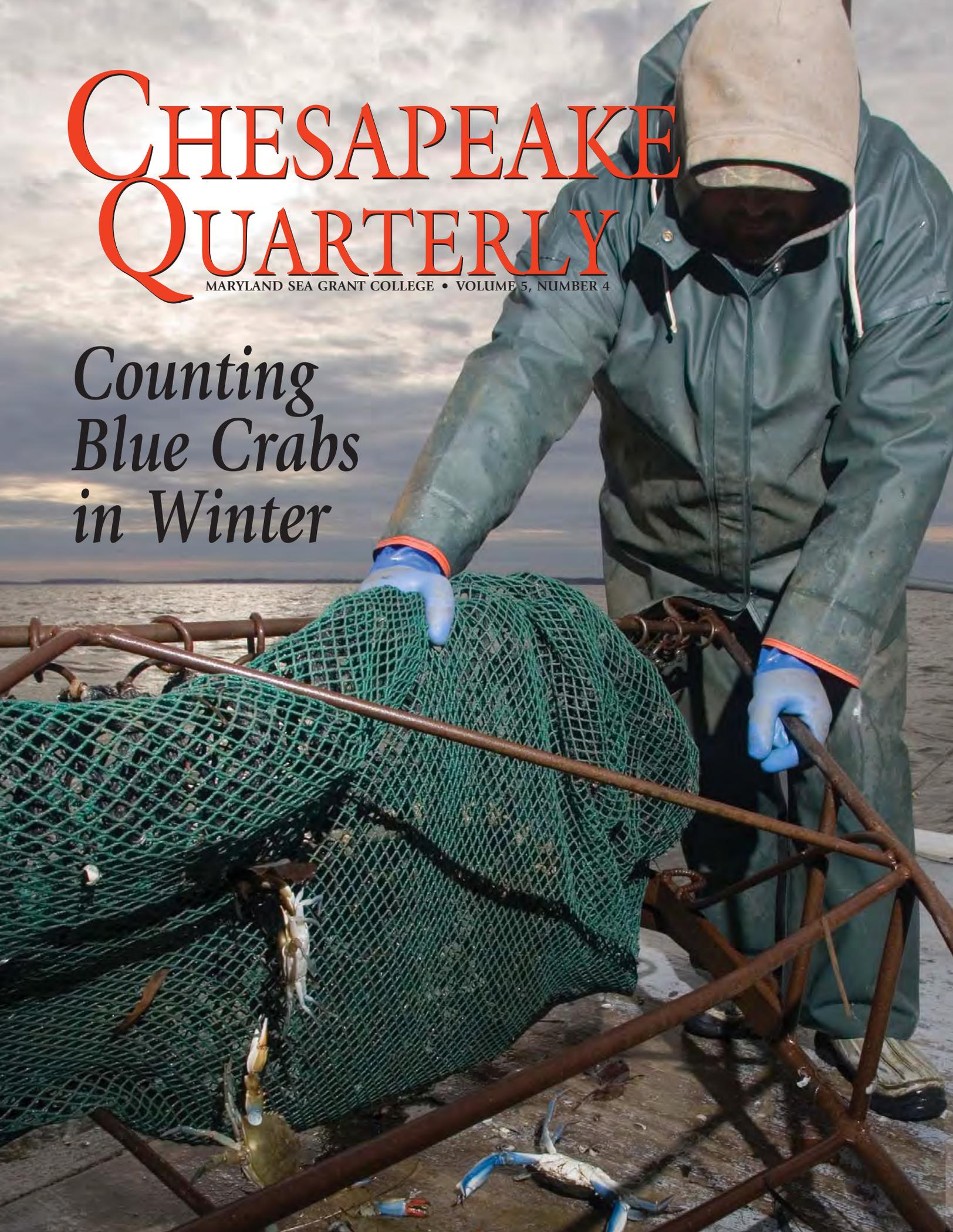


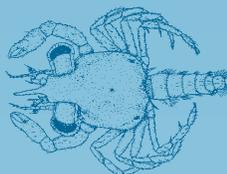
CHESAPEAKE QUARTERLY

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Counting Blue Crabs in Winter



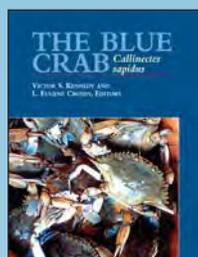
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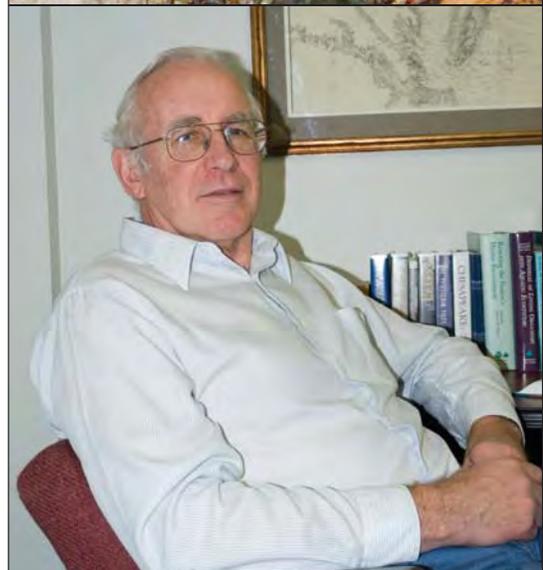
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CHESAPEAKE QUARTERLY

February 2007

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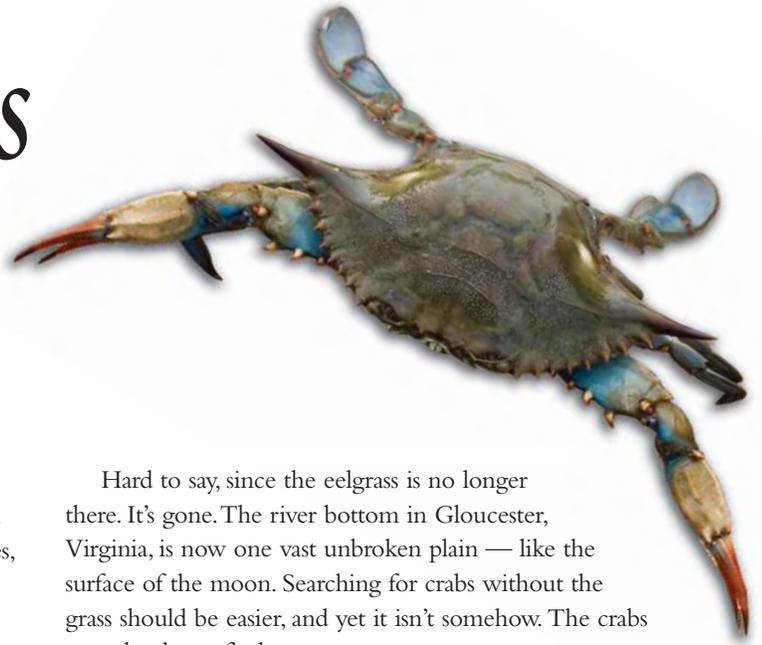
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Cover photo: Dredging crabs is winter work for mate Eddie Weber aboard the *Mydra Ann*, as watermen help scientists survey blue crabs in the Chesapeake. PHOTOGRAPH BY SKIP BROWN.

Opposite page: A crab dredged from the winter mud still wears its vibrant blues and reds. PHOTOGRAPH BY SKIP BROWN.

How Are Crabs Doing, Really?



There is something pugnacious about a blue crab.

Unlike a fish that flops or an eel that slides, a crab is all armor. It wears its skeleton on the outside — joints, angles, and spikes, a strong lightweight shield that would make NASA proud. Blue crabs are tough. They can apparently thrive amid decaying fish, rotting pilings, and the refuse of a careless human populace.

And yet the blue crab has its delicate side. A female crab's sex life seems almost prim. After about 21 molts — the blue crab equivalent of becoming a consenting adult — a female crab will mate only once. She will lie in the shelter of a male crab's claws, counting on him to fend off threats as she sheds her shell, her final molt. After a few days of courting and mating, she will watch her male escort leave to seek out other partners.

