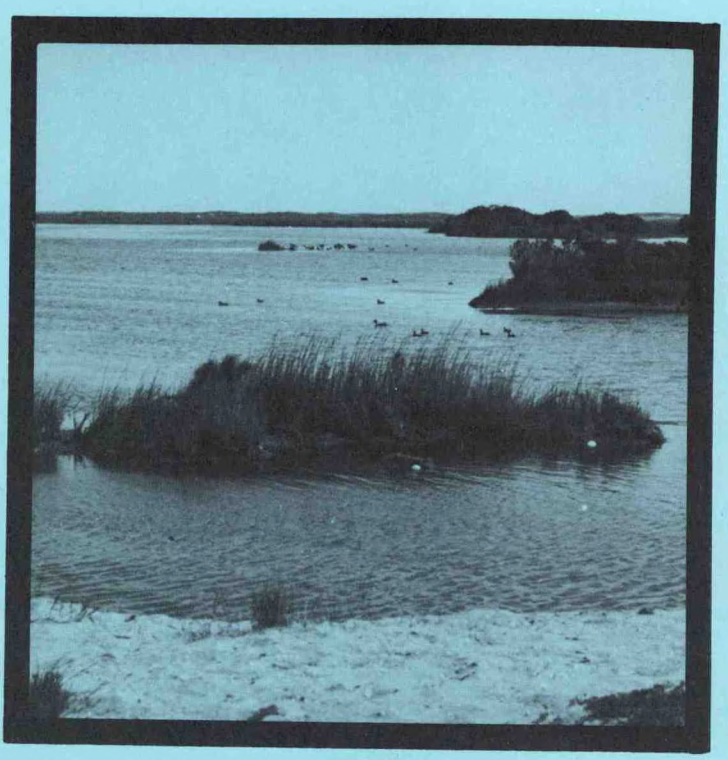
Marine Environmental Assessment

CHESAPEAKE BAY

JUNE – AUGUST 1985



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service
Assessment and Information Services Center

CLIMATE IMPACT ASSESSMENT
UNITED STATES

The AISC/Marine Environmental Assessment Division (MEAD), Marine Assessment Branch (MAB), produces periodic assessments of weather impacts on economic sectors of marine environmental activity. The Chesapeake Bay region served as a prototype for assessment development. From September 1981 through March 1982, MAB issued monthly assessments of Chesapeake Bay in the economic sectors of fisheries, recreation, and transportation. We now issue quarterly assessments in order to extend the service to other marine areas within existing resource limitations. Once each year we publish an Annual Summary giving a longer-term perspective of the impacts for the calendar year.

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Marine Environmental Assessment

CHESAPEAKE BAY

JUNE – AUGUST 1985

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Washington, D.C.
November 1985

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CHESAPEAKE BAY MARINE ASSESSMENT

The marine ecosystem exhibits many complex interrelationships which are difficult to measure. Climatic events do not often produce an obvious immediate response in the marine environment. The extended intervals that frequently exist between a climate event and the observed impact present a problem different from the land oriented assessments Assessment and Information Services Center (AISC) produces. This difference necessitates relating changes in climatic variables to marine environmental changes on a quarterly basis. For Chesapeake Bay, June through August covers the warm, relatively stable summer months; September through November covers the dynamic fall period of decreasing temperatures and water column turnover and vertical mixing; December through February covers the cold winter period; and March through May covers the dynamic spring period of increasing temperatures and nutrient enrichment.

The AISC effort in Chesapeake Bay is a first step toward providing operational marine assessments for major water bodies within and adjacent to the United States.

Table 1.--Environmental impact summary, Chesapeake Bay, June-August 1985.

IMPACT SECTOR

EVENT	FISHERIES							RECREATION					TRANSPORATION					
	Finfish harvest activities (general)	Shellfish harvest activities (general)	Oyster population (Diseases)	Finfish (Fish Kills)	Shellfish (Crab Kills)	Blue crab distribution	High salinity finfish species	Boating	State park usage	Swimming			Port operations	Cost to shippers				
Above normal salinities			−			+	+											
Below normal streamflow			−															
High numbers stinging nettles										−								
Low dissolved oxygen				−	−													
High winds (July)													−	−				
Extended periods dry weather	+	+						+	+									

+ Favorable

− Unfavorable

No identifiable effect, data unavailable, or not applicable

Chesapeake Bay Marine Environment

1. Highlights - General Events and Impacts

Blue crabs were plentiful in Chesapeake Bay during summer 1985. Landings of hard crabs in Maryland were considerably higher in quantity compared to the summer 1984 quarter. Crabbers in Virginia experienced marketing problems from the abundance of crabs and low prices. Extended periods of dry weather provided favorable conditions for watermen to work.

Continuing high salinities provided favorable conditions for oyster diseases. High prevalences of the oyster pathogen, Dermo, were detected in oysters sampled in Maryland.

High salinity finfish species such as black sea bass and sea robins were reported in areas of upper Bay tributaries which are normally nearly fresh water. Blue crabs were also reported unusually far into upper portions of some Bay tributaries.

An unusually high number of fish and crab kills occurred in creeks and tributaries of Chesapeake Bay in Maryland. Low dissolved oxygen was the probable cause of many of these kills in summer 1985.

Stinging nettles appeared early, ended early, and were in well-above-average abundance in mid-summer 1985, providing unfavorable conditions for water-contact recreation. Park attendance and boating activity showed increases over summer 1984 during periods of extended dry weather.

Shipping companies incurred increased costs due to productive time lost because of excessive winds at the Port of Baltimore. Crane down-time because of excessive winds may have cost shippers more than $166,000. Most of the shutdowns in the summer 1985 quarter were in July, reflecting windy conditions in that month.

2. Weather and Oceanography

2.1 Weather

The summer quarter of 1985 was moderately dry (precipitation 8 percent below normal for the quarter) and slightly cooler than normal (0.7°F below normal). A gradual increase in precipitation is shown in the averages of the three months, from -16 percent in June to -1 percent in August (Figure 1 and Table 2). Individual stations showed wide variations in precipitation. The middle Bay region was especially dry during summer 1985. Hurricane Danny produced substantial amounts of rainfall in August at the Patuxent and Richmond stations.

The summer quarter average rainfalls in 1985 and 1984 were both below normal, though their distributions over the region differed. In 1984 the three Pennsylvania stations and Chantilly had rainfall surpluses, and in 1985 Richmond, Norfolk, Wilkes-Barre, and Aberdeen had surpluses.

Temperatures during the summer quarter averaged slightly below normal but were near normal in July. Temperatures in July 1985 exceeded those in July 1984. Temperatures during the quarter included a record low of 55°F at Royal Oak, July 24th, record highs of 98°F and 99°F at Washington and Patuxent, respectively, on both the 14th and 15th of August, and a record low of 58°F at Patuxent on August 23rd.

