



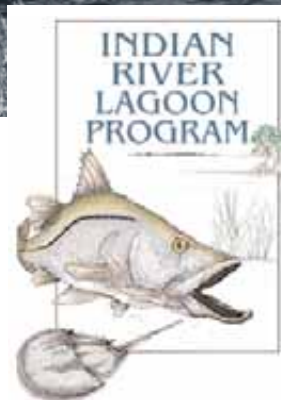
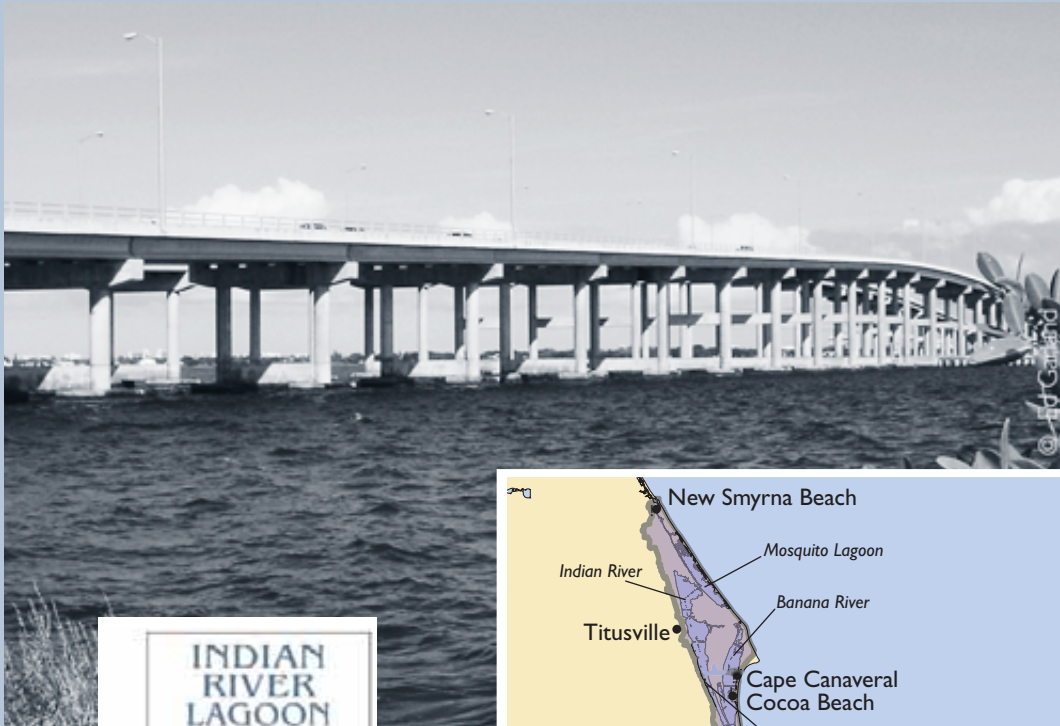
*This document contains overall and specific condition of the Indian River Lagoon National Estuary Program from the National Estuary Program Coastal Condition Report. The entire report can be downloaded from <http://www.epa.gov/owow/oceans/nepccr/index.html>*

## National Estuary Program Coastal Condition Report

### Chapter 4: Southeast National Estuary Program Coastal Condition, Indian River Lagoon National Estuary Program

June 2007

## Indian River Lagoon National Estuary Program



[www.sjrwmd.com/programs/outreach/irlnep](http://www.sjrwmd.com/programs/outreach/irlnep)



### Background

Located along Florida’s east coast and stretching 156 miles from Volusia County to Palm Beach County, FL, the Indian River Lagoon is one of the most diverse estuaries in North America and one of Florida’s most popular fishing destinations, with more than 1 million anglers visiting the Lagoon area each year (U.S. EPA, 2000c). The Lagoon and its surrounding watershed include a wide variety of habitats that support a diverse assemblage of plants and animals (SJRWMD, 2004). These habitats range from xeric scrub through pine

flatwoods, tropical and temperate hardwood hammocks, salt marshes, mangrove swamps, and other intertidal communities to seagrass meadows and other SAV communities (Hill, 2002).

This region’s broad diversity of habitats support more than 4,300 different species, including 700 saltwater and freshwater fish species and 310 bird species (SJRWMD, 2004). Thirty-six of the species found in this region are classified as threatened or endangered, including the Southeastern beach mouse, Atlantic salt-marsh snake, bald eagle, and Florida scrub jay

(SJRWMD, 2004; U.S. EPA, 2006d). In addition, an estimated one-third of Florida's endangered West Indian manatees live in the Indian River Lagoon. Commercially, the estuary is one of the most important waterways in Florida and is a productive nursery ground for an estimated \$300 million in annual commercial fishing revenues, including \$100 million from inshore species. The Indian River Lagoon accounts for 50% of Florida's total East Coast fisheries landings (SJRWMD, 1994). In addition, tourism and recreation contribute \$540 million to the local economy, and the influx of tourists and part-time residents to the area is considerable (SJRWMD, 2002).

In 1987, the Florida Legislature passed the Surface Water Improvement and Management (SWIM) Act, which designated the Indian River Lagoon as a priority waterbody in need of restoration and special protection (Florida Statutes, Chapter 373.451–373.4595). Created in 1990, the Indian River Lagoon NEP (IRLNEP) fosters active participation by other federal agencies, notably the FWS, NASA, and USACE. It also manages a local government cost-share program that assists counties and municipalities with planning and implementing pollution-abatement projects, typically small-scale efforts with an emphasis on stormwater treatment. For instance, both the St. John's River Water Management District (SJRWMD) and South Florida Water Management District (SFWMD) focus on projects designed to improve water and sediment quality, restore or enhance the seagrass community in the Lagoon, or rehabilitate wetlands, recovering many of the natural functions of these areas.

## Environmental Concerns

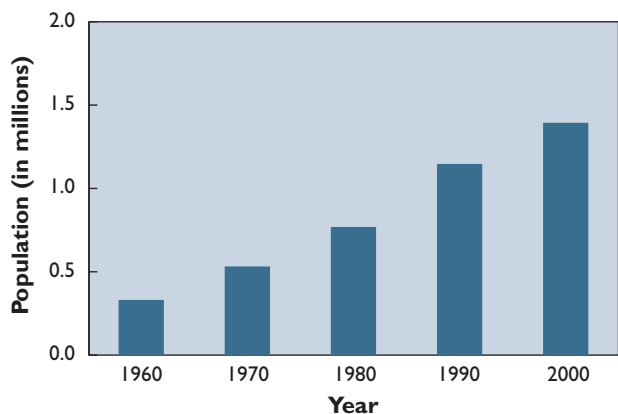
The primary environmental concerns for the Indian River Lagoon include the loss or alteration of habitat, the impact of alterations to the area's hydrology, and the discharge of pollutant-laden wastewater and stormwater into the Lagoon. Approximately 75% of the Lagoon's salt marshes and mangrove wetlands have been lost or altered. In addition, the conversion of native uplands and wetlands to urban and agricultural land uses has negatively affected the rate, timing, volume, and quality of water flow to the St. Lucie River and the Indian River Lagoon, resulting in excessive discharges of fresh water that have degraded shellfish habitat, closed

shellfish-harvesting areas, reduced water clarity, promoted algae growth, and contributed to the destruction of seagrass beds and other valuable habitats. Estuarine hydrology and salinity are also affected by releases from Lake Okeechobee and other drainage systems. Metals, pesticides, and herbicides present in surface runoff and water from the canal system bioaccumulate in the food chain and have been associated with an increased incidence of fish abnormalities, decreases in the health of fisheries, and impacts on the resident bottlenose dolphin population (Sime, 2002; SJRWMD, 2006).

## Population Pressures

The population of the 6 NOAA-designated coastal counties (Brevard, Indian River, Martin, Okeechobee, St. Lucie, and Volusia) coincident with the IRLNEP study area increased by more than 327% during a 40-year period, from 0.3 million people in 1960 to almost 1.4 million people in 2000 (Figure 4-19) (U.S. Census Bureau, 1991; 2001). This rate of population growth for the IRLNEP study area is almost four times the rate of 71.1% calculated for the Albemarle-Pamlico Estuarine Complex and more than twice the rate of 131.4% calculated for all NEP-coincident coastal counties of the Southeast Coast region. In 2000, the population density of these 6 coastal counties was 308 persons/mi<sup>2</sup>, almost double the density of 168 persons/mi<sup>2</sup> for the collective NEP-coincident coastal counties of the Southeast Coast region (U.S. Census Bureau, 2001). Population pressures for the IRLNEP area are likely higher due to the extensive development of the area associated with the Kennedy Space Center at Cape Canaveral and from the residential development that has occurred in these counties. Despite the area's high population growth, a good portion of the land surrounding the IRLNEP study area is associated with state and federal lands that have been designated for protection as national seashore, wildlife areas, or forests.

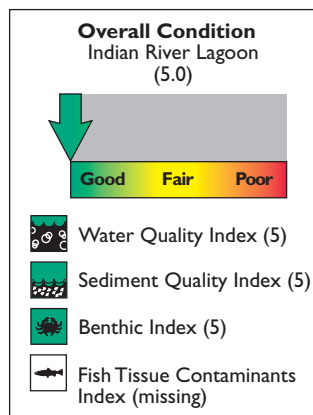
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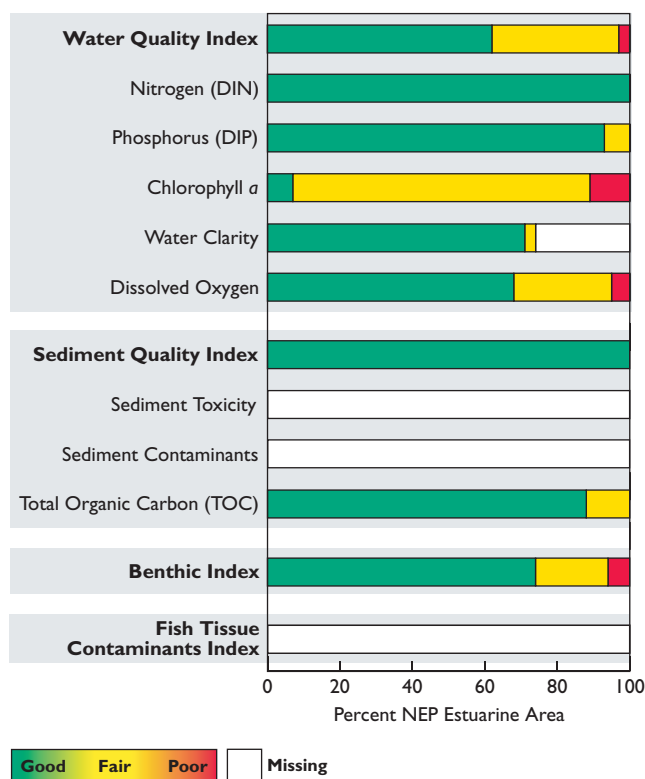
**Figure 4-19.** Population of NOAA-designated coastal counties of the IRLNEP study area, 1960–2000 (U.S. Census Bureau, 1991; 2001).

### NCA Indices of Estuarine Condition—Indian River Lagoon

The overall condition of the Indian River Lagoon is rated good based on three of four indices of estuarine condition used by the NCA (Figure 4-20). The water quality, sediment quality, and benthic indices were each rated good for the Indian River Lagoon, and data were unavailable to calculate a fish tissue contaminants index for this estuary. Figure 4-21 provides a summary of the percentage of estuarine area rated good, fair, poor, or missing for each parameter considered. This assessment is based on data from 45 NCA sites sampled by EMAP in the IRLNEP estuarine area in 2001 and 2002. Due to the rotating basin schedule in Florida, the NCA only sampled the northern portion of the Lagoon (approximately 230 mi<sup>2</sup>) in 2001 and 2002; the remainder of the estuarine area was sampled in 2003, but these data are not yet available. Please refer to Tables 1-24, 1-25, and 1-26 (Chapter 1) for a summary of the criteria used to develop the rating for each index and component indicator.



**Figure 4-20.** The overall condition of the IRLNEP estuarine area is good (U.S. EPA/NCA).



**Figure 4-21.** Percentage of NEP estuarine area achieving each rating for all indices and component indicators — Indian River Lagoon (U.S. EPA/NCA).



## Water Quality Index

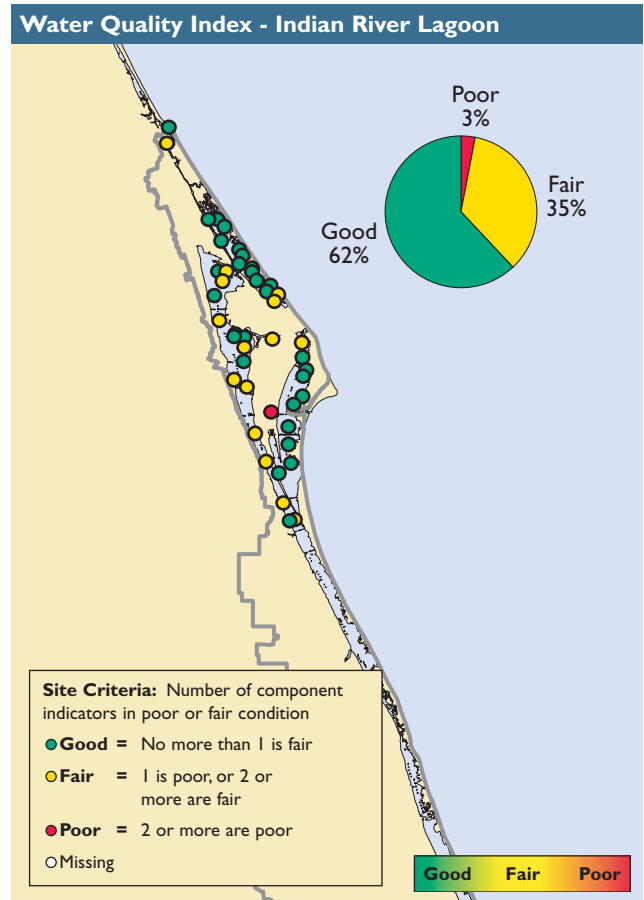
The water quality index for the northern portion of the Indian River Lagoon is rated good (Figure 4-22). This index was developed using NCA data on five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. Only 3% of the Lagoon's estuarine area was rated poor for water quality, and 36% of the area was rated fair.

**Dissolved Nitrogen and Phosphorus** | The Indian River Lagoon is rated good for nutrient concentrations, with 100% and 93% of the estuarine area rated good for DIN and DIP concentrations, respectively. Only 7% of the Lagoon's estuarine area was rated fair for DIP concentrations.

**Chlorophyll *a*** | Concentrations of chlorophyll *a* in the northern portion of the Indian River Lagoon are problematic, and the Lagoon is rated fair for this component indicator. Overall, the Lagoon received a fair rating because 11% of the estuarine area was rated poor for chlorophyll *a* concentrations, and the combined value for fair and poor ratings was 93%. Only 7% of the IRLNEP estuarine area was rated good for chlorophyll *a* concentrations.

**Water Clarity** | Despite the fair rating for chlorophyll *a* concentrations, the Indian River Lagoon is rated good for water clarity. Water clarity was rated poor at a sampling site if light penetration at 1 meter was less than 20% of surface illumination. None of the estuarine area of the Indian River Lagoon was rated poor for water clarity, 4% of the area was rated fair, and 91% of the area was rated good.

**Dissolved Oxygen** | The Indian River Lagoon is rated fair for dissolved oxygen concentrations. Although 68% of the estuarine area was rated good for this component indicator, 5% of the area was rated poor, and 27% of the area was rated fair.



**Figure 4-22.** Water quality index data for the Indian River Lagoon, 2001–2002 (U.S. EPA/NCA).





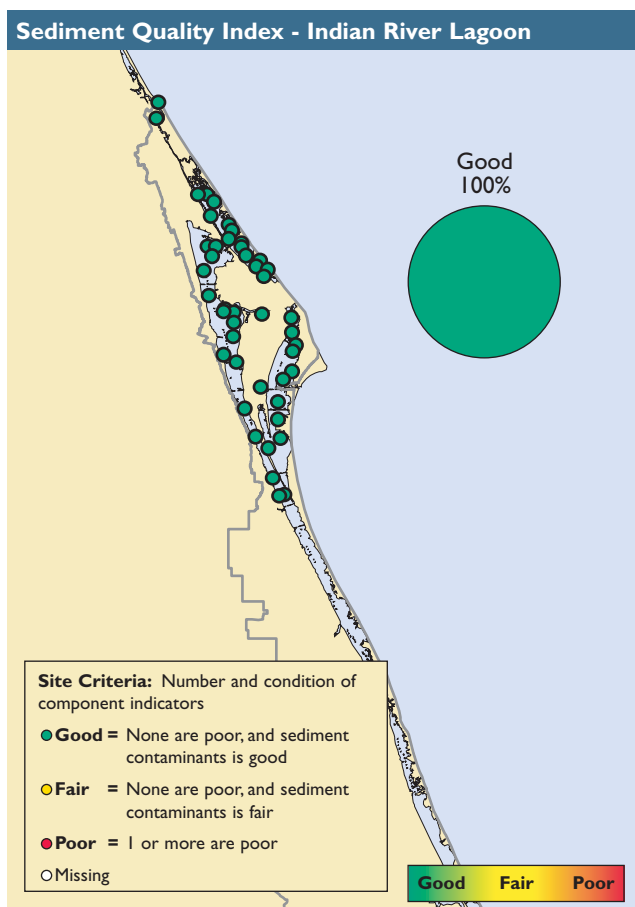
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### Sediment Quality Index

The sediment quality index for the Indian River Lagoon is rated good; however, this rating is based only on NCA data for one component indicator (sediment TOC). Data on sediment toxicity and sediment contaminant concentrations were not assessed in the 2001–2002 NCA surveys. All of the IRLNEP estuarine area (100%) was rated good for the sediment quality index (Figure 4-23).

**Sediment Toxicity** | The NCA surveys did not collect sediment toxicity data for the Indian River Lagoon in 2000 and 2001; therefore, sediment toxicity in the Lagoon has not been rated for this report.



**Figure 4-23.** Sediment quality index data for the Indian River Lagoon, 2001–2002 (U.S. EPA/NCA).

**Sediment Contaminants** | The NCA surveys did not collect sediment contaminants data for the Indian River Lagoon in 2000 and 2001; therefore, sediment contaminant concentrations in the Lagoon have not been rated for this report.

**Total Organic Carbon** | The Indian River Lagoon is rated good for TOC concentrations, with only 12% of the estuarine area rated fair and the remaining 88% rated good for this component indicator.



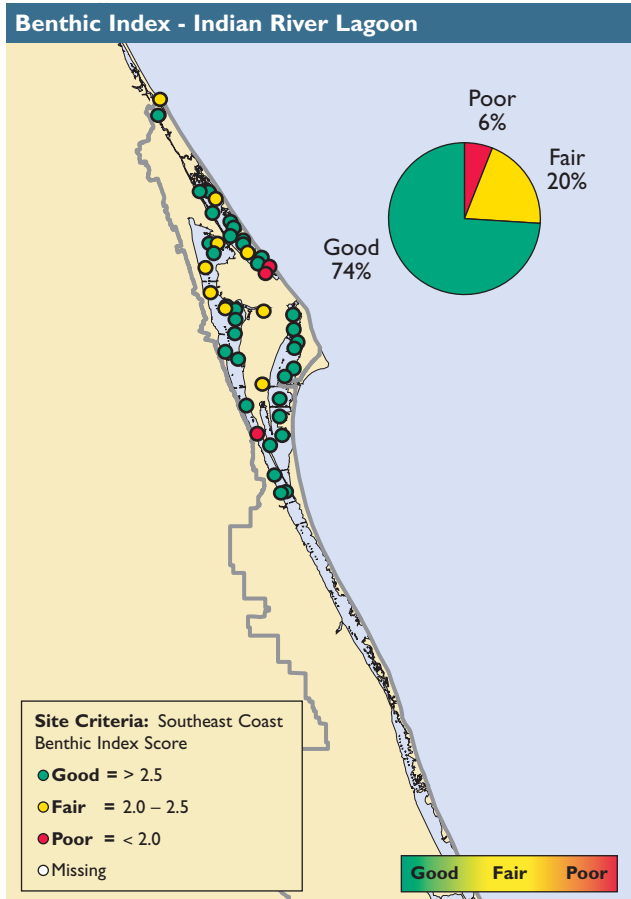
### Benthic Index

Based on the Southeast Coast Benthic Index, the benthic condition of the Indian River Lagoon is rated good. The benthic index shows that 6% of the estuarine area was rated poor, 20% of the area was rated fair, and 74% of the area was rated good (Figure 4-24).

Although only 6% of the estuarine area exhibited degraded benthic condition, 33% of the sampling sites representing this degraded area were associated with some measure of adverse water quality (Figure 4-25). There were no areas of degraded benthic condition associated with poor TOC concentrations; however, no sediments were analyzed for sediment toxicity or sediment contaminant concentrations, so the co-occurrence of degraded benthic condition with either of these component indicators could not be evaluated.



The roseate spoonbill feeds on shrimp, small fish, and aquatic insects (Ryan Hagerty, FWS).

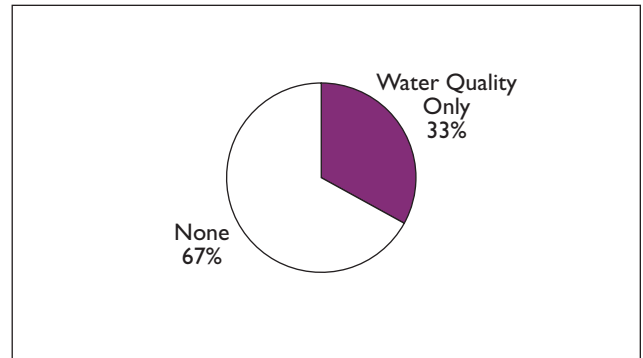


**Figure 4-24.** Benthic index data for the Indian River Lagoon, 2001–2002 (U.S. EPA/NCA).



### Fish Tissue Contaminants Index

The NCA survey did not assess the level of fish tissue contaminants in the northern portion of the IRLNEP study area during 2001 or 2002; therefore, a fish tissue contaminants index for the Indian River Lagoon was not developed for this report.



**Figure 4-25.** Percent of sampling sites in the Indian River Lagoon where poor benthic condition overlaps with other indices rated poor (U.S. EPA/NCA).



Hands-on educational activities help children learn about the Indian River Lagoon estuary (Ed Garland).

## HIGHLIGHT

## Seagrass Monitoring in the Indian River Lagoon

The primary habitat of concern within the Indian River Lagoon is the Lagoon's seagrass community. Seagrass beds are valuable because they provide habitat and nursery areas for estuarine animals, enhance water quality by removing nutrients and stabilizing sediments, and serve as one of the planet's most productive ecosystems (Dawes, 1981; Zieman, 1982; Lewis, 1984; Virnstein et al., 1987). The seagrass community is sensitive to water quality conditions, particularly those parameters that affect water clarity, such as turbidity, suspended matter, color, and chlorophyll *a* concentrations (a surrogate for phytoplankton). As a result, the seagrass community in the Indian River Lagoon is an effective indicator of water quality (IRLNEP, 1996; Steward et al., 2003).

The IRLNEP, through the program's sponsor, the SJRWMD, has developed a monitoring program to assess the state of the Lagoon's seagrass community. This monitoring program has two major components: Lagoon-wide mapping and a series of fixed transects at selected sites throughout the Lagoon.

Lagoon-wide seagrass mapping provides an overall picture of seagrass resources throughout the Indian River Lagoon. Lagoon-wide maps are produced every two to three years, with the production process involving several steps, including aerial photography, ground-truthing, photo-interpretation and delineation of polygons containing seagrass beds, registration of these polygons to a base map, digitization of these polygons into GIS, and production of seagrass maps (Dobson et al., 1995). Appropriate management measures are developed and implemented to address

problems or to provide protection for specific areas, and both problem and healthy areas are designated based primarily on the abundance of seagrass. Comparisons of these maps with historic maps can be used to detect changes in seagrass coverage, set targets for seagrass restoration, and document seagrass recovery (Virnstein and Morris, 1996).

Although these seagrass maps are produced every two to three years, aerial photos are taken each year to document any changes that occur during the period between map development. Photos are taken at USGS Quadrangle map scale (1:24K; 1 inch = 2,000 feet), generally during the spring, when water clarity conditions are best for photography (Virnstein and Morris, 1996). These maps have several limitations, including (1) the interval between mapping events; (2) that smaller seagrass beds (< 1/4 acre) are not mapped; (3) that certain seagrass species (such as *Halophila*) or areas of sparse seagrass are often not visible in aerial photographs and are not usually mapped; and (4) that locating the edge of a bed may have errors up to 100 feet (Virnstein and Morris, 1996).

Fixed-seagrass transects are used to determine whether local areas are healthy or stressed; whether conditions are stable, improving, or declining; and the amount of change in the health or extent of seagrass beds. Sampling fixed transects allows researchers the ability to reliably detect small-scale changes in depth distribution, abundance, and species composition over time (Morris et al., 2001).

Presently, more than 80 seagrass transects have been established in the Indian River Lagoon. These transects are monitored twice each year—in the summer and winter—on dates that roughly correspond to times of maximum and minimum seagrass abundance. Measurements are made every 33 feet along each transect and include data on the depth, percent cover of seagrass, and canopy height of each seagrass species present. Shoot counts are made at the center and deep edges of seagrass beds. In addition, researchers estimate percent cover and biomass of drift algae present, measure light attenuation at the deep edge of the seagrass bed, and



take an underwater video as an archival record of conditions at the time of sampling (Morris et al., 2001)

Data collected through transect monitoring can be analyzed at several geographic and temporal scales. Three geographic scales (e.g., Lagoon-wide, by segment, and site-specific) and two temporal scales (e.g., annual and seasonal) can be used to present and analyze the data (Morris et al., 2001).

The use of large-scale mapping coupled with fixed transects is an effective method of evaluating the health of the seagrass community in the Indian River Lagoon. Lagoon-wide maps provide information about patterns and trends from a “big picture” perspective, whereas individual transects provide similar information on a localized basis. This information is valuable when developing or evaluating the effectiveness of management strategies.



Seagrass monitoring in the Indian River Lagoon, Florida (SJRWMD).

## Indian River Lagoon National Estuary Program Indicators of Estuarine Condition

### Water and Sediment Quality

Indicators of water quality for the IRLNEP include the following:

- Chlorophyll *a* levels (µg/L)
- Reduction of muck accumulation (extent and volume removed).

In recent years, algal blooms in the Indian River Lagoon have been a concern. Several of these blooms have included HAB species, which are considered potentially harmful to human health or natural resources. In order to track the occurrence of HABs, chlorophyll *a* levels are monitored by the IRLNEP as one of the key indicators of water quality. Increased nutrient concentrations are reflected in elevated chlorophyll *a* concentrations found in the southern Banana River and the Cocoa-Melbourne/Palm Bay area, where the 10-year chlorophyll *a* average concentration is greater than 8 µg/L. Although nutrient concentrations are also elevated, chlorophyll *a* levels are lower in the Vero Beach area, most likely due to increased flushing through nearby ocean inlets. A similar reduced algal response to elevated nutrient concentrations is seen in the Fort Pierce and St. Lucie River areas, where shorter residence times and increased flushing may also play a role (Steward et al., 2003). Overall, it appears that the fair rating assigned by the analysis of NCA data for the northern portion of the Indian River Lagoon agrees with the IRLNEP monitoring data for chlorophyll *a*. Both sets of data suggest that chlorophyll *a* levels are somewhat elevated and in need of mitigation measures, but that there are still many areas of the Lagoon system where levels remain low.

The amount of muck (e.g., mineral soils, clays, and silts mixed with organic matter) removed from the Indian River Lagoon is an important metric that is primarily monitored near the mouth of the Lagoon's tributaries. Re-suspension of estuary muck during wind events decreases water clarity, which has a negative effect

on the health and extent of seagrass and other SAV. Based on NEP monitoring data, turbidity levels have not shown a declining trend over time in the Indian River Lagoon; however, the analysis of NCA data for the northern portion of the Lagoon shows that water clarity throughout the Lagoon is generally good. Water clarity varies considerably throughout the Lagoon's reaches, and suspended solids likely have the most significant influence on turbidity levels in central portions of the Lagoon (Steward et al., 2003).

### Habitat Quality

Seagrass coverage is the primary biological indicator of ecosystem health used by the IRLNEP. According to IRLNEP data, the Lagoon experienced a net gain in seagrass coverage of nearly 4,000 acres from 1992 to 1999. The long drought in the late 1990s may have been largely responsible for this positive trend, but the cumulative effects of restoration work should help to maintain this growth. SAV beds in Indian River Lagoon include *Halodule*, *Ruppia*, *Syringodium*, *Thalassia*, and three *Halophila* species (Steward et al., 2003). One species, Johnson's seagrass (*Halophila johnsonii*), is a federally listed species found only in the coastal lagoons of eastern Florida between Sebastian Inlet and Biscayne Bay (Smithsonian Marine Station at Fort Pierce, 2006).

Assessment of seagrass resources in the Indian River Lagoon is based on the number of acres of seagrass coverage over time (net gain or loss), the maximum depth of the edge of seagrass beds, and the percent of sunlight reaching the target depth of about 5.6 feet. Segments of the Indian River Lagoon containing the largest acreage of seagrass coverage are found around North Merritt Island, within and adjacent to the federally protected NASA/Kennedy Space Center/Merritt Island National Wildlife Refuge complex (north Indian River Lagoon and northern Banana River), and at the Canaveral National Seashore (southern Mosquito Lagoon). These segments have shown little change in seagrass coverage since the 1940s (Steward et al., 2003). In Hobe Sound, located at the very southern end of the Indian River Lagoon, seagrass coverage exceeds 90% coverage of potential habitat (SJRWMD, 2004). The

largest area of poor seagrass coverage extends from the Cocoa area to the Melbourne/Palm Bay area. This area has experienced the greatest loss (70%) of seagrass coverage since the early 1940s. Across the entire Lagoon, potential seagrass coverage is approximately 118,000 acres. In 1999, seagrass coverage was approximately 59% of the Lagoon's total potential seagrass acreage (Steward et al., 2003).

### Living Resources

Although stormwater management and enhancing seagrass production remain the highest priorities, the IRLNEP has identified invasive, exotic species and aquatic animal health as emerging challenges to the Lagoon's ecosystem. During the past several years, there has been increasing concern over the number of wildlife-related disease and mortality events in the Lagoon, possibly a symptom of a wider-scale problem regarding the overall health of the estuarine system. Despite considerable progress and success in rehabilitating impounded wetlands as habitat and improving water quality conditions in the Lagoon during the past two decades, a number of fairly recent, possibly interconnected wildlife-related mysteries remain unsolved. They include the skin disease *Lobomycosis*, which is occurring on much of the Lagoon's resident dolphin

population; fibropapillomas lesions on many of the green turtles found in the Lagoon; an increased incidence of tumors in hard clams; decreases in the population of horseshoe crabs; the recent appearance of saxitoxin in puffer fish in the northern Lagoon, resulting in a ban on catching puffers throughout the Lagoon and health advisories regarding human consumption of these fish; the sporadic occurrence of "spicy" tasting clams; and the appearance of invasive species, such as the Australian spotted jellyfish (*Phyllorhiza punctata*) in the central Lagoon and the exotic macroalgae *Caulerpa brachypus* in the southern portion of the estuary (SJRWMD, 2004).

To address these problems, the IRLNEP is taking the lead in forming an Indian River Lagoon Task Force. The goal of this task force will be to integrate monitoring and research results to determine if a commonality of cause exists and to prevent or reduce future occurrences. Key stakeholders in supporting CCMP implementation have continued to respond to the IRLNEP's priority challenges of reducing stormwater discharges to the Lagoon and enhancing valuable wildlife habitat through invasive plant control, endangered lands acquisition, and reconnection of impounded wetlands to the estuary (SJRWMD, 2004).



The Indian River Lagoon has a resident dolphin population (Commander Grady Tuell, NOAA Corps).



## Current Projects, Accomplishments, and Future Goals

The greatest tangible improvement to date in the Indian River Lagoon is the hydrologic reconnection of more than 23,000 acres of impounded wetlands since 1989 under the SWIM Act (in addition to nearly 5,000 acres reconnected through other programs). These impoundment reconnections restore many natural functions provided by salt marshes and mangrove wetlands (Steward et al., 2003).

There is also a noticeable increase in public awareness of the Lagoon's problems and its ecology, as well as an understanding of the projects that are underway to benefit the Lagoon's recovery and management. Much has been accomplished, but the IRLNEP recognizes that more work remains to be done to reach restoration targets established for seagrass and coastal wetlands. Preventative safeguards, vigilance, and education are needed to ensure that achievements in addressing problems in the Indian River Lagoon are maintained and that progress continues in protecting and restoring the water quality and natural resources of the Lagoon (Steward et al., 2003).

There is also good progress taking place within the Indian River Lagoon watershed. More than 56,000 acres of wetlands and uplands have been acquired for various purposes (such as water quality remediation projects and habitat preservation). The various agencies and local governments with jurisdiction over the Indian River Lagoon basin have made good progress in ending discharges of treated wastewater, removing harmful muck deposits, and making incremental improvements in stormwater management throughout the basin. In recent years, the IRLNEP has tackled some of the most important and controversial issues to address pollution in the Indian River Lagoon basin, such as addressing the impact of septic tanks on water quality, promoting the acquisition of environmentally sensitive lands, promoting the development of regional stormwater management plans, and participating in the development of local management plans for threatened and endangered species.

Some of the ongoing goals of the IRLNEP include:

- Attaining and maintaining water and sediment of sufficient quality to support a healthy, macrophyte-based estuarine Lagoon ecosystem
- Attaining and maintaining a functioning macrophyte-based ecosystem that supports endangered and threatened species, fisheries, and wildlife
- Improving the understanding and management of impacts of invasive and exotic species and the emerging challenges to aquatic animal health
- Achieving heightened public awareness and coordinated interagency management of the Indian River Lagoon ecosystem (Steward et al., 2003).

## Conclusion

Based on data collected by the NCA, the overall condition of the Indian River Lagoon is rated good. In general, the IRLNEP considers seagrass coverage in the Indian River Lagoon to be a key indicator of trends in environmental condition. Areas with good seagrass coverage are located adjacent to fairly undeveloped watersheds or close to inlets, whereas areas of extensive SAV loss and sparse seagrass are adjacent to highly developed watersheds or shoreline areas. The areas with poorest water quality are Cocoa to Melbourne/Palm Bay, the southern Banana River, and the Vero Beach, Fort Pierce, and St. Lucie River areas. Areas of the Indian River Lagoon adjacent to larger tributaries and major drainages systems experience elevated levels of nutrients and total suspended solids.