Male crabs continue to molt and grow throughout their lives, but once a female crab mates, she keeps the same shell. And unlike male crabs, who spend their lives rambling through the whole Bay, the female crab heads south, toward the saltier waters of the lower Chesapeake. Picture an expectant mother walking many miles to give birth. In summer, in Virginia's tidal waters, she will release her brood into the oceanic unknown.

Most of that expansive litter will wash offshore into the Atlantic, but many of her mite-sized offspring will make their way back into the Bay, where they will begin to look and act like blue crabs.

What's riding on that return is a way of life for working watermen and the seafood industry they support — and for the rest of us a sense of place, a sense of the Chesapeake.

So many of us have memories tied to the blue crab. We've caught them by dangling chicken necks from a dock. Or bought them at a roadside stand. We've eaten hard crabs steamed and seasoned with Old Bay. Or pan-fried soft crabs. We've eaten backfin and claw meat in crab cakes and soups and deviled crabs. We remember summer picnics, tables spread with newspaper, and whacking crab claws with wooden mallets.

When I was a kid we didn't even use bait. We just walked barefoot through the eelgrass and scooped up crabs, hard or soft, with a dipnet.

If I could return to my grandmother's house on the river, years after she has passed away, and walk those shallow grassbeds again, would the crabs still be there?

Hard to say, since the eelgrass is no longer there. It's gone. The river bottom in Gloucester, Virginia, is now one vast unbroken plain — like the surface of the moon. Searching for crabs without the grass should be easier, and yet it isn't somehow. The crabs seem harder to find.

Has the river really changed that much, or has memory created a crab-filled river that never was?

Crab stocks have in fact dwindled over time, according to biologist Victor S. Kennedy, editor of a new 800-page reference text on the blue crab. He points to reports in the late 1800s of crabbers in sailing skiffs catching as many as 2400 crabs in a morning's work. Less than century later, similar estimates fell to half that, even though by that time crabbers had engine-powered boats. In his foreword to *The Blue Crab*, Kennedy notes that when it comes to our natural resources most Americans don't have any idea of just how much we have lost.

If crab populations have fallen from their former heights, what's the prognosis now for blue crabs in the Bay?

The arithmetic of blue crab abundance is abstruse, a complex formula of egg production, larval survival, and finally each year's crop of young crabs — what fisheries scientists call recruitment. And then, deducted from that, the percentage that predators and crabbers will catch.

Some say that blue crabs are doing fine in the Chesapeake. Others say that the fishery could be in danger of collapse. Where is the truth? And how can we be sure?

To answer with some confidence how blue crabs are doing, researchers, resource managers, and commercial crabbers are working to document just how many crabs there really are in the Bay. Scientists, working with watermen, are searching for crabs in winter, surprising them while they sleep. Other researchers are constructing population models to help set new targets for sustainable crabbing. And bi-state efforts have led to new limits on commercial and recreational crabbing.

But other mysteries remain — especially the apparent decline of females in the lower Bay, where blue crabs spawn. How worried should we be that the spawning stock remains so far below average? How are blue crabs doing, really?

— Jack Greer

Taking Stock of Blue Crabs

By Jack Greer

Beneath a steel gray January sky Roger Morris backs down on the *Mydra Ann*. Propwash boils at the stern. This channel off Kent Narrows, lined with pilings and white workboats, is slim and his workboat carries an out-sized wooden platform on the stern. He guns the engine again and the bow swings easily past the closest piling.

This is the fourth winter that Morris has put his crabbing boat, a white 45-foot Bay workboat, in the service of science. His ambitious assignment: to help the Maryland Department of Natural Resources (DNR) determine how many crabs are in the Chesapeake Bay by surveying them during their winter sleep.

Counting crabs is an important job in a bay that produces more blue crabs than any other estuary in the country — a bay where most working watermen depend on crabs for the majority of their fishing income.

Regulations that can cut into a waterman's catch ultimately come from assumptions about the size of crab stocks — assumptions that lie at the center of heated arguments among crabbers, managers, and conservationists. This winter survey is meant to help settle disputes by providing a concrete census of blue crabs in the Chesapeake.

Morris, who hails from Church Creek, south of Cambridge, is a fifth-generation waterman. At forty-four, he's hunted crabs up and down the Bay for thirty-one years. From April through December, he runs crab pots with his mate Eddie Weber and, before she got too old, his dog Tilly. Some winters he used to go after crabs with a heavy metal dredge, down near Cape Charles where the Bay meets the Atlantic. That's cold hard work, and Morris says he's lucky to have this winter contract where the workdays are shorter and the pay steady.

He steers south against the tide running into Kent Narrows and heads along the east side of Kent Island on Maryland's Eastern Shore. As the *Mydra Ann* pulls away from the Narrows, the hulk of an old oyster shucking house slides by, its beach a scatter of shell. Farther out the shore fades to a long low line of pine, still green in the heart of winter. Morris is the only crabber on the water this



Counting crabs is an important job in a bay that produces more blue crabs than any other estuary in the country.

morning, and he's come to search for crabs in a most unusual way — by looking where he doesn't expect to find them.

In the cabin with Morris, watching the readout from the computerized global positioning system (GPS), stands Chris Walstrum from the Maryland DNR. At thirty-two he's young and athletic, with short hair, an easy smile, and a can-do attitude. In another life he might've been a test pilot, but when he was five his family moved from Baltimore down to Kent Island, and he learned to crab and fish with his father and four brothers. He eventually married a local girl and settled on the Eastern Shore. He also got a joint environmental degree from Salisbury University and the University of Maryland Eastern Shore, with a marine emphasis. The Bay never left him, and when he graduated in 1996 he picked up a job with the DNR.





When water temperatures dropped, this blue crab swam to the bottom and buried itself in the mud — only to have researchers dig him up again, disturbing his long winter's sleep. They're hoping to get a count on how many crabs, come spring, will be rising out of the mud and scrambling around the Bay. Since 1989, watermen like Roger Morris (opposite page) and his mate Eddie Weber (above left) have been working with scientists like Chris Walstrum and Heather Brown (above right) to dredge crabs out of the mud at more than 1500 sites around the Bay. Their data help researchers gauge blue crab stocks in the Chesapeake Bay.



Skip Brown

Walstrum's now on his tenth year of the winter crab survey — known as the winter dredge survey because the tool of choice is a Virginia dredge, the same dredge that Morris once used to hunt crabs near the capes, the same dredge that now sits on the wide wooden platform in the stern.

The Virginia dredge is imposing, some six to eight feet wide and weighing about 250 pounds. Protruding from a metal bar are iron teeth five to seven inches long. That dredge and this unconventional quest have brought together these two men — a waterman and a biologist — on a winter's day to seek blue crabs out of season.

Morris leaves the wheel in the cuddy cabin and walks to the outside steering station on the starboard side. He wears tan camouflage overalls and a blue-brimmed white hat that says "United Refrigeration" across the front. Morris is clean-shaven, except for a close-cropped goatee that is going white, and he has sharp blue eyes that look right at you. As he gets ready to drop the dredge he handles the controls without looking.

The computer displays a random coordinate, and as Walstrum marks the spot with the GPS, Morris releases a long length of rattling chain from a drum in the center of the boat. The dredge rumbles over a roller at the stern and into about 19 feet of water. When the metal teeth dig into the bottom, the chain snaps tight and the *Mydra Ann* lurches, then regains her pace, pulling like a plow horse. Morris will drag the dredge for exactly one minute at exactly three knots. He has done this the

Long and low, the 45-foot *Mydra Ann* is a classic Bay workboat. Spring, summer, and fall she carries captain Roger Morris out for crab potting with his mate Eddie Weber. In winter, for the past four years, she's taken aboard experts like Chris Walstrum (opposite page) from the Maryland Department of Natural Resources and pulled up crabs to count for the winter dredge survey.

same way every time, for every dredge, for four winters.

