



*This document contains the Executive Summary of the National Estuary Program Coastal Condition Report. The Executive Summary contains a concise, short restatement of the main points of the entire report. The entire report can be downloaded from <http://www.epa.gov/owow/oceans/nepccr/index.html>*

# National Estuary Program Coastal Condition Report

## Executive Summary

June 2007

## EXECUTIVE SUMMARY

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Estuaries are bodies of water that provide transition zones between the fresh water from rivers and the saline environment of the ocean. The various interactions that occur between fresh water and salt water in estuaries result from the specific physical and hydrological characteristics of these waterbodies. These characteristics produce unique environments that support wildlife and fisheries and contribute substantially to the economy of the United States.

The nation's estuaries are a subset of U.S. coastal waters and encompass a wide variety of coastal habitats, including wetlands, salt marshes, coral reefs, mangrove and kelp forests, seagrass meadows, tidal mudflats, and upwelling areas. These estuarine habitats provide spawning grounds, nurseries, shelter, and food for fish, shellfish, and other wildlife species, as well as nesting, resting, feeding, and breeding habitat for 75% of waterfowl and other migratory birds.

As part of the 1987 amendments to the Clean Water Act, the Section 320 National Estuary Program (NEP) promotes comprehensive planning efforts to help protect nationally significant estuaries in the United States that are deemed to be threatened by pollution, development, or overuse. Since the inception of the program, 28 estuaries have been nominated by their respective state Governors and officially designated as NEP estuaries, and in 2007, the NEP will celebrate 20 years of restoring and protecting these nationally significant estuaries. As one of the U.S. Environmental Protection Agency's (EPA's) most successful watershed programs, the NEP demonstrates the effectiveness of a stakeholder-driven, collaborative process to address water quality problems and to target habitat restoration.

Individual NEPs are required to monitor the effectiveness of their management activities to address estuary-specific priority actions. The Clean Water Act also requires that EPA report periodically on the condition of the nation's estuarine waters. Coastal states provide EPA with valuable information about the

condition of their estuarine resources; however, because the individual states and the NEPs and their partners use different approaches for data collection and the evaluation of estuarine condition, it has been difficult to compare this information among states, NEPs, or on a regional or national basis.

To better address questions about the condition of the nation's estuaries, EPA, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), the U.S. Department of the Interior (DOI), and the U.S. Department of Agriculture (USDA) agreed to participate in a multi-agency effort to assess the condition of all U.S. estuaries, including the NEP estuaries. To minimize the problems created by compiling data collected using different sampling methods, the collaborating agencies chose to assess estuarine condition using nationally consistent monitoring surveys, the results of which are compiled periodically into a series of reports called the *National Coastal Condition Reports*.

Published in 2001, the first *National Coastal Condition Report* (NCCR I) reported that the nation's collective estuarine resources were in fair condition. This assessment was based on available data, collected from 1990 through 1996, that were used to characterize about 70% of the nation's estuarine resources. Agencies contributing data to the NCCR I included EPA, NOAA, DOI, and USDA. The second *National Coastal Condition Report* (NCCR II), published in 2004, was based on available data from 1997 to 2000 that were representative of 100% of the estuarine area of the conterminous 48 states and Puerto Rico. These data show that the nation's estuaries continue to be rated in fair condition. Agencies contributing to the NCCR II included EPA, NOAA, the U.S. Fish and Wildlife Service (FWS), and USGS, as well as several state, regional, and local organizations that provided information on the current condition of the nation's coastal waters.

The objective of this *National Estuary Program Coastal Condition Report* (NEP CCR) is to report on the condition of the nation's 28 NEP estuaries. The NEP CCR presents two major types of monitoring data for each NEP estuary: (1) data collected as part of EPA's National Coastal Assessment (NCA) and (2) data collected by the individual NEPs or by the NEPs in partnership with interested stakeholders, including state environmental agencies, universities, or volunteer monitoring groups. Together, these data paint a picture of the overall condition of the coastal resources of the nation's NEP estuaries.

The ratings developed in this report are based solely on NCA monitoring data and not the data collected by the individual NEPs. The NCA data—the most comprehensive and nationally consistent data available related to estuarine condition—were collected from 1997 through 2003 for four primary indices of estuarine condition (water quality index, sediment quality index, benthic index, and fish tissue contaminants index). These indices were assigned a good, fair, or poor rating for each NEP estuary according to the rating criteria presented in Table ES-1. These ratings were then used to create overall condition ratings for the collective NEP estuaries of each coastal region (Northeast Coast, Southeast Coast, Gulf Coast, West Coast, and Puerto Rico) and the nation (Figure ES-1). The overall condition rating for the nation's collective NEP estuaries is based on a weighted average of the regional index scores. More detailed information on the component indicators for water quality and sediment quality, when available, is also presented throughout this report.

