

MARINE NOTES

SPOTLIGHT ON ECOLOGY

AN ENDLESS INVASION?

Green Crabs, New England Intruders, Move West

BY MICHAEL W. FINCHAM

On Martha's Vineyard, the new scallop season opened with high skies, bouncing sunlight and blustery winds but only modest hopes that a good harvest would be had this winter out of the harbors, bays and tidewater ponds of this picturesque island.

So Mike Picciandra spent this windy first morning fishing for scallops — and in the afternoon he went fishing for green crabs. Picciandra has a daily limit on scallops: as soon as he catches three bushels he has to quit. On a good day he may get \$8 a pound for his scallops.

On green crabs, however, he has no season, no limits — just as green crabs have no season, no daily limit on scallops: they keep eating scallops all day, every day. And that's one reason Picciandra goes out after green crabs. The other reason is money: the green crab

is so unpopular up here, it carries a price on its head. "The town puts a bounty on these crabs," he explains, "and I as a bounty hunter, I go out and catch the crabs." He'll only get 40 cents a pound for his green crabs, and most of them will end up on a compost pile, but he reasons that by the end of the day there'll be fewer

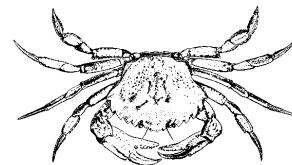
Most scallop fishermen think of the green crab as a local pest, but few realize it is actually a transplant from European seas.

40 cent crabs eating up \$8 scallops.

Only four years ago, the scallop fleet that motored out of Edgartown harbor on opening day numbered more than 100 boats. This year the winds are so high and the hopes are so low that the "fleet" totals less than 20 boats. For several weeks, Picciandra and other fishermen had been motoring out to Cape Pogue Bay and Edgartown Har-

bor and Sengekon-tacket Pond to check on

this year's crop, and by opening day the word has gone round the island: another off year for scallops.



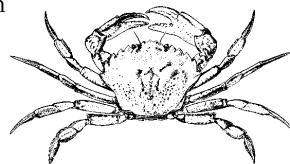
An Unwanted Bounty

Green crabs are probably not the primary culprit in the scallop decline — but they stand accused as accessories to the crime. Most scallop fishermen think of the green crab as a local pest, but few of them realize this small green predator is an immigrant into these coastal waters, a transplant from European seas like the North Sea and the Baltic.

For marine scientists, green crabs are a prime example of yet another successful invasion of American waters by an exotic species. That makes them an instructive case study for the developing science of "invasion ecology."

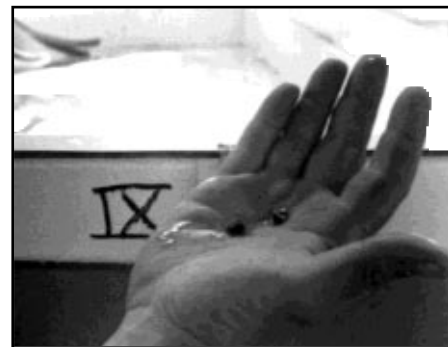
Green crabs may be exotics, but

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Michael W. Fincham

Food for crabs or food for people? Paul Bagnall, a shellfish biologist, checks seed scallops at a nursery run by the Martha's Vineyard Shellfish Group. Last year the group planted 600 thousand seed scallops in the harbors, bays and ponds around the island.

Green crabs are probably not the primary culprit in the scallop decline — but they stand accused as accessories to the crime.

Invaders, continued

you catch them much the same way you catch blue crabs, their larger, more popular cousins. Picciandra uses a technique familiar to any Chesapeake Bay waterman: he builds pyramid-shaped wire mesh traps, baits them with fish and sets them in the water attached to crab buoys. Every two or three days, he checks his pots and makes his haul. "I weigh them up, tag them, and then once a week I submit a voucher to the town treasurer and they pay me."

That bounty on the green crab is paid by the town of Edgartown, the scenic village on Martha's Vineyard where Hollywood filmed the blockbuster movie *Jaws* 20 years ago. In that epic, a great white shark slid

around eating hapless swimmers and hard-drinking fishermen. In Edgartown today, green crabs are leaving people alone, but they are attacking scallops and other native shellfish.

"Green crabs are a problem in our ponds because they eat soft shell clams, quahogs and oysters — as well as scallops," explains Paul Bagnall, the shellfish biologist for Edgartown and the man responsible for putting a bounty on green crabs. He wants to protect the scallop fishing in Sengokontacket Pond, a two-mile salt-water embayment shared by Edgartown and the neighboring town of Oak Bluffs.

Over the last year, he placed more than a quarter million seed scallops in the pond from the town's small shellfish hatchery. He hopes most of those scallops are caught by fishermen rather than green crabs.

Bounty programs are somewhat controversial as a predator control technique. Proponents like Paul Bagnall make this simple argument: every time you catch a crab, you save a number of scallops, clams and oysters. Opponents to bounties argue that crab populations in a tidewater pond reach a steady state equilibrium. Every time you catch a crab, you simply open up space for another crab to move in. The bounty is wasted money and effort.

The arguments for and against are largely theoretical, the evidence mostly anecdotal. As a result, a number of New England towns have sporadically tried bounties in hopes of protecting their shellfish beds. And most have abandoned them without knowing whether they worked or not.

Good evidence might come from the work of Greg Ruiz, an ecologist who has been setting a lot of traps for green crabs along the Atlantic coastal marshes of Connecticut and along the Pacific coastal bays north of San Francisco. As a graduate student, Ruiz worked with Jim Carlton, one of the country's leading researchers in invasion ecology, and his early research centered on San Francisco Bay, this country's hottest site for invasive exotics. Now with the Smithsonian Environmental Research Center on Maryland's Chesapeake Bay, Ruiz has been studying the history and pattern of green crab immigrations. His question: can we predict the ecological impacts of future invasions?

Claws II

According to Ruiz, there have been two major green crab invasions of American waters: one on the east coast, one on the west coast. The green crabs of Martha's Vineyard are descendants of the first influx that be-

gan more than 150 years ago. Their ancestors reached the Atlantic coast under sail, riding along in the dry ballast of wooden ships or clinging to the mossy crevices of heavily fouled outer hulls.

Those green crabs first found suitable habitat in coastal embayments from New Jersey to Cape Cod. In the early 1900s, they began spreading northwards, ranging up through Maine and the maritime provinces of Canada, all the way to Cape Sable, Nova Scotia. Their arrival in Maine in the 1950s coincided with dramatic declines in the soft clam fishery, setting off an earlier search for predator control strategies.

The second great invasion of green crabs was discovered as recently as 1989 in San Francisco Bay. First a fisherman found a large male crab in his gill net. The next summer bait trappers began finding green crabs in lagoons along the west side of the bay. Since scientists were able to track this west coast episode nearly from the start, this second invasion has revealed much more about the green crab's migratory strategy.

These recent immigrants probably arrived as stowaways in the ballast water of big commercial ships hauling televisions, trucks and cars — and the oil to run them. According to Jim Carlton, now an ecologist with Williams College, there are also a number of other less obvious routes. Green crabs, like their ancestors, could also be hanging onto the fouling found in seawater pipes of big ships. Or they could have come west directly from New England, tucked in with the seagrass and kelp used for packing and shipping Maine lobsters and Atlantic bait worms.

On the Western Front

The green crab invasion, according to Ruiz and Carlton, works something like this. Young green crabs thrive best in fairly protected coastal ponds and lagoons and embayments. There they eat molluscs, crustaceans, polychaetes and green algae. Though they have trouble cracking a hard clam, they can dig out soft clams

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To Catch a Bay Scallop

On the opening day of scallop season Mike Picciandra spent the morning on his knees in his small green, home-made skiff. This is the position he assumes for “dipping” — one of the odder, older ways to catch a bay scallop here on the tidewater ponds of Martha's Vineyard.

The “dipping” position looks a lot like the praying position. On his knees, he leans against the gunnel, glances at the heavens, then bends over and peers down at the bottom of the pond. Wielding a long-handled net, he plucks scallops off the bottom of the pond — one scallop at a time.

To find his prey, he buries his face in his “peeper,” a home-made, four-sided funnel with a plate of glass on the bottom, a viewing port on top and a lot of duct tape in between.

By placing the glass on the water, he flattens out the surface chop. And *voilà*: he has a clear view of the bottom of the pond and whatever scallops are growing there. He also calls his contraption a “Buck Rogers,” because it looks sort of space age. Sort of.

In the “dipping” position, peering down through his “peeper,” Mike Picciandra looks like an ancient oracle trying to decipher the future by reading the entrails of animals or the tea leaves at the bottom of his cup. What he sees through his peeper is enough to drive a man to prayer or to drink. “It looks like the surface of the moon down there,” he groans.

“Twas not always so. When he is not trying to read the future, Picciandra reads up on the past, and finds it a happier story. “In 1945 and 1946, right after the war, we had 260 fishermen in the town, in the ponds. Four years ago we had 280 fisherman, and now we have 80 licenses with 60 of them given out to people over sixty. And I’m right in line for mine.”

Those great days could come again, says Picciandra, an optimist by nature, who dreams of peering down at a pond bottom paved over with shellfish. Edgartown's seed planting program is helping, and so is its bounty on predators like green crabs and spider crabs. But he would

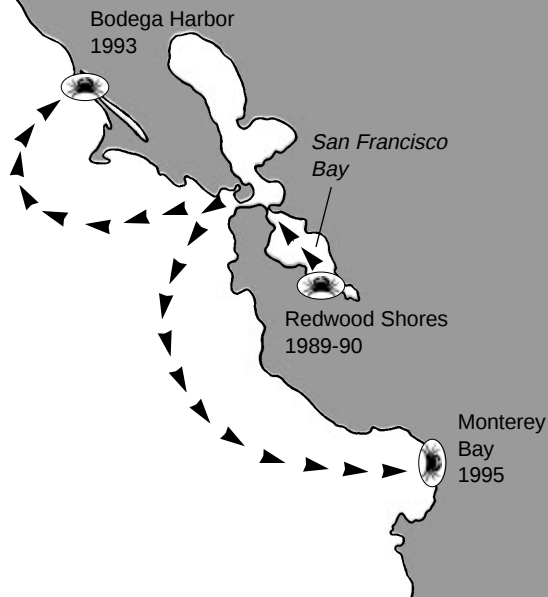
also like to see rededging and reductions of nitrogen from the sewage treatment plant.

“This pond does two things for the people of this country. It provides a place for those little bay scallops to spawn, and it is also a catcher, a fisherman. If the pond is environmentally sound, it has the ability to catch spat,” he argues. “And there is more shellfish spat in this pond right here than there are pennies in the national debt.” ■



Michael W. Fincham

Green Crabs: The Western Invasion



tinues to increase, green crabs will invade other estuaries — and so will other species. “What we’ve seen over the last few decades is really an explosion in the amount of commercial traffic that is bringing in ballast water to different parts of the world,” explains Ruiz. “At an any one time, there may be tens of thousands of vessels moving around the world carrying ballast water. The effect has really been to open up a conduit for the transfer of species from one part of the world to another part of the world.”

Whether bounty programs work remains an open question. In Edgartown, Paul Bagnall claims his bounty program is helping green crabs, scallops and fishermen coexist. “We have removed over 15,000 pounds of green crabs over the last five months from this pond,” he says. “We have reaped the benefit of this by having a scallop harvest up here this year. It isn’t the best the pond has ever seen, but there are certainly plenty of nice healthy scallops to be harvested.”

Will Edgartown — beset by green crabs and a growing population — ever see great scallop harvests again? Picciandra, for one, says it could happen — but only if the town deals with problems like reseeding, re-dredging, rising nitrogen levels, spider crabs, green crabs and the influx of yet another non-native species: *Codium fragile*, a bottom-rooting alga that locals call Japanese grass. In many parts of the pond Japanese grass is replacing the eelgrass beds that new scallops like to set on.

Though the threat of more invasions looms large with the approach of every tanker and container ship across the horizon, marine exotics remain a small, nearly invisible blip on the environmental radar screens of most Americans. “Look at the problems it is causing us,” laughs Picciandra, the bounty hunter. “I’m killing this green crab for two years, and seeing it all around — and I didn’t know that it didn’t belong here.” ■



Michael W. Fincham

Mike Picciandra ponders yet another exotic threat. The local name for this immigrant species is Japanese grass, but it is actually an alga (Codium fragile) that roots itself to the bottom, much like seagrass. It can replace eelgrass beds that scallops like to set on.

Invaders, continued

buried six inches deep. In these food-rich coves and ponds and marshes they can grow and reproduce in sufficient numbers to create a “beachhead population.” On the west coast, green crabs took three years to establish a beachhead in San Francisco Bay.

Their first major foray beyond the Golden Gate came in 1993 when they reached Bodega Harbor 75 miles north. According to Ruiz, it was not grown crabs but crab larvae, offspring of the beachhead crabs, that made

the trip, gliding northwards at five miles a day on the current. These excursions probably occurred during short windows of opportunity lasting five to fifteen days when the normal northerly winds die down. Since 1993, green crabs have been building up a new beachhead in Bodega Harbor from where a new crop of larvae can travel north towards Oregon, Washington and Canada.

On the Global Front

As the entire globe becomes a free trade zone and shipping traffic con-

Rhode Island Spill on the Web



On Friday, January 19, 1996, the tugboat *Scandia* ran aground on the south shore of Rhode Island, along with its 340-foot barge, the *North Cape*. Some 820,000 gallons of No. 2 home heating oil leaked into the sea, creating the worst oil spill in Rhode Island's history.

Rhode Island Sea Grant has developed a page on the World Wide Web to transmit information about the North Cape Spill. The Web site shows a chronology of the spill, gives frequent updates about the status of seafood and other resources, and includes maps and photographs.

The oil spill Web address is: <http://brooktrout.gso.uri.edu:80/riseagrant/oilspill.html>.

Sea Grant Wins Web Awards

Sea Grant programs around the country have been garnering awards on the World Wide Web. A number of sites, including the Mid-Atlantic Sea Grant site, designed by Maryland Sea Grant, have been awarded Four Stars by the Magellan group, an indepen-

dent web site information broker. The Madison-Area JASON World Wide Web site (<http://www.seagrant.wisc.edu/education/jason/madison.html>), designed by Wisconsin Sea Grant, was chosen as one of the Top Five Sites of the Day on March 4, 1996 by NSCA at the University of Illinois in Urbana-Champaign. Other Top Five sites have included sites by Pepsi, Microsoft and the Walt Disney company.

Indian Head Comes to Campus

On the first day of the spring semester an unusual class took place in Marie Mount Hall on the College Park Campus. The attendees all contended with the same parking problems, the same difficulty in finding the classroom — but interestingly, none of those present were, strictly speaking, students.

The “class” in question was a roundtable — called a “charrette” — convened by the University of Maryland's Environmental Finance Center (EFC). Around the table were a town manager, representatives from state and federal agencies — including the multi-state Chesapeake Bay Program — and experts in the area of environmental management and finance.

Joe Mangini, town manager of Indian Head, Maryland, had come to the University seeking advice concerning stormwater flooding in the center of their town. Representatives from a nearby naval base also attended the charrette and revealed that they, too, faced a similar stormwater problem.

The panel of experts who wrestled with the issues facing the town included representatives of Charles County, where Indian Head resides, and Prince William County in Virginia, which has pursued an aggressive stormwater policy.

The charrette was part of an ongoing effort by the EPA and the University of Maryland to examine the issue of financing environmental projects at the local level. For more information about the Maryland EFC, call Elizabeth Hickey at Maryland Sea Grant (301) 405-6383.

Oceanography Program “Strong”



The National Research Council ranked oceanography at the University of Maryland College Park as a “strong” program, in terms of scholarly quality and program effectiveness.

Ranking number 9 (for effectiveness) and 10 (for quality) in the country, oceanography topped the list of doctoral programs at UMCP. This is remarkable, when one consid-

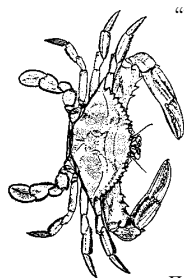
ers that UMCP does not have an oceanography department. What it does have is the Marine-Estuarine-Environmental Sciences (MEES) program, a System-wide marine science program that draws on faculty from the Center for Environmental and Estuarine Studies (CEES) and other units.

“This is one System-wide program that has helped to bring the [University of Maryland's] institutions together,” says Chris D'Elia, Director of Maryland Sea Grant. According to D'Elia, a signal event for the MEES program has been the use of the interactive video network (IVN), which enables instructors to reach students on campuses throughout the UM System. Using IVN, the MEES program has increasingly drawn on research faculty to expand coursework in oceanography and marine science.

End Notes

Conferences, Etc.

■ Blue Crab Conference April 18-19, 1996



"The Blue Crab Fisheries of North America: Research, Conservation and Management" will be held at the Holiday Inn in Baltimore's Inner Harbor, in conjunction with the annual National Shellfisheries Association (NSA) meeting. This meeting will expand upon findings resulting from previous meetings, including a conference organized in 1985 by the Mississippi-Alabama and Louisiana Sea Grant programs on the nation's blue crab fishery.

According to organizers of the conference, the time is ripe for a new analysis — the U.S. blue crab fishery has experienced a number of changes, with the Gulf Coast crab harvest now equal to that of the Chesapeake Bay. To register (\$20) or for more information, contact Dr. Aaron Rosenfield at the Oxford Field Station in Oxford, Maryland, phone (410) 226-5193; fax (410) 226-5925.

■ Biotech Course June 3-7, 1996

The University of Maryland Sea Grant College is sponsoring an intensive one-week course in marine biotechnology. Designed specifically for Extension agents and specialists, the course will run from Monday, June 3 through Friday, June 7, at the Center of Marine Biotechnology at the Christopher Columbus Center in Baltimore. A registration fee of \$75 will cover cost of the course text, lecture notes, and other reference materials. Deadline for registration is April 5 for Extension

agents and specialists in the Mid-Atlantic region. After that date, slots will be opened to all others. For more information, contact Dr. Reggie Harrell by phone, (410) 221-8466, or e-mail: harrell@hpel.umd.edu.

■ Marine Educators Conference August 1-5, 1996

The 1996 annual conference of the National Marine Educators Association (NMEA) is entitled, "Making Connections: Global Lessons from the Gulf of Main." The meeting, the 20th annual conference of NMEA, will be held at the University of New Hampshire in Durham. Speakers include well-known marine scientist Sylvia Earle. For more information write: University Conference Office, University of New Hampshire, 11 Brook Way, Durham, NH 03824-3509, or call (603) 862-1900.

Noteworthy

■ Tree-mendous Maryland

Trees help form the ecological fabric of our temperate landscape, and they benefit the Chesapeake watershed in particular. As part of the Tree-mendous Maryland campaign, the Maryland Department of Natural Resources is sponsoring a series of "Spring Tree Planting, Care and Maintenance" workshops. The workshops will cover planting, pruning, watering, insect and disease control. All workshops run from 8:30-4:00. The dates, locations and phone numbers for the workshops are: March 16, Prince George's Community College, (301) 464-3065; March 23, Frederick Community College, (301) 473-8417; and April 20, Chesapeake College, (410) 778-4439.

Publications, Etc.

■ Bay Journal Celebrates 5th Year

Since March, 1991 Karl Blankenship has been writing and editing the *Bay Journal*, an outstanding tabloid on Chesapeake Bay issues and restoration efforts produced by the Alliance for the Chesapeake Bay.

The *Journal* carries excellent articles by Blankenship, and by others in the Bay community, including William Matuszeski, director of the regional Chesapeake Bay Program. To subscribe, write the Alliance for the Chesapeake Bay, 6600 York Road, Suite 100, Baltimore, MD 21212.

■ Zebra Mussels and Aquaculture



North Carolina Sea Grant has produced a leaflet advising aquaculturists how to guard against the unwanted zebra mussel.

Prepared by James Rice, Extension fisheries specialist at North Carolina State University, the four-page fact sheet reveals that, according to a recent 31-state survey, most aquaculturists are unaware that zebra mussels present a potential problem. The fact sheet also shows a map of the eastern U.S., with dark shading indicating states where zebra mussels have shown up — a swathe that now stretches from the Great Lakes states south to the Gulf of Mexico and from the Mississippi River northeast into New England. The flier (single copies are free) is available from Maryland Sea Grant, 0112 Skinner Hall, University of Maryland, College Park, MD 20742.

EMECS Publication Summarizes Conference



Our Coastal Seas: What Is Their Future? summarizes the 1993 conference held in Baltimore, Maryland on the Environmental Management of Enclosed Coastal Seas (EMECS).

The 180-page softcover book begins with a dedication to Ian Morris, former director of the University of Maryland Center for Environmental and Estuarine Studies, and key originator of the international project that led to the EMECS effort.

The volume includes remarks by the honorable Toshitami Kaihara, Governor of Japan's Hyogo Prefecture, who met with Ian Morris during the original coastal seas study, and by former Governor William Donald Schaefer, who was responsible for bringing the EMECS Conference to Baltimore. *Our Coastal Seas* includes brief summaries of fifty-four sessions under the headings of Philosophy and Policy, Citizen Involvement, Governance, Science and Research, Case Studies, and Special Problems.

Covered in the summaries are science and policy issues associated with such coastal seas as the Chesapeake Bay, the Gulf of Mexico, Puget Sound, the U.S. Great Lakes, the Baltic Sea, the Black and Caspian Seas, the Mediterranean Sea, and the Seto Inland Sea of Japan. The book also includes a brief description of the staged roundtable debate over the Madrigal Sea, a fictionalized and entertaining summit meeting which is also available on videotape from Maryland Sea Grant.

To order either *Our Coastal Seas* (\$12.95) or *The Challenge of the Madrigal Sea* (\$24.95) write the Maryland Sea Grant College, 0112 Skinner Hall, University of Maryland, College Park, MD 20742, or call (301) 405-6376.

Calendar, Etc.

CBL Seminars

Chesapeake Biological Lab, Coastal Chemistry Laboratory, Solomons, Maryland, Fridays, 11:00-12:00 p.m. For information, call (410) 326-4281.

March

29 — Russell Hill, Center of Marine Biotechnology, Baltimore, MD, "Natural products and metal resistance in marine actinomycetes"

April

12 — Michael R. Roman, UMCEES Horn Point Environmental Laboratory, "Physical biological controls on carbon cycling in the central equatorial Pacific"

19 — Jennifer Lee, Department of Chemistry, UMCP, "Cadmium cycling in the ocean and interactions with phytoplankton: Cadmium as a nutrient"

26 — Mark Luckenbach, Virginia Institute of Marine Science, College of William and Mary, "Virginia's oyster reef restoration program"

May

3 — Raleigh Hood, UMCEES Horn Point Environmental Laboratory, "Modeling the seasonal mixing layer in the biological production cycles in the North Atlantic Ocean"

HPEL Seminars

Horn Point Environmental Lab Lecture Hall, Horn Point, Maryland, 11:00-12:00 p.m. For information, call (410) 228-8200.

March

27 — Tom Miller, UMCEES Chesapeake Biological Laboratory, "Recruitment in Atlantic cod: From individuals to cohorts" and at 4:00 p.m., Takashi Kamiyama, Nansei National Fisheries Research Institute, Hiroshima, Japan, "Role of cysts in population dynamics of tintinnid ciliates"

April

3 — Mike Pace, Institute of Ecosystem Studies, N.Y., "Top-down and bottom-up regulation of microbial food-webs: Whole lake experiments"

10 — Mark O'Donohue, University of Brisbane, Australia, "Marine plants as bioindicators in Moreton Bay"

15 — Ron Phillips, Battelle, Richland, Washington, "A comparison of the phenology and reproductive biology of *Zostera marina* L. in North America"

17 — Dave Kirchman, University of Delaware, "Controlling flows through the microbial loop"

24 — Glen Wheless, Old Dominion University, "Visualizations of Chesapeake Bay circulation in response to environmental forcings"

May

8 — Pat Glibert, UMCEES Horn Point Environmental Lab, "Bottom-up and top-down control in mesocosms of differing sizes and shapes"

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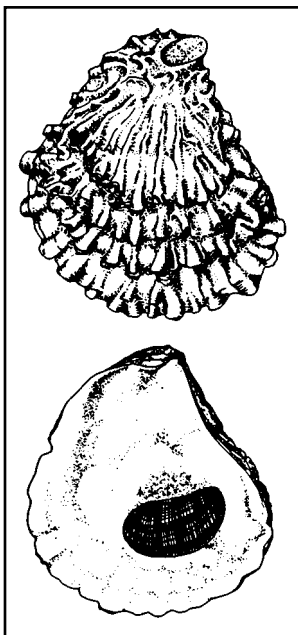
Sea Grant

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The Eastern Oyster: *Crassostrea virginica*

Victor S. Kennedy, Roger I.E. Newell, and Albert F. Eble, editors

The most comprehensive synthesis about Crassostrea virginica since Paul Galtsoff's landmark 1964 work, The American Oyster



The Eastern Oyster: *Crassostrea virginica*, a new book from Maryland Sea Grant, contains 21 chapters focusing on such topics as anatomy, the shell, larval biology, feeding, reproduction, genetics, predation, diseases and defense mechanisms, aquaculture and management. 772 pages, hard cover, 8½ x 11 format, with 400 photographs, drawings and diagrams. Available June 1996. Price, \$95 U.S.

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