Standing on the platform ready to bring up the heavy dredge are his regular crabbing mate, Eddie Weber, and Heather Brown of the DNR. While Weber comes from the Eastern Shore near Cambridge, Brown was born and raised in Canada, and she's not bothered by the winter weather, since she has "a bit of polar bear" in her.

When the dredge comes up Morris drags it behind the stern for a moment to wash it clean, and then hauls it aboard. Weber and Brown each grab an end of the metal dredge's cloth net and dump the contents onto the wide platform. There is a clatter of empty oyster shells and then silence. A single horseshoe crab, flat on its back, wags its prehistoric spike of a tail. But there are no blue crabs here. Not a one.

Where are the crabs? Is this simply a place where they chose not to bury themselves this winter, or is the empty dredge a sign that blue crabs are dwindling?

When blue crabs get scarce, people get nervous in Bay country. The Chesapeake is a tidal kingdom for crabs. Maryland and Virginia have recently landed some 50 to 60 million pounds of hard crabs between them in a single year. That's a good number of crabs, but only half of what the two states landed in 1993, when watermen

pulled in a reported 120 million pounds. From picking houses to soft-crab sheds to high-priced restaurants, there's a lot riding on the Bay's blue crab.

Knowing for sure how crabs are doing, and whether or not the population is stable or sliding, can only come after more than a thousand scrapes have sampled more than a thousand random sites — sites where crabs may or may not normally hide. That's the random part.

It's not easy for a crab hunter to dredge for crabs where he doesn't expect to find them, but Morris says that after four years he's getting used to it. He says it's the way it's got to be done.

Walstrum explains that the winter dredge survey uses a random sampling protocol to remove the human variable as much as possible. Consider, for example, if every survey captain went looking for crabs where he expected to find them. Some captains would have more luck, some less. In the end the survey would largely measure the varying skill and good fortune of the different survey teams. In addition, results would be biased toward a larger abundance of crabs, since undoubtedly all the captains would discover places where crabs congregate. If the survey teams were lucky, every year would look like a good year, says Walstrum.

To get a more objective reading, the surveyors use a method devised by fish-



Maryland and Virginia have recently landed some 50 to 60 million pounds of hard crabs between them in a single year. That's a good number of crabs, but only half of what the two states landed in 1993.

of Maryland and Virginia.

When Morris arrives at the next station he drops the dredge a second time. Again the chain snaps tight and the *Mydra Ann* digs in. Will this random walk along the Bay bottom turn up any crabs this time?

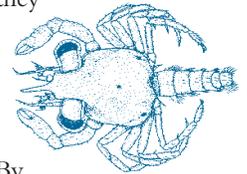
Looking south past Kent Island across the broad expanse of the

Bay and down toward Virginia, one wonders — how could anyone ever expect to count all the crabs in the Chesapeake?

Where Do Crabs Come From?

If place of birth means anything, practically every crab in the Chesapeake is a Virginian. All the Bay's female crabs migrate south to the lower end of the estuary to spawn during the warmer months, from June to September. Though scientists believe females mate only once, they can have multiple broods, and their production is prolific — as many as 8 million eggs per spawn, when things are working right. After spawning, crab larvae drift to sea, where they grow in salty seawater. Beginning in about mid-July, the year's crop of tiny crabs starts returning to the Bay, a homecoming wave that continues right through October and into November. At the end of their month-and-a-half larval sojourn, they metamorphose from what looks like an extraterrestrial flea to

something that resembles a cross between a shrimp and a crab (a megalopa). As the baby crabs return, they settle in underwater grass beds and other habitat in the lower Bay and continue to grow. By the time this crop of crabs reaches about three-quarters of an inch, about as big as a thumbnail, they begin to disperse into the Bay, though precisely what drives them — crowding or the search for food — remains unclear.



While Bay crabs are Virginians, many apparently move to Maryland for personal growth. Whatever the reason for their wanderings, by early autumn falling temperatures catch them and wherever they are they hunker down to hibernate.

Young crabs spend their first winter buried in the mud. In fact all Bay blue crabs, young or old, remain buried throughout the cold months, in a remarkable state of suspended animation. They don't move, don't feed. They barely breathe. As with all animals that hibernate, this capacity to wait, to slow down their physiology to just this side of death, allows them to make it through cold temperatures. Since they can't heat themselves metabolically, as warm-blooded creatures do, they have evolved a way to wait for warmer waters, when they can move again.

And move they do as Bay temperatures begin to rise above fifty-five degrees in the spring. A wave of crabs begins to emerge from the bottom, generally from south to north as the sun works its way back up from the equator. While some crabs are literally on a march up the Bay, scientists believe that many are simply emerging from their burrows as warmer temperatures gradually move



up the estuary. This south-to-north warming may make it appear that crabs are moving north when in fact they are just popping out of the mud in sequence, from the lower Bay to the top — like sports fans rising in a wave.

With warmer waters, crabs go into high gear. They feed and molt and grow. Last year's crop of tiny crabs will now mature rapidly and mate during the summer. In less than a year, this batch of crabs will go from drifting larvae to mature adults, capable of mating. After they mate, female crabs will travel back down the Bay. Most overwinter and spawn early the next summer, though some precocious females spawn before water temperatures drop. Then the cycle begins again.

Tracking crabs during all this seasonal coming and going presents a real challenge. In addition to the winter dredge, scientists use a number of other surveys to keep up with blue crabs. Both the

Maryland DNR and the Virginia Institute of Marine Science (VIMS) have run summer trawl surveys for many years, and George Abbe at the Morgan State Estuarine Research Center has run a crab pot survey since 1968.

These surveys, and especially the winter dredge survey, have proved crucial. In the past, resource managers relied largely on harvest reports to gauge the abundance of crabs in the Bay. Harvests are still an important barometer of blue crab stocks, but harvests respond to everything from weather to economics. When prices go down and costs go up, for example, crabbers may simply pull their pots.

Independent surveys paint a more accurate picture of the Bay's blue crab stocks by counting crabs the same way year after year, using statistically reliable methods. They also raise serious questions. Now that we can count crabs better than ever before, who will answer the question

of how many crabs constitute a sustainable population? How many crabs are enough?

Conflict Over Crabs

There is arguably no one who has tried harder than Tom Miller to count the Bay's blue crabs. As a researcher, he is on the receiving end of all those data collected by Walstrum and Morris and the small army of others who labor at surveying the blue crab. A researcher at the UMCES Chesapeake Biological Laboratory, he works out of a small office in Kopp House, a quaint white cottage on the shores of the Patuxent River. Stacked with books and reports, his desk sports a crab sculpture that raises bronze claws toward the ceiling. On the wall a bumper sticker proclaims, Attack Crab on Duty. Deskbound this morning, Miller has to adjust the blinds to dim the bright winter light that bounces off the Patuxent just outside the door.

The Case of the Missing Females



Skip Brown

Rom Lipcius is worried. He's been watching crabs for more than a decade, mostly looking for females. Now this fisheries ecologist from the Virginia Institute of Marine Science (VIMS) is worried because he isn't finding them.

At least not in the numbers he's hoping for: Of all the information gathered on the blue crab in the past twenty years, the data collected by Lipcius and his colleagues is almost certainly the most disturbing.

Every summer since 1988, from July through September, VIMS has towed a trawl net — 45 times each month — through the Bay's mainstem spawning area. This large swath of the southern Bay, which stretches from the Rappahannock River down to the Bay mouth, is where most Bay crabs spawn. For nearly a decade now, Lipcius and his colleagues have pulled up an average of less than one female crab per tow. Some might argue that they just don't know how to catch crabs. Not so. In 1990 the team netted eight female crabs per tow. In 1991 they averaged nearly three. But by 1996 just slightly more than one.

From eight to three to two to

less than one female crab per tow. That's a precipitous drop, but the bad news doesn't stop there. The worse news is that since 1998 the number hasn't risen. Year after year, the numbers have been in the basement, and that's why Lipcius is worried.

How worried, say on a scale of 1 to 10?