June:

Cooler-than-normal temperatures prevailed in the Chesapeake Bay area during June. Most of the stations were also very dry, especially in the middle Bay area. Norfolk, in contrast, experienced a very wet June.

June had only four to six periods of rainfall from the eight cold fronts and four warm fronts that crossed during the month. A cold front on the 1st produced over an inch of rain at Wilkes-Barre but little or none in the south portion of the region. A second cold front on the 3rd initiated a period of rainy weather that lasted until the 7th. Heavy thundershowers struck the Washington area on the 5th. Sharp warming preceded a cold front on the 10th. A storm developed on this front and brought widespread rain and strong northwesterly winds on the 12th. Fair weather and cool temperatures followed.

This pattern repeated on the 16th - 18th, bringing showers followed by northwesterly winds and cooler temperatures. Warming again preceded a cold front on the 24th which brought brief thundershowers and gusty, northerly winds to the Bay area. Cloudy, cool weather prevailed over the region until warmer temperatures returned on the 29th along with a few showers.

Precipitation during June averaged 3.02 inches among the 11 stations, 16 percent below normal (Table 2). Norfolk received 97 percent more than normal rainfall, while Chantilly received 73 percent below normal rainfall. Eight stations were below normal in rainfall for the month, and three stations were above (Table 2).

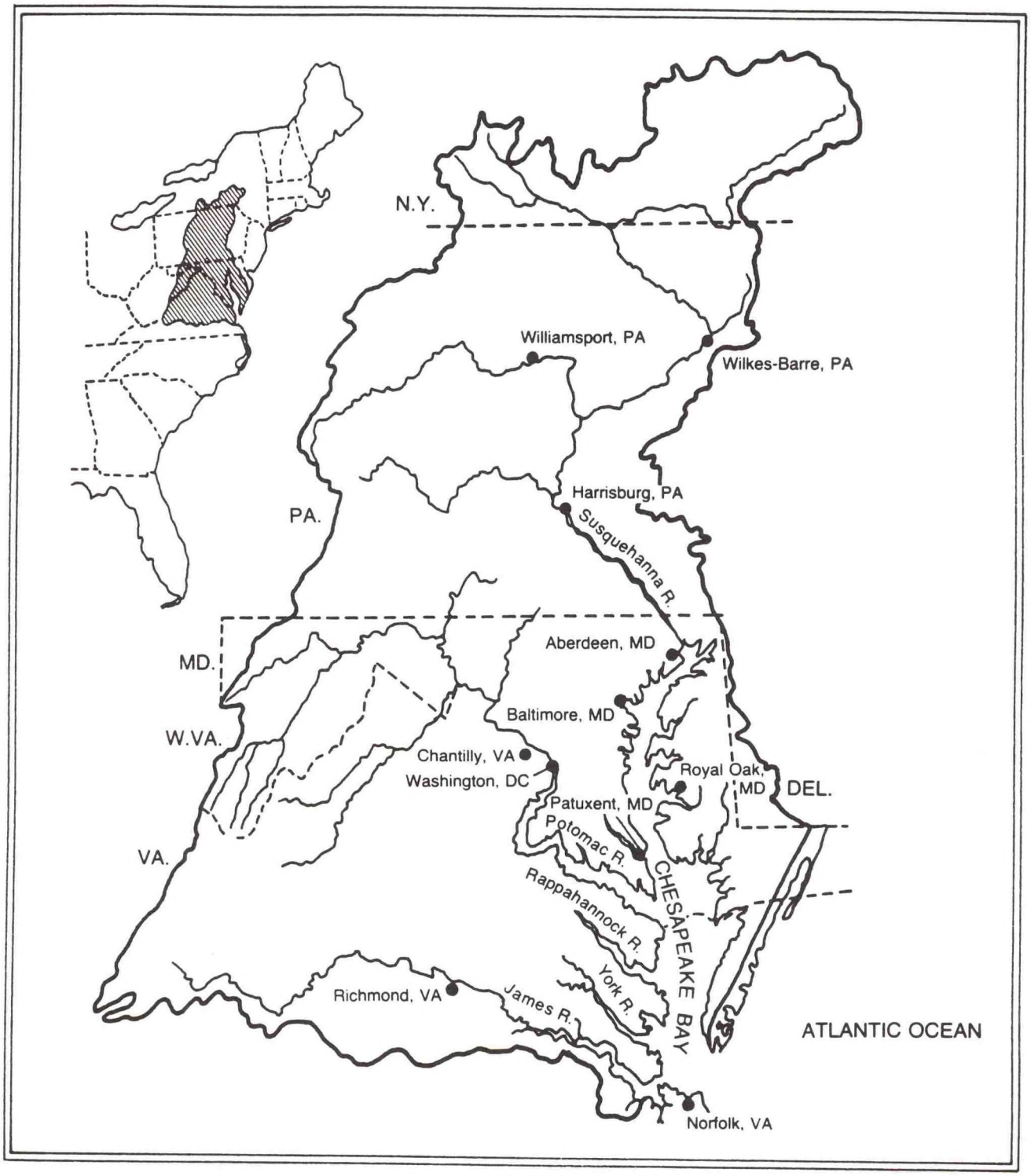

Figure 1. Selected meteorological stations, Chesapeake Bay watershed (Modified EPA map).

Table 2.--Total precipitation, mean air temperatures, and departures from normal for 11 stations, Chesapeake Bay watershed, June - August 1985.

Station	Total Precipitation (inches) and Departure from Normal Observed/*Anomaly (% of normal)			Air Temperature and Departure from Normal Observed/*Anomaly (Deg. F)		
	June	July	August	June	July	August
Williamsport, PA	2.49/-36%	3.47/-11%	4.28/+31%	64.4/-3.9	71.0/-1.5	70.1/-1.0
Wilkes-Barre, PA	3.00/-12%	6.09/+80%	2.62/-25%	63.8/-3.6	70.1/-1.7	69.0/-1.0
Harrisburg, PA	3.07/-15%	2.50/-25%	2.14/-35%	69.4/-1.8	75.9/+0.1	74.1/-0.2
Aberdeen, MD	4.04/+14%	4.60/+9%	3.99/+2%	71.3/-1.2	76.5/+0.1	75.3/+0.5
Baltimore, MD	2.44/-35%	2.53/-35%	3.72/-19%	70.4/-1.8	76.4/-0.4	74.5/-1.1
Washington, DC	2.05/-39%	2.91/-25%	2.35/-47%	72.3/-2.2	79.0/+0.1	76.7/-0.9
Chantilly, VA	1.14/-73%	2.34/-38%	3.35/-19%	69.7/-1.0	75.9/+0.4	73.4/-0.9
Royal Oak, MD	2.41/-30%	3.97/-10%	4.29/-16%	71.9/-1.6	77.1/-0.6	75.6/-1.0
Patuxent, MD	1.77/-49%	2.18/-47%	6.98/+60%	72.4/-0.6	78.3/+0.3	76.8/-0.2
Richmond, VA	4.01/+11%	5.31/+3%	10.58/+111%	74.3/+0.8	79.0/+1.2	77.5/+0.7
Norfolk, VA	6.81/+97%	6.14/+19%	1.89/-65%	74.2/-0.1	78.2/-0.2	77.2/-0.5
Average	3.02/-16%	3.82/-7%	4.20/-1%	70.4/-1.5	76.1/-0.2	74.6/-0.5

*Anomaly = departure from 30-year average for each month.

