CHESAPEAKE BAY LIVING RESOURCES 1999

ANNUAL REPORT

Prepared by the Living Resources Subcommittee
Chesapeake Bay Program

November 2000

EXECUTIVE SUMMARY

The Chesapeake Bay is North America's largest and most biologically diverse estuary, home to more than 3,600 species of plants, fish and animals. For more than 300 years, the Bay and its tributaries have sustained the region's economy and defined its traditions and culture. It is a resource of extraordinary productivity, worthy of the highest levels of protection and restoration.

The CBP's Living Resources Subcommittee is committed to the restoration, enhancement, protection and management of the living resources of the Chesapeake Bay. Living resources include fish, invertebrates, waterbirds, as well as submerged aquatic vegetation (SAV), wetlands, and other shoreline and riverine systems that are important to water quality and fish and wildlife habitats. In cooperation with Bay Program partners, the LRSc supports the restoration of streams, wetlands, SAV and aquatic reefs, and the removal of dams and stream blockages to support fish passage. The subcommittee also guides the development of Chesapeake Bay-specific fishery management plans. Its biological monitoring and ecosystem modeling programs contribute significantly to the understanding of the Chesapeake Bay's living resources and their interrelationships with one another, the land and water.

Ten workgroups, and the Chesapeake Bay Stock Assessment Committee (a joint committee with the National Oceanic and Atmospheric Administration), support the LRSc. The workgroups are: Aquatic Reef Habitat; Ecosystem Modeling; Exotic Species; Fish Passage; Fisheries Management Plans; Habitat Objectives/Restoration; Monitoring; SAV; Waterfowl and Other Waterbirds; and Wetlands.

The Chesapeake Bay Program partnership, formed in 1983 and reaffirmed in 1987 by the states of Virginia, Maryland, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and the U.S. Environmental Protection Agency, is the governing entity that makes this work possible. The CBP formally reaffirms its partnership and recommits to protect and restore the Chesapeake Bay's ecosystems through the *Chesapeake 2000 Agreement*, and expands its commitment by further involving individuals, businesses, communities and governments in realizing the shared vision of a restored Chesapeake Bay.

TABLE OF CONTENTS

WETLANDS

The Chesapeake Bay watershed contains nearly 1.5 million acres of wetlands. Ten percent are located in tidal estuarine areas, and the rest are located in upland forested or riparian areas. Wetlands in the Chesapeake Bay watershed have been heavily compromised and often destroyed by human activity. From the 1780s to the 1980s, nearly two million acres of wetlands were lost in Maryland, Pennsylvania and Virginia combined. Since the late 1980s the Wetlands Workgroup has been committed to restoring and protecting all Chesapeake Bay wetlands.

Progress and Goals

In 1999 the Wetlands Workgroup focused its restoration and protection activities at the community level.

Wetlands Restoration and Protection Goal

The 1999 Executive Council endorsed a wetlands restoration and protection goal to include in the new *Chesapeake 2000 Agreement*. In it, the states have made three separate commitments regarding wetlands: no net loss of current wetland resources, a net gain of 25,000 acres of wetlands, and a commitment to help local communities develop and implement locally generated community- or watershed-based wetlands preservation plans. Both the restoration and the preservation components of the goal will be fully implemented by 2010. The three states will report to the Chesapeake Bay Program every year on their no-net-loss achievement and their progress toward meeting their portion of the 25,000-acre goal.

Community Wetlands Restoration Pilot Workshop

The Wetlands Initiative Program, begun in 1997, provides a planning tool to local governments and communities for combining wetland protection and restoration with other land use management strategies. After completing several pilot projects in 1998, in 1999 the workgroup focused on developing a manual to describe the initiative, and sponsored a one-day workshop in Lancaster County, Pennsylvania to facilitate the effort. The workshop's success prompted the workgroup to run the assessment for the entire watershed and make the data sets available to all interested users. The workgroup plans to summarize the results from the initiative for each small watershed and incorporate them into the CBP's Watershed Profiles Internet-based tool. The manual, data and wetland profiles will be completed in 2000.

SUBMERGED AQUATIC VEGETATION

The Bay grasses that grow in the shallow waters of the Chesapeake Bay are ecologically essential to the Bay's living resources. Submerged aquatic vegetation, or SAV, also provides food for waterfowl and habitat for fish, crabs and invertebrates. SAV filters suspended sediments

and oxygenates the surrounding water and substrate. In order for Bay grass species to grow and flourish, sufficient levels of light must reach their underwater leaves. Unfortunately, sedimentation and an overabundance of algae often combine to reduce these light levels in the Bay, with the result that many of the underwater grass beds that once covered 400,000 acres of the Bay have disappeared.

Progress and Goals

Total Baywide SAV acreage increased to an estimated 68,125 acres in 1999, although more than 3,000 of those previously mapped in 1998 where not mapped this year due to extreme weather conditions. The most dramatic increases were found in Tangier Sound, where grasses had decreased during the previous six years. Grasses increased from 6,610 acres in 1998 to 10,618 acres in 1999, a 61 percent gain.

The SAV workgroup continues to implement the Bay Program's SAV policy by promoting monitoring, protection and restoration of the Bay's underwater grasses, and by promoting SAV research and outreach programs. The workgroup made progress in all five areas this year, but there was an increased emphasis on SAV restoration. The number of groups transplanting underwater grasses in the Chesapeake Bay in 1999 increased dramatically over the previous year. The most important SAV transplanting projects included sites in the St. Mary's River, in conjunction with St. Mary's College; the James and York rivers, with the Virginia Institute of Marine Science (VIMS); eelgrass seed planting, also with VIMS; Bay Grasses in Classes projects, with the Maryland Department of Natural Resources (MD DNR); Chesapeake Bay Foundation (CBF) projects; projects in conjunction with the Aberdeen Army Environmental Center; Alliance for the Chesapeake Bay projects on Department of Defense sites; and Shallow Creek, in the Patapsco River, which was undertaken with the U.S. Fish & Wildlife Service (US FWS) and the Corps of Engineers.

Although the results of these projects will not be apparent for several more years, so far the workgroup has gleaned important information from their efforts.

- There is intense interest in grass planting among the public and in schools. Some groups conducting planting projects (especially MD DNR and CBF) have recruited large numbers of volunteers to raise and plant underwater grasses.

- Site selection continues to be an important factor in planting success, and methods for site selection are being refined using the latest research.

- Some species grow well from seeds (especially wild celery) and have the best prospects for large-scale propagation.

- Methods for laboratory propagation from cuttings for species that do not grow well from seeds are improving, but they are still too expensive for most large-scale planting, and they do not work for eelgrass.

- Progress with propagation led workgroup members to set a goal for the eventual elimination of the harvest of whole plants for planting projects. Harvesting is still needed for some species, especially eelgrass.

- In areas with high densities of resident waterfowl, plastic fencing, which lasts longer than metal, protects newly planted grasses for the first year or two.

- Participants in planting projects can learn a great deal from each other. The workgroup shared information at three meetings late 1999 and early 2000, and revised planting guidelines as a result.

OYSTER REEF RESTORATION

Oyster reefs play an important ecological role in the Chesapeake Bay by providing habitat for the Bay's oysters, finfish and crabs. Historically, reefs of densely packed individual oysters created a hard surface over many acres of Bay bottom and formed a three-dimensional habitat for Bay creatures. In recent years, reef acreage has been lost to harvest pressure, oyster diseases and pollution. Harvesting techniques have reduced many three-dimensional reefs to flat surfaces.

The *Aquatic Reef Habitat Plan* establishes specific goals to rebuild and restore reefs as habitat for the oyster and other reef community species. The plan commits Bay Program signatories to "enhancing, protecting and restoring benthic reefs as ecological systems to benefit the oyster resource and the diverse ecological community associated with Chesapeake Bay structured reefs." Approximately 5,000 acres each in Maryland and Virginia, and 1,000 acres in the Potomac River, must be designated as oyster reef habitat by the year 2000.

The Aquatic Reef Habitat Workgroup continues to grapple with questions concerning the designation of oyster reef habitat in the Chesapeake Bay and the Potomac River, and is making significant progress toward the year 2000 goal. Funded projects focus on reef restoration and creation, as well as the ecological evaluation of created reefs.

Progress and Goals

Reef restoration progressed significantly in 1999. In Virginia, a total of five reefs were constructed–two reefs in Mobjack Bay, two in the Lafayette River and one in the York River. Virginia also reported considerable improvements in the status of the oyster resource, especially in terms of spat set, in association with most of its reconstructed reefs. Additional large, disease-tolerant oysters were transplanted from high-salinity areas in the Bay to reefs in the Piankatank and Great Wicomico rivers. Spat set improved substantially in these rivers after large oysters were placed on the constructed reefs. Citizen volunteers continued to make impressive efforts in the Lower Chesapeake Bay area to grow hatchery-produced, disease-tolerant oysters and to place them on reefs in the Lynnhaven, Lafayette and Elizabeth rivers. Spat set improved more than 20-fold in these rivers after broodstock oysters were placed on the reefs. Maryland constructed reefs in 1999 in the Severn River area. Reefs of shell mounds of different size and heights are being

compared. More than three million hatchery-produced seed oysters were placed on the reef sites.

