The University of Georgia

MARINE EXTENSION SERVICE

Coastal Georgia Adopt-A-Wetland

TRAINING MANUAL

An Invitation to Monitor Georgia's Coastal Wetlands

www.shellfish.uga.edu

By
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The Marshes of Glynn

By Sidney Lanier

Glooms of the live-oaks, beautiful-braided and woven
With intricate shades of the vines that myriad-cloven

Clamber the forks of the multiform boughs, —
Emerald twilights, —
Virginal shy lights,
Wrought of the leaves to allure to the whisper of vows,
When lovers pace timidly down through the green colonnades
Of the dim sweet woods, of the dear dark woods,

Of the heavenly woods and glades,

That run to the radiant margin sand-beach within

The wide sea-marshes of Glynn; —

Beautiful glooms, soft dusks in the noon-day fire, —
Wildwood privacies, closets of lone desire,
Chamber from chamber parted with wavering arras of leaves, —
Pure with a sense of the passing of saints through the wood,
Cool for the dutiful weighing of ill with good; —

O braided dusks of the oat and woven shades of the vine,
While the riotous noon-day sun of the June-day long did shine
Ye held me fast in your heart and I held you fast in mine;
But now when the noon is no more, and riot is rest,
And the slant yellow beam down the wood-aisle doth seem
Like a lane into heaven that leads from a dream, —
Ay, now when my soul all day hath drunken the soul of the oak,
And my heart is at ease from men, and the wearisome sound of the stroke

Of the scythe of time and trowel of trade is low,
And belief overmasters doubt, and I know that I know,
And my spirit is grown to a lordly great compass within,

That the length and the breadth and the sweep of the marshes of Glynn
Will work me no fear like the fear they have wrought me of yore
When length was fatigue, and when breadth was but bitterness sore,
And when terror and shrinking and dreary unnamable pain
Drew over me out of the merciless miles of the plain, —

Oh now, unafraid, I am fain to face

The vast sweet visage of space.
To the edge of the wood I am drawn, I am drawn,

Where the gray beach glimmering runs, as a belt of the dawn,

For a mete and a mark
To the forest-dark: —
So:

Affable live-oak, leaning low, —
Thus—with your favor—soft, with a reverent hand,
(Not lightly touching your person, Lord of the land!)
Bending your beauty aside, with a step I stand
On the firm-packed sand

Free

By a world of marsh that borders a world of sea.

Sinuous southward and sinuous northward the shimmering band
Of the sand-beach fastens the fringe of the marsh to the folds of the sand.

Inward and outward to northward and southward the beach-lines linger and curl
As a silver-wrought garment that clings to and follows the firm sweet limbs of a girl.
Vanishing, swerving, evermore curving again into sight,
Softly the sand-beach wavers away to a dim gray looping of light.
And what if behind me to westward the wall of the woods stands high?
The world lies east: how ample, the marsh and the sea and the sky!
A league and a league of marsh-grass, waist-high, broad in the blade,
Green, and all of a height, and unflecked with a light or a shade,
Stretch leisurely off, in a pleasant plain,
To the terminal blue of the main.
Oh, what is abroad in the marsh and the terminal sea?

Somehow my soul seems suddenly free

From the weighing of fate and the sad discussion of sin,
By the length and the breadth and the sweep of the marshes of Glynn

Ye marshes, how candid and simple and nothing-withholding and free
Ye publish yourselves to the sky and offer yourselves to the sea!
Tolerant plains, that suffer the sea and the rains and the sun,
Ye spread and span like the catholic man who hath mightily won
God out of knowledge and good out of infinite pain
And sight out of blindness and purity out of a stain.