Temperatures during June averaged 1.5°F below normal among the 11 stations, ranging from 0.8°F above normal at Richmond (the only station above normal) to 3.9°F below normal at Williamsport (Table 2). Temperatures at most stations reached their coolest during the month around the 14th and 15th.

Richmond's monthly low of 47°F on the 14th was a record low there for that date. Temperatures reached into the 90's from Baltimore southward on the 24th when eight of the 11 stations had their highest temperature of the month.

Winds in the Bay area gusted to 30 mph or more on at least six occasions during the month, with the highest gust of 42 mph at Chantilly on the 24th. Wind gusts of 20 mph or more were reported on nine other occasions in the area.

July:

July weather, like that of June, was somewhat below normal in precipitation, but was normal in temperature except for the northernmost stations. The remains of Tropical Storm Bob brought increased precipitation to the area on the 26th and 27th.

A frontal wave brought showers to the Bay area at the beginning of the month, with the greatest amounts around Richmond and Norfolk. This system advanced up the coast bringing scattered showers and thundershowers on the 2nd and 3rd to a number of the stations. A trough produced showers and thundershowers at almost all of the stations on the 6th. Two weak cold fronts followed on the 7th and 8th, dropping minimum temperatures into the 50's in some areas. Aberdeen received more than an inch of rain from the 6th through the 8th. Stationary cold fronts brought widespread showers to the area on the 9th and 10th and again on the 12th and 13th. A strong cold front brought widespread showers and thundershowers to the area on the 22nd. Fair weather followed for a short period in the wake of this front. The remains of Tropical Storm Bob produced extensive rain in a path covering much of the Chesapeake Bay through the 26th. A cold front on the 29th brought over 2 inches of rain to the Norfolk area. This was followed by another cold front on the 30th. Showers occurred nearly every day from the 25th through the 31st in the lower Bay area.

Precipitation during July averaged 3.82 inches (7 percent below normal) among the 11 stations in Figure 1. Amounts ranged from 6.14 inches (19 percent above normal) at Norfolk to 2.18 inches (47 percent below normal) at Patuxent. Wilkes-Barre with 6.09 inches was 80 percent above normal (Table 2). The longest period without rain in the area was from the 16th through the 20th at most stations. Wilkes-Barre, Harrisburg, Washington, and Richmond each received in excess of one inch of rainfall from the remains of Tropical Storm Bob on the 25th and from the cold front on the 26th. Norfolk received 2.26 inches on the 29th from a developing low pressure system, but nearby drought was not relieved.

Temperatures were near normal, averaging 0.2°F below normal among the 11 stations in Figure 1, ranging from 1.7°F below normal at Wilkes-Barre to 1.2°F above normal at Richmond (Table 2). Average temperatures rose from the beginning of the month through the 15th, reaching 99°F at Richmond, before falling precipitously as a cool air mass from Canada drove southward. Temperatures rebounded to monthly highest values at six of the 11 stations on the 20th or 21st (four had highest temperatures for the month on the 15th) before falling

sharply again on the 23rd. All but Norfolk had lowest temperatures of the month on the 24th. Wilkes-Barre's 49°F and Royal Oak's 55°F were each record lows for that date.

Winds gusted to 44 mph at Patuxent during a squall-line thunderstorm on the 10th, and winds gusted to 48 mph at Washington on the 25th as the remains of Tropical Storm Bob drifted northward. Wind gusts exceeded 30 mph twice more at Patuxent and six times more at Washington, usually in conjunction with thunderstorm activity. Winds reached 20 mph or greater on 15 other occasions at Patuxent during the month, and on seven occasions at Royal Oak.

August:

Weather during August was cool and dry at most stations around Chesapeake Bay especially around Washington. A short heat wave near the middle of the month set new record high temperatures for the 14th and 15th at both Washington and Patuxent. A new monthly maximum temperature record of 99°F was set at Patuxent on the 14th, and a new daily minimum temperature record of 58°F was set at Patuxent on the 21st.

Seven cold fronts passed through the Chesapeake Bay area during August. Cold fronts on the 1st and the 11th brought little precipitation, but brought lower temperatures and northerly winds. Heavy rains accompanied the cold front passage on the 7th. A storm from the Mid-west brought widespread light-to-moderate precipitation from the 24th to the 26th. Record high temperatures preceded a cold front on the 16th. Record low temperature followed a cold front on the 20th. Heavy rains occurred on the 20th at Richmond, Patuxent, and near-by areas, but little rain fell to the southeast or northwest of these stations. Light to moderate rain showers and strong wind gusts accompanied the cold front on the 30th.

Precipitation during August averaged near normal for the 11 stations, although it varied from more than twice normal at Richmond to only one-third of normal at Norfolk (Table 2). Distribution of precipitation showed large variations over the month. Royal Oak and Patuxent received most of their rainfall during the middle of the month. Aberdeen and stations to the north received precipitation at the end of the first week and during the last week of the month.

Temperatures for the 11 stations averaged 0.5°F below normal with departures ranging from 1.1°F below normal at Baltimore to 0.7°F above normal at Richmond (Table 2).

Winds gusted to 45 mph at Patuxent during a thunderstorm on the 30th. Gusts reached 32 mph at Patuxent on the 20th. Gusts of 30 mph or greater were recorded twice at Washington. Gusts reached 20 mph or more on 17 other occasions at either Patuxent or Washington.

2.2 Streamflow

Bay streamflow remained below normal through July for the seventh consecutive month, though in August streamflow rose above normal (Figure 2). Streamflow had been below normal in each month since September 1984 except in December 1984 and August 1985. The cumulative streamflow anomaly for January through August 1985 was a deficit of 4.3 trillion gallons (Figure 3). The 1985 cumulative deficit contrasts sharply with the excess of six trillion gallons reached in the comparable period of January - August 1984. Bay salinities rose to above-normal in the winter 1984-85 quarter following the below-normal streamflow in the fall 1984 quarter. Salinities have since remained above normal at nearly all Bay stations through August 1985 (See Section 2.3, Oceanography).