In addition to the NCA-based assessments, this report provides individual profiles of the 28 NEP estuaries that describe the indicators each NEP uses to address specific environmental concerns, including water and sediment quality, habitat quality, living resources, and environmental stressors, as appropriate. Each profile includes background information on the NEP estuary discussed, maps of the NEP study area, and data on the population pressures that affect the study area, including the total population (2000), population density (2000), and population growth rate (1960–2000) in NOAA-designated coastal counties that

are within or transect the boundaries of the study area (i.e., NEP-coincident coastal counties). A short discussion of an individual NEP's current projects, accomplishments, and future goals is also provided in each profile, as well as a Highlight article, developed by the individual NEP, that describes a representative species, program, or activity for the NEP. These profiles are not meant to be exhaustive or comprehensive reports, but are included to provide the reader with a perspective about the variety of habitats and species that each NEP estuary shelters, the salient or unique aspects about the nature of the estuary, the problems of most concern to local stakeholders, and the ongoing and planned initiatives to continue monitoring and managing the environmental health of the estuary. The monitoring data derived from the NEPs will be used to develop an effective management plan for protecting and improving the condition of the nation's NEP resources.



Estuaries are critical for the survival of a number of species, including the Brown Pelican, which nests and breeds along the nation's coasts (John Theilgard).

## Describing Estuarine Condition

This report presents two types of monitoring data to provide a perspective on the condition of the nation's NEP estuaries: data collected by the NCA and data collected by the individual NEPs and their partners.

## National Coastal Assessment (NCA) Monitoring Data

The monitoring data derived from EPA's NCA are used exclusively in this report to develop indices of estuarine condition for the 28 NEP estuaries and to calculate regional and national ratings of NEP estuarine condition. The NCA survey was designed to assess the percentage of the nation's estuaries and coastal waters exhibiting poor, fair, or good condition using consistent and comparable environmental indicators, and data from this survey was used for the NCCR series, which includes

this NEP CCR. The probability survey design, indices, and component indicators of the NCA survey are appropriate to assess estuarine condition at state, regional (e.g., Gulf Coast), or national scales. When probability survey designs incorporate geographic areas smaller than a state, as in the case of the NEPs, assessments can be made of the condition of each strata, provided a sufficient number of samples were taken to achieve the desired confidence level.

The NCA sampled a minimum of 20 (typically 35–50) monitoring sites to assess the condition of each NEP estuary. Twelve hundred and thirty-nine NCA sites were sampled in the NEP estuarine areas. In addition, the NCA was designed to assess condition during the summer season, when estuaries are expected to be the most stressed (i.e., highest water temperature). These data are also used to determine reference conditions to assess ecological responses to stressors and to set state criteria and standards.

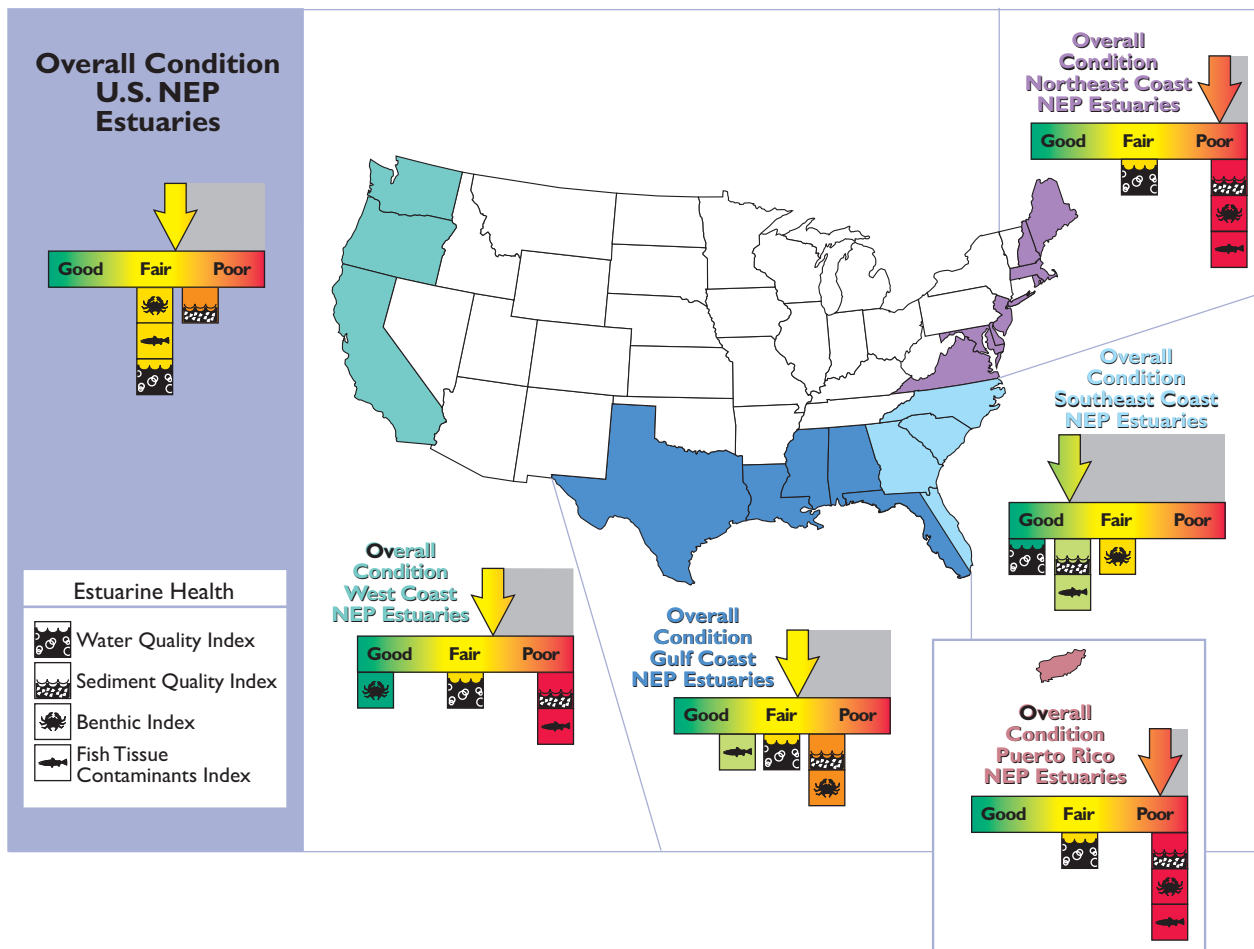






Figure ES-1. National and regional overall condition ratings for NEP estuaries based on NCA results (1997–2003).



Table ES-1. NCA Indices Used to Assess Estuarine Condition

 Water Quality Index	<p><b>Water Quality Index</b>—This index is based on five water quality component indicators (dissolved inorganic nitrogen [DIN], dissolved inorganic phosphorus [DIP], chlorophyll <i>a</i>, water clarity, and dissolved oxygen).</p> <p><b>Ecological Condition by Site</b></p> <p><b>Good:</b> No component indicators are rated poor; and a maximum of one component indicator is rated fair.</p> <p><b>Fair:</b> One component indicator is rated poor; or two or more component indicators are rated fair.</p> <p><b>Poor:</b> Two or more component indicators are rated poor.</p> <p><b>Ranking by NEP Estuary or Region</b></p> <p><b>Good:</b> Less than 10% of the NEP estuarine area is in poor condition, and more than 50% of the NEP estuarine area is in good condition.</p> <p><b>Fair:</b> 10% to 20% of the NEP estuarine area is in poor condition, or more than 50% of the NEP estuarine area is in combined poor and fair condition.</p> <p><b>Poor:</b> More than 20% of the NEP estuarine area is in poor condition.</p>
 Sediment Quality Index	<p><b>Sediment Quality Index</b>—This index is based on three sediment quality component indicators (sediment toxicity, sediment contaminants, and sediment total organic carbon [TOC]).</p> <p><b>Ecological Condition by Site</b></p> <p><b>Good:</b> No component indicators are rated poor, and the sediment contaminants indicator is rated good.</p> <p><b>Fair:</b> No component indicators are rated poor, and the sediment contaminants indicator is rated fair.</p> <p><b>Poor:</b> One or more component indicators are rated poor.</p> <p><b>Ranking by NEP Estuary or Region</b></p> <p><b>Good:</b> Less than 5% of the NEP estuarine area is in poor condition, and more than 50% of the NEP estuarine area is in good condition.</p> <p><b>Fair:</b> 5% to 15% of the NEP estuarine area is in poor condition, or more than 50% of the NEP estuarine area is in combined poor and fair condition.</p> <p><b>Poor:</b> More than 15% of the NEP estuarine area is in poor condition.</p>
 Benthic Index	<p><b>Benthic Index</b> (or a surrogate measure)—This index indicates the condition of the benthic community (organisms living in estuarine sediments) and can include measures of benthic community diversity, the presence and abundance of pollution-tolerant species, and the presence and abundance of pollution-sensitive species.</p> <p><b>Ecological Condition by Site</b></p> <p><b>Good, fair, and poor</b> were determined using regionally dependent benthic index scores.</p> <p><b>Ranking by NEP Estuary or Region</b></p> <p><b>Good:</b> Less than 10% of the NEP estuarine area has a poor benthic index score, and more than 50% of the NEP estuarine area has a good benthic index score.</p> <p><b>Fair:</b> 10% to 20% of the NEP estuarine area has a poor benthic index score, or more than 50% of the NEP estuarine area has a combined poor and fair benthic index score.</p> <p><b>Poor:</b> More than 20% of the NEP estuarine area has a poor benthic index score.</p>
 Fish Tissue Contaminants Index	<p><b>Fish Tissue Contaminants Index</b>—This index indicates the level of chemical contamination in target fish/shellfish species.</p> <p><b>Ecological Condition by Site</b></p> <p><b>Good:</b> For all chemical contaminants listed in Table 1-21 (Chapter 1), composite fish tissue contaminant concentrations are below the EPA Advisory Guidance* concentration range.</p> <p><b>Fair:</b> For at least one chemical contaminant listed in Table 1-21, composite fish tissue contaminant concentrations are within the EPA Advisory Guidance concentration range.</p> <p><b>Poor:</b> For at least one chemical contaminant listed in Table 1-21, composite fish tissue contaminant concentrations are above the EPA Advisory Guidance concentration range.</p> <p><b>Ranking by NEP Estuary or Region</b></p> <p><b>Good:</b> Less than 10% of the fish samples analyzed (Northeast Coast region) or the monitoring stations where fish were caught (all other regions) are in poor condition, and more than 50% of the fish samples analyzed (Northeast Coast region) or the monitoring stations where fish were caught (all other regions) are in good condition.</p> <p><b>Fair:</b> 10% to 20% of the fish samples analyzed (Northeast Coast region) or the monitoring stations where fish were caught (all other regions) are in poor condition, or more than 50% of the fish samples analyzed (Northeast Coast region) or the monitoring stations where fish were caught (all other regions) are in combined poor and fair condition.</p> <p><b>Poor:</b> More than 20% of the fish samples analyzed (Northeast Coast region) or the monitoring stations where fish were caught (all other regions) are in poor condition.</p>

\*The EPA Advisory Guidance concentration is based on the non-cancer ranges for all contaminants except PAH (benzo(a)pyrene), which are based on a cancer range because a non-cancer range for PAHs does not exist (see Table 1-21, Chapter 1).