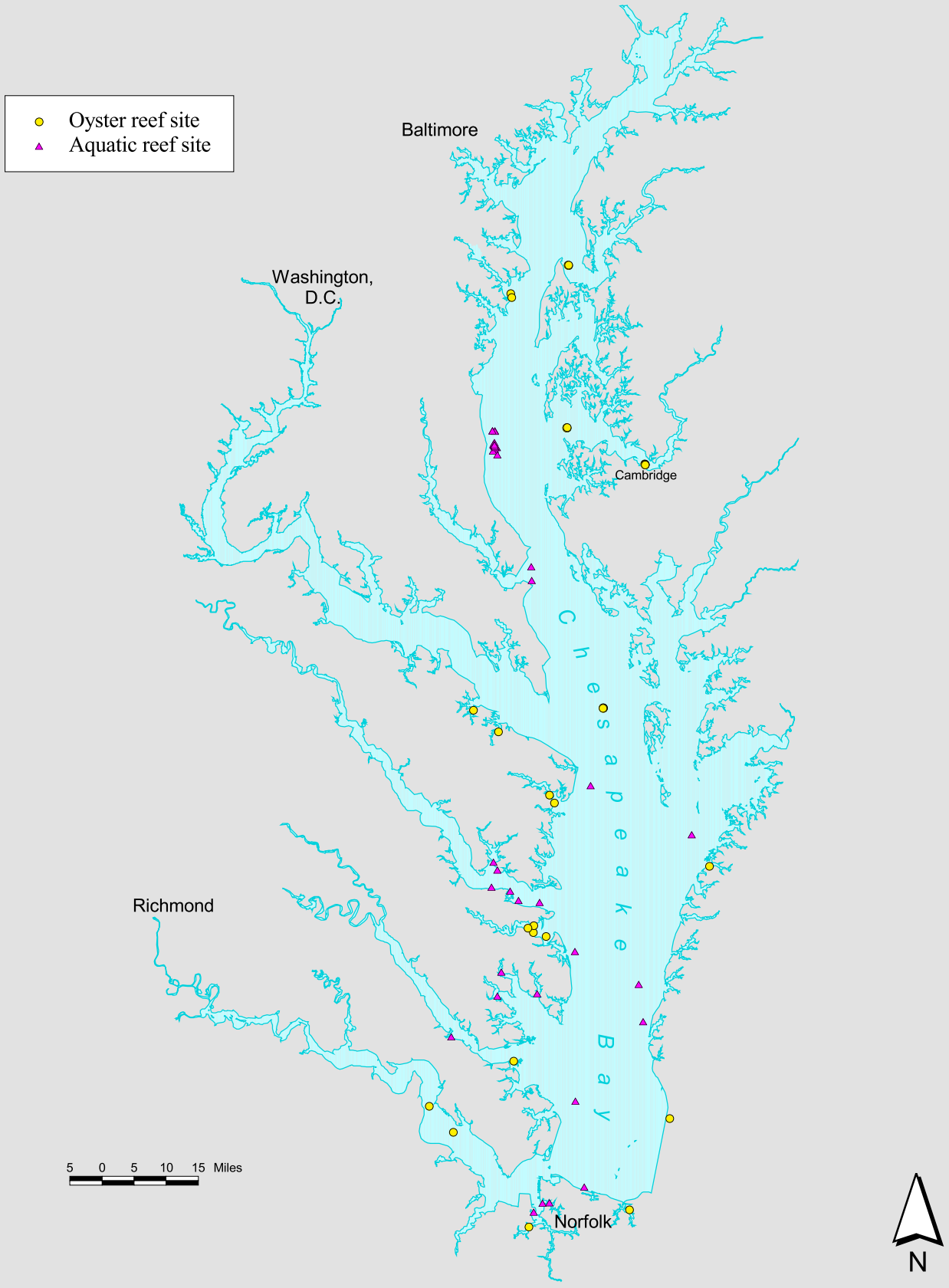
Reef Ecology Studies

Three-dimensional reefs provide substantial benefits for oysters compared with hard substrates. Ecological studies of Virginia's constructed reefs show that other animals, including crabs, recreational finfish and clams, also benefit from three-dimensional oyster reefs. Monitoring efforts associated with the Virginia reef projects have suggested three important ecological functions of such reef structures. First, they provide the best configuration for positioning oysters to maximize fertilization success in the Bay's tidal system. Second, the three-dimensional structure protects juveniles from predation, which results in a higher rate of survival than occurs when oysters live on the bottom. Third, oysters appear to grow faster on the reef structure than on the bottom.

Oyster Spat Set and Harvest Update

The 1999 Maryland spat set was moderate, and improved in relation to 1998. The spat set index in 1999 was 29, compared to 4 in 1998. Spat set in Virginia improved in the James River and was very good in the vicinity of several of the reef restoration sites. A summer and fall drought resulted in higher salinities, which resulted in significant oyster mortalities in some areas of Virginia in 1999, and which could increase the likelihood of more significant disease mortalities throughout the Bay in 2000. Oyster harvests in the Chesapeake Bay improved in 1998 and 1999, with Virginia harvesting approximately 50,000 bushels and Maryland harvesting more than 423,000 bushels, a substantial increase over last year's 285,000 bushels.