"Around an 8. The blue crab has lost its buffer," Lipcius says. This is worrisome, he feels, because there are threats that could take the stock even lower: shoreline development that destroys nursery areas; a loss of prey, such as clams, that crabs feed on; a change in food webs, including more competition from cow-nosed rays; a loss of seagrasses; and climate change.

And on top of all this is what Lipcius calls "compensatory fishing," the tendency to fish a stock harder as it declines. Since crabbers will try to take home the same catch, no matter how many crabs are out there, the lower the stock, he says, the higher the percentage taken by crabbers.

These low numbers of female spawners puzzle many in the crab research community. While harvests are below the period average of 1990-2005, they have not crashed. And the winter dredge survey, now the gold standard for counting crabs in the Bay, shows adult female abundance holding fairly steady since about 1994.

Why the discrepancy?

In the course of all his crab counting, the soft-spoken Miller has found himself smack in the middle of a noisy controversy. Disagreements over how blue crabs are doing — and whether recent declines reflect natural cycles or dangerous overfishing — have led to red-faced debates among watermen, researchers, environmentalists, and resource managers. And those debates have drawn the combatants to the types of studies that clutter his desk.

With a kind round face, spectacles, and close-cropped thinning hair, Miller looks at home here in his casual V-neck sweater, but it's been a long road to this perch on the Patuxent. Unlike Roger Morris or Chris Walstrum, Miller did not rise from the shores of Dorchester County or Kent Island. Born in Southeast London, Miller is the son of a London cab driver and, along with his sister, the first in their family to attend college. When he was about five his family moved downriver

In the mid-1990s, many watermen reported that they were fishing harder and longer to catch fewer crabs, and some scientists warned that the stock could be nearing collapse.

past Greenwich, and he still remembers playing by the marshes along the Thames. "It wasn't like this," he says, indicating the broad Patuxent just outside the window. "It was more like New Jersey."

Nevertheless, an interest in nature and in things marine stayed with him, and he is now a well-regarded expert. His expertise: the population dynamics of fish — and crabs.

When Miller came to the Chesapeake in 1994, he could not foresee the central role he would play in the great two-state

debate over the blue crab. The question at the center of that debate: how much fishing pressure can the Bay's crab stocks withstand?

In the mid-1990s nervousness over the heavily fished blue crab had reached a fever pitch. Many watermen reported that they were fishing harder and longer to catch fewer crabs, and some scientists warned that the stock could be nearing collapse. Other watermen said crabs were fine, and some scientists stated that the stock decline was just part of a long-term cycle. Decision makers heard contradictory arguments from both scientists and watermen, as concern rose among seafood processors, environmental groups, and the general public.

While many watermen shared those worries about the crab, they also feared that new regulations could curb their catch. To address the controversy, the Chesapeake Bay Commission formed the

First, according to researchers like Tom Miller at the University of Maryland Center for Environmental Science, harvests can stay at least somewhat constant in the face of stock declines, because crabbers will simply work harder to catch a similar amount of crabs.

Second, female blue crabs are prodigious spawners. They can produce as many as 8 million eggs or so per female, and even though they mate only once, they store the inseminating fluid and can spawn several times. That's a lot of eggs, even from a relatively small confederacy of females. Since we have not witnessed a collapse of the stock, Lipcius explains, there are evidently enough eggs to keep the population going.

For now.

The worry, according to researchers like Lipcius and Miller, is that there is bound to be a threshold somewhere, a tipping point beyond which a loss of spawning females will mean a loss of adequate egg production. We just don't know where we will hit that threshold.

If do we approach that tipping point, will there be any warning? No, says Lipcius, and Miller agrees. It's likely that stocks would continue at a steady level until female crab abundance dropped below a certain point. The only warning would probably be numbers of years of low female crab abundance — precisely the kind of data the VIMS trawl survey has turned up since the early 1990s.

According to Lipcius, an environmental factor, such as dying seagrasses or the degradation of nursery areas by development,

could push the blue crab over the edge. If this does happen, there will not likely be a quick rebound, he says, because all these factors — climate, habitat, fishing — would operate to keep crab numbers down.

In fact, he says, we may already be seeing what he calls an equilibrium shift, a slide toward a new, lower level for blue crabs that may be difficult to bring back.

What should be done? For one thing, Lipcius says, we should do more to protect spawning females. The Blue Crab Subcommittee of the Virginia Marine Resources Commission has made a formal recommendation to do just that. The subcommittee, on which Lipcius serves, wants to extend the spawning sanctuary for blue crabs from its current limit at the Bay mouth clear down to the North Carolina border. This is because surveys have found large numbers of egg-bearing females (called sponge crabs) close along the Atlantic shore. During the summer the seashore is evidently a hotbed for spawning blue crabs.

Lipcius says that the subcommittee is also recommending a new review of Virginia's crab regulations, to make sure that they are all working in concert to protect the spawning stock. Lipcius, who was instrumental in establishing the summer spawning sanctuary in the Virginia portion of the mainstem Bay, leaves us with a word of caution. The sanctuary, he says, will only protect female crabs if we let them live long enough to make it that far.

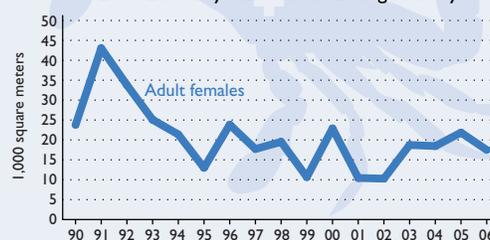
—J.G.

Tracking the Abundance of Adult Female Crabs

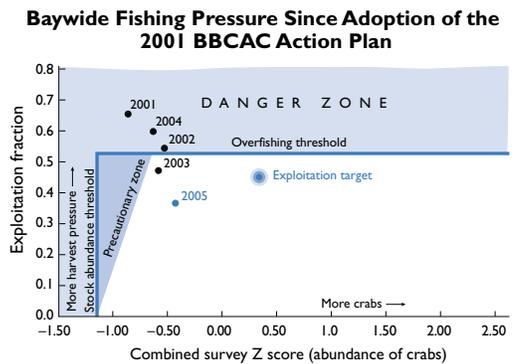
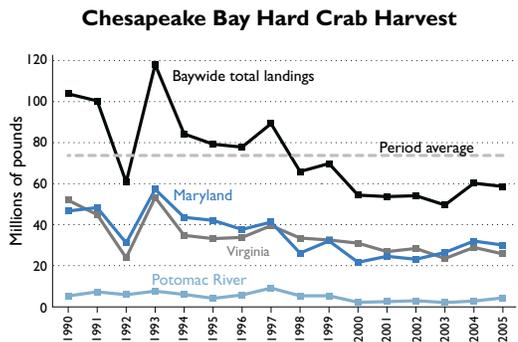
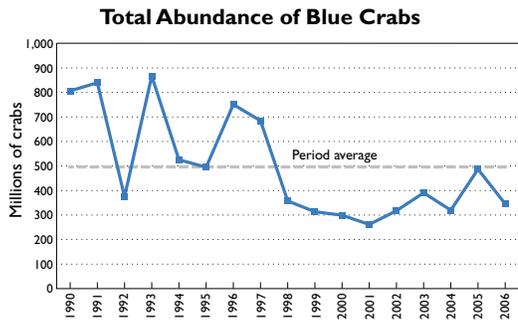
2005 Virginia Summer Trawl Survey



2005-2006 Baywide Winter Dredge Survey



Down and staying down has been the story for female crabs in the lower Bay, according to the summer trawl survey undertaken by the Virginia Institute of Marine Science each year (upper graph). The picture does not look quite so grim in data from the winter dredge survey (lower graph), but the two graphs may each have a story to tell. According to some experts, it may be that female crabs are just not making it down to the spawning grounds because of high fishing pressure. Other concerns, such as loss of habitat and shifting food webs may also play a part. Whatever the reason, these low survey numbers are worrisome for the Bay blue crab despite a recent lessening of fishing pressure. GRAPHS REPRINTED, WITH PERMISSION, FROM BLUE CRAB 2005 STATUS REPORT, BI-STATE BLUE CRAB TECHNICAL ADVISORY COMMITTEE, CHESAPEAKE BAY COMMISSION.