As the marsh-hen secretly builds on the watery sod,
Behold I will build me a nest on the greatness of God:
I will fly in the greatness of God as the marsh-hen flies

In the freedom that fills all the space 'twixt the marsh and the skies:
By so many roots as the marsh-grass sends in the sod
I will heartily lay me a-hold on the greatness of God:
Oh, like to the greatness of God is the greatness within
The range of the marshes, the liberal marshes of Glynn

And the sea lends large, as the marsh: lo, out of his plenty the sea
Pours fast: full soon the time of the flood-tide must be:
Look how the grace of the sea doth go
About and about through the intricate channels that flow

Here and there,
Everywhere,

Till his waters have flooded the uttermost creeks and the low-lying lanes,
And the marsh is mesed with a million veins,
That like as with rosy and silvery essences flow

In the rose-and-silver evening glow.
Farewell, my lord Sun!

The creeks overflow: a thousand rivulets run
'Twixt the roots of the sod; the blades of the marsh-grass stir;
Passeth a hurrying sound of wings that westward whirr;
Passeth, and all is still; and the currents cease to run;
And the sea and the marsh are one.

How still the plains of the waters be!
The tide is in his ecstasy.
The tide is at his highest height:

And it is night.
And now from the Vast of the Lord will the waters of sleep
Roll in on the souls of men,
But who will reveal to our waking ken
The forms that swim and the shapes that creep

Under the waters of sleep?
And I would I could know what swimmeth below with the tide comes in
On the length and the breadth of the marvellous marshes of Glynn.

Baltimore, 1878

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Introduction

Welcome to the Coastal Georgia Adopt-A-Wetland (CGAAW) program! This is a hands-on education program that promotes wetland conservation through volunteer monitoring. Wetlands are valuable coastal resources, playing an important role in water quality, sediment retention, flood control, and wildlife habitat. This program is designed to complement the Georgia Adopt-A-Stream program, which is coordinated by the Department of Natural Resources Environmental Protection Division. Essentially, the Adopt-A-Wetland program is the marine counterpart of the Adopt-A-Stream program, and shares the same goals, namely to:

1) increase public awareness of the state's nonpoint source pollution and water quality issues
2) provide citizens with the tools and training to evaluate and protect their local waterways
3) educate the public on the importance of wetlands
4) collect quality baseline data and determine the health of our coastal wetlands.

How to Get Started

This manual contains all the information you will need to begin monitoring your adopted wetland. Our volunteer groups include school classes 5th grade and up, civic organizations, individuals, families, neighbors, friends, clubs, and companies. The first step is to attend a hands-on training workshop where instruction will be provided on water quality monitoring and/or the biological-sampling methods used to determine wetland habitat health. Free training workshops are provided at regular intervals in Savannah and on an as needed basis for those in other areas of coastal Georgia who cannot travel. Visit www.shellfish.uga.edu to view upcoming training workshops. Volunteers who attend a workshop and pass a QA/QC (Quality Assurance/Quality Control) test will be considered QA/QC data collectors for one year. All the supplies your monitoring group will need to collect data for an annual period are provided on a loan basis. After an individual is certified in monitoring, a site must be chosen for adoption and registered. A watershed survey and map assessment must also be completed for this particular site on an annual basis. The watershed survey and map assessment is a simple checklist of land uses and activities that influence your wetland site. If you have questions or need help to complete the survey, call your AAW coordinator at 912-598-2348. It is also necessary to obtain a map of the wetland you are choosing to adopt. This can be accomplished via the internet **(www.topozone.com)**, through your local AAW coordinator, or the USGS.

There are many levels of monitoring available, ranging from basic visual surveys, which are conducted four times per year, to monthly water testing. Depending on your level of involvement, monitoring may consist of one or several of the following:

Visual Monitoring: Participants conduct a simple visual survey four times per year, consisting of observations of the plants, soil conditions, and water conditions.

Biological Monitoring: Biomonitoring determines the types and abundance of macroinvertebrates and plants that live in wetland areas. The diversity of species present helps us to assess water quality and habitat health. Healthy ecosystems usually contain great diversity and stressed habitats support less species with a greater number of individuals. This is also conducted quarterly.

Physical/Chemical Monitoring: This involves the monthly collection of information about specific water quality parameters (e.g. temperature, pH, dissolved oxygen, salinity, turbidity, and settleable solids). This is conducted on a monthly basis.

