

ENVIRONMENTAL SENSITIVITY INDEX: ST. JOHNS RIVER, FLORIDA

INTRODUCTION

Environmental Sensitivity Index (ESI) maps have been developed for the St. Johns River, from Jacksonville south (upstream) to Sanford, Florida. The section of river from Jacksonville to the river mouth at Mayport was published in digital and hardcopy format as part of the East Florida ESI atlas (1996). Six maps from East Florida are included in this hardcopy atlas to provide coverage of the lower river to the ocean (maps #1-6). However, no new data and no edits have been incorporated for these six maps. The St. Johns River ESI maps include information for three main components: shoreline and wetland habitats; sensitive biological resources; and human-use resources. Background information, as well as the methods of data collection and presentation, are summarized in the following sections.

SHORELINE AND WETLAND HABITAT MAPPING

Shoreline habitats for the St. Johns River were mapped during overflights conducted in December 1996 (maps #1-6 from East Florida were mapped during overflights conducted in May 1993). Overflights were conducted using fixed-wing aircraft, flying at elevations of 300-500 feet and slow air speed. An experienced geomorphologist segmented and classified the shoreline habitats directly onto hardcopy maps which contained shoreline and wetlands data and scanned basemap images from 1:24,000 U.S. Geological Survey (USGS) topographic maps. Where appropriate, multiple habitats were delineated for each shoreline segment. Where there were complex changes in the shoreline, the most current aerial photographs were used to update shoreline position and type.

Vertical aerial photographs were provided by the St. Johns River Water Management District (SJRWMD) for use in shoreline mapping. Wetlands data were obtained from land-use/land-cover data provided by the SJRWMD, classified using a modified version of the Florida Land Use, Cover, and Forms Classification System (Florida Department of Transportation, 1985). The various wetlands classes were collapsed into three categories for the ESI maps and databases. Freshwater marshes and selected wet prairies were collapsed into the ESI freshwater marsh category (ESI=10B). Wetland hardwood forests, wetland coniferous forests, and wetland forested mixed were collapsed into the ESI swamp category (ESI=10C). Mixed scrub-shrub wetlands were categorized as ESI scrub-shrub (ESI=10D).

Prediction of the behavior and persistence of oil on shoreline habitats is based on an understanding of the dynamics of riverine and lacustrine environments, not just the substrate type and grain size. The sensitivity of a particular shoreline habitat is an integration of the following factors:

- 1) Shoreline type (substrate, grain size, elevation, origin)
- 2) Exposure to current, wave, and tidal energy
- 3) Biological productivity and sensitivity
- 4) Ease of cleanup

All of these factors are used to determine the relative sensitivity of shoreline habitats. Key to the sensitivity ranking is an understanding of the relationships between: physical processes, substrate, shoreline type, product type, fate and effect, and sediment transport patterns. The intensity of energy expended upon a shoreline by river currents, wave action, boat wakes, and tidal action directly affects the persistence of stranded oil. The need for shoreline cleanup activities is determined, in part, by the slowness of natural processes in removal of oil stranded on the shoreline.

These concepts have been used in the development of the ESI, which ranks shoreline environments as to their relative sensitivity to oil spills, potential biological injury, and ease of cleanup. Generally speaking, areas exposed to high levels of physical energy, such as river currents or waves, and low biological activity, rank low on the ESI scale, whereas sheltered areas with associated high biological activity have the highest ranking. The list below includes the shoreline habitat types that occur in the current study area, presented in order of increasing sensitivity to spilled oil (the shoreline classification for maps #1-6 differs—see appropriate legend).

- 1B) Exposed, Solid Man-made Structures
- 3) Eroding Scarps in Unconsolidated Sediments
- 6B) Riprap
- 8B) Sheltered, Solid Man-made Structures
- 9B) Vegetated Low Banks
- 10B) Freshwater Marshes
- 10C) Freshwater Swamps
- 10D) Scrub-shrub Wetlands


These shoreline habitats are described on pages 9-11, in terms of their physical description, predicted oil behavior, and response considerations. See the East Florida ESI atlas (1996) for shoreline descriptions pertaining to maps #1-6.

SENSITIVE BIOLOGICAL RESOURCES



A wetland and aquatic ecologist with Research Planning, Inc. (RPI) collected and compiled the biological information presented on the maps with the assistance of state and regional biologists and resource managers from the Florida Game and Fresh Water Fish Commission (FGFWFC), the Florida Department of Environmental Protection (FDEP), and other agencies and organizations. Digital point data for various resource groups were provided by FGFWFC and the Florida Natural Areas Inventory (FNAI). Digital data for wetland and aquatic habitat types, and other land-use/land-cover features, were provided by SJRWMD. Information collected and depicted on the maps denotes the key biological resources that are most likely at risk in the event of an oil spill. Seven major categories of biological resources were considered during production of the maps: marine mammals, terrestrial mammals, birds, reptiles and amphibians, fish, shellfish, and habitats/rare plants.

Spatial distribution of the species on the maps is represented by polygons and points, as appropriate. Associated with each of these representations is an icon depicting the types of resources that are present. Species have been divided into groups and subgroups with similar taxonomy, morphology, life-history, and/or behavior relative to oil spill vulnerability and sensitivity. The icons reflect this grouping scheme. The groups are color coded, and the subgroups are represented by different icons as follows:

MARINE MAMMALS

-  Manatees
-  Whales



TERRESTRIAL MAMMALS

-  Bears
-  Small Mammals

BIRDS

-  Diving Birds
-  Gulls and Terns
-  Passerine Birds
-  Pelagic Birds
-  Raptors
-  Shorebirds
-  Wading Birds
-  Waterfowl






REPTILES / AMPHIBIANS

-  Other Reptiles / Amphibians
-  Turtles



FISH

-  Protected / Rare Fish

SHELLFISH

-  Crabs
-  Crayfish / Lobsters
-  Freshwater Mussels
-  Freshwater Snails
-  Shrimp

HABITATS / PLANTS

-  Floating Aquatic Vegetation
-  Protected / Rare Plants

The polygon or point color and pattern are the same for all the animals in one group (i.e., birds are green, fish are blue). When there is more than one major resource group in a polygon, the polygon is then assigned the multigroup color and pattern (black hatch). Also associated with each biological polygon or point feature on the map is a number (located under the icon). This number references a table on the reverse side of the map with a complete list of species found in the polygon as well as concentration, seasonality, and life-history information on each species.

There are some species that are found throughout specific geographical areas or habitat types. Displaying the polygons for these species sometimes covers large areas, making the maps very difficult to read. Thus, species which occur over the majority of certain geographic areas or habitats are often identified in a small box which states that they are "COMMON IN ...", (e.g., Common in Wetlands). This approach informs the user of the presence of these species, while maintaining readability of the map. In all instances, data for species listed as "common in area" exist as polygons in the digital coverages. The use of "common in area" is implemented on a map per map basis, depending on the size and number of polygons present on an individual map. The use of "common" refers to the spatial extent of the polygon(s) in question, but not the relative concentration or abundance of the species involved.

For many biological resources, information and expert knowledge may not be available for all geographic locations. For this reason, absence of a resource on a map does not necessarily mean it is not present. Under the descriptions of the various biological resource groups, the geographical limits of available knowledge, or the survey boundaries of particular studies, are given when known. Where applicable, survey boundaries for individual sources are provided in the digital database.

MARINE MAMMALS

Two subgroups of marine mammals are depicted for the St. Johns River atlas, whales and manatees. Bottlenose dolphins are not depicted on the maps due to widespread abundance and an assumed low sensitivity to oil spills. Dolphins are likely to be present throughout the estuarine portion of the lower river and in nearshore ocean waters. An emergency contact for dolphins in Florida is the National Marine Fisheries Service, Protected Species Management Branch, 813/570-5312.

The whale distributions depicted in the St. Johns River atlas encompass an area that has been declared "Designated Critical Habitat" by the National Marine Fisheries Service (NMFS). This area extends from the mouth of the Altamaha River, Georgia to Jacksonville, Florida (from the Atlantic shoreline to 15 nautical miles offshore), and from Jacksonville to Sebastian Inlet, Florida (from the Atlantic shoreline to 5 nautical miles offshore). The designated critical habitat delimits a seasonal calving and juvenile area for the northern right whale. Based on expert opinion, large numbers of juvenile humpback whales are also likely to occur in the same area and season as the right whales. An emergency contact for right and humpback whales is the NMFS, Protected Species Management Branch, 813/570-5312.

Manatees can be present throughout all inshore and nearshore waters of Florida, including the entire St. Johns River. The maps, however, emphasize higher concentration areas where manatees are most likely to be found. Concentration areas are often associated with ocean inlets, estuaries, river banks, and wintering or cold-weather aggregation sites. When feeding, manatees may also concentrate in areas with submerged or floating aquatic vegetation. In the St. Johns River, major concentration areas and calving activity tend to occur in calm backwater areas, such as in protected coves or creek mouths. Specific calving areas were not indicated beyond the description given above. Manatees may give birth anytime during the year, although calving is more common in spring and summer months. The major winter aggregation site for manatees in the St. Johns River is Blue Spring, which is also a state park. Eighty or more manatees may be found in Blue Spring during wintering months.

Little is known concerning the potential impacts of oil on manatees. They may be vulnerable to oiling since they spend a great deal of time at or just below the water surface, and must surface to breathe. Likely impacts would include eye, mucous membrane, and respiratory tract irritation, although these impacts are not expected to be severe. One scenario that could result in more severe effects would be if large accumulations of oil became stranded in an area among floating or submerged vegetation. Manatees feeding on or surfacing to breathe through the vegetation could ingest or aspirate large quantities of oil.

In addition to direct oil spill vulnerability, spill responders (boat operators in particular) should be aware of manatee concentration areas in order to avoid boat collisions or other activities which could injure, kill, or disturb manatees. As part of the Florida Manatee Sanctuary Act, signs may be posted in critical manatee areas requiring "slow" or "idle" boat speeds during certain times of year. Also of concern, heavy boat traffic or other response-related disturbance in the vicinity of manatee wintering sites could cause the animals to leave the area, exposing them to cold temperatures that could result in severe stress or death. Emergency contacts for manatees in the St. Johns River are: the Florida Marine Patrol, 800/DIAL-FMP; the FDEP Marine Mammal Pathobiology Laboratory, 813/893-2904; and Blue Spring State Park, 904/775-3663.

Marine mammal distributions are displayed on the maps as a brown hatch polygon. However, if species in addition to marine mammals are included in the polygon, a black hatch (multigroup) polygon is used. A brown icon with a whale or manatee silhouette is associated with the polygons, indicating the presence of marine mammals. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been listed by the state (S) or federal (F) government as endangered (E) or threatened (T). The next column provides an estimate of the concentration of the species at the site. Concentration is indicated as "HIGH", "MED", or "LOW". These estimates are subjective, based on local expert opinion on the relative concentrations in the area. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column. The final columns denote time-periods for sensitive life-history stages or activities, such as calving. For many species there is a temporal shift in seasonality with spatial changes in location. Temporal information included in the tables is specific to the one polygon that it references.

TERRESTRIAL MAMMALS

Terrestrial mammals depicted in the St. Johns River atlas include river otter, round-tailed muskrat, Florida long-tailed weasel, and Florida black bear. River otters are likely to occur in and around nearly all inland water-bodies, especially where wetlands are present. In the atlas, river otters are depicted in and along smaller, relatively undeveloped streams and creeks which are bordered by large tracts of wooded swamp. These locations are considered highly sensitive

habitats, and are also expected to hold the largest concentrations of river otter. River otters and other semi-aquatic fur-bearing mammals can be severely impacted by swimming through oil slicks or coming into contact with oiled wetland vegetation. Impacts from matting of the fur can include loss of buoyancy and insulation resulting in sickness, hypothermia, or death. Impacts from the grooming of oiled fur can include oil ingestion leading to irritation, sickness, or death.

Round-tailed muskrats are only depicted in the atlas where FGFWFC or FNAI observation or occurrence data indicated their presence. It is possible that their distribution is wider than that depicted. Round-tailed muskrats prefer shallow (<50 cm depth) marshes, particularly those containing maiden-cane and pickerelweed vegetation and soft, deep substrates for burrowing (Lefebvre, 1992). Similar to river otters, muskrats could be severely impacted by coming into contact with oil stranded on the water surface or on marsh vegetation. Oil which penetrated the soil through muskrat burrows could be particularly damaging to the animals and the marsh, and could present a long-term contamination problem. Round-tailed muskrat are considered a rare species of conservation interest due to potentially low population size.

Florida black bear are only depicted in the atlas where potential habitat data from FGFWFC indicated large tracts of land with the highest habitat scores, located adjacent to the shoreline or in large areas of wooded swamp connected to the river or its tributaries. It was assumed that impacts to bears from waterborne spills would be more likely in such areas. In several locations, FGFWFC and FNAI observation or occurrence records may also be shown. The actual or potential distribution of black bears in the study area is likely to be much wider than that depicted in this atlas. Bears could potentially be at risk to spills because they use both wetland and aquatic habitats, making extensive use of forested swamps. Black bears in Florida are listed as threatened by the state, and are of conservation interest due to low population size, low reproductive rate, habitat loss, and habitat fragmentation.

Florida long-tailed weasels were only depicted where FGFWFC or FNAI observation or occurrence data indicated their presence. Weasels use a variety of habitats, including wetlands, but would not be expected to be at great risk during spills. Weasels are rare in Florida and therefore may be of conservation interest.

Emergency and expert contacts for terrestrial mammals in the St. Johns River study area include: the FGFWFC Hazardous Spill Coordinator, 904/921-5982; the FGFWFC Northeast Region Nongame Biologist, 904/758-0656; and the FGFWFC Central Region Nongame Biologist, 352/732-1225.

Terrestrial mammal distributions are displayed on the maps as a brown hatch polygon. However, if species in addition to terrestrial mammals are included in the polygon, a black hatch (multigroup) polygon is used (e.g., river otter and wading birds). In addition, in some cases where FGFWFC and FNAI observation or occurrence data were used, point locations are displayed on the maps as brown dots to indicate that a species could be present in the vicinity. A brown icon with a bear or small mammal silhouette is associated with the polygons and points, indicating the presence of terrestrial mammals. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been listed by the state (S) or federal (F) government as endangered (E) or threatened (T). The next column provides an estimate of the concentration of the species in the polygon or at the site. For river otter, concentration is listed as "HIGH" or "MED". These estimates are subjective, based on local expert opinion on the relative concentrations in the area. For most black bear polygons, concentrations are listed as "POTENTIAL", since source information was based on potential habitat maps. For FGFWFC and FNAI observation or occurrence data, counts of individuals at each site are listed in the concentration column. Where counts were not available, the concentration column was left blank. Even though concentration may not be listed, it should be recognized that the number of individuals or the importance of the site was still significant enough to be included in observation or occurrence databases. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column.

BIRDS

Birds are divided into several species subgroups based on taxonomy, morphology, life-history, and behavior relative to oil spill vulnerability and sensitivity. The species table lists all the birds included on the maps, sorted by subgroup. These species were included either because of their likelihood of impact by an oil spill or special protection status as threatened or endangered. The major bird types emphasized for the St. Johns River include wading birds, waterfowl, and certain raptors, including the bald eagle.

Colonial nesting sites are mapped for wading birds (and other associated species). Major potential wader foraging areas are also mapped, identified using maps and expert knowledge provided by FGFWFC. Wading birds, including wood storks, limpkins, ibis, and various herons and egrets, can be found throughout the St. Johns River,

particularly in wetland and shallow aquatic habitats. In addition to general wading bird foraging areas, foraging areas for wood storks were emphasized. Limpkin foraging sites were also emphasized in a few specific locations.

Wintering and migratory waterfowl concentrations were mapped based on data collected during FGFWFC mid-winter waterfowl surveys and surveys conducted at Lake Woodruff National Wildlife Refuge by the U.S. Fish and Wildlife Service (USFWS). Waterfowl are often associated with wetland and aquatic habitats, including open-water areas. Waterfowl concentrations may at times be linked to the abundance of submerged aquatic vegetation (SAV), including hydrilla. In some locations, SAV may be so abundant that areas which appear on the maps as open or deep water may provide habitat for large numbers of dabbling ducks which are typically associated with shallow vegetated areas. Waterfowl generally increase in abundance moving south along the St. Johns River. The area from the southern portion of the atlas to the headwaters of the river (south of the study area) has been recognized as a "waterfowl habitat area of major concern" in the North American Waterfowl Management Plan (USFWS, 1994).

Raptors, including bald eagle, osprey, American swallow-tailed kite, and Northern harrier are included in the atlas. These species can be present throughout the St. Johns River study area, typically associated with wetland and aquatic habitats. Special emphasis was placed on mapping bald eagle nests, based on data provided by FGFWFC. There are great numbers of bald eagle nests present throughout the atlas, with the Lake George area standing out as one of the largest bald eagle nesting concentrations in the state and nation. Though other raptors (such as osprey) may be highly abundant throughout the study area, or abundant locally or seasonally, only a few locations are mapped based on observation and occurrence records maintained by local resource managers, FGFWFC, and FNAI.

Waterfowl and diving birds (cormorant, anhinga, pelicans) are usually at greatest risk during oil spills because they spend a great deal of time on the water surface. Waterfowl can also become oiled through contact with oiled marsh vegetation. Wading birds primarily become oiled on the legs and bill while wading for prey. They may also be oiled on the upper body and feathers by coming in contact with oiled marsh vegetation. Gulls and some raptors (bald eagle) may be at risk because they are often attracted to and will prey on sick or injured prey which is contaminated. This behavior may result in oiling of feathers and ingestion of oil. Terns and other types of raptors (osprey) may also be oiled while diving for prey.

Oiling of birds reduces the buoyancy, water repellency, and insulation provided by feathers, and may result in death by drowning or hypothermia. Preening of oiled feathers and scavenging may also result in ingestion of oil resulting in irritation, sickness, or death. Oil brought back to the nest by contaminated adults can have severe impacts on the survival of eggs and young. Bird oiling, particularly waterfowl and wading birds, may continue even after the floating oil slicks have been removed, depending on the extent of oiled vegetation. Emergency and expert contacts for birds in the St. Johns River include: the FGFWFC Hazardous Spill Coordinator, 904/921-5982; the FGFWFC Waterfowl Management Section, 904/488-5878; the FGFWFC Northeast Region Nongame Biologist, 904/758-0656; and the FGFWFC Central Region Nongame Biologist, 352/732-1225.

Bird distributions are shown on the maps as polygons with a green hatch pattern. However, if species in addition to birds are included in a polygon, a black hatch (multigroup) polygon is used. For bird nesting sites, the data may be displayed as point locations using a green dot (e.g., bald eagles, wading bird colonies). Point locations from FGFWFC and FNAI observation or occurrence data are also displayed on the maps as green dots in some cases, to indicate that certain species could be present in the vicinity. For bald eagle nests, the point data may not always represent the exact location of the nest site, but may indicate the presence of a nest in the immediate vicinity.

For polygons, nesting sites, and observation/occurrence sites, a green icon with the appropriate bird silhouette (wading bird, waterfowl, etc.) is used to indicate the presence of birds. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column indicates whether the species has been listed by the state (S) or federal (F) government as endangered (E) or threatened (T). The next column provides an estimate of the concentration of each species at the site. For bird polygon data, concentration is usually indicated as "HIGH", "MED", or "LOW". These concentration estimates are subjective, based on expert opinion on relative concentrations in the area. Concentration may also be listed numerically where data were available, such as for some waterfowl surveys. For bird nesting point data, the number of nests is provided, or a relative concentration is given, such as those described above. Concentrations for the observation and occurrence data from FGFWFC or FNAI are usually provided as the highest count of individuals recorded at each site. Where counts were not available, the concentration column was left blank. Even though concentration may not be listed, it should be recognized that the number of individuals or the importance of the site was still significant enough to be included in databases maintained by FGFWFC and FNAI. Seasonality for each species is shown in the next twelve columns representing the months of the year. If the species

is present at the location in a particular month, an 'X' is placed in the month column. The last column denotes the nesting season for each species, if nesting occurs in an area or at a site. For many species there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or point that it references.

REPTILES AND AMPHIBIANS

Reptiles and amphibians depicted in the St. Johns River atlas include sea turtles and a variety of other protected and/or rare aquatic and terrestrial species including snakes, lizards, turtles, and frogs. American alligators are not depicted on the maps due to widespread abundance and an assumed low sensitivity to oil spills. Alligators may be present in many freshwater areas, especially those associated with marshes and swamps. Alligators may also be present in estuarine areas where access to freshwater is locally available. For more information on American alligators, contact the FGFWFC, Wildlife Research Laboratory, 352/955-2230.

Sea turtle nesting beaches and in-water habitats are included for the coastal portion of the atlas. In-water habitats represent known foraging, developmental, migratory, or other areas where sea turtles are likely to occur in substantial numbers. Information on in-water distributions of sea turtles is extremely limited, and the data portrayed on the maps reflect this partial knowledge. It should be noted that sea turtles can occur throughout all coastal waters of the state. Nesting beaches include sand beach areas where sea turtles come ashore to nest. Nesting beaches indicated on the maps correspond closely to beaches surveyed during the 1994 nesting season. Not all potential nesting beaches are surveyed; thus, lack of nesting polygons does not necessarily represent absence of sea turtle nesting. It should be noted that in addition to direct oiling, sea turtle adults, nests, and young may also be at risk from response activities and equipment. Beach cleanup operations and heavy machinery can disturb both adult and hatchling turtles, as well as their nests. Ruts left on the beach by heavy equipment can entrap hatchlings trying to get to the water, resulting in death from exposure or predation. Hatchlings may also be killed by entrapment behind booms placed to protect the shoreline. Flood lights used for night operations or security could disorient adult turtles or hatchlings, causing them to move towards oiled areas or roads. Expert or emergency contacts for sea turtles are the FDEP, Florida Marine Research Institute, 813/896-8626 during business hours, or 800/241-4653 (FDEP Emergency Pager, ID# 2744867) during non-business hours.

Other reptiles and amphibians included in the St. Johns River atlas include the gopher tortoise, spotted turtle, Eastern indigo snake, Florida pine snake, Florida scrub lizard, and Florida gopher frog. These species may be of conservation interest due to their protected and/or rare status. These species were only depicted in the atlas where FGFWFC or FNAI observation or occurrence data indicated their presence. Most of the species mapped are not directly at risk to oil spilled on the St. Johns River. However, disturbance related to spill response and cleanup could affect these species in some locations, as could spills into other water bodies or onto land. It should be noted that a variety of other reptile and amphibian species are likely to occur throughout the St. Johns River and associated wetland areas, and could be at risk during spills.

In general, aquatic reptile species are usually at greater risk during oil spills. Additional attributes which place some reptiles at risk are reproductive: eggs and nesting behavior. Similar to bird eggs, reptiles eggs are very sensitive to oil contamination. Reptile eggs can also be quite vulnerable to spills, because many species bury their eggs in the substrate. Small amounts of oil directly contacting egg surfaces, and oil overlying nesting cavities, have both been shown to effect hatching success and embryonic development in reptiles. Additionally, in the event of land-based spills, terrestrial reptiles which use burrows (e.g., gopher tortoise, Eastern indigo snake, Florida pine snake) may be at high risk. Amphibians are generally at great risk during oil spills, due to their permeable skin and the reliance of most species on aquatic and wetland habitats, especially for reproduction and juvenile life stages. Juvenile (and adult) life stages relying on gills for respiration are particularly at risk from oil which becomes mixed into the water column or accumulates in shallow, stagnant, backwater areas. Species or life stages relying on moist skin for respiration are also at high risk, as are terrestrial species that use burrows. An expert contact for protected and/or rare reptiles and amphibians is the FGFWFC, Wildlife Research Laboratory, 352/955-2230.

Sea turtle nesting areas are depicted as polygons with a red hatch pattern. Other reptile and amphibian occurrences are depicted using a red dot. A red icon with a turtle or lizard/salamander silhouette is used to indicate the presence of reptiles or amphibians. The number under the icon references a table on the reverse side of the map. In the tables, the first column gives the species name. The second column indicates whether the species has been listed by the state (S) or federal (F) government as endangered (E) or threatened (T). The next column provides an estimate of the concentration of the species at a site. Concentration is indicated as "HIGH", "MED", or "LOW" for sea turtles. For sea turtle nesting beaches, concentrations are based on nesting densities recorded during surveys coordinated and permitted by FDEP. For in-water sea turtle distributions, concentration estimates are

subjective and are based on local expert opinion. For other reptiles and amphibians, concentrations are usually provided as the highest count of individuals recorded at each site. Where counts were not available, the concentration column was left blank. Even though concentration may not be listed, it should be recognized that the number of individuals or the importance of the site was still significant enough to be included in databases maintained by FGFWFC and FNAI. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column. For sea turtles, the last three columns indicate nesting, hatching, and internesting time periods. Nesting refers to the time when adult females move onto the beaches, construct nests, and deposit eggs. Hatching refers to the time when young are hatching and emerging from the nests. Internesting refers to the time prior to and during nesting when both adult males and females are concentrated in nearshore waters. Mating may also be occurring at this time. For many species there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon that it references. Though not indicated by the turtle nesting beach polygons, internesting/mating concentrations are likely to occur within 2-3 kilometers of the shoreline.

FISH

Fish included in the St. Johns River atlas are limited to protected and/or rare anadromous and freshwater species. A variety of other fish, many of commercial or recreational importance, were not included as a part of this project. Species depicted in this atlas include shortnose sturgeon, Atlantic sturgeon, bluenose shiner, dusky shiner, river goby, and snail bullhead. These species were mapped using occurrence records from FNAI and specimen records from the Florida Museum of Natural History, University of Florida. Important commercial species for the St. Johns River may include American eel, channel catfish, and white catfish. Estuarine species are also commercially harvested, including various drums and striped mullet. Major recreational species include largemouth bass, bluegill, and black crappie, as well as a variety of estuarine species. Many species of commercial/recreational interest use portions of the St. Johns River as nursery habitat during juvenile life stages. Anadromous species such as American shad, hickory shad, blueback herring (in addition to sturgeon) also use portions of the river or its tributaries for spawning. Fish are primarily at risk when oil becomes mixed into the water column or accumulates in shallow areas. Smaller fish which are restricted to certain locations or habitats, including juvenile and larval stages of commercial or recreational species, are typically at greater risk during spills. It should be noted that some species of conservation interest are vulnerable or imperiled largely because they are found in only a single or a few locations. Particular areas of concern during spills would include small creeks and backwater wetland areas with restricted water circulation. An expert contact for freshwater fish and fisheries on the St. Johns River is the FGFWFC Fisheries Office, 904/985-7880. Additional contacts for protected and rare species include the Florida Museum of Natural History, University of Florida, 352/392-1721. An expert contact for marine and estuarine fish and fisheries is the FDEP, Florida Marine Research Institute, 813/896-8626.

Fish are displayed on the maps using a blue hatch polygon, a blue dot, or a marker icon. If species in addition to fish are included in a polygon, a black hatch (multigroup) polygon is used (e.g., fish and shellfish). A blue icon with a fish silhouette is associated with the polygons or points to indicate the presence of fish. In cases where point records were not necessarily location specific, an icon was used alone as a marker to indicate that a species may be located in or distributed throughout the general vicinity. The number under each icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been listed by the state (S) or federal (F) government as endangered (E) or threatened (T). The next column provides an estimate of the concentration of the species in the polygon or at the site. For fish, the concentration field was not completed because concentrations were not known. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column. The final columns list the time-periods for various life-history stages and activities including spawning, larvae, juveniles, and adults. Due to the nature of the available data, and the lack of information concerning the life-history of certain species, all occurrence and museum records were assumed to be adult fish. General life-history time-periods were only completed for sturgeon, and are not geographically specific (e.g., spawning for the Atlantic sturgeon may occur at such and such a time, but is not necessarily linked to the location where sturgeon are indicated).

SHELLFISH

Shellfish included in the St. Johns River atlas include crustaceans and mollusks. The species table lists all the shellfish shown on the maps, sorted by subgroup. Species of conservation, commercial, and recreational importance are depicted, including shrimp and blue crab (fisheries species) and imperiled or rare crayfish, freshwater snails, and freshwater mussels. Similar to the fish, shellfish are mainly at risk if oil becomes mixed into the water column or accumulates in

shallow areas. It should be noted that some species of conservation interest are vulnerable or imperiled largely because they are found in only a single or a few locations. Small creeks and backwater wetland areas with restricted water circulation would be major areas of concern, for both juvenile fisheries species and several species of conservation interest. For shrimp and blue crab, general distributions are mapped, as well as a few specific nursery areas known to have exceptionally high concentrations of juveniles. An expert contact for commercial and recreational fisheries species in the St. Johns River is the FDEP, Florida Marine Research Institute, 813/896-8626. Contacts for species of conservation interest include the Florida Museum of Natural History, University of Florida, 352/392-1721.

The distributions of shellfish are shown as polygons with an orange hatch pattern. If species in addition to shellfish are included in the polygon, a black hatch (multigroup) pattern is used. In a few locations, orange dots may also be used to depict point data provided by FGFWFC or FNAI. Orange icons are associated with the polygons and points, and the silhouette of the subgroup is shown. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been listed by the state (S) or federal (F) government as endangered (E) or threatened (T). No shellfish currently have such designations, though several may be under consideration for listing. The next column provides an estimate of the concentration of each species at the site. Concentration is generally indicated as "VERY HIGH", "HIGH", "MED", or "LOW". These estimates are subjective based on local expert opinion on the relative concentrations in the area. In some cases where information was not available, the concentration column may not be completed. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at a location in a particular month, an 'X' is placed in the month column. The final columns indicate time periods for spawning, larvae, mating, juveniles, and adults. Spawning refers to the release of gametes to the water column during reproductive periods, or the mass release of larvae. Mating applies to shellfish which form temporary reproductive pairs for fertilization of gametes (e.g., blue crabs), with later release of more developed larval young. For some rare species for which life-history information is not known, all occurrences were assumed to be adults. For many species there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or point that it references.

HABITATS/RARE PLANTS

Aquatic habitats depicted for the St. Johns River atlas include floating aquatic vegetation (FAV). FAV in this atlas may include fully floating plants, rooted aquatic plants with floating leaves, and some plants which may be classified elsewhere as emergent aquatics. FAV may include species such as water lettuce, spatterdock, water hyacinth, and water lily. SAV is not depicted in this atlas, though it is quite widespread and abundant. Spatial data for SAV was not available for the study area. Current studies by SJRWMD to map the distribution of SAV are on-going. SAV may include a variety of species, including *Vallisneria* (a dominant native species) and hydrilla in freshwater portions of the study area. Widgeon grass (*Ruppia maritima*) may also occur in estuarine areas. A variety of different resource types, including fish, shellfish, amphibians, reptiles, birds, and manatees may be associated with or concentrated around FAV and/or SAV beds, taking cover or feeding in these habitats. Certain species of both FAV and SAV, especially exotic species such as water hyacinth and hydrilla, are considered nuisance or pest species, and may be managed using various harvest and control techniques. Both FAV and abundant SAV may also pose unique spill response problems such as trapping oil among floating or exposed plant parts and hindering boat and equipment access or operations. An expert contact for aquatic vegetation is the Center for Aquatic Plants, University of Florida, 352/392-9613. Control and management of nuisance and invasive aquatic plants on the St. Johns River is coordinated by the U.S. Army Corps of Engineers (in navigable waters), 904/328-1002, and SJRWMD, 904/329-4276.

Protected and rare plants are included in the St. Johns River atlas wherever FNAI occurrence data indicated their presence. In many cases, especially for terrestrial species, these plants may not be directly at risk to waterborne spills. The main concern with rare plants is site disturbance which can be associated with response activities such as equipment staging, use of heavy machinery and large work crews, and access to the shoreline. This is especially true for rare or endangered plants which may only be known from a few locations in the state or world-wide. An expert contact for protected and/or rare plants is the FNAI, 904/224-8207.

The distribution of FAV is shown as polygons with a purple hatch pattern. Icons were not associated with the FAV polygons in order to make the maps easier to read. Protected and/or rare plants are depicted using a purple dot. A purple icon with a plant silhouette is associated with each dot, and the number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been listed by the state (S) or federal (F) government as endangered (E) or threatened (T). The next column provides an estimate of the concentration of species at the site. Concentration is not given for either

FAV or protected and/or rare plant occurrences. The species seasonality is shown in the next twelve columns, representing the months of the year. If a species is present at a location in a particular month, an 'X' is placed in the month column.

HUMAN-USE FEATURES

The human-use features depicted on the maps are those that either could be impacted by an oil spill or could provide access for response operations. All features are represented by icons indicating the type of resource:

 Airport	 National Park
 Aquaculture	 Recreational Beach
 Archaeological/ Historic Site	 Recreational Fishing
 Boat Ramp	 State Park
 Coast Guard	 Water Intake
 Dive Site	 Water Supply/ Treatment Facility
 Lock/Dam	 Wildlife Refuge/ Aquatic Preserve
 Marina	

Airport—Location of airports, airfields, landing strips, etc., whether they are manned or unmanned. The locations were obtained from land-use/land-cover data provided by SJRWMD and from USGS topographic maps.

Aquaculture—Location of aquaculture sites and facilities including hatcheries, aquaculture farms, etc. Aquaculture locations were obtained from land-use/land-cover data provided by SJRWMD and from expert sources. The site name, owner/manager, emergency contact name, and telephone number are provided on the back of the maps when known.

Archaeological/Historic Site—Location of archaeological and/or historic sites in close proximity to the shoreline or in aquatic/ wetland areas. This information was gathered from the Florida Master Site File, maintained by the Bureau of Archaeological Research, Florida Department of State. Site information was collected and compiled as polygons. These polygons may contain single sites or several sites, and may encompass larger archaeological or historic districts. The exact location of these sites are not represented on the maps due to their sensitivity to disturbance. Instead, generalized locations are depicted to indicate single or multiple site presence in the general vicinity. For more specific locational information, information on the type of site(s) present, and guidance during response operations, please contact the Florida Site File Supervisor, 904/487-2299.

Boat Ramp—Location of boat ramps. This information was gathered from 1996 overflight observations, aerial photographs, the Florida Atlas and Gazetteer (DeLorme Mapping, 1989), and digital data provided by the FGFWFC.

Coast Guard—Location of Coast Guard facilities (maps #1-6 only). This information was obtained from topographical maps.

Dive Site—Location of recreational dive sites. These sites were identified using DeLoach (1993). Dives sites in the St. Johns River are associated with caves, springs, and spring runs. Dive sites generally refer to the use of SCUBA, though some sites may be restricted to snorkeling only.

Lock/Dam—Location of lock/dam water control structures. The only site included in this atlas was the St. Johns Lock on the Cross Florida Barge Canal. This location of this site was identified using USGS topographic maps.

Marina—Location of marinas. This information was gathered from 1996 overflight observations and aerial photographs.

National Park—Location of areas managed by the National Park Service, including national parks, national seashores, and national monuments (maps #1-6 only). Digitized boundaries were provided by the Geoplan Center, University of Florida, Department of Urban and Regional Planning.

Recreational Beach—Location of recreational beaches (maps #1-6 only). Most sand beaches in Florida can be considered recreational beaches. Icons only designate beach locations where access, parking, and facilities are present. Locations of recreational beaches were determined using the Florida Atlas and Gazetteer (DeLorme Mapping, 1989) and local expert information.

Recreational Fishing—Location of recreational freshwater fishing sites. Recreational fishing locations were determined using the Florida Atlas and Gazetteer (DeLorme Mapping, 1989) and local expert information.

State Park—Location of areas managed by the FDEP, Division of Recreation and Parks, including state parks, state recreation areas, state reserves, state preserves, etc. Digitized boundaries were provided by the Geoplan Center, University of Florida, Department of Urban and Regional Planning (maps #1-6) and FDEP (study-wide).

Water Intake—Location of water intakes. The general locations of water intakes associated with power plants were provided by B. Oven with the FDEP Power Plant Sighting Group and L. Coakley with Florida Power and Light. Specific locations for water intakes were provided by plant managers or environmental/emergency response staff for the various sites. The locations of water intakes associated with aquaculture sites were provided by contacts at those facilities, when known. For all the water intakes included in this atlas, the site name, owner/manager, contact person, and telephone number are provided on the backs of the maps.

Water Supply/Treatment Facility—The locations of water supply facilities and sewage treatment plants in the vicinity of the study area were obtained from land-use/land-cover data provided by SJRWMD. These facilities were included because it is possible that they may maintain water intakes not mapped during this project. In addition, the location of these facilities could be useful during hazardous material spills into other local water bodies, into sewer systems, or onto lands adjacent to the St. Johns River.

Wildlife Refuge/Aquatic Preserve—Location of areas managed by the USFWS as National Wildlife Refuges, or the FDEP Bureau of Submerged Lands and Preserves, Division of State Lands, as State Aquatic Preserves. Digitized boundaries for the aquatic preserves were provided by FDEP. Boundaries for Lake Woodruff National Wildlife Refuge were provided by the USFWS Division of Realty.

MANAGEMENT AREA CONTACT LIST

The names and telephone numbers for the various managed lands/waters are listed below.

NAME TELEPHONE

NATIONAL PARK SERVICE

Fort Caroline National Memorial	904/641-7155
Timucuan Ecological and Historic Preserve	904/641-7155

NATIONAL WILDLIFE REFUGES

Lake Woodruff National Wildlife Refuge	904/985-4673
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STATE DIVISION OF RECREATION AND PARKS

Big Talbot Island State Park	904/251-2320
Blue Spring State Park	904/775-3663
Fort George Island State Cultural Site	904/251-2320
Hontoon Island State Park	904/736-5309
Little Talbot Island State Park	904/251-2320
Lower Wekiva River State Reserve	407/884-2009
Ravine State Gardens	904/329-3721
Yellow Bluff Fort State Historic Site	no information

STATE AQUATIC AND BUFFER PRESERVES

Nassau River-St. Johns River Marshes Aquatic Preserve	904/870-2710
Wekiva River Aquatic Preserve	407/330-6727

NATIONAL FORESTS

Ocala National Forest (not mapped)	
Lake George Ranger District	352/625-2520
Seminole Ranger District	352/669-3153

GEOGRAPHIC INFORMATION SYSTEM DATA

The entire atlas product is stored in digital form in a Geographic Information System (GIS). The information is stored as maps and associated databases. The format for the data varies depending on the type of information or features for which the data are being stored. The three major formats are shoreline habitat classification, biological resources, and human-use features.

Under separate cover is a metadata document which details the data dictionary, processing techniques, and descriptive information for the digital data sets that were used to create this atlas. Below is a brief synopsis of the information contained in the digital version. Refer to the metadata file for a full explanation of the data and its structure.

SHORELINE HABITAT CLASSIFICATION

The shoreline habitat classification is stored as lines and polygons with associated attributes. In many cases, a shoreline may have two or three different classifications. These multiple classifications are represented on the maps by double and triple line patterns and in the database by ESI#1/ESI#2, where ESI#1 is the landward-most classification and ESI#2 is the seaward-most classification. In addition to the line features, various wetland types (ESI=10) are also stored as polygons.

SENSITIVE BIOLOGICAL RESOURCES

Biological resources are stored as points or regions. Associated with each feature is a unique identification number which is linked to a series of databases that further identify the resources. The first data set consists of a list of the species and the concentration of each species. This dataset is then linked to a dataset that describes the life history of each species (temporal presence and reproductive/life-history time periods at month resolution) for the specified map feature. Other databases linked to the first data set are: the species identification database, which includes common and scientific names and Natural Heritage Program Global Ranks for all species; the species status database, which gives information for state and/or federal threatened or endangered listings; and the sources database, which provides source metadata for each biological feature.

HUMAN-USE FEATURES

Human-use features are represented as lines, points, or regions. The resource name, the owner/manager, a contact person, and an emergency phone number are included in the database for aquaculture sites and water intakes when this information was known. All metadata sources are documented at the feature level.

REFERENCES

Listed below are the major hardcopy reference materials used during this project. In some instances, reference materials were not directly used as source materials, but were instead used or interpreted by scientists or resource managers who provided expert knowledge or other data concerning resources depicted in the atlas. Other references given below provide summary or background information on the study area and its natural resources.

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At Research Planning, Inc., Mark White and Scott Zengel were the project managers. Shoreline mapping was conducted by Miles O. Hayes. Biological and human-use data were collected and compiled by Scott Zengel. Mark White, Lee Diveley, Christopher Locke, Kara Hastings, Zach Nixon, and William Holton entered the data and produced the final maps, under the supervision of Joanne Halls. Systems administration was coordinated by William Holton. Graphics were provided by Joe Holmes and Rebecca Cox. Dot Zaino prepared the final text.

SPECIES LIST*

Common Name	Species Name
MAMMALS	
MARINE MAMMALS	
<u>Humpback whale</u>	<i>Megaptera novaeangliae</i>
<u>Northern right whale</u>	<i>Eubalaena glacialis</i>
<u>West Indian manatee</u>	<i>Trichechus manatus</i>
TERRESTRIAL MAMMALS	
<u>Florida black bear</u>	<i>Ursus americanus floridanus</i>
Florida long-tailed weasel	<i>Mustela frenata peninsulae</i>
Northern river otter	<i>Lutra canadensis</i>
Round-tailed muskrat	<i>Neofiber alleni</i>
BIRDS	
DIVING BIRDS	
Anhinga	<i>Anhinga anhinga</i>
Belted kingfisher	<i>Ceryle alcyon</i>
Brown pelican	<i>Pelecanus occidentalis</i>
Common loon	<i>Gavia immer</i>
Double-crested cormorant	<i>Phalacrocorax auritus</i>
Pied-billed grebe	<i>Podilymbus podiceps</i>
GULLS AND TERNS	
Black skimmer	<i>Rynchops niger</i>
Gull-billed tern	<i>Sterna nilotica</i>
Laughing gull	<i>Larus atricilla</i>
<u>Least tern</u>	<i>Sterna antillarum</i>
Royal tern	<i>Sterna maxima</i>
Sandwich tern	<i>Sterna sandvicensis</i>
PASSERINE BIRDS	
<u>Florida scrub jay</u>	<i>Aphelocoma coerulescens</i>
<u>Red-cockaded woodpecker</u>	<i>Picoides borealis</i>
PELAGIC BIRDS	
Northern gannet	<i>Morus bassanus</i>
RAPTORS	
American swallow-tailed kite	<i>Elanoides forficatus</i>
<u>Bald eagle</u>	<i>Haliaeetus leucocephalus</i>
Northern harrier	<i>Circus cyaneus</i>
Osprey <i>Pandion haliaetus</i>	
SHOREBIRDS	
American oystercatcher	<i>Haematopus palliatus</i>
Black-bellied plover	<i>Pluvialis squatarola</i>
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>
Common snipe	<i>Gallinago gallinago</i>
Dunlin	<i>Calidris alpina</i>
Greater yellowlegs	<i>Tringa melanaleuca</i>
Hudsonian godwit	<i>Limosa haemastica</i>
Killdeer	<i>Charadrius vociferus</i>
Least sandpiper	<i>Calidris minutilla</i>
Lesser yellowlegs	<i>Tringa flavipes</i>
Lesser-golden plover	<i>Pluvialis dominica</i>
Long-billed dowitcher	<i>Limnodromus scolopaceus</i>
Marbled godwit	<i>Limosa fedoa</i>
Pectoral sandpiper	<i>Calidris melanotos</i>
Peep	<i>Calidris spp.</i>
<u>Piping plover</u>	<i>Charadrius melodus</i>
Purple sandpiper	<i>Calidris maritima</i>
Red knot	<i>Calidris canutus</i>
Ruddy turnstone	<i>Arenaria interpres</i>
Sanderling	<i>Calidris alba</i>
Semipalmated plover	<i>Charadrius semipalmatus</i>
Semipalmated sandpiper	<i>Calidris pusilla</i>
Sharp-tailed sandpiper	<i>Calidris acuminata</i>
Shorebirds	
Short-billed dowitcher	<i>Limnodromus griseus</i>
Solitary sandpiper	<i>Tringa solitaria</i>
Spotted sandpiper	<i>Actitis macularia</i>
Stilt sandpiper	<i>Calidris himantopus</i>
Western sandpiper	<i>Calidris mauri</i>
Whimbrel	<i>Numenius phaeopus</i>
White-rumped sandpiper	<i>Calidris fuscicollis</i>
Willet <i>Catoptrophorus semipalmatus</i>	
Wilson's phalarope	<i>Steganopus tricolor</i>
Wilson's plover	<i>Charadrius wilsonia</i>

SPECIES LIST*

Common Name	Species Name
BIRDS (continued)	
WADING BIRDS	
Black rail	<i>Laterallus jamaicensis</i>
Cattle egret	<i>Bubulcus ibis</i>
<u>Florida sandhill crane</u>	<i>Grus canadensis pratensis</i>
Glossy ibis	<i>Plegadis falcinellus</i>
Great blue heron	<i>Ardea herodias</i>
Great egret	<i>Casmerodius albus</i>
Green-backed heron	<i>Butorides striatus</i>
Limpkin	<i>Aramus guarana</i>
Little blue heron	<i>Egretta caerulea</i>
Snowy egret	<i>Egretta thula</i>
Tricolored heron	<i>Egretta tricolor</i>
Wading birds	
White ibis	<i>Eudocimus albus</i>
<u>Wood stork</u>	<i>Mycteria americana</i>
Yellow-crowned night heron	<i>Nyctanassa violacea</i>
WATERFOWL	
American coot	<i>Fulica americana</i>
American wigeon	<i>Anas americana</i>
Blue-winged teal	<i>Anas discors</i>
Bufflehead	<i>Bucephala albeola</i>
Canvasback	<i>Aythya valisineria</i>
Common moorhen	<i>Gallinula chloropus</i>
Fulvous whistling-duck	<i>Dendrocygna bicolor</i>
Gadwall	<i>Anas strepera</i>
Green-winged teal	<i>Anas crecca</i>
Hooded merganser	<i>Lophodytes cucullatus</i>
Lesser scaup	<i>Aythya affinia</i>
Merganser	
Mottled duck	<i>Anas fulrigula</i>
Northern pintail	<i>Anas acuta</i>
Northern shoveler	<i>Anas clypeata</i>
Red-breasted merganser	<i>Mergus serrator</i>
Redhead	<i>Aythya americana</i>
Ring-necked duck	<i>Aythya collaris</i>
Ruddy duck	<i>Oxyura jamaicensis</i>
Waterfowl	
Wood duck	<i>Aix sponsa</i>
REPTILES AND AMPHIBIANS	
AMPHIBIANS	
Florida gopher frog	<i>Rana capito aesopus</i>
OTHER REPTILES	
<u>Eastern indigo snake</u>	<i>Drymarchon corais couperi</i>
Florida pine snake	<i>Pituophis melanoleucus mugitus</i>
Florida scrub lizard	<i>Sceloporus woodi</i>
TURTLES	
Gopher tortoise	<i>Gopherus polyphemus</i>
<u>Green sea turtle</u>	<i>Chelonia mydas</i>
<u>Leatherback sea turtle</u>	<i>Dermochelys coriacea</i>
<u>Loggerhead sea turtle</u>	<i>Caretta caretta</i>
Spotted turtle	<i>Clemmys guttata</i>
FISH	
ANADROMOUS	
Atlantic sturgeon	<i>Acipenser oxyrhynchus</i>
<u>Shortnose sturgeon</u>	<i>Acipenser brevirostrum</i>
FRESHWATER	
Bluenose shiner	<i>Pteronotropis welaka</i>
Dusky shiner	<i>Notropis cummingsae</i>
River goby	<i>Awaous tajasca</i>
Snail bullhead	<i>Ameiurus brunneus</i>
SHELLFISH	
CRABS	
Blue crab	<i>Callinectes sapidus</i>
Stone crab	<i>Menippe spp.</i>

* Threatened and endangered species are designated by underlining.

SPECIES LIST*

Common Name	Species Name
SHELLFISH (continued)	
CRAYFISH	
Big-cheeked cave crayfish	<i>Procambarus delicatus</i>
Black Creek crayfish	<i>Procambarus pictus</i>
Silver Glen Springs cave crayfish	<i>Procambarus attiguus</i>
FRESHWATER MUSSEL	
Florida lance	<i>Elliptio waltoni</i>
St. Johns elephantear	<i>Elliptio monroensis</i>
FRESHWATER SNAIL	
Blue Spring hydrobe	<i>Aphaostracon asthenes</i>
Blue Spring siltsnail	<i>Cincinnatia parva</i>
Dense hydrobe	<i>Aphaostracon pycnus</i>
Enterprise siltsnail	<i>Cincinnatia monroensis</i>
LOBSTER	
Spiny lobster	<i>Panulirus argus</i>
SHRIMP	
Brown shrimp	<i>Penaeus aztecus</i>
Pink shrimp	<i>Penaeus duorarum</i>
White shrimp	<i>Penaeus setiferus</i>

HABITATS/PLANTS

FLOATING AQUATIC VEGETATION

Floating aquatic vegetation

RARE PLANTS

<u>American chaffseed</u>	<i>Schwalbea americana</i>
<u>Ashe's savory</u>	<i>Calamintha ashei</i>
<u>Bartram's ixia</u>	<i>Sphenostigma coelestina</i>
<u>Catesby's lily</u>	<i>Lilium catesbaei</i>
Chapman's sedge	<i>Carex chapmanii</i>
<u>Curtiss' milkweed</u>	<i>Asclepias curtissii</i>
<u>Fall-flowering pleat-leaf</u>	<i>Nemastylis floridana</i>
<u>Florida bonamia</u>	<i>Bonamia grandiflora</i>
<u>Florida hartwrightia</u>	<i>Hartwrightia floridana</i>
Florida mountain-mint	<i>Pycnanthemum floridanum</i>
Florida three-awned grass	<i>Aristida rhizomophora</i>
<u>Florida willow</u>	<i>Salix floridana</i>
<u>Green milkweed</u>	<i>Asclepias viridula</i>
<u>Gulf hammock indian plantain</u>	<i>Hasteola robertiorum</i>
<u>Lake-side sunflower</u>	<i>Helianthus carnosus</i>
<u>Large-flowered grass-of-parnassus</u>	<i>Parnassia grandifolia</i>
<u>Ocala vetch</u>	<i>Vicia ocalensis</i>
<u>Okeechobee gourd</u>	<i>Cucurbita okeechobeensis</i>
Piedmont jointgrass	<i>Coelorachis tuberculosa</i>
<u>Pond spice</u>	<i>Litsea aestivalis</i>
Scrub bay	<i>Persea humilis</i>
Scrub holly	<i>Ilex opaca</i>
Slender-leaved dragon-head	<i>Physostegia leptophylla</i>
Spoon-flower	<i>Peltandra sagittifolia</i>
<u>St. John's susan</u>	<i>Rudbeckia nitida</i>
Variable-leaf crownbeard	<i>Verbesina heterophylla</i>
<u>Yellow star anise</u>	<i>Illicium parviflorum</i>

* Threatened and endangered species are designated by underlining.

SHORELINE DESCRIPTIONS

EXPOSED, SOLID MAN-MADE STRUCTURES

ESI = 1B

DESCRIPTION

- These structures are vertical, hard, and impermeable walls (referred to as seawalls in some instances) and pilings exposed to direct wave action, boat wakes, and river currents. They are not always continuous, with different land owners having different designs. In some areas, narrow zones of vegetated banks separate the individual structures, but the hard structures make up well over 50% of the shoreline.
- They are present along developed areas where the shoreline is exposed to potential erosion by waves or boat wakes or where marinas have been built. These structures comprise a large percentage of the shoreline, of both the lake and river sections.