Health charts for the Chesapeake blue crab show that abundance (top graph) persists at below-average levels. Harvests (middle) have also fallen. The good news is that in 2005 fishing pressure (bottom schematic) fell below the target recommended by the Bi-State Blue Crab Advisory Committee in 2001. If fishing pressure stays down, stocks should rise, unless other environmental factors are at play. GRAPHS REPRINTED, WITH PERMISSION, FROM BLUE CRAB 2005 STATUS REPORT, BI-STATE BLUE CRAB TECHNICAL ADVISORY COMMITTEE, CHESAPEAKE BAY COMMISSION.

Bi-State Blue Crab Advisory Committee (BBCAC), chaired by Delegate John Wood, Jr. from Maryland and Delegate Robert Bloxom from Virginia. BBCAC, as it came to be called, brought together legislators, scientists, watermen, seafood processors, and resource managers to seek consensus.

Miller, with his quiet manner and steady focus, played a central role in providing the group with understandable estimates of Bay crab stocks and fishing pressure. He led meetings of researchers from

different laboratories around the Bay to reach an important consensus: that there was a point at which fishing pressure could threaten the blue crab, and we were right on that danger line.

In countless meetings Miller presented this warning to politicians, to environmentalists, to watermen. The force of this and other scientific information led the Bi-State Committee in 2001 to issue an Action Plan for managing the Bay's blue crab fishery. The plan called for establishing the first-ever Baywide thresholds for the blue crab fishery.

"It was remarkable to see Tom Miller's evolution," says Ann Swanson, Executive Director of the Chesapeake Bay Commission. "Just to see how much he grew in terms of explaining these complex ideas in his head, and how he was able to express all those ideas in a way that people could understand."

Miller gives a lot of credit for the success of BBCAC and the work that followed it to the strong state and federal funding support that researchers have received and to the good science that's come out of it. "We wouldn't be having this conversation," he says, "without all this work that's gone on for the last ten years."

Though Miller is a modest man, and declines to take credit for the importance of his role in the crab debate, in 2001 UMCES presented him with the President's Award for Excellence in the Application of Science.

In 2005 Miller and other researchers released a new analysis of Bay crab stocks, funded by the Chesapeake Bay Office of the National Oceanic and Atmospheric Administration (NOAA). This assessment confirmed that fishing pressure on the Bay's blue crab stock had reached dangerous levels during the late 1990s and early 2000s.

Correcting for changes in past record-keeping, the researchers found that the biggest catch of blue crabs occurred back

in 1966, and the lowest came in 2001. In fact, 2000, 2001, and 2002 catches were all at the bottom of the list. Miller and his colleagues found that fishing pressure — at its worst when stocks are low and fishing effort is high — crossed into the danger zone three times: in 2001, 2002, and 2004.

In Miller's words, in the years immediately prior to 2005 we had been "skating on thin ice." In 2005 fishing pressure dropped below the target, and the stock size increased enough to move away from the precautionary zone (see graph at left).

Even with recent improvement in the stock, the Bay's blue crab population continues to linger below the long-term average.

Having spent more than a decade laboring to understand the blue crab population, Miller still worries about how we manage the Chesapeake's great crab factory. In particular, he asks, when will we establish a well-thought-out target for fishing pressure, a level that will allow productive harvests without threatening the crab stock?

In fisheries science a target represents where you *do* want to go, in contrast to a threshold, which defines where you *don't* want to go.

The thresholds drawn by BBCAC set the limits of fishing pressure and of stock size. BBCAC also set a target that would keep fishing pressure comfortably below the danger line — and preserve 20 percent of the spawning stock to ensure future generations of blue crabs.

The thresholds and the target were major accomplishments, says Miller, but he still isn't fully satisfied. The target may be right in terms of general stock dynamics, he says, but he's disappointed that it doesn't do more. "What kind of fishery do we want to manage for?" he asks. "Do we want more hard crabs or more soft crabs? Do we want more protection of females? In certain places? At certain times?"

His biggest disappointment is that in the Chesapeake Bay, and especially with BBCAC no longer funded, there is no effective forum for discussing these issues or making these choices. "We need to move forward collaboratively [working

Tracking Crabs on the Move

It's hard enough for scientists to count blue crabs in winter, when the crabs are sitting still. It's even tougher to track them the rest of the year, when they're on the move. But that's what researchers must do if they are to understand the basic elements of blue crab biology — behavior, migration patterns, and growth. This is a daunting challenge, since the Bay is 200 miles long, with countless creeks and coves where crabs can hide.

Anson "Tuck" Hines and his colleagues at the Smithsonian Environmental Research Center (SERC) have searched for crabs on the move, using every trick in the book. They have tagged young crabs by injecting them with tiny microwires and elastomer paints. They have marked older crabs with large metal labels and strapped electronic transmitters on their backs.

For those of us who wonder what blue crabs do during the day and where they go, Hines and his colleagues have come up with a surprising number of answers.

Working with colleague Tom Wolcott of North Carolina State University, the research group has followed female crabs with data-logging backpacks all the way down the Bay. Coupled with tag returns from watermen, the study showed that inseminated females tended to move along the Bay's deep channel, mostly the Eastern edge — and mostly they walked. From mid-Bay this slow crawl can take more than a month.

Hines's group has also tracked small crabs coming the other way, heading north from Virginia. For three years SERC Researcher Eric Johnson has used trawls and seines to spot juvenile crabs as they migrate up the Bay. He's watched them arrive in the Potomac, beginning in late August and continuing through September and October. He's followed them north to the Magothy River, above Annapolis.

Hines and Johnson want to know: Are these young crabs walking? Swimming? Do they favor the Eastern or Western shores?

Johnson found some answers by trawling for small crabs as they passed between Cove Point and Taylor Island, where the Bay narrows. He caught a number of these intrepid juveniles in the middle of the Bay, he says, traveling at the surface, at night, on a flood tide. They appeared to ride the tides like a conveyor belt, Johnson says, to get up the Bay. Though preliminary, these findings fit well with other research that shows larval crabs moving out of the Bay and then back in, as they ride Bay and ocean currents.

But tracking crabs as they move through the whole Bay is tough work. What if scientists could shrink the nation's largest estuary down to the size of one small tidal tributary and then track the movement, behavior, and distribution of crabs?

Hines and his colleagues have in a sense

done just that. Their miniature Bay is the Rhode River, south of Annapolis, where SERC resides. Hines has set out to determine how many crabs are in this one river; how they distribute themselves, and when they come and go.

During the past two years they have tagged a remarkable 5,137 crabs. Even more remarkably, over 2,400 have come back to them — a very high rate for such surveys. Of those returned, 31 percent came from recreational crabbers. Given the information they get from both recreational and commercial crabbers,

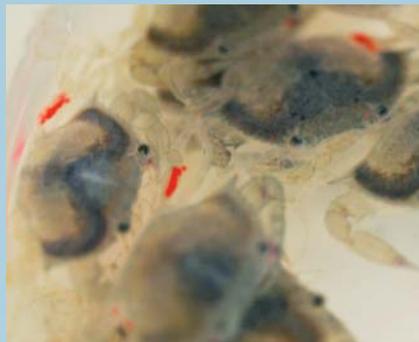
Hines and his group can document how many crabs were caught using trotlines or crab pots, or by week-enders dangling a chicken neck.

All this tracking has led to a detailed picture of crabs in this one tributary. Hines estimates that there are about 60,000 to 120,000 adult crabs in the Rhode River; over an area of about 585 hectares. Work in the river has also shown that blue crabs tend to "partition" themselves by sex and by size.

Their crab census has also calculated an average fishing rate in the river — about 58 percent over two years. That's in line with removal rates often seen in the whole Bay, says Hines. It's also well above the 46 percent fishing target recommended by the Bi-State Blue Crab Advisory Committee in 2001. At times, he says, fishing pressure in the river can be "intense."