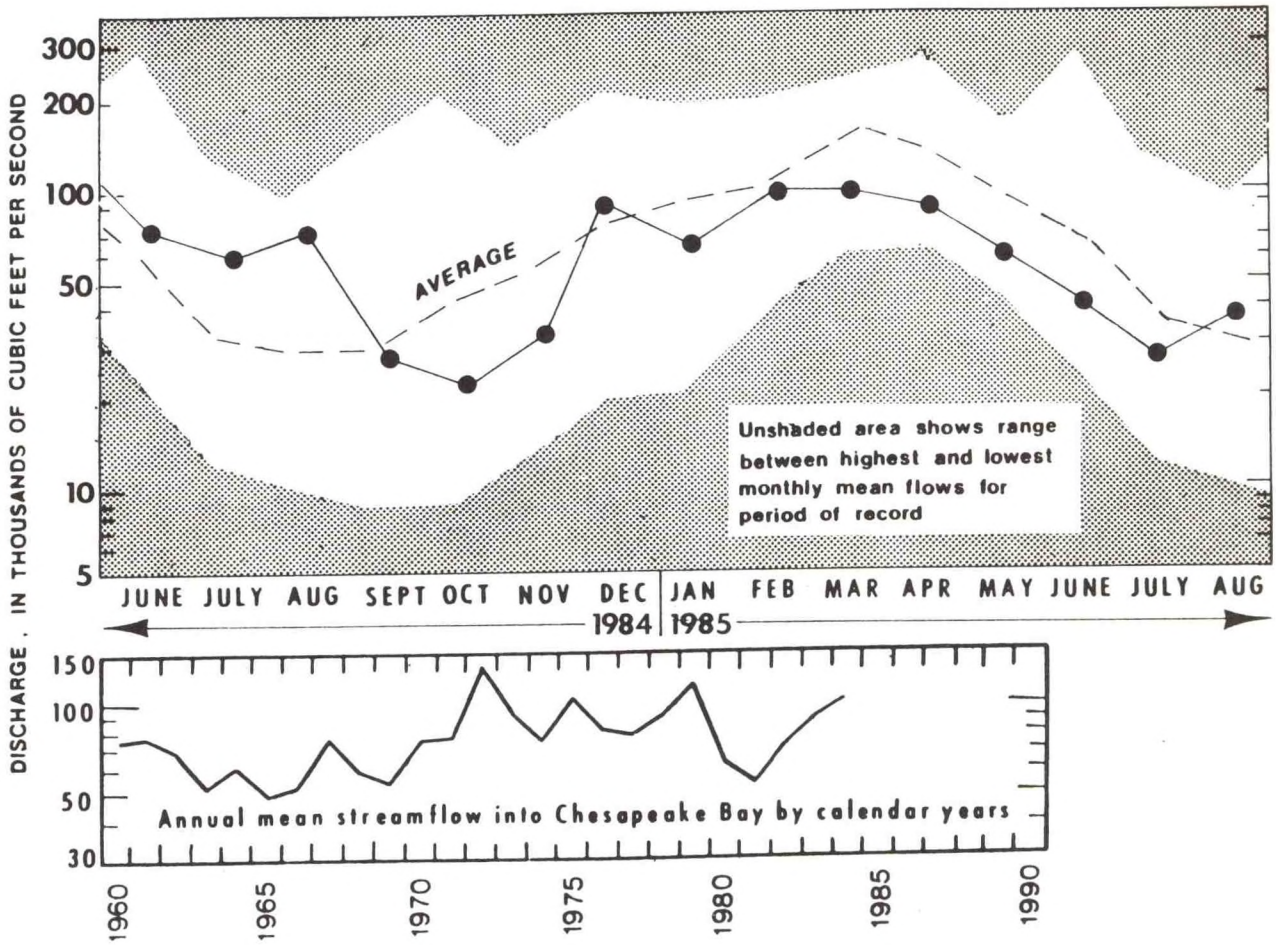

Figure 2.--Monthly streamflow into Chesapeake Bay, June-August 1985 and annual mean flow 1960-1984. Bay streamflow was below-normal in June and July and above-normal in August. Streamflow has been below-normal in all months of 1985 to date except August. Data from U.S. Geological Survey.

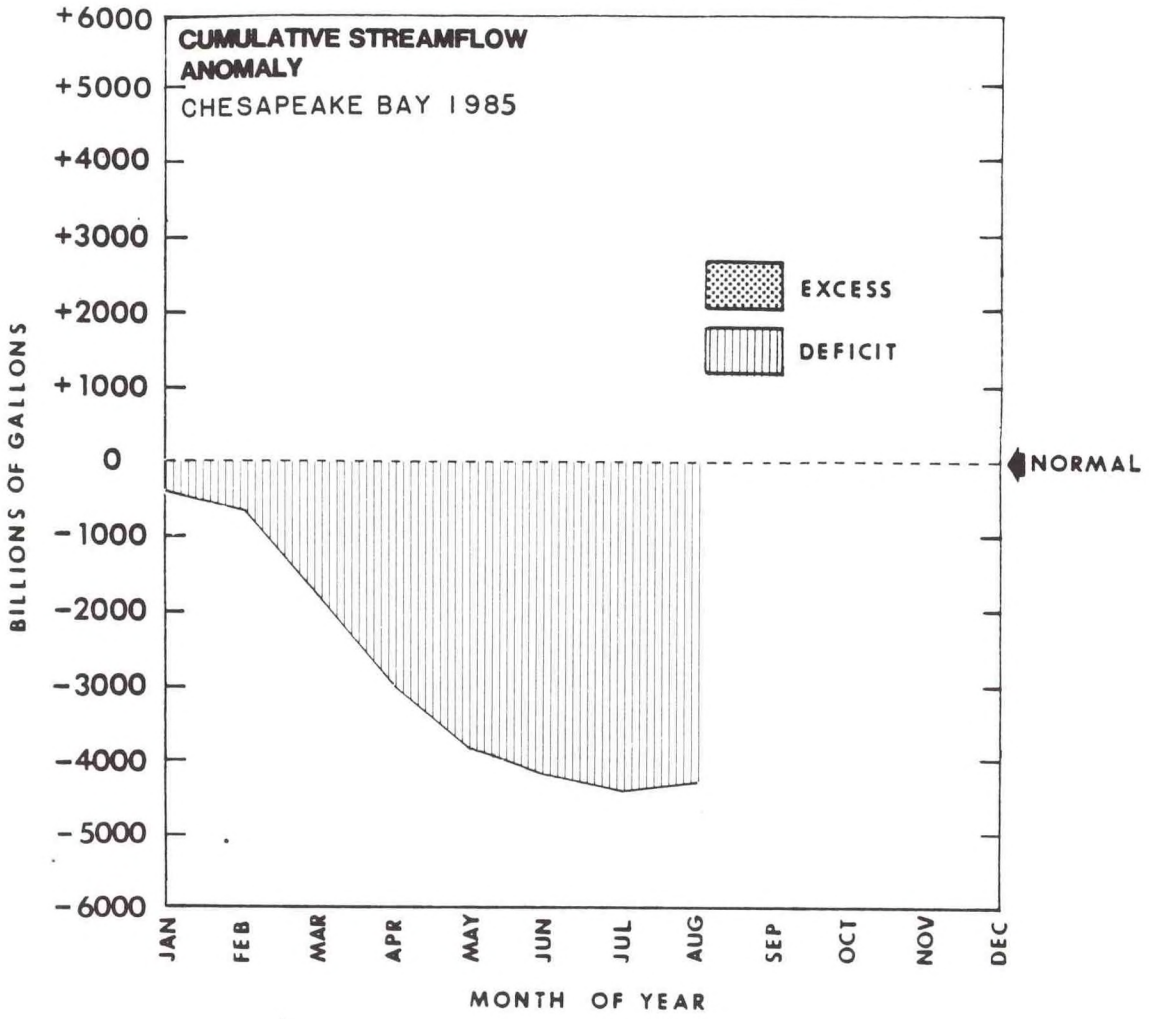

Figure 3.--Cumulative monthly streamflow anomaly, Chesapeake Bay, 1985. The cumulative streamflow anomaly (monthly sum of negative and positive departures from normal by calendar year) for January through August 1985 was a deficit of 4.3 trillion gallons. Data from U.S. Geological Survey.

2.3 Oceanography

Salinities around the Bay maintained normal seasonal cycles but were above normal throughout the quarter at all stations (Table 3 and Figure 4). Bay water temperatures were slightly below normal at most stations during the quarter.

Salinity:

Salinities were well above normal at all stations in June and averaged 3.3 parts per thousand above normal for the month. July salinity was above normal at all stations. However, at the Bay-Bridge station the anomaly dropped 3.7 parts per thousand in July while still showing above-normal salinity. August salinity remained above normal at all stations. Higher-than-normal salinities probably reflect a year-long deficit of fresh water inflow into the Bay (See Section 2.2, Streamflow).

Temperature:

Water temperatures were slightly below normal in the upper Bay (Baltimore, Annapolis) during the quarter, and near normal in the lower Bay, except at Kiptopeke in June, where the monthly mean temperature was slightly above normal. Data for August at Kiptopeke are unavailable.

Table 3.--Bay surface salinities and surface water temperatures, June - August 1985.

Station	Surface Salinity and Departure from Normal Observed/*Anomaly (ppt)			Surface Water Temperature and Departure from Normal Observed/*Anomaly (Deg. F)		
	June	July	August	June	July	August
Baltimore, MD	8.9/+2.9	9.7/+2.8	10.4/+2.4	72.2/-1.9	77.5/-2.0	78.7/-0.8
Annapolis, MD	11.1/+3.1	12.0/+2.8	12.5/+2.3	73.2/-1.3	78.6/-1.6	79.0/-0.7
Solomons, MD	15.1/+3.9	15.8/+3.2	16.9/+3.4	74.9/+0.4	79.9/-0.2	80.6/+0.5
Kiptopeke, VA	27.4/+1.6	28.8/+2.4	N/A	74.7/+2.6	78.1/+0.9	N/A
Bay Bridge-Tunnel, VA	27.1/+4.9	25.3/+1.2	26.8/+1.2	73.4/-0.7	78.1/-0.9	79.2/-0.7

*Anomaly = departure from long-term monthly averages.
All salinity data are provisional. Salinities are based on water densities normalized to 15°C. Cruise data were used to supplement salinity for the Kiptopeke station which was unavailable for August.

N/A = Not available.

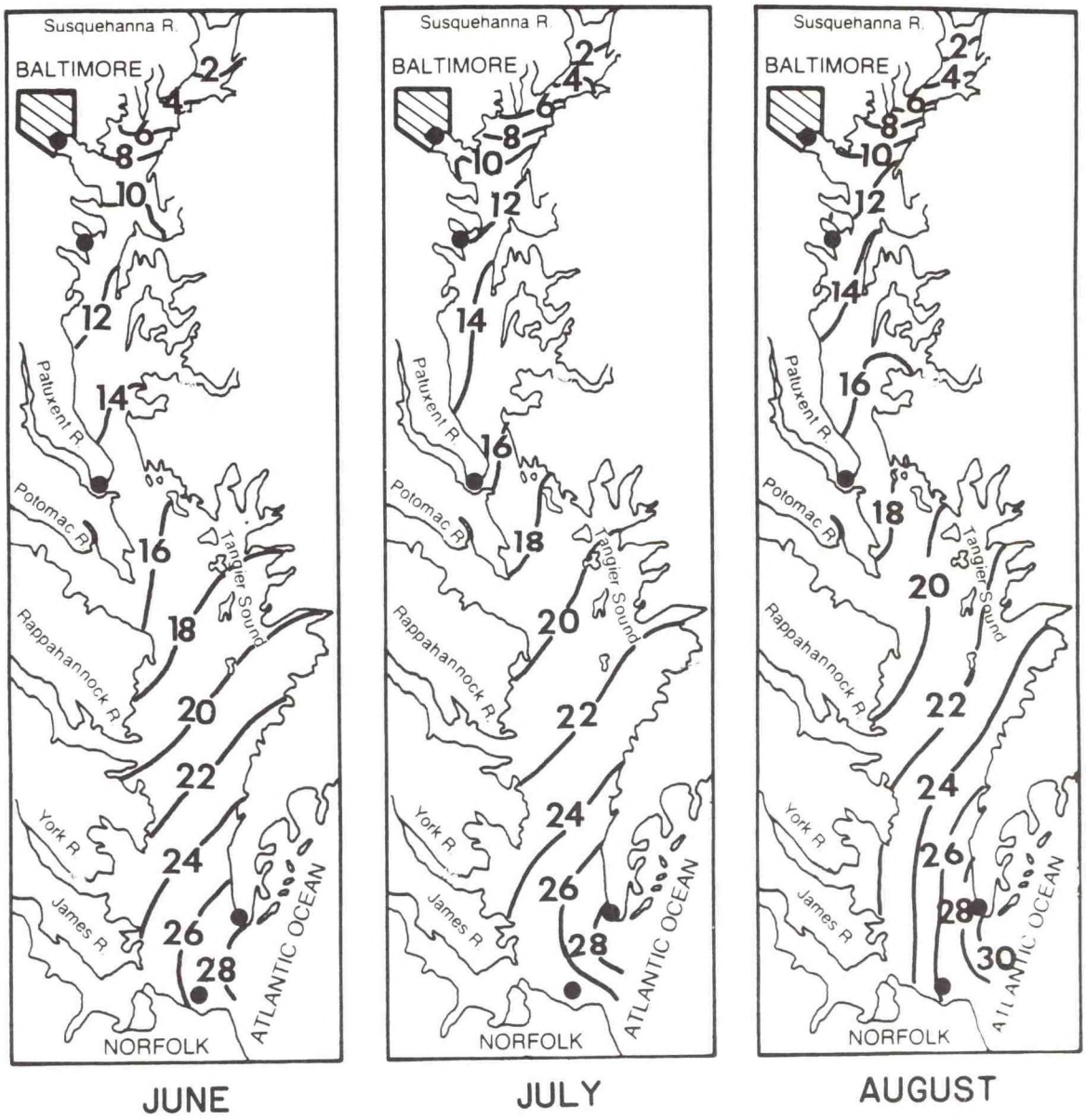

Figure 4.--Mean surface salinity distribution, Chesapeake Bay, June-August 1985. Isohalines (parts per thousand) are linearly interpolated from designated station data. Salinities were above normal at all stations during the summer 1985 quarter. Salinity values rose steadily following normal seasonal trends, with most stations showing strong positive anomalies. Data from National Ocean Service, NOAA. Data from cruises and other sampling stations are used to supplement NOS station data.