Chesapeake Bay Program Reef Restoration Sites



Map shows reef construction through 1999

FISHERIES MANAGEMENT

Chesapeake Bay fishery management plans, or FMPs, focus on preserving the ecological, economic, and social values of selected species by managing for sustainable use and to protect habitats. These plans enable Chesapeake Bay scientists and managers to quantify biologically appropriate levels of harvest; identify habitat requirements and challenges; integrate fishery issues and concerns into habitat restoration and protection measures; monitor the status of the resource; and define management measures. They also provide a format for undertaking compatible, coordinated management measures in the Chesapeake Bay.

The Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission help determine options for fishery management for coastal migratory species. For these species, Chesapeake Bay FMPs outline how Bay jurisdictions will comply with federal regulations and identify any circumstances specific to the Bay region that require additional attention. They also create a forum to specifically address fishery resource problems, especially with regard to habitat concerns, that are unique to the Bay.

Progress and Goals

In 1999 the Living Resources Subcommittee's FMP workgroup reviewed the *1991 American Eel FMP*, the *1994 Horseshoe Crab FMP* and the *1994 Oyster FMP* and recommended that the oyster FMP be revised by 2001 and that major amendments be made to the eel and horseshoe crab plans, to be drafted by December 2000. They also updated six FMPs (the *1991 Summer Flounder FMP*; the *1993 Black Drum FMP*; the *1993 Red Drum FMP*; the *1994 Spanish/King Mackerel FMP*; the *1997 Black Sea Bass FMP* and the *1998 Tautog FMP*). The updates consisted of evaluating whether the plans' goals and objectives were still appropriate, adding the most recent fishery statistics, adding the monitoring and research results, and defining the current status of the resource. Work continued on revising the *1989 Alosid FMP* (shad and herring) and the *1991 Weakfish/Spotted Seatrout FMP*. These revisions will also be completed by December 2000.

Additional priorities for the year 2000 include reviews of the striped bass, black and red drum, and blue crab FMPs. The FMP workgroup will use the results of the Chesapeake Bay Stock Assessment Committee (CBSAC) blue crab projects and the blue crab targeting effort to develop quantitative management measures for the blue crab stock. The workgroup also will explore the use of Chesapeake Bay modeling results in relationship to fishery issues. These efforts will facilitate the transition to a multispecies management strategy and a consideration of ecosystem processes.

FISH PASSAGE

In a 1993 directive, the Executive Council established a 10-year goal of reopening 1,357 miles of blocked Chesapeake Bay tributary waters to migratory fish, including American and

hickory shad, blueback herring, alewives and eels, by 2003.

Progress and Goals

By the end of 1999, Bay jurisdictions, working through the Fish Passage Workgroup, completed almost 90 projects, including the construction of 35 fish ladders and lifts, 45 dam removals and breaches and numerous reconstructed culverts and dam notches. The workgroup is able to report opening more than 1,100 miles of Bay tributary waters to migratory fishes.

Some of the Bay's largest projects were completed only recently. A fishway at Bosher's Dam in Richmond, Virginia, opened 137 miles of the mainstem James River to Lynchburg, in addition to more than 200 miles of high-quality tributaries. Shad were observed using this fishway in May 1999.

A new fish ladder at the York Haven Dam on the Susquehanna River was completed in late 1999, to become operational in spring 2000. This is the final mainstem blockage on the Bay's largest tributary, and will reopen 435 miles of the Susquehanna to Binghamton, New York, the West Branch to Lock Haven, and the Juniata River to Warriors Ridge.

High-priority projects that remain to be completed include a fishway at the Abutment Dam in Petersburg, Virginia, which will open 121 miles of the Appomattox River, and the removal of Embrey Dam on the Rappahannock River at Fredericksburg, Virginia, which will open an additional 71 miles to migratory fish. With these and numerous other planned dam removals and fishway projects, the Fish Passage Workgroup expects to reach and exceed the 2003 goal.

All Bay jurisdictions, the US FWS and two tribal governments are involved in hatchery culture and stocking of American shad larvae in an effort to rebuild populations of this important species. In 1998 and 1999, more than 65 million marked American shad were released in the Susquehanna, Patuxent, Patapsco, Choptank, Potomac, Mattaponi, Pamunkey and James rivers. Maryland also cultured and stocked more than 30 million hickory shad larvae in several tributaries.

HABITAT RESTORATION

The Habitat Objectives and Restoration Workgroup (HORW) develops and maintains guidelines for the protection of water quality and habitat conditions necessary to support the living resources found in the Chesapeake Bay watershed.

Progress and Goals

In 1999 the workgroup continued to focus on tasks that contribute to the fulfillment of the Bay Program's *Chesapeake Bay Habitat Restoration: A Framework for Action*. It completed another year of implementing projects within each of the CBP's jurisdictions that are specifically designed to restore habitat within the watershed.

In 1999 the workgroup achieved funding for several proposed projects to restore 431 acres of wetlands, 64.5 acres of riparian forest buffers, and 17.3 miles of streams. In addition, previously funded projects were completed this year, to restore 161.5 acres of wetlands, 9 miles of riparian forest buffers, and 5 miles of streams.