For about five years Hines and his team have worked with homegrown crabs produced by a crab hatchery led by Yonathan Zohar and Oded Zmora at the University of Maryland Center of Marine Biotechnology (COMB). They've also collaborated closely with Rom Lipcius and Rochelle Seitz at the Virginia Institute of Marine Science (VIMS) to compare blue crab ecology and the fate of released hatchery crabs in the upper and lower portions of the Bay. These hatchery crabs provide a unique opportunity to study growth rates and survival because they are all of a known age.

The team tags small juvenile crabs with a microwire that stays with the crab even through molting. They detect these microwires



Hair-thin injected microwires (above) that a metal detector can sense and injected red elastomer (above left) are two methods used to mark small crabs for recapture. Thousands of tiny crabs come from a hatchery at the University of Maryland Center of Marine Biotechnology, where researchers spawn and raise them in closed systems. Scientists at the Smithsonian also mark large crabs with external tags (below left) — and offer cash rewards for their return.



Photos by Alicia Young

by waving a wand-like metal detector over the crabs, and they can even locate them after a small crab has landed in the belly of a fish. They also tag different hatchery classes (cohorts) — up to tens of thousands of crabs — by injecting their legs with tiny drops of different-colored elastomer paints.

They can distinguish between crabs that stay near or journey far, go deep or stay shallow, burrow in bare sites or seek out woody debris.

Their hope, Hines says, is to be able to replicate this information about movement and behavior for other tidal tributaries around the Bay, to develop a more detailed picture of how crabs behave in the Chesapeake.

Our understanding of crab ecology has come a long way, according to Hines. So has our application of science to policy. He gives credit to researchers like Tom Miller at the University of Maryland Center for Environmental Science who have taken on the challenge of Baywide blue crab stock assessment. And to the winter dredge survey conducted by the Maryland Department of Natural Resources and VIMS, which despite its limitations, is the best measuring tool we have, he says. He points to major funding from Congress and federal and state agencies that has brought great advances in data collection and research during the past two decades.

"Go back and read William Warner's book, *Beautiful Swimmers*," he says, referring to the 1976 classic. "We've learned a lot since then."

— J.G.

with the watermen],” he says. “This is our biggest challenge.”

End Game

Aboard the *Mydra Ann*, the crew hauls the Virginia dredge over the roller and onto the wide stern. Weber and Brown each grab a side of the net and spill oyster shells onto the platform, but this time there are a few live oysters in the pile and dangling from the net two good-sized male crabs. Weber pulls them off and sets them down so Walstrum can measure and weigh them.

The bigger one measures 159 mm (over 6 inches) from spine to spine and weighs in at 272 grams (almost 10 ounces) — definitely a keeper if this were summertime and you were stocking up for a crab feast. But this is a survey, not a hunt, and Walstrum flicks the Jimmie crabs back into the water. Will they survive? Hard to say, he says. Walstrum believes that the smaller the crab the better chance it has. Then again, the water’s not too cold so far this winter — with any luck the crabs will seek the mud and wait for spring.

The *Mydra Ann*, almost 14 feet wide and powered by a 375-horsepower Caterpillar diesel, steams steadily from station to station through one-foot seas. When headed up-wind, the cuddy cabin helps to block cold spray thrown back from the bow. Inside the cabin a heater keeps the crew warm between stations, though it’s not too cold today. Not like some days, when they endure freezing rain or snow. According to the crew, it has to blow a gale before they’ll call off a survey trip.

It’s also unlike other days when a single dredge may bring up as many as a 100 crabs. On those runs Morris has to power around in circles until they can count and measure them all.

The next scrape is not one of those big hits, but a half dozen crabs come aboard, including a male with a bent claw and a large female (called a sook). Though the winter dredge survey cannot tell us why these crabs have come to the deeps off Kent Island, it provides us with the concrete particulars. It shows, without preju-

dice, where the females are in winter, where the males are. Because hibernating crabs don’t move, it allows the design of a random survey, plotted over miles of Bay bottom.

The results have been remarkable. Thanks to the winter dredge survey resource managers now have some confidence that they can approximate how many crabs (see graph, p. 10), and of what size and sex, inhabit the Chesapeake Bay.

Despite our new knowledge, mysteries remain. We still can’t determine the age of blue crabs, and we still don’t know how old they get. We don’t fully understand the effects on blue crab stocks of prolonged periods of low dissolved oxygen or dying Bay grasses. Most importantly, researchers are not certain what’s happening to female crabs in the Chesapeake. While the winter dredge survey shows female crab numbers evening out, an annual assessment by VIMS shows a disturbing picture of decline that has lasted more than a decade. (See “The Case of the Missing Females, p. 8.”)

As Roger Morris powers the *Mydra Ann* back to the Kent Narrows marina, he too voices concern. He knows a half dozen watermen who have left the crab business and gone to work on tugboats. It’s a steady job and it keeps them on the water. “The water is all they know,” he says.

Morris sees fewer and fewer young people going into commercial fishing, and as he turns into his slip he says, “Just look at the boats in this marina. They’re all run down. It’s a shame.”

Working the water, he says, “it’s history.”

And yet there are still blue crabs in the Chesapeake. Sooks still migrate toward the sea each fall, and a new crop of crabs moves up the Bay each spring, spreading into countless rivers and creeks, where even children can catch them with a chicken neck. So far blue crabs keep playing their role in the food web, as key predators and scavengers. And as long as there are blue crabs in the Bay, we have to believe that there will be men like Morris who, despite the economic odds, will go out to catch them. This is because one

mystery surrounding blue crabs remains — how they take whatever they find on the bottom of the Bay and through some divine alchemy transmute it into the sweetest seafood. If we can find the right balance between catching crabs and conserving them, we can only hope that this magic will endure. ✓

For More Information

Blue Crabs in the Chesapeake (Maryland Sea Grant), www.mdsg.umd.edu/crabs
Annual Blue Crab Status Reports and publications from the Chesapeake Bay Commission, www.chesbay.state.va.us/crabPubs.htm

General Background from the Chesapeake Bay Program, www.chesapeakebay.net/crabshell.htm
Blue crab research at SERC, www.serc.si.edu/labs/fish_invert_ecology/bluecrab/overview.jsp

Blue crab research at COMB, www.umbi.umd.edu/%7Ecomb/programs/aquaculture/bluecrab.html
Stock Assessment Report, <http://hjordt.cbl.umces.edu/crabs/Assessment05.html>
About the Bi-State Blue Crab Advisory Committee, www.chesbay.state.va.us/bbcachistory.htm

Maryland Crabbing Information and Regulations, www.dnr.state.md.us/fisheries/crab/crabindex.html

Virginia Regulations, www.mrc.virginia.gov
Virginia Trawl Survey, www.fisheries.vims.edu/rawlseine/mainpage.htm

Paper on the Bi-State Blue Crab Advisory Committee: Betsi Beem. 2006. Planning to Learn: Blue Crab Policymaking in the Chesapeake Bay. Coastal Management, 34:167-182.



Michael W. Fincham

A team of researchers, led by Elizabeth North (shown above with a jar containing crab larvae), is currently tracking tiny blue crabs that drift offshore and then journey back into the Chesapeake and Delaware bays. Learn more about this regional effort supported by the Sea Grant programs of Maryland, Delaware, and Virginia at http://northweb.hpl.umces.edu/research/BlueCrab_SG.htm

Knauss Fellows 2007

Knauss Marine Policy Fellowships for 2007 were awarded to three graduate students in Maryland, all at the University of Maryland. The fellowship was established in 1979 and is coordinated by the National Sea Grant Office of the National Oceanic and Atmospheric Administration (NOAA). Named for John A. Knauss, a former NOAA administrator, the program provides graduate students across the country with an opportunity to spend a one-year paid fellowship working with policy and science experts in Washington, D.C.

Lauren McChesney is spending her fellowship year with the Marine Mammal Commission under the supervision of the Executive Director, Tim Ragen. Lauren will have the opportunity to work on a variety of issues, including climate change effects on Arctic marine mammals, possible reauthorization of the Marine Mammal Protection Act, and development of U.S. policy for the 2007 meeting of the International Whaling Commission. McChesney completed a B.S. in Biology with a concentration in Environmental Science at SUNY Cortland in 2003. She finished a wetlands analysis project in the Adirondacks before entering the MEES program at the University of Maryland in 2004. With her advisor, Dr. Katia Engelhardt, McChesney monitored the invasion and expansion of the submersed aquatic weed, *Hydrilla verticillata*, at Otter Point Creek, Maryland, and studied the effects of sediment particle size and nutri-



ents on the competitive abilities of Hydrilla and a native species, *Vallisneria americana*. She is currently writing her thesis and will receive her M.S. in 2007.

David Kidwell began work at NOAA's Center for Sponsored Coastal Research (CSCOR) in the hypoxia research program. He is helping assess the ecological impacts of hypoxia in the Gulf of Mexico and develop future research and management strategies for the program. Kidwell obtained his B.A. in Biology from the



University of Maryland, Baltimore County in 2001, during which time he volunteered as an aquarist assistant at the National Aquarium in Baltimore. After graduation, he worked for several years as a park ranger in Anne Arundel County Maryland. He began work on his M.S. degree in the MEES program in 2004 and has been conducting his research at USGS Patuxent Wildlife Research Center (PWRC) under Dr. Matthew Perry. Kidwell's thesis research is focused on the distribution and habitat use of surf scoters in Chesapeake Bay. In addition to his thesis work, he has participated in a variety of seaduck related research at PWRC, including satellite telemetry and food habits, as well as salvaging scoter eggs in Saskatchewan, Canada, for use in a captive colony. Kidwell is writing his thesis and will graduate in 2007.

Tom Smerling joined the National Ocean Service's Office of Special Projects (SP), under SP Director Dan Farrow. He is providing support to the Gulf of Mexico Alliance, a regional partnership



formed to enhance the ecological and economic health of the Gulf, and he will staff other projects as well.

Smerling comes to NOAA with an extensive background in public policy. A graduate of the University of Minnesota, and a former Humphrey Scholar at the Hubert H. Humphrey Institute of Public Affairs, he moved to Washington, D.C. where he served as a Leadership Fellow in the American Enterprise Institute's foreign policy program and a Senior Consultant at the National Democratic Institute for International Affairs. Subsequently he founded and directed for 13 years a think tank on U.S. Middle East policy.

As an M.S. candidate in Sustainable Development and Conservation Biology at the University of Maryland College Park, Smerling and a team of students recently developed a resource manual for the U.S. Fish and Wildlife Service for estimating the impact of sea level rise on coastal wildlife refuges, including a new quantitative model. His research interests include estuarine ecology and marine mammal conservation.

For more information about Knauss Marine Policy Fellowships, visit the web at www.mdsg.umd.edu/Policy/Knauss.

Meet the Editor of The Blue Crab

The Man Behind the Book

By Jack Greer

The less this is about me, the better.” So said Vic Kennedy as he sat down to be interviewed about the new book he has just edited, an extensive reference work on the blue crab. It’s the most comprehensive text ever published on this — or any other — species of crab.

Those who know him well know that Kennedy does not care for grandstanding and doesn’t have much patience for self-aggrandizement. A senior researcher at the University of Maryland Center for Environmental Science (UMCES), he is the author of numerous journal articles and the editor of many proceedings, reports, and books, including *The Blue Crab: Callinectes sapidus* and an earlier, equally comprehensive reference work, *The Eastern Oyster: Crassostrea virginica*.

Sitting in the library at the UMCES Horn Point Laboratory, wearing blue jeans and a muted shirt, Kennedy projects a comfortable presence. At the same time his gray eyes, intent behind his glasses, hint at a certain tenacity. Vic Kennedy has a sharp dry wit, a capacious mind, and some forty years experience as a scientist and scholar.

Most of that career has been spent here at Horn Point, on Maryland’s Eastern Shore, and most of his research has focused on shellfish, including oysters and crabs. For seven years he directed the ambitious interdisciplinary project known as MEERC (Multiscale Experimental Ecosystem Research Center) — a study of how scale and size affect the function of both natural and experimental ecosystems. And from 2002–03, he also served as the Director of the Cooperative Oxford Laboratory, a federal-state partnership in Oxford, Maryland. Through all these positions he has managed to return to what

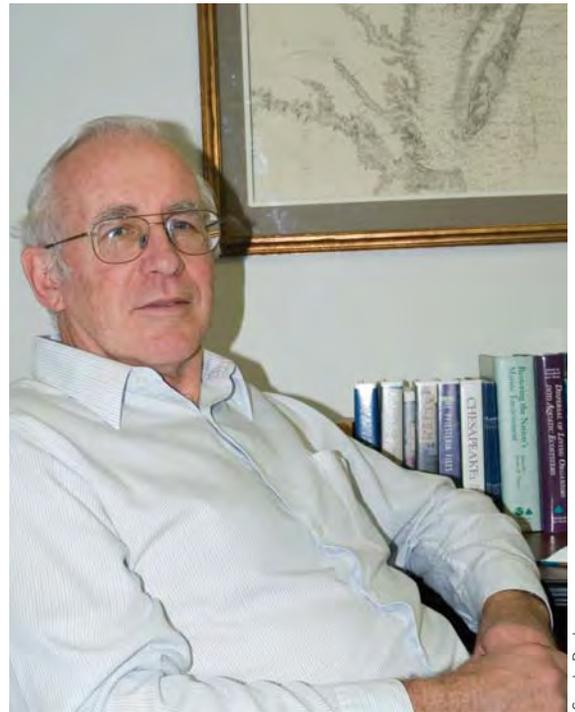
he enjoys — biological research, scientific writing, and a level of scholarly synthesis that has brought him wide respect among his peers.

It’s been a long journey since Kennedy first came to the Chesapeake Bay as a graduate student looking for a job.

The year was 1965, and well-known Bay scientist Joseph Mihursky was looking to hire some help. At that time Mihursky was a new faculty member at the UMCES Chesapeake Biological Lab (CBL), studying the effects of thermal pollution from the Chalk Point power plant on the Patuxent River. He had a grant to gather baseline data, and he needed an up-and-coming researcher to help. Kennedy, a doctoral student at the University of Rhode Island (URI), needed a place to finish his research on bivalve physiology.

And so Kennedy — who was born in Britain, raised in Canada, and received his graduate education in New England — found his way to CBL’s remote Hallowing Point Field Station on the Patuxent River. At that time there was no bridge across the lower Patuxent linking Solomons to the growing population south of the river, and the development boom that would one day hit Calvert County was still far off in the future. Kennedy came to a quieter, more pristine Bay.

The Bay and its marine laboratories would eventually bring him back. After returning to URI to complete his dissertation, he accepted a three-semester visiting



Sandy Rodgers

Books that synthesize have always held a fascination for Professor Victor S. Kennedy. This year will see the release of *The Blue Crab: Callinectes sapidus*, edited by Kennedy and the late L. Eugene Cronin. Kennedy, a researcher at the University of Maryland Center for Environmental Science, also served as the lead editor of another major synthesis, *The Eastern Oyster: Crassostrea virginica*.

professorship at Chapman University in California. He then returned to CBL for a year before heading off in 1973 for two post-doctoral stints, one in New Zealand and one in Newfoundland. In 1976, he came back to the Chesapeake, to Horn Point, where he would make his home for the next thirty years and more. During this time he set out on another kind of journey, one tied to his love of books.

“I’ve always had an affinity for books,” he says, “and for books that synthesize.” As a graduate student Kennedy came across the 1964 landmark work, *The American*

Oyster, by Paul Galtsoff, and he was immediately impressed by its scholarship. He also speaks fondly of Joel W. Hedgpeth's *Treatise on Marine Ecology*, a two-volume work — one on ecology and the other on paleoecology — published in the 1950s.

When Kennedy speaks about such works he gets excited — the way an English major might get excited about a poetry anthology. It's clear that books mean something to him. This passion is not simply for words but for synthetic thinking, and it repeatedly led him into the role of scholarly editor.

When scientists at CBL started the journal, *Chesapeake Science* — which became *Estuaries*, and now *Estuaries and Coasts* — Martin Wiley, the editor, asked Kennedy to become an associate editor. That was in 1976, the same year that Kennedy took his position at Horn Point. He was also tapped to edit proceedings of the new Estuarine Research Federation (ERF). After each biennial national meeting he would lug back a satchel of papers, and then start sending them out for review. He took pride in getting good reviewers for each paper, and in getting out each proceedings within the year. He worked with a contractor to prepare the camera-ready copy, and viewed all this as part of the creative process.

In 1986, Kennedy succeeded Bob Kendall as editor of the *Transactions of the American Fisheries Society*. He learned a lot from Kendall, who would cover submitted papers with comments and corrections. He saw how good editing can make language sharper, better.

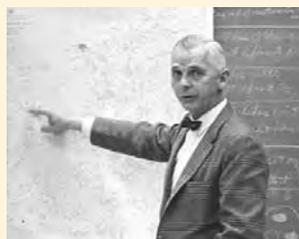
Kennedy — whose mother was a teacher — has a keen eye for faulty grammar and shoddy spelling. Holding up a paper at arm's length, he adds, "I'm not bragging, but I can spot spelling errors at a glance."

He feels fortunate that he's worked with colleagues who appreciate the importance of editing, synthesis, and this brand of scholarship. Not every administrator does. Many think of editing as a "second-rate activity," he says.

"I've always looked at editing as a creative activity," says Kennedy.

L. Eugene Cronin Scholar and Gentleman

Co-editing the new blue crab book with Victor S. Kennedy is L. Eugene Cronin, or simply Gene to those who knew him. A native Marylander, Gene Cronin played a pivotal role in the advancement of marine science in both Maryland and Delaware. He



Gene Cronin, 1917-1998.

He began his career in 1943 as a biologist at the Chesapeake Biological Laboratory (CBL), at that time a state lab. In 1950 he moved to the University of Delaware to establish the marine laboratory at Lewes, which later became the College of Marine Studies.

When Cronin returned to CBL in 1955, he became its director, following Reginald V. Truitt, who founded the lab in 1925. In this role Cronin oversaw CBL's affiliation with the University of Maryland in 1961 and served as the first head of the Natural Resources Institute, the forerunner of the UM Center for Environmental Science.

Cronin later served as the head of the Chesapeake Research Consortium, and even after retirement he remained active in Bay science and policy. His influence helped to shape the Chesapeake Bay Program and the course of Bay fisheries policy. In 1994 he won the prestigious Mathias Medal in recognition of lifelong scientific contributions to Bay management. His special interest throughout his career was the blue crab.

During the late 1990s, Cronin and Vic

Kennedy came together in common purpose to undertake a capstone effort, the compilation of the first-ever reference text on the blue crab, *Callinectes sapidus*. With characteristic energy and focus, Cronin helped to pull together an advisory group of researchers, including

Charles Epifanio, Anson "Tuck" Hines, Romuald Lipcius, and the late Austin Williams. Cronin also launched a personal campaign to raise funds for the book's publication. He succeeded in securing generous support from the Fairplay Foundation, the National Oceanic and Atmospheric Administration's Chesapeake Bay Office, the Chesapeake Bay Foundation, the Maryland Department of Natural Resources, I.T. Todd, and Edmond Stanley, as well as from the Maryland Sea Grant College and others.

Cronin did not live to see the blue crab book take its present shape. In December 1998 he passed away at the age of eighty-one, in his hometown of Annapolis, Maryland. His presence permeates the book, however, and it will stand as a lasting reminder of his commitment to the advancement of our knowledge about the blue crab.

The book is dedicated to the memory of L. Eugene Cronin.

— J.G.

He went on to make major contributions not only in peer-reviewed research articles but also in key works of synthesis. He authored *Maryland's Oysters: Research and Management*, in which he and his colleague Linda Breisch scrutinized the management of the state's oyster industry and key research needs. In a seminal paper, "Sixteen Decades of Political Management of the Oyster Fishery in Maryland's Chesapeake Bay," Kennedy and Breisch called attention to the warnings of scientists about the potential collapse of the oyster fishery and how over many years those warnings were largely ignored.

After the oyster, Kennedy turned his attention to a major species for which there existed no in-depth reference volume, the Bay's famed blue crab. The need was clear to Kennedy, who worries that most people don't even realize just how many crabs once flourished in the Bay. The urgency was also obvious to long-time researcher, L. Eugene Cronin, a well-regarded expert on blue crab biology. He was also the director of CBL when Kennedy first showed up as a graduate student back in the mid-1960s.

Cronin played an important role in Kennedy's early career and became a lead-

continued on p. 16

Man Behind the Book, *continued*

ing figure in the Chesapeake research community. (See “L. Eugene Cronin: Scholar and Gentleman,” p. 15.)

“Gene was a good guy,” Kennedy says. “He paid attention to people at my level [graduate students]. He spoke to me. He welcomed me. He listened to talks that graduate students gave at professional meetings.”

Kennedy would know Gene Cronin for some thirty years before Cronin’s death in 1998. It was toward the end of that long relationship that the two men resolved to edit a book on the blue crab.

The book was years in the making. Before his death, Cronin helped set the book’s shape and to garner funds for its publication. Kennedy and Cronin pulled together experts from across the continent to write chapters on evolution, anatomy, growth, reproduction, disease, and other aspects of the crab’s biology, ecology, and management.

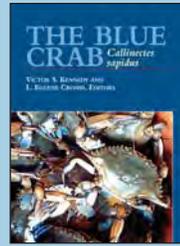
When Cronin died, Kennedy was on his own. Characteristically, he did what he does so well — not only did he co-author three chapters but he oversaw the rigorous review of each submission, editing,

proofing, confirming permissions, examining graphics, more editing, indexing, and checking, checking, checking.

“Vic Kennedy deserves enormous credit for his patience, persistence, and skill in editing this book,” says Anson “Tuck” Hines of the Smithsonian Environmental Research Center, author of one of the book’s chapters and co-author of another.

No doubt preparing the 800-page book tested both his patience and his perseverance, but Kennedy’s affinity for books has not faltered. He still believes in their value — even in the face of an explosion of electronic media and a new reliance on the Internet. He worries about the ephemeral nature of digital information. “I can go and find a copy of a 19th century report by the U. S. Commission on Fish and Fisheries,” he says, “but if I have a disk that’s fifteen years old, I have to search for a machine that can read it.” He notes that the Library of Congress is also very concerned about this loss of digital informa-

New Reference Book



The Blue Crab:
Callinectes sapidus
Victor S. Kennedy and
L. Eugene Cronin, editors
Published by Maryland Sea Grant

An essential resource for researchers, students, and managers, this book is the first truly comprehensive reference work on the blue crab, *Callinectes sapidus*. The 800-page, hard cover, 8-1/2 x 11 volume contains hundreds of drawings and photographs (some in color), plus subject and species indexes. Chapters cover systematics; anatomy of larval, juvenile, and adult stages; molting and growth; reproduction; diseases and parasites; physiology; ecology of all life history stages; history of blue crab fisheries in the U.S.; and population dynamics. To order a copy of the book, which sells for \$125.00, visit the web at: www.mdsg.umd.edu/store/BC/ or call 301.405.6376. Copies will ship in late April 2007.

tion, information that may exist only on a disk somewhere.

Kennedy says he hopes that the new crab book, along with the oyster book he edited with Roger Newell and Albert Eble, will provide the same satisfaction for future scholars that he experienced starting out — the same intellectual jumping off place he found in works by Galtsoff and Hedgpeth. ✓

Send us your comments — visit *Chesapeake Quarterly Online* at www.mdsg.umd.edu/CQ

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