Habitat Enhancement Projects: These projects are designed to improve the health of your site. Examples of habitat enhancement projects include planting buffers, marsh restoration, oyster recycling, and regular litter pick-ups. Keeping your wetland clean can be one of the most effective ways of improving wetland health.

All levels of monitoring provide very important information concerning the health of coastal wetlands, and their protection. It is your decision as to which activities you will perform at your adopted site. This should be decided based upon your group's abilities and resources. Typically, groups start out with the chemical/physical protocol and subsequently add the biological component.

How Will My Data Be Used?

Information acquired from the monitoring surveys will be incorporated into the University of Georgia Marine Extension Service's GIS (Geographic Information System) database that will centralize all known water quality data for the coastal region. For more information on the GIS database please contact Doug Atkinson at 706-542-1581 or email dougis@uga.edu. Your data will also be submitted to the Adopt-A-Stream database at the State Environmental Protection Division office in Atlanta. For more information about the Adopt-A-Stream database, please contact Allison Hughes 404 675 1635 or email Allison_Hughes@dnr.state.ga.us. Each group or individual that adopts a site will be provided with an annual report by MAREX that summarizes and interprets their respective data.

Sometimes problems arise at various wetland sites and being aware of what to look for is important to the health of coastal wetlands. If warning signs are spotted, volunteer groups should notify the appropriate agencies through their "Emergency Contact List". In 2004, a wetland group (the Ogeechee River Citizens Brigade) in Richmond Hill noticed high sedimentation and a coffee color to the water at a normally healthy pond near their home. They reported this to the appropriate Department of Natural Resources (DNR) office, which investigated the problem, and found that a developer was at fault. The developer was fined and required to follow strict development guidelines while buildings were being constructed. In addition to detecting problems, data collected is also used to establish baseline conditions for waters that would not otherwise be assessed.

Safety Issues

Your safety is critical. Safety precautions need to be emphasized especially on the coast. Sudden storms can pop up and accidents can happen. The following information has been taken from the United States Environmental Protection Agency's website dealing with volunteer monitoring and assessing water quality (www.epa.gov/owow/monitoring/). Follow these tips at your adopted site:

- Always monitor with at least one partner. Let someone else know where you are, when you intend to return, and what to do if you do not come back at the appointed time.
- Develop a safety plan. Bring your cell phone or a radio. Locate the nearest medical center and write down directions on how to get between the center and your site(s) so that you can direct emergency personnel. Have each member of the sampling team complete a medical form that includes emergency contacts, insurance information, and pertinent health information such as allergies, diabetes, epilepsy, etc.
- Have a first aid kit handy. Know any important medical conditions of team members (e.g., heart conditions or allergic reactions). It is best if at least one team member has first aid/CPR training.
- Listen to weather reports. Never go sampling if severe weather is predicted or occurs while at the site.
- Never wade in swift or rapidly rising water and watch for rip tides or currents.
- Watch for wildlife and insects such as ticks, hornets, and wasps. Know what to do for bites or stings.
- Watch for poison ivy, poison oak, sumac, and other vegetation that can cause rashes and irritation.
- Do not monitor if the site appears to be extremely polluted.
- Dress appropriately by following the advice of "Maude the Marsh Mucker" (page 16).
- If at any time you feel uncomfortable about the condition of the wetland or your surroundings, **stop monitoring** and leave the site at once. Your safety is more important than the data!

When using chemicals:

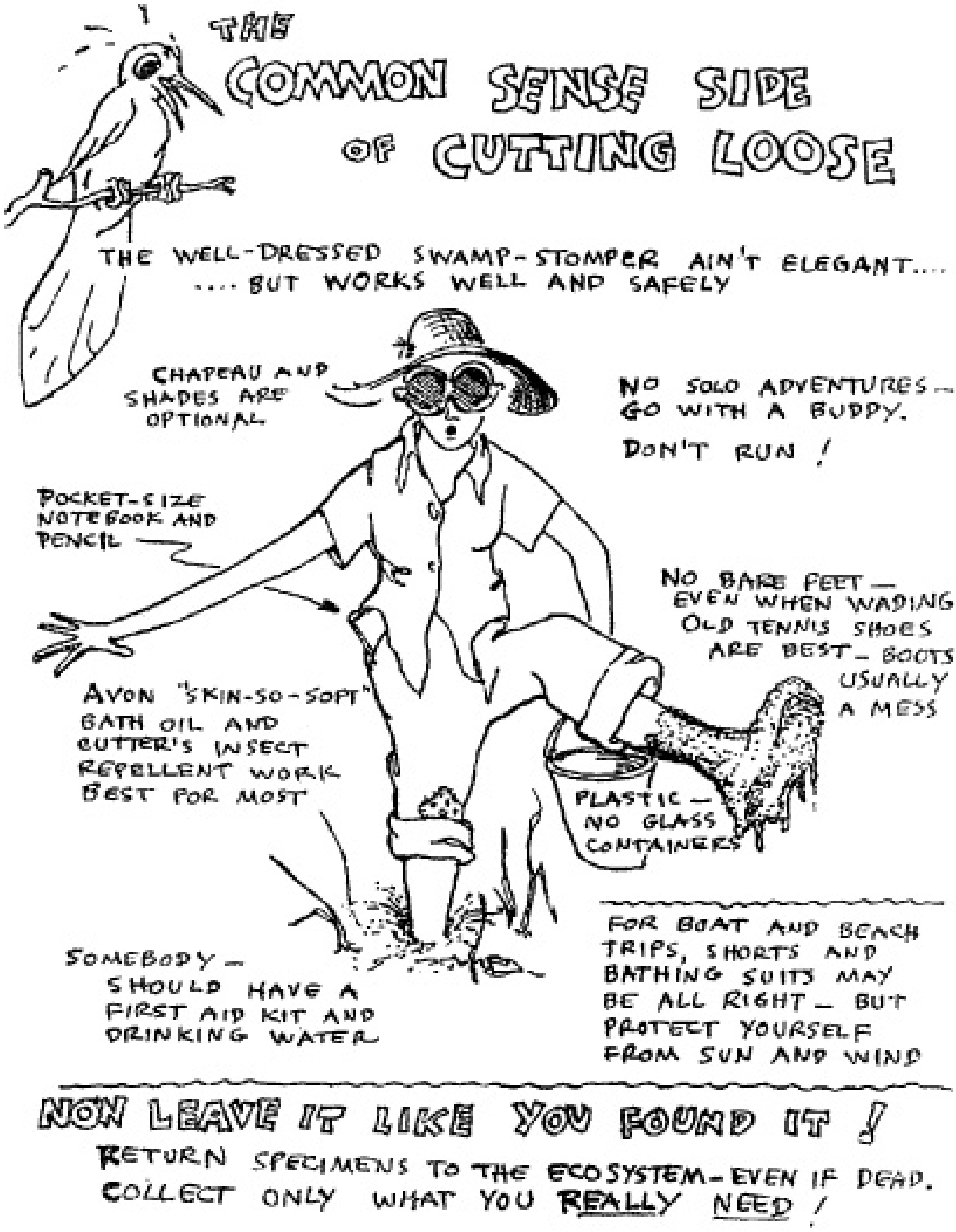
- Know your equipment, sampling instructions, and procedures before going out into the field. Prepare labels and clean equipment before you get started.
- Keep all equipment and chemicals away from small children. Many of the chemicals used in monitoring are poisonous. Tape the phone number of the local poison control center to your sampling kit.
- Avoid contact between chemical reagents and skin, eye, nose, and mouth. Never use your fingers to stopper a sample bottle (e.g., when you are shaking a solution). Wear safety goggles when performing any chemical test or handling preservatives.
- Know chemical cleanup and disposal procedures. Wipe up all spills when they occur. Return all unused chemicals to your program coordinator for safe disposal. Close all containers tightly after use. Don't switch caps.
- Know how to use and store chemicals. Do not expose chemicals or equipment to temperature extremes or long-term direct sunshine.
- Be sure you have emergency telephone numbers and medical information with you at the field site for everyone participating in fieldwork (including the leader) in case there is an emