The semi-rural location offers diverse opportunities for outdoor activities from sailing, windsurfing, canoeing, and kayaking to biking, hiking, fresh and salt water fishing. SMS students may participate in a broad range of cultural and athletic activities on the nearby William & Mary campus.

A limited number of apartments for SMS graduate students are available on the William & Mary campus in Williamsburg. There are no housing facilities on the VIMS campus; however, most students live in Gloucester Point and surrounding communities. Rental housing is plentiful and rates are reasonable. It is advisable for students to have access to transportation as most living quarters are not within convenient walking distance of the campus.





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