Given the parameters of the NCA methodology, the NEP CCR is not designed to assess the temporal variability or extent (i.e., how often within a summer these conditions exist or the area affected) of highly variable water quality parameters (e.g., nutrient, chlorophyll *a*, or dissolved oxygen concentrations). In addition, the report does not provide the specific location of poor, fair, or good conditions, but rather the proportion of a larger area that exhibits such conditions, nor does it answer local estuary-specific management questions regarding the location, temporal extent, or frequency of degraded conditions for rapidly changing parameters.

This report is appropriate for defining the percentage of the nation's NEP waters (nationally, regionally, and on an individual estuary basis) that exhibit poor, fair, or good conditions for fairly stable summer characteristics, such as sediment contaminant levels and benthic condition, which often reflect conditions integrated over months or even years. However, to maintain NCA monitoring at a reasonable cost, measurements were taken one time per sampling site during the summer over a modest number of sites; therefore, the resulting NCA survey data provide a less accurate view of the ephemeral conditions associated with an estuary's water column, where water quality conditions may change weekly, daily, or even hourly during a summer sampling period.

## National Estuary Program (NEP) Monitoring Data

To assess the overall condition of each NEP estuary, the NCA data should be evaluated in addition to data collected locally by the NEPs over a longer time period and at more sampling locations. For example, degraded benthic condition may not necessarily be caused solely by the high sediment contaminant levels measured by the NCA, but may also be caused by short-term stresses, such as sporadic hypoxia or algal blooms. The NCA “snapshot” approach may not capture these stresses because they occur outside the summer diurnal sampling period; therefore, an assessment of NEP-specific data is necessary.

The NEP monitoring data are derived from the individual NEPs and are discussed in this report to provide information on NEP monitoring methods and indicators developed to address site-specific estuarine concerns. Because these data are collected using methods unique to each individual NEP, they generally cannot be used to make comparisons among estuaries at the regional or national level. A summary of the data is provided in the individual NEP profiles in the hope that information about the types of indicators that have been developed, implemented, and found to be effective in assessing spatial and temporal trends for one NEP estuary will also prove useful to other NEPs.



Boating, fishing, swimming, and bird watching are just a few of the numerous recreational activities that people enjoy in estuaries (Toni Droscher; PSAT).

To find out if there is an NEP in your coastal area and to obtain detailed environmental monitoring data for the 28 NEP estuaries, please visit [www.epa.gov/owow/estuaries](http://www.epa.gov/owow/estuaries), [www.nationalestuaries.org](http://www.nationalestuaries.org), or [www.epa.gov/emap](http://www.epa.gov/emap).

## Summary of Findings

With this NEP CCR, the collaborating agencies and the individual NEPs strive to provide a benchmark of estuarine condition that paints a comprehensive picture of the nation's NEP estuaries. The report indices are based on the large amount of NCA monitoring data collected from 1997 through 2003 on the condition of the nation's NEP estuaries. NCA rating scores for estuarine condition are based on a 5-point system, where a score of less than 2.0 is rated poor; 2.0 to less than 2.3 is rated fair to poor; 2.3 to 3.7 is rated fair; greater than 3.7 to 4.0 is rated good to fair; and greater than 4.0 is rated good.

The major findings of this report are as follows:

- An assessment of the ecological monitoring data shows that the overall condition of the nation's NEP estuaries is generally fair (2.7), but that regionally, the Puerto Rico (1.5) and Northeast Coast (1.5) regions are rated poor, the Gulf Coast (2.75) and West Coast (2.5) regions are rated fair, and the Southeast Coast region is rated good to fair (4.0) for overall condition (Table ES-2). The

overall condition ratings for the nation's NEP estuaries are based on four primary indices of estuarine condition—a water quality index, sediment quality index, benthic index, and fish tissue contaminants index.

- The **water quality index** for the nation's collective NEP estuaries is rated fair (3.6), with the Northeast Coast (3.0), Gulf Coast (3.0), West Coast (3.0), and Puerto Rico (3.0) regions rated fair and the Southeast Coast region (5.0) rated good for this index. Water quality data, including data on the five component indicators (DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen), were available for all NEP estuaries of the United States.
- The **sediment quality index** for the nation's collective NEP estuaries is rated fair to poor (2.1), with the Northeast Coast (1.0), West Coast (1.0), and Puerto Rico (1.0) regions rated poor; the Gulf Coast region (2.0) rated fair to poor; and the Southeast Coast region (4.0) rated good to fair for this index. Sediment quality index ratings were based on three component indicators: sediment toxicity, sediment contaminants, and sediment TOC. For some NEPs, two of the three component indicators for assessing sediment quality were not monitored, and the sediment quality index was based solely on the measurement of one component indicator. Typically, sediment TOC

**Table ES-2. Regional and National Rating Scores<sup>a</sup> for Indices of Estuarine Condition and Overall Condition for the Nation's NEP Estuaries**

Index	Northeast Coast	Southeast Coast	Gulf Coast <sup>b</sup>	West Coast	Puerto Rico <sup>c</sup>	United States <sup>d</sup>
Water Quality Index	3	5	3	3	3	3.6
Sediment Quality Index	1	4	2	1	1	2.1
Benthic Index	1	3	2	5	1	2.7
Fish Tissue Contaminants Index	1	4	4	1	1	2.6
<b>Overall Condition</b>	<b>1.5</b>	<b>4.0</b>	<b>2.75</b>	<b>2.5</b>	<b>1.5</b>	<b>2.7</b>

<sup>a</sup> Rating scores are based on a 5-point system, where a score of less than 2.0 is rated poor; 2.0 to less than 2.3 is rated fair to poor; 2.3 to 3.7 is rated fair; greater than 3.7 to 4.0 is rated good to fair; and greater than 4.0 is rated good.

<sup>b</sup> This rating score does not include the impact of the hypoxic zone in offshore Gulf Coast waters.

<sup>c</sup> This rating score includes only San Juan Bay Estuary, Puerto Rico.

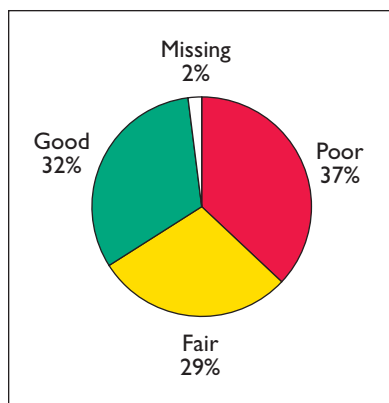
<sup>d</sup> The U.S. score is based on an areally weighted mean of the regional index scores.



was more consistently monitored among sites than sediment toxicity or sediment contaminant concentrations. The NCA did not evaluate the Peconic Estuary for sediment quality, and only sediment TOC data were available for the four NEP estuaries located in Florida (Indian River Lagoon, Charlotte Harbor, Sarasota Bay, and Tampa Bay).

- The **benthic index** for the nation’s collective NEP estuaries is rated fair (2.7), with the Northeast Coast (1.0) and Puerto Rico (1.0) regions rated poor, the Gulf Coast region (2.0) rated fair to poor, the Southeast Coast region (3.0) rated fair, and the West Coast region (5.0) rated good for this index. Benthic indices were developed for the NEP estuaries of the Northeast Coast, Southeast Coast, and Gulf Coast regions, and benthic community diversity was used as a surrogate indicator of biological condition for the West Coast and Puerto Rico regions. No assessment was possible using the benthic community diversity indicator for three West Coast estuaries (Lower Columbia River Estuary, Morro Bay, and Santa Monica Bay).
- The **fish tissue contaminants index** for the nation’s collective NEP estuaries is rated fair (2.6), with the Northeast Coast (1.0), West Coast (1.0), and Puerto Rico (1.0) regions rated poor, and the Southeast Coast (4.0) and Gulf Coast (4.0) regions rated good to fair for this index. NCA data for the fish tissue contaminants index were not available for several of the NEP estuaries, including Casco Bay, the Indian River Lagoon, Charlotte Harbor, Sarasota Bay, and Tampa Bay.

- Nationally, 37% of the NEP estuaries are in poor overall condition (Table ES-3, Figure ES-2). Regionally, roughly 100% of Puerto Rico’s NEP estuary (San Juan Bay Estuary) is in poor overall condition, and 46% of the Northeast Coast, 46% of the Gulf Coast, 36% of the West Coast, and 23% of the Southeast Coast NEP estuaries are in poor overall condition.



**Figure ES-2.** Overall condition data for U.S. NEP estuaries (U.S. EPA/NCA).

### Comparison of NEP Estuaries with All U.S. Estuaries

A primary goal of the NCCR series is to provide a benchmark of estuarine condition to measure the success of estuarine programs over time. To achieve this goal, the conditions reported in the NCCR series and the NEP CCR need to be comparable. Comparing data between the NCCR II (inclusive of both NEP and non-NEP estuaries) and the NEP CCR is complicated because, in some cases, common indicators were not available for both reports. For example, the NCCR II used five environmental indices to determine coastal condition—water quality, sediment quality, benthic

**Table ES-3. Percent of NEP Estuarine Area in Poor Condition by Index and Region**

Index	Northeast Coast	Southeast Coast	Gulf Coast	West Coast	Puerto Rico	United States
Water Quality Index	9	4	13	4	8	8
Sediment Quality Index	21	6	15	17	33	15
Benthic Index	26	15	20	4	65	17
Fish Tissue Contaminants Index	38	10	12	32	40	23
<b>Overall Condition</b>	<b>46</b>	<b>23</b>	<b>46</b>	<b>36</b>	<b>100</b>	<b>37</b>

condition, fish tissue contaminant concentrations, and coastal habitat condition; however, information on coastal habitat condition was not available for the current NEP CCR. To facilitate a comparison between the two reports, the rating scores for the NCA indices reported in the NCCR II were recalculated, to the extent possible, using the methods followed in the NEP CCR. The coastal habitat index and its effect on regional and national ratings were excluded from the NCCR II scores presented in this report. Table ES-4 summarizes the rating scores by index and region, comparing the NCCR II and the NEP CCR results.

Table ES-4 shows that the overall condition score for the nation's collective NEP estuaries is 2.7 (rated fair) and that this score is slightly higher than the NCCR II score of 2.6 (rated fair) for overall condition for all U.S. estuaries (both NEP and non-NEP estuaries). On a national basis, it appears that the collective NEP estuaries score slightly higher for two of the four indices (water quality index and benthic index) than the scores for all U.S. estuaries, comparably for the fish tissue contaminants index, and slightly lower for the sediment quality index.

Regionally, the rating results are somewhat mixed when comparing NEP estuaries to all U.S. estuaries, although the regional overall condition scores are not appreciably different between the two groups (within 0.25 points or less of the corresponding score). For example, the regional overall condition scores for the

NEP estuaries are higher for the Northeast Coast and West Coast regions, comparable for the Southeast Coast and Gulf Coast regions, and lower for Puerto Rico than the regional overall condition scores for all estuaries (both NEP and non-NEP).

It is noteworthy that the most complete data set collected in the NCA was for the water quality index, whereas data for the sediment quality index (predominately for the sediment toxicity and sediment contaminants component indicators), benthic index, and fish tissue contaminants index were missing for some NEPs. In addition, EPA's *Clean Water State Revolving Fund Programs 2005 Annual Report* noted that \$53 billion in funding has been spent over the past 18 years to rebuild and upgrade wastewater treatment plants (WWTPs), resulting in expanded capacity for secondary and tertiary treatment of wastewater to remove nutrients, heavy metals, and organic contaminants. These strides, coupled with more stringent water quality standards for industrial dischargers, have resulted in water quality improvements in many areas; however, the legacy of contamination remains in the sediments of many estuaries as byproducts of the Industrial Revolution and years of discharging without the protective mandates of the Clean Water Act. This residual contamination may result in reduced benthic community health and in the bioaccumulation of chemical contaminants in fish and shellfish tissues.

**Table ES-4. Regional and National Rating Scores\* by Index for All U.S. Estuaries (NCCR) and for NEP Estuaries**

Index	Northeast Coast		Southeast Coast		Gulf Coast		West Coast		Puerto Rico		United States	
	NCCR	NEP	NCCR	NEP	NCCR	NEP	NCCR	NEP	NCCR	NEP	NCCR	NEP
Water Quality Index	2	3	4	5	3	3	3	3	3	3	3.0	3.6
Sediment Quality Index	1	1	4	4	3	2	2	1	1	1	2.6	2.1
Benthic Index	1	1	3	3	2	2	3	5	1	1	2.2	2.7
Fish Tissue Contaminants Index	1	1	5	4	3	4	1	1	NA	1	2.6	2.6
<b>Overall Condition</b>	1.25	1.50	4.0	4.0	2.75	2.75	2.25	2.50	1.67	1.50	2.6	2.7

\* Rating scores are based on a 5-point system, where a score of less than 2.0 is rated poor; 2.0 to less than 2.3 is rated fair to poor; 2.3 to 3.7 is rated fair; greater than 3.7 to 4.0 is rated good to fair; and greater than 4.0 is rated good.

## Population Pressures Affecting the NEPs

Population pressures on coastal counties coincident with the individual NEP study areas or collectively on NEP-coincident coastal counties within a specific region were evaluated with respect to both temporal and spatial perspectives using total population (2000), population density (2000), and percent population growth rate (1960–2000). Total population provides a perspective of the total number of individuals using the various resources within the NEP-coincident coastal counties at any point in time, and population density provides a measure of how saturated the associated NEP-coincident coastal counties are with respect to human development. The population growth rate over a specific time interval provides an indication of how quickly human development in an area occurs and the coinciding infrastructure development that would be needed to provide for the associated residential and commercial development and services. When assessed collectively, these population measures provide information about

the pressures exerted by society on the NEP coastal ecosystems.

Regionally, the NEP-coincident coastal counties of the Northeast Coast region contained the highest total population in 2000 (38 million), followed by the West Coast (30 million), Gulf Coast (11 million), and Southeast Coast (3 million) regions. Population density values also showed that the NEP-coincident coastal counties of the Northeast Coast region have the highest regional density (1,055 persons/mi<sup>2</sup>), followed by the West Coast (421 persons/mi<sup>2</sup>), Gulf Coast (287 persons/mi<sup>2</sup>), and Southeast Coast (168 persons/mi<sup>2</sup>) regions. By comparison, Puerto Rico had the highest population density in 2000 of any NEP region (5,055 persons/mi<sup>2</sup>). In contrast, population growth rates for these same regional areas show a different pattern, with the Gulf Coast region having the highest growth rate (133%), closely followed by the Southeast Coast (131%) and West Coast (100%) regions, and lastly by the Northeast Coast (24%) region.



Estuarine waters serve as habitat and breeding areas for hundred of species of birds and other wildlife (John Theilgard).

## Correlation Between NEP CCR Index Scores and Population Pressures

Population data reveal some patterns for both total population and population density with respect to population pressures within the NEP-coincident coastal counties. As shown in Table ES-5, when the population in the coastal counties is greater than 2 million people, as it is for 11 NEPs, the overall condition scores for these NEPs range from 1.0 (rated poor) to 3.0 (rated fair), with a mean score of 2.26 (rated fair to poor). For the 8 NEPs with populations between 1 to 2 million people, the overall condition scores range from 1.5 (rated poor) to 5.0 (rated good), with a mean score of 3.30 (rated fair). For the 9 NEPs with populations less than 1 million people, the overall condition scores range from 1.75 (rated poor) to 5.0 (rated good), with a mean score of 3.45 (rated fair). Although it is clear that the NEPs with the highest populations (> 2 million) showed the lowest overall condition scores, as well as scores with the smallest range of values, the overall condition scores for the other two population groups varied widely; however, the mean overall condition scores tended to be slightly higher in the NEPs with the lowest total population.

The population density results (Table ES-6) are very similar to the total population results. For the 5 NEPs with population densities greater than 1,000 persons/mi<sup>2</sup> in NEP-coincident coastal counties, the overall condition scores range from 1.0 (rated poor) to 4.33 (rated good), with a mean score of 2.16 (rated fair to poor). For the 8 NEPs with population densities ranging from 500 to 1,000 persons/mi<sup>2</sup>, the overall condition scores range from 1.75 (rated poor) to 3.5 (rated fair), with a mean score of 2.58 (rated fair). Finally, for the 15 NEPs with the lowest population densities (less than 500 persons/mi<sup>2</sup>), the overall condition scores range from 1.75 (rated poor) to 5.0 (rated good), with a mean score of 3.39 (rated fair). A slight difference among the three population density groups shows an increase in the mean overall condition scores as the population density decreases.

Although the mean overall condition scores based on total population and population density within the NEP-coincident coastal counties appear to exhibit some patterns, it should be noted that within any of the total population groups (Table ES-5) or population density groups (Table ES-6), there is a high degree of variability in the overall condition scores for the individual NEPs that can be inconsistent with the patterns exhibited in the mean overall condition scores.

**Table ES-5. Comparison of Total Population of NEP-Coincident Coastal Counties with the NCA Mean Overall Condition Scores for the NEP Estuaries**

Total Population of NEP-Coincident Coastal Counties	Range in NCA Overall Condition Scores Observed	NCA Mean Overall Condition Score	Number of NEP Estuaries
> 2 million	1.0–3.0	2.26	11
1–2 million	1.5–5.0	3.30	8
< 1 million	1.75–5.0	3.45	9

**Table ES-6. Comparison of Population Density of NEP-Coincident Coastal Counties with the NCA Mean Overall Condition Scores for the NEP Estuaries**

Population Density of NEP-Coincident Coastal Counties	Range in NCA Overall Condition Scores Observed	NCA Mean Overall Condition Score	Number of NEP Estuaries
> 1,000 persons/mi <sup>2</sup>	1.0–4.33	2.16	5
500–1,000 persons/mi <sup>2</sup>	1.75–3.5	2.58	8
< 500 persons/mi <sup>2</sup>	1.75–5.0	3.39	15

## NEP Environmental Concerns

The NEP estuaries have been affected by a wide variety of environmental concerns, several of which have been adopted by the NEPs as priority management activities for their respective estuaries. For this report, more than two dozen major environmental concerns were identified by the NEPs, including the following:

- Habitat loss/alteration
- Declines in fish and wildlife populations
- Excessive nutrients
- Toxic chemical contaminants
- Pathogens
- Alteration of freshwater flows
- Introduction of invasive species.

Some environmental concerns have commonality in many NEPs, whereas others are more NEP-specific because they relate to the unique climactic, hydrologic, geologic, or geomorphologic conditions associated with an individual estuary. Figure ES-3 shows a variety of environmental concerns identified by the 28 NEPs.

## Shortcomings of Available Data

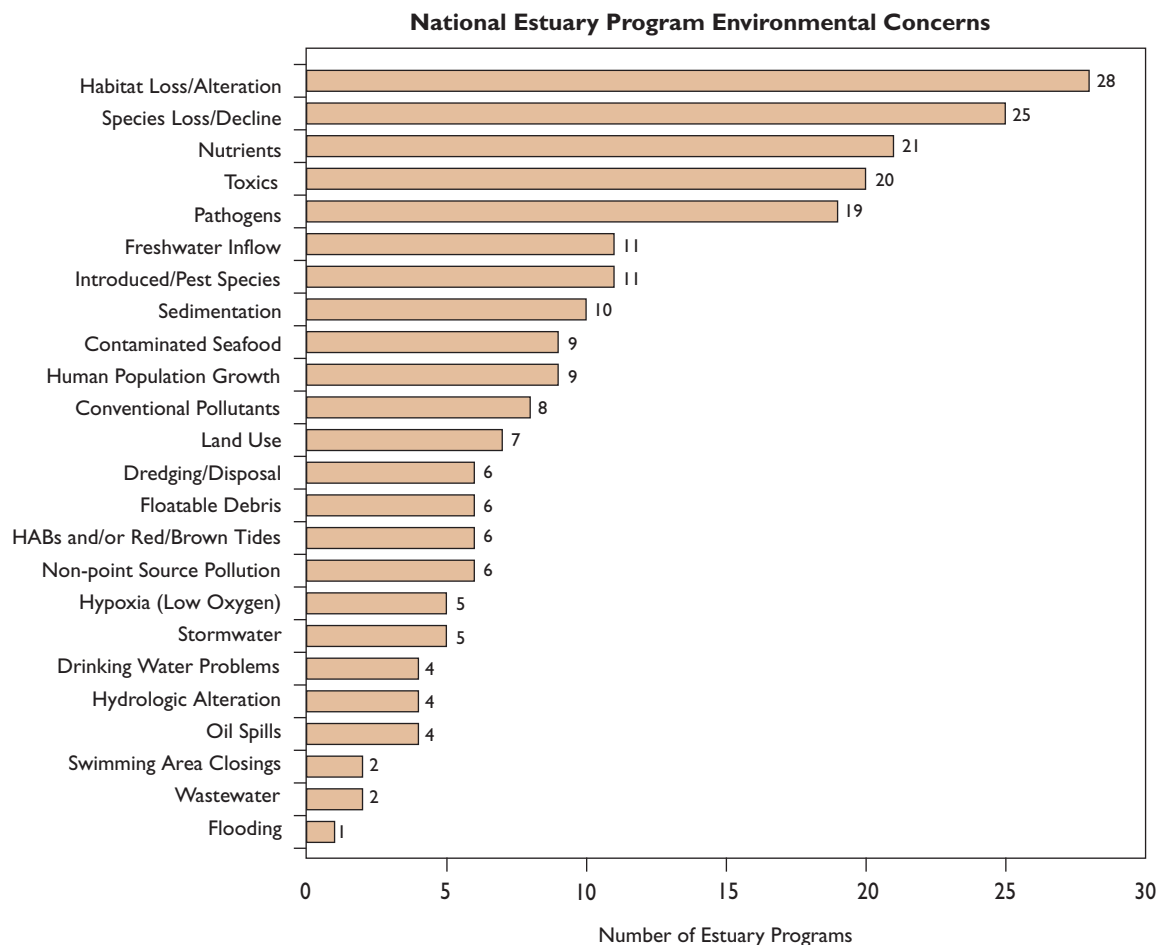
This NEP CCR provides estimates of estuarine condition on a national, regional, and individual scale for the 28 NEP estuaries. These estimates are based on nationally consistent and comparable NCA data on four primary indices of estuarine condition. For about one-third of the NEP estuaries, however, complete data on all four NCA indices were not available. As a result, an NEP estuary and its respective region may have received either a higher or a lower overall condition score and rating than would have been achieved if the missing data were available for use in the analysis of estuarine condition. This report makes the best use of the available NCA data to characterize and assess the condition of the nation's NEP estuaries; however, it cannot represent all individual NEP estuarine systems at all of the appropriate temporal and spatial scales necessary to assess the overall condition of these estuaries.

In addition to the NCA data presented in this report, the individual NEPs have also been mandated the responsibility of monitoring environmental conditions in their individual estuaries to assess whether the



U.S. coastal areas are home to roughly 40% of the U.S. population (John Theilgard).





**Figure ES-3.** List of environmental concerns of the nation's 28 individual NEPs.

environmental health of the estuary is degrading and, if possible, to help restore ecological condition. Because each NEP estuary's suite of environmental concerns are site-specific, each state, NEP, and its stakeholders have often developed monitoring and assessment methods that are unique to their estuary. Individual NEP monitoring may not be randomized spatially (as was done for the NCA) because NEP monitoring may target specific areas to ascertain specific sources of contamination or to obtain more detailed information about a particular environmental concern relevant to the NEP estuary.

It is important that the users of this report realize the shortcomings and limitations of the data presented, both from the NCA and from the individual NEPs. Both of these data sources taken together can often show very different results for the same estuarine index

or component indicator. For example, although the NCA survey data may indicate that dissolved oxygen concentrations in the water column are in good condition, this assessment is based on monitoring conducted in an estuary during daylight hours only for a one-day period in the summer season during a given year. In contrast, the individual NEP monitoring data may indicate that dissolved oxygen levels at the same site are poor based on hourly monitoring conducted over a 24-hour monitoring cycle, including hours after dark when oxygen concentrations often drop due to plant respiration. Both of these data collection methods are correct within the limitations of the conditions under which the monitoring was conducted and the analysis used to evaluate the data.

## Conclusion

There was no consistent and comparable NCA estuarine survey at the inception of the NEP. However, based on the probabilistic sampling results collected by the NCA from 1997 through 2003, the NEP estuaries scored equal to or higher than all U.S. estuaries combined.

During the past 20 years, population pressures along the coasts have increased. By 2000, more than two-thirds of the coastal population lived in NEP-coincident counties, which comprise less than 6% of the coastal land area. Since 1987, as NEPs have attempted to address their individual environmental concerns, they have made many improvements to areas that are assessed by NCA. For example, work by the individual

NEPs and their partners to make improvements in WWTPs, assist with the implementation of stormwater management plans, or identify primary sources of non-point source pollution may result in better ratings for water quality parameters in the NEP estuaries. The NEPs have also directed resources towards addressing some environmental concerns that are not directly assessed by the NCA. For example, habitat loss and alteration is listed as an environmental concern for all 28 NEP estuaries, and the individual NEPs have worked hard to monitor, conserve, protect, and restore important habitats (e.g., SAV, wetlands) in their study areas, including restoring and/or protecting more than one million acres of habitat between 2000 and 2006.



Tourism, fisheries, and other commercial activities thrive on the wealth of natural resources supplied by estuaries (John Theilgard).