3. Impact of Climate/Weather on Bay Fisheries, Recreation, and Transportation

3.1 Fisheries

Blue crabs were plentiful in Chesapeake Bay during summer 1985. Crabbers in the lower Bay experienced marketing problems from the abundance of crabs and low prices. High salinities provided favorable conditions for oyster diseases in Chesapeake Bay. High prevalences of the oyster pathogen, Dermo, were detected in oysters sampled in Maryland. Stinging nettles appeared early, ended early, and were in well-above-average abundance in mid-summer 1985.

Shellfish:

Blue crabs were plentiful in Chesapeake Bay during summer 1985. Landings of hard crabs in Maryland in June - August 1985 were considerably higher in quantity compared to the summer 1984 quarter (Table 4). The combined landings of hard and soft crabs in Maryland in June and July 1985 showed an increase of over two million pounds in each of those months over June and July 1984. August 1985 combined landings were about one million pounds higher than August 1984. The combined value of the June 1985 catch was about $1 million higher than June 1984, though the value of the July and August 1985 catch remained very close to the 1984 value for those months, reflecting a decrease in price per pound.

The abundance of crabs during spring and summer 1985 reflected primarily the highly successful 1983 year class of crabs. Crabs from the 1983 spawn were the main source of the Bay catch throughout the summer of 1985. Crabs hatched in 1984 probably began to enter the fishery as some attained market size in the late summer of 1985. Watermen in Maryland had noted the presence of large numbers of smaller crabs in late spring which probably also contributed to the late summer harvest. Unusually warm water temperatures in spring 1985 favored the growth of both the 1983 and 1984 year classes of crabs.

Crabbers in Virginia experienced marketing problems from an abundance of crabs and low prices. The ex-vessel price per pound (price received by the harvester at dockside) for hard crabs in Virginia in June 1985 was only $0.18 compared to $0.28 in June 1984 (Table 4). Much of the Virginia catch consisted of smaller crabs which brought lower prices. Smaller crabs are commonly sold to packing houses for crab meat. Lower prices and the glut of crabs available to packing houses contributed to the reduced sales and lower hard crab landings in June 1985 in Virginia. Watermen in Virginia also faced competition from other states such as Maryland, Delaware, and New Jersey which had larger crabs available.

The range of suitable habitat for blue crabs was extended into upper portions of Bay tributaries, following the above-normal salinities in summer 1985. Watermen reported an increase in number and size of crabs in areas such as the upper portion of the Potomac River.

Soft crab landings showed large increases in Maryland and Virginia in June 1985 over June 1984 (Table 4). Soft crab production began about two to three weeks earlier than normal in Virginia in spring 1985, and production continued to be unusually good through May. Soft crab landings continued to be good through July in Virginia where large increases were seen over June - July 1984.

Table 4.--Blue crab landings, hard, soft and peeler, Maryland and Virginia, June - August 1984-1985.

		Maryland				Virginia			
		Hard		Soft and peeler		Hard		Soft and peeler	
		Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars
June	1984	6,191	3,358	602	1,132	8,264	2,276	121	121
	1985	7,805	3,485	1,001	2,172	5,308	949	196	189
	1984-85 % change	+26%	+4%	+66%	+92%	-36%	-58%	+62%	+56%
July	1984	8,405	3,549	524	1,268	5,729	1,090	140	152
	1985	10,573	3,815	486	997	6,433	1,025	206	197
	1984-85 % change	+26%	+7%	-7%	-21%	+12%	-6%	+47%	+30%
August	1984	11,388	3,520	606	1,243	4,567	827	177	179
	1985	12,608	4,049	495	658	N/A	N/A	N/A	N/A
	1984-85 % change	+11%	+15%	-18%	-47%	--	--	--	--

Data from Maryland Department of Natural Resources and Virginia Marine Resources Commission. Landings for Potomac River proper are not included. All 1985 landings are preliminary.

N/A = Not available.

Soft crab production in Maryland showed a 66 percent increase in June 1985 over June 1984, though landings were lower in July and August, 1985 than in 1984.

Finfish:

Fishermen noted the unusual occurrence of several species of high salinity finfish in upper Bay tributaries that are normally nearly fresh water. The occurrence of these species in upper portions of Bay tributaries coincided with higher-than-normal Bay salinities as were observed in summer 1985. Black sea bass and sea robins were reported as far north in the Bay as the Magothy River.

A 475 pound bull shark was taken off Sandy Point, MD, in August. Bull sharks are known to stray far into estuarine and even fresh water areas, though sharks in this size range (9.5 feet) are very rarely reported in the upper Bay.

Diseases:

The Maryland Department of Natural Resources reported high prevalences of the oyster pathogen, Dermo, in oysters in the Maryland portion of Chesapeake Bay. Dermo was found to be widespread in oysters on both the east and west sides of the Bay. High prevalences of Dermo are sometimes detected in oysters in fall months, however, prevalences were very high in sampled areas in July 1985. Normally, four to eight percent of the oysters on a bar may show the presence of Dermo. In July 1985, 52 percent of the oysters sampled from the Cornfield Harbor area in the lower Potomac River showed infections. In the Nanticoke River Middle Ground oyster bar, all 50 oysters in a 50 oyster sample were infected by Dermo. Seventy percent of the 50 oysters in the sample showed infections lethal to the oysters. Results of the fall 1985 survey should indicate the extent of oyster mortality from the disease. New infections usually occur in mid-summer and mortalities can occur after approximately six weeks.

The continuing high salinities in Chesapeake Bay during summer 1985 provided favorable conditions for infections by both oyster diseases, MSX and Dermo. The extent of damage to oyster bars from MSX and Dermo may not be seen until the results of the fall 1985 sampling are evaluated. High prevalences of MSX disease were also reported in some northern oyster stocks in Massachusetts and Great South Bay, NY.

Stinging nettles:

The stinging nettle infestation began and ended early and nettles appeared in well-above-average abundance in mid-summer. Nettle strobilation (generation of ephyrae from the polyp stage) occurred earlier than usual in 1985 and did not last the normal length of time compared to the previous 20 year period. Sampling by the Chesapeake Biological Laboratory (CBL) in May 1985 showed very high counts of sea nettle ephyrae (a developmental stage). In the first two weeks of July, few ephyrae were observed. The adult phase of the nettle, or medusa, lasts about three months. Medusae were first observed in early June. Site counts by the Chesapeake Biological Laboratory (CBL) at Solomons, MD. showed 50-70 individuals in mid-June. Nettle counts then increased rapidly, averaging 100 in the CBL observation area during the first week of July and 435 during the last week in July. One thousand nettle medusae were counted on

July 31, ten times the average count for the last week in July. Nettle counts dropped off sharply in the first two weeks of August to 200 per day. By mid-August, nettle counts were only eight per day, finally reaching days with zero counts by the third week in August. Nettle medusae normally disappear in the upper Bay in the second or third week of September. The cause of the sudden disappearance of the nettles in summer 1985 is unclear at present.

Blooms, fish kills:

The Maryland Office of Environmental Programs reported an unusually high number of fish kills in creeks and tributaries of Chesapeake Bay. Low dissolved oxygen contributed to fish and crab kills in upper portions of Bay tributaries in summer 1985. Many of the kills occurred in embayments, or areas which experienced light winds and poor mixing during extended dry periods in mid-to-late summer. Crab kills also occurred in areas where water was anoxic and crabs were unable to get out of traps.

A large algae bloom occurred in July in the Potomac River. Patches of the blue green algae, Microcystis, were observed floating on the surface in a wide area of the Potomac River including Gunston Cove and Mattawoman Creek and from Hallowing Point to Maryland Point. Microcystis last appeared as an extensive bloom in summer 1983, affecting a 20 mile stretch of the Potomac River. Cell densities of phytoplankton sampled in July by the Maryland Office of Environmental Programs averaged 30,507 cells/ml, 39 percent higher than the previous five-year average for July.

Submerged aquatic vegetation:

Submerged aquatic vegetation has shown a large increase in the number of species in the upper Potomac River in the last four years. Approximately 12 to 15 species were observed in summer 1985 in the tidal Potomac River.

The submerged aquatic plant, Hydrilla, showed heavy infestations in areas of the upper Potomac. Hydrilla also showed heavy infestations in the Potomac in summer 1984. Hydrilla is considered a threat to navigation and recreation and can rapidly infest large areas. Hydrilla showed thicker growth in the same areas affected in summer 1984 and spread farther upstream and downstream in the Potomac River.

Another submerged aquatic plant, Eurasian watermilfoil, also showed heavy infestations in the Potomac River. Eurasian watermilfoil is considered, like Hydrilla, a nuisance plant which clogs waterways. Eurasian watermilfoil begins seasonal growth earlier than Hydrilla in springtime.

3.2 Recreation

Marine recreational activity during the summer 1985 quarter around Chesapeake Bay increased during extended periods of dry and warm weather. Park attendance showed a very large increase in July, while Search and Rescue cases were up considerably in August.

National Weather Service Marine advisories and warnings for the Chesapeake Bay from June through August 1985 are listed in Table 5. A total of 15 small craft advisories were issued for the quarter. Small craft advisories were issued twice on the same day at different locations on June 5, July 23, and August 2. No gale warnings or special marine warnings were issued for the quarter. During the same period in 1984, ten special marine warnings for thunderstorms and three small craft advisories were issued.

The U.S. Coast Guard conducted a total of 1,430 Search and Rescue (SAR) operations in the Bay area during the 1985 summer quarter (Table 6). During the same period in 1984, 1,296 SAR cases were handled. Group Baltimore and Group Eastern Shore handled more total SAR cases during the 1985 summer quarter than in 1984. Group Eastern Shore handled 53 in 1984 and 101 in 1985. Group Baltimore handled 634 in 1984 and 765 in 1985.

Maryland Department of Natural Resources accident statistics for recreational boating are listed in Table 7. The total number of accidents for June through August 1985 decreased slightly from 136 in 1984 to 119 in 1985. The cumulative number of boating accidents in Maryland through August 1985 was 174 compared to 161 in 1984. From June through August 1985, a total of 119 boating accidents occurred with 43 injuries, 11 fatalities, and $ 289,131 in property damage.

Attendance and revenue for selected Maryland and Virginia state parks are listed in Table 8. Most state parks showed large attendance and revenue increases. The addition of a swimming pool contributed to the large attendance increases at Chippokes in summer 1985. Attendance at Westmoreland, Chippokes, Sandy Point, and Point Lookout increased during all months during the 1985 summer quarter over summer 1984.