PREDICTED OIL BEHAVIOR

- Any oil that is deposited will be rapidly removed from exposed faces during periods of high wave action. Oil persistence on any specific shoreline is related to the incoming wave and boat wake energy. The more continuous the wall, the more rapidly it will be cleaned naturally, because oil will tend to remain longer in any crevasses or breaks between individual structures.
- The most resistant oil would remain as a patchy band at or above the high-water line.

RESPONSE CONSIDERATIONS

- High-pressure spraying may be required to remove oil for aesthetic reasons and prevent leaching of the oil from the structure.
- Cleanup crews should make sure to recover all released oil.



ERODING SCARPS IN UNCONSOLIDATED SEDIMENTS ESI = 3

DESCRIPTION

- These scarps are composed of relatively soft, unconsolidated sediments.
- The scarps show evidence of active erosion, and beaches in front of the scarps are narrow or absent.
- They are quite rare, comprising only a few hundred feet of the shoreline at the Jacksonville Naval Air Station.

PREDICTED OIL BEHAVIOR

- Any stranded oil will form a band along the high-water line.
- There is some potential for oil penetration into any sediment accumulations at the base of the scarp, but active erosion of the scarp will also erode the oil.

RESPONSE CONSIDERATIONS

- In most cases, cleanup is not necessary because of the short residence time of the oil.
- The need for removal of oiled sediments should be carefully evaluated because of the potential for increased erosion.
- Manual labor and close supervision should be used so that the minimal amount of sediment is removed during cleanup.



RIPRAP

ESI = 6B

DESCRIPTION

- These structures are composed of cobble- to boulder-sized quarried rocks that have been placed along the shoreline for protection and stabilization.
- Riprap is placed behind beaches, along harbors, and as groins perpendicular to the shoreline.
- Riprap is rare, comprising only a small percentage of the developed shoreline.

PREDICTED OIL BEHAVIOR

- Deep penetration of oil between the boulders is likely where the riprap is placed at the water line.
- Oil adheres readily to the rough rock surfaces.
- If oil is left uncleaned, it may cause chronic leaching until the oil hardens into an asphalt deposit.

RESPONSE CONSIDERATIONS

- When the oil is fresh and liquid, high-pressure spraying and/or water flooding may be effective, making sure to recover all released oil.
- Heavy and weathered oils are more difficult to remove, requiring scraping and/or hot-water spraying.
- It may be necessary to replace heavily oiled riprap.



SHORELINE DESCRIPTIONS

SHELTERED, SOLID MAN-MADE STRUCTURES

ESI = 8B

DESCRIPTION

- These structures include revetments, seawalls, piers, and docks usually constructed of concrete or wood.
- They usually extend to the water surface.
- They are found inside marinas and in canals in highly developed areas, as well as along the shoreline of the more sheltered reaches of smaller streams and sloughs. They comprise a significant percentage of the shoreline.

PREDICTED OIL BEHAVIOR

- On impermeable surfaces, the oil will form a band at the water line.
- If oil is left uncleaned, it may cause chronic leaching until the oil hardens into an asphalt deposit.

RESPONSE CONSIDERATIONS

- High-pressure spraying may be required to remove oil for aesthetic reasons and prevent leaching of the oil from the structure.
- Cleanup crews should make sure to recover all released oil.



VEGETATED LOW BANKS

ESI = 9B

DESCRIPTION

- Vegetated low banks are colonized by terrestrial plants that grow in aerated soils.
- They typically occur along the upper reaches of streams and embayments, but may occur along shorelines of the lakes where swamps are not present or where upper bottomland hardwoods have been harvested. Small trees, grasses and woody debris lines are commonly present at the shore.
- They have a wide distribution but comprise a relatively low percentage of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil will adhere to any vegetation along the water line.
- Very heavy accumulations will be trapped along shoreline irregularities and pool in any surface depressions and among logs and woody debris.

RESPONSE CONSIDERATIONS

- All free oil should be removed by vacuum, low-pressure flushing, etc.
- Vegetation removal should be conducted only when deemed necessary and under close supervision, but this is a distinct possibility along this type of shoreline.



FRESHWATER MARSHES

ESI = 10B

DESCRIPTION

- Freshwater marshes are grassy wetlands composed of freshwater vegetation.
- They are the only type of marsh occurring within the mapping area, but they are very common throughout the area, particularly in the southern reaches.
- Those along major channels are exposed to strong currents and boat wakes; inland areas are highly sheltered.
- The substrate is seldom exposed since daily water-level changes are low; greater changes occur during floods.
- Resident flora and fauna are abundant with numerous species and high utilization.

PREDICTED OIL BEHAVIOR

- Oil adheres readily to marsh vegetation.
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation. There may be multiple bands.
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper, to the limit of tidal influence or elevated water levels associated with a flood event.

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally.
- Natural removal processes and rates should be evaluated prior to conducting cleanup.
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore.



- Cleanup activities should be carefully supervised to avoid vegetation damage.
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized.
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place.

SHORELINE DESCRIPTIONS

FRESHWATER SWAMPS

ESI = 10C

DESCRIPTION

- Freshwater swamps consist of forested wetlands (at least 6 m in height), which are regularly flooded.
- They are the most common type of shoreline in the mapping area, increasing in abundance toward the south.
- The sediment tends to be fine-grained with large amounts of organic debris.
- They are seasonally flooded, though there are many low, permanently flooded areas.
- Resident flora and fauna are abundant with numerous species.

PREDICTED OIL BEHAVIOR

- Oil behavior depends on whether the swamp is flooded or not.
- During floods, most of the oil passes through the forest, coating the vegetation above the waterline, which changes levels throughout the flood event.
- Oiled woody vegetation is less sensitive than marshes to oil impacts.
- Some oil can be trapped and pooled on the swamp flood plain as water levels drop.
- Penetration into the floodplain soils is usually limited because of high water content, muddy substrate, surface organic debris, and vegetation cover.
- Large amounts of oily debris can remain if water levels drop.
- During dry periods, terrestrial spills flow downhill and accumulate in depressions or reach water bodies.

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally.
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore.
- Under stagnant water conditions, herding of oil with water spray may be needed to push oil to collection areas.
- Oily debris can be removed where there is access.
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized.
- Trimming of oiled portions of the vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place.



SCRUB-SHRUB WETLANDS

ESI = 10D

DESCRIPTION

- Scrub-shrub wetlands consists of woody vegetation less than 6m tall including true shrubs, small trees, and trees and shrubs that are stunted because of environmental conditions. Scrub-shrub wetlands may also include young tree stands in areas which are logged.
- Scrub-shrub wetlands are not common, but they occur throughout the area, increasing in abundance toward the south.
- The sediment tends to be fine-grained with large amounts of organic debris.
- They are seasonally flooded, though there may be low, permanently flooded areas.
- Resident flora and fauna are abundant with numerous species.

PREDICTED OIL BEHAVIOR

- Oil behavior depends on whether the wetland is flooded or not.
- During floods, most of the oil passes through the wetland, coating the vegetation above the waterline, which changes levels throughout the flood event.
- Oiled woody vegetation is less sensitive than marshes to oil impact.
- Some oil can be trapped and pooled on the wetland flood plain as water levels drop.
- Penetration into the floodplain soils is usually limited because of high water content, muddy composition, surface organic debris, and vegetation cover.
- Large amounts of oily debris can remain if water levels fall.
- During dry periods, terrestrial spills flow downhill and accumulate in depressions or reach water bodies.

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally.
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore.



- Under stagnant water conditions, herding of oil with water spray may be needed to push oil to collection areas.
- Oily debris can be removed where there is access.
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized.
- Trimming of oiled portions of the vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place.