EXOTIC SPECIES

The Exotic Species Workgroup implements the Chesapeake Bay regional policy that guides the intentional introduction of exotic species. The workgroup also addresses strategies for preventing and controlling accidental introductions.

Progress and Goals

- The workgroup produced a paper, *History, Management and Status of Introduced Fishes in the Chesapeake Bay*, to identify what species have been introduced intentionally and unintentionally in the basin in order to fulfill an aquaculture task of the Chesapeake Bay Program Implementation Plan.

- The workgroup also produced a report, *Risk Assessment of the Potential Effects of Stocking Triploid-Certified Grass Carp in the Potomac River Watershed on Submerged Aquatic Vegetation*, which assesses the potential risk that legal stocking of triploid certified grass carp poses to SAV. The workgroup is currently working with jurisdictions on the disposition of this report.

In the coming year, the workgroup plans to:

- Establish a ballast water management voluntary program, which would coordinate with a national program;

- Establish a Chesapeake Bay ballast water task force;
- Develop exotic species management plans for species that are deemed problematic to the restoration and integrity of the Bay's ecosystem;
- Review VIMS' non-native oyster research and the Virginia Seafood Council's non-native oyster market-testing proposal and make recommendations to the Virginia Resources Commission;
- Develop and implement an outreach and education program, in collaboration with the Communication and Education Subcommittee;
- Participate with the National Aquatic Nuisance Species Task Force in investigating the possibility of establishing a regional Aquatic Nuisance Species panel.

WATERFOWL AND OTHER WATERBIRDS

The Chesapeake Bay is home to more than 60 species of migratory waterbirds, including two raptor species, bald eagles and osprey. More than half of these birds are present only during the winter months. After the wintering populations depart for northern breeding grounds, populations of native waterfowl, such as wood ducks and black ducks, in addition to large populations of exotic or non-native waterfowl, such as mute swans, resident Canada geese, and mallards, breed in the Chesapeake Bay watershed. The raptor species and many thousands of colonial waterbirds, including herons, egrets, cormorants, pelicans, gulls, and terns, also depend on the fish resources and secluded predator-free nest sites to raise their young.

The Waterfowl and Other Waterbirds Workgroup consists of biologists from both state and federal agencies involved with the waterfowl management of the Chesapeake Bay Region. The workgroup is a loose confederation of waterfowl biologists working toward implementing the Chesapeake Bay Waterfowl Policy and Management Plan.

Progress and Goals

Waterfowl Concentration Database and Atlas

Biologists from all three states continue to collect data on the location and numbers of waterfowl concentrations during the Midwinter Waterfowl Survey. In 1998 the CBP provided $22,000 for late winter concentration surveys, an area in which information has been lacking. Only a small part of the survey was flown in 1998, because the mild winter resulted in an early spring migration, indicating that a survey would not be productive. The survey was flown in late February to early April 1999. The data are being used in the diving duck/benthos portion of the

Living Resources Data Analysis Workshop. Several species of waterbirds, in particular ruddy ducks and scaup, were abundant during the late winter, and their distribution appeared to be farther up rivers and small bays than during the January surveys.

Gillnet Bycatch of Birds

In 1998, the U.S. Fish and Wildlife Service began to assess the mortality of birds caught in anchored gillnets from the coast of Virginia through New Jersey. This project is relevant to Chesapeake Bay waterbirds, which leave the Bay and pass through gillnetted areas as they migrate up the coast. Fishers also have proposed that monofilament gillnets be allowed in the mainstem of the Bay. In 1999, gillnets were also counted during the late winter waterfowl surveys mentioned above. Several gillnets were observed in close proximity to diving ducks in the Potomac River and in Virginia's Western Shore Rivers. A bird bycatch problem exists in these areas and the fishery should be evaluated.

Invasive Species

Several workgroup members are working on a variety of projects related to invasive species. Mute swans, resident Canada geese, phragmites and nutria are invasive species that severely degrade waterbird habitat in the Bay. Several workgroup members participated in the Atlantic flyway's triennial mute swan survey in August. Approximately 4,400 birds were counted in the Chesapeake Bay–an increase of about 38 percent over the 1997 survey. While the mute swan population is increasing in all states, the Maryland's population is increasing rapidly and may be expanding into neighboring states.

BIOLOGICAL MONITORING

The Living Resources Monitoring Workgroup focuses on three goals: creating, maintaining and updating biological and living resources monitoring databases, making monitoring results accessible, and overseeing the CBP zooplankton monitoring program.

Progress and Goals

The workgroup accomplished these goals and produced several new products during 1999 that enhance the usefulness and accessibility of biological monitoring data, including:

- Updates of the Living Resources and Biological Monitoring web pages on CIMS to include 1998/1999 data sets from CBP biological monitoring programs, additional web links to CBP partner databases, tables of plankton indicators and the larval striped bass habitat indicator, and accompanying method documentation.

- A CBP chlorophyll fluorescence database accessible through online queries. (Other databases were made accessible in earlier years.)

- FGDC-compliant metadata for the plankton and benthos CIMS relational living

resources databases.

- Applications to calculate CBP zooplankton indicators from CIMS databases, and display them graphically in the Ecological Metric Interpretation Tool (EMIT) and on the CIMS web page.

- A computer program, called the Light Attenuation Import Tool (LAIT), which uses standard output from a LiCor light sensor data logger and enters them into a CBP water quality database.

The workgroup members completed the first plankton split sample study comparing the Maryland and Virginia plankton monitoring program components (phyto-, micro- and mesozooplankton) and drafted a report on the results. The 1998 version of the *Status Report on Chesapeake Bay Program Biological and Living Resources Monitoring Databases* was revised. Both reports were published in 2000.

Members of the monitoring workgroup also reviewed and contributed to the Living Resources section of the draft *Basin-Wide Monitoring Strategy*, and continued to explore the applicability of a computer-based habitat suitability model (HSM). The HSM was developed by NOAA Silver Spring as a tool to integrate monitoring data and generate measures of habitat quality. Members will participate in a two-part Living Resources Data Analysis Workshop, sponsored by STAC in 2000. Workshop products will include refined approaches to analyzing existing data to better address questions and CBP management information needs, and specific information derived from monitoring data regarding menhaden, oysters and benthos-eating waterfowl.

New GIS Products and Support

Base Data

- **Fish Passage:** The GIS support team updated fish passage databases to reflect changes in status of blockages due to opening or onsite inspection. The historic (1970s) ranges of yellow and white perch were digitized from reports.

- **Habitat Restoration:** The team performed analyses to quantify and map forest fragmentation throughout the Chesapeake Bay watershed, and performed habitat restoration targeting efforts, such as targeting SAV restoration for blue crabs, and the placement of dredged material for beneficial use. The team also developed a method for targeting riparian forest buffer restoration on agricultural land.

- **Living Resources:** The GIS team created maps for Living Resources documents, presentations and displays; provided technical support and data to Bay Program partners; and identified priority living resource areas from potential habitat maps.

- **Reefs:** Locations of new oyster reef sites in the Bay were added to the database and maps were updated to show these locations. Oyster sanctuary area data were obtained and digitized.

- **SAV:** The GIS team obtained SAV bed delineation data for 1998 from VIMS and updated Upper Patuxent SAV Tier goals using new bathymetry data.

Web Site Additions

Living resources data were prepared for inclusion in the CBP interactive mapping application.

Wetlands

National Wetland Inventory (NWI) data for 13 quads in Virginia were funded and processed. Phase I of the wetlands initiative was conducted for Pennsylvania.

GIS Goals

In 2000, the GIS team will:

- Acquire and process 87 more NWI quads for Virginia and New York;

- Conduct Phase 1 of the Wetlands Initiative for Maryland and Virginia;

- Continue to develop habitat restoration targeting applications; and

- Make more living resources data accessible on the Web and improve Web-based data exploration tools.

CHESAPEAKE BAY STOCK ASSESSMENT COMMITTEE

The Chesapeake Bay Stock Assessment Committee (CBSAC) was established in 1985 by the NOAA National Marine Fisheries Service to develop a Baywide cooperative program for assessing the fishery resources of the Chesapeake Bay. Each year the committee funds Bay-area fisheries research to improve the regional information required for stock assessments.

The *1987 Chesapeake Bay Agreement* called for the development of a compatible Baywide stock assessment program and pledged "to develop, adopt and begin to implement a Baywide plan for assessment of commercially, recreationally and ecologically selected valuable species." Accordingly, CBSAC developed the Chesapeake Bay Stock Assessment Plan and now assesses the Bay's fishery resources and identifies data needs for stock assessment models. The CBSAC's recommendations include ways to collect catch, effort and biological data from commercial and recreational landings, in addition to long-term surveys for estimating the relative abundance of important species in all regions of the Bay and its tributaries. CBSAC supports

studies that are designed to estimate the relative influence of fishing mortality, natural mortality and habitat modification on patterns of trends in abundance.

CBSAC's Technical Subcommittee addresses issues related to specific stock assessment needs and provides the committee with scientific advice. In 1999 CBSAC updated the following report.

2000 Chesapeake Bay Blue Crab Advisory Report

State of the Stock

Analysis of long-term fishery independent surveys conducted in the Chesapeake Bay (Maryland and Virginia trawl surveys, Calvert Cliffs crab pot survey and Baywide winter dredge survey) indicates that blue crab abundance has been below average in recent years, while length-based estimates of fishing mortality indicate that the stock is currently fully exploited. The estimated unweighted average fishing mortality rate (F) of 0.9 in 1999 is equal to the most conservative spawning potential threshold established in recent stock assessments ($F_{10\%} = 0.9$)[2]. Baywide harvest over the recent three years (1997-99) averaged 72 million pounds and is not significantly different from the time series average of 70 million pounds. The 1999 Baywide harvest of 69.2 million pounds is slightly below the time series average.

Management Advice

As was the case in 1998, the current average, unweighted fishing mortality rate (F = 0.9) did not exceed the threshold fishing mortality rates (F = 1.21 or F = 0.9)[2, 3] established by recent stock assessments. At the same time, average fishing mortality rates have matched or exceeded one threshold (F = 0.9)[2] all other years since 1994. Fishing mortality rates from certain single surveys exceeded the other threshold (F = 1.21)[3] in 1996 and 1997. As pointed out in last year's report, there is an urgent need to establish target fishing mortality rates, which are distinctly lower and more risk-averse than current threshold rates, which are sometimes inappropriately interpreted as targets. In addition, it is critical that a carefully designed data collection program is in place prior to implementation of management objectives currently being formulated by the Bi-State Blue Crab Advisory Committee (BBCAC). The design of the data collection program should be based, in part, on the need for improved information on: (1) harvest and effort data for the commercial and recreational fisheries; (2) growth rates; (3) size at maturity; and (4) the age, size, sex and maturity composition of the harvest and stock.

Blue Crab Stock Distribution

For the purposes of this report, blue crab distribution within the Chesapeake Bay and its tributaries was considered as a unit stock.

Data

Data from the two trawl surveys and the Calvert Cliffs pot survey are based on calendar year collections through 1999. The winter dredge survey data represent seasonal collections through the 1999/00 season. For abundance indices, the dredge survey is referred to as 2000 data. For estimates of fishing mortality rates, the dredge survey is referred to as 1999 data since the mortality took place in 1999. In general, age 0 crabs are less than 60 mm in carapace width; age 1

crabs are from 60 to < 120 mm and age 2+ crabs are 120 mm or greater in carapace width. These age cutoffs do not represent the actual growth patterns of many crabs, but they do provide a consistent way to calculate abundance indices across years and across surveys. Cutoff points are under review through CBSAC-funded work and the indices to be presented in the 2001 advisory report will likely reflect changes brought about through that funded work.

Biological Reference Points

The biological reference points, or threshold fishing mortality rates, according to recent stock assessments, are $F_{10\%} = 1.21$ [3] and $F_{10\%} = 0.9$ [2]. $F_{10\%}$ refers to that level of spawning potential which is 10 percent of the spawning potential expected in a stock in which no fishing occurs. This threshold fishing mortality rate was based on a longevity of eight years, which corresponds to a natural mortality rate (M) of 0.375 (using the formula M = 3 / longevity). Age-specific partial recruitment was based on the selectivity of the harvest gears and established as 10 percent (age 0), 75 percent (age 1), 95 percent (age 2) and 100 percent (age 3+).

Fishing Mortality

The average, unweighted (four surveys) fishing mortality rate is 0.90 in 1999 (range = 0.85 to 0.94). None of the current fishing mortality rates exceeded the threshold fishing mortality rate $F = 1.21$[3]. Two of the survey fishing mortality rates did exceed the threshold fishing mortality rate $F = 0.9$[2].

Recruitment (1997-00)

Results from the winter dredge survey and the Maryland trawl survey indicate below-average recruitment over the most recent three years. The Virginia trawl survey indicates average recruitment during this time period. (The Calvert Cliffs Pot survey was not included because it does not sample recruits.) With data for the three surveys combined, there does not appear to be a trend in recruitment in recent years, but six of the last eight years have been below the time series average.

Exploitable Biomass (1997-00)

Average exploitable biomass (generally crabs > 60mm in carapace width) for the last three years was considered average for both the Maryland trawl survey and the Calvert Cliffs pot survey. The Virginia trawl survey and the winter dredge were below the long-term average. As with recruits, the average of the abundance indices has been below the time series average for six of the last eight years.

Spawning Stock Biomass (1997-00)

Based on a Z-scaled index of mature females, spawning stock biomass was not significantly different from the long-term average for three of the four surveys (Maryland Trawl, Winter Dredge and Calvert Cliffs) and was below average for the Virginia Trawl Survey. Spawning stock biomass is currently below the time series (1968-00) average and has been for six of the last eight years.

Harvest

A three-year (1997-99) average, commercial Baywide harvest (72 million pounds) is near the long-term average of 70 million pounds. The 1999 Baywide harvest of 69.2 million pounds is near the long-term average and is an increase over 1998. For the 1945-1998 period, Baywide commercial harvests exceeded 100 million pounds in 1966, 1981, 1983 and 1993. The 1993 harvest of 113 million pounds is the highest recorded harvest. No representative Baywide measures of the recreational blue crab harvest exist.

Special Comments

The Chesapeake states have been very successful in managing several valuable species, such as striped bass, in large part because the necessary data needed to make the appropriate management decisions has been available. Blue crabs have not been as well managed as striped bass primarily because the data necessary to do so has not been available. We believe that a strong commitment to long-term funding of essential blue crab monitoring and research activities will yield benefits to the crab fishery similar to those seen for other Chesapeake Bay species, such as striped bass.

1. Technical Subcommittee Participants:

Chris Bonzek–VIMS
John Hoenig–VIMS
Phil Jones, Chair–Maryland DNR
Tom Miller–CBL
Rob O'Reilly–VMRC
Derek Orner–NMFS/NCBO
Anne Richards–NMFS/NEFSC
Alexi Sharov–Maryland DNR
Doug Vaughan–NMFS/SEFSC

2. Miller and Houde, 1998

3. Rugolo, *et al.*, 1997

ECOSYSTEM PROCESS MODELING

Progress and Goals

In recent years, modeling has become an integral part of the Chesapeake Bay Program's management efforts, particularly since the *1993 Chesapeake Bay Agreement* adopted the Strategy for the Restoration and Protection of Ecologically Valuable Species. A wide range of modeling approaches have been used to simulate various processes, populations and communities in the Chesapeake Bay and its tributaries. This year marks the end of a five-year program, begun in 1994. The diverse results of this work have been described in detail in six major reports, numerous scientific meetings and peer-reviewed publications. Throughout this study period, ecosystem modeling activities have focused on several major areas that were chosen for their relevance to the mission of the Chesapeake Bay Program. The goal of these activities was to

provide numerical and statistical analyses that improve the CBP's ability to predict and assess living resource responses to variations in nutrient loadings.

The results of these modeling activities addressed four concerns that the CBP considers critical:

- Nutrient loading and benthic-pelagic processes in open water;
- Water quality effects on submerged aquatic vegetation;
- Factors affecting the planktonic food-webs; and
- Bioenergetic models as tools for assessing the temporal and spatial dynamics of aquatic fish populations.

The results of these studies are presented in two final reports:

- *Ecosystem Models of the Chesapeake Bay Relating Nutrient Loading, Environmental Conditions and Living Resources*, published by the University of Maryland Center for Environmental Science.
- *Bioenergetics Growth Model for the Blue Crab, Callinectes sapidus, in Chesapeake Bay*, published by the NOAA Great Lakes Environmental Research Laboratory.

NEW PUBLICATIONS

Reports

- *The 2000 Users' Guide to Chesapeake Bay Program Biological and Living Resources Monitoring Data*
- *Chesapeake Bay Program Oyster Restoration: Workshop Proceedings and Agreement Statements*
- *1999 State of the Chesapeake Bay*
- *Distribution of Submerged Aquatic Vegetation in the Chesapeake Bay–1998* (Published in 1999)

Fact Sheets

- *What's New...with Living Resources in 1999*
- *Snapshot of the Chesapeake Bay–How's It Doing?*

THE CHESAPEAKE BAY PROGRAM

The Chesapeake Bay Program is a regional partnership that has led and directed the restoration of the Chesapeake Bay since 1983. The Chesapeake Bay Program partners include the states of Maryland, Pennsylvania and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the U.S. Environmental Protection Agency (EPA), which represents the federal government; and participating citizen advisory groups.

Since its inception, the Chesapeake Bay Program's highest priority has been to restore the Bay's living resources–its finfish, shellfish, underwater grasses and other aquatic life and wildlife. Because water quality improvements are essential to living resource restoration, the *1987 Chesapeake Bay Agreement* set a goal to reduce the nutrients nitrogen and phosphorus entering the Bay by 40 percent by the year 2000. In the 1992 Amendments to the agreement, partners agreed to maintain the 40 percent goal beyond the year 2000 and to attack nutrients at their source–upstream in the tributaries. The Chesapeake Executive Council, comprised of the governors of Maryland, Pennsylvania and Virginia; the mayor of Washington, D.C.; the EPA administrator; and the chair of the Chesapeake Bay Commission, continues to guide the restoration with directives and policies that address habitat restoration, toxic pollution prevention and point source and agricultural nonpoint source nutrient pollution reductions. Bay Program initiatives encourage the watershed's 1,650 local governments to address land use management, growth and development, stream corridor protection and infrastructure improvements.

Nutrient pollution reductions are achieved through voluntary agricultural management practices, urban nutrient management strategies and nitrogen-reducing technologies for wastewater treatment plants. Habitat restoration efforts focus on reestablishing Bay grasses, protecting and planting riparian forest buffers, opening fish passages, creating and restoring aquatic reefs, and Baywide management of fish stocks. Toxic contaminants are declining in many parts of the Bay since regional action plans have been established, and a voluntary industrial pollution prevention program was implemented. Other improvements include fisheries and habitat restoration, recovery of Bay grasses, nutrient and toxics reductions and significant advances in estuarine science.

U.S. Environmental Protection Agency
Chesapeake Bay Program Office
410 Severn Avenue
Annapolis, MD 21403
1-800-YOUR BAY
www.chesapeakebay.net