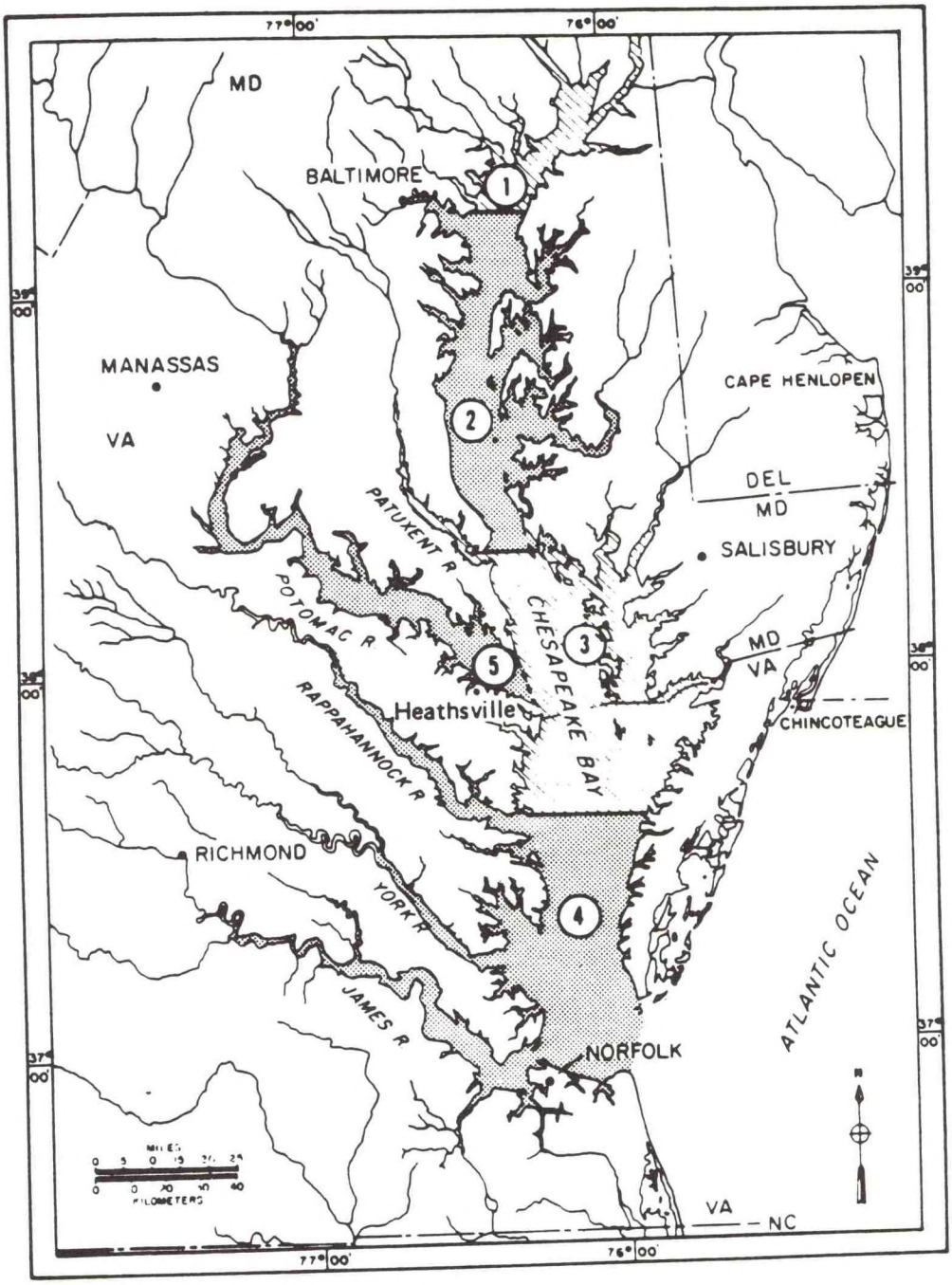

Figure 5.--National Weather Service (NWS) forecast areas for Chesapeake Bay.

Key to forecast areas:

1 = Head of Bay to Baltimore Harbor
2 = Baltimore Harbor to Patuxent River
3 = Patuxent River to Windmill Point
4 = Windmill Point to Mouth of Bay
5 = Tidal Potomac River

Table 5.--Marine advisories/warnings, Chesapeake Bay, June - August 1985 (National Weather Service data). For definition of areas see Figure 5.

	Date	Condition Report[1]	Location[2]
June	5	A	Patuxent River to Mouth of Bay
	5	A	Head of Bay to Patuxent River and Tidal Potomac River
	12	A	Entire Bay and Tidal Potomac River
	15	A	Baltimore Harbor to Mouth of Bay
	23	A	Baltimore Harbor to Windmill Point
	25	A	Patuxent River to Mouth of Bay
	26	A	Entire Bay
	30	A	Mouth of Bay
July	23	A	Head of Bay to Windmill Point and Tidal Potomac River
	23	A	Mouth of Bay
	25	A	Entire Bay and Tidal Potomac River
August	2	A	Mouth of Bay
	2	A	Patuxent River to Windmill Point
	19	A	Head of Bay to Windmill Point
	24	A	Head of Bay to Windmill Point

[1] Key to Condition Reports:

A = Small Craft Advisory (Wind 25-34 knots)
B = Gale Warning (Wind 34-47 knots)
C = Storm (Wind 47-64 knots)
D = Special Marine Warning (Unusual weather phenomena)

[2] Windmill Point = North side of Rappahannock River

Table 6.--U.S. Coast Guard Search and Rescue (SAR) caseload, June - August 1985.

Month	Number of Search and Rescues					
	Group Baltimore		Group Eastern Shore		Group Norfolk	
	1984	1985	1984	1985	1984	1985
June	215	167	10	30	210	176
July	216	286	20	35	239	184
August	203	312	23	36	160	204
Totals	634	765	53	101	609	564

Group Baltimore - most of Upper Bay
Group Eastern Shore - lower central portion of Eastern Shore
Group Norfolk - most of Lower Bay

Table 7.--Maryland marine accident statistics, June - August 1985.

Month	No. of Boating Accidents		No. of Injuries		No. of Deaths		Property Damage	
	1984	1985	1984	1985	1984	1985	1984	1985
June	37	32	12	7	4	4	$82,342	$30,631
July	55	52	16	26	5	4	$54,168	$179,854
August	44	35	11	10	0	3	$123,099	$78,646
Totals	136	119	39	43	9	11	$259,609	$289,131

Data Source: Maryland Department of Natural Resources Marine Police. All categories are for recreational boating. Includes Potomac River to Virginia shoreline. Data are preliminary.

Table 8.--State parks attendance and revenue, selected Maryland and Virginia facilities, June - August 1985.

Facility	Month					
	June		July		August	
Maryland	Attendance	Revenue	Attendance	Revenue	Attendance	Revenue
Sandy Point	94,507	$76,015	96,548	$106,715	63,746	$59,127
Point Lookout	43,326	$25,956	44,086	$ 23,176	40,890	$25,718
Virginia						
Westmoreland	27,664	$12,981	48,775	$ 18,839	26,327	$16,519
Chippokes	12,253	$ 1,985	29,520	$ 6,512	10,816	$ 2,482
York River	10,466	$ 920	12,627	$ 1,149	7,688	$ 846
Seashore	104,713	$32,891	157,112	$ 34,036	96,753	$32,541

Data from Maryland Department of Natural Resources, Forest, Park, and Wildlife Service; and Virginia Department of Conservation and Economic Development, Division of State Parks. Revenue does not always reflect usage levels. Special scheduled activities, seasonal revenue changes, and equipment breakdown influence total revenue amounts.

3.3 Transportation

Winds in excess of 40 mph shut down crane operations 22 times at the Port of Baltimore for a total of 41 hours and 35 minutes (Table 9). During the same period in summer 1984, winds shut down crane operations 6 times for a total of 14 hours and 13 minutes.

Table 9.--Number of crane shutdowns and productive time lost due to wind at Port of Baltimore, June - August 1985.

Date		Number of Shutdowns	Productive Time Lost (Hours:Minutes)
June	3	1	1:35
	12	1	:36
	14	1	3:55
	18	1	1:26
	20	2	5:33
	24	1	2:57
July	11	1	2:25
	12	2	4:04
	13	1	:07
	15	2	5:04
	16	1	:50
	21	1	1:21
	22	2	1:26
	23	1	:21
	25	2	7:02
	26	2	3:53
Totals		22	42:35

Data from Maryland Port Administration.

Most of the shutdowns in the summer 1985 quarter were in July, reflecting windy conditions in that month. The number of shutdowns in July (15 in July 1985) was very high compared to the previous two years (3 in July 1984 and 2 in July 1983).

Losses incurred by individual container-line shippers from crane down-time includes pay to stevedore crews at $1500 per hour and vessel down time at $2500 per hour. Based on the total downtime, shippers may have experienced costs in excess of $166,000 due to excessive winds in the summer 1985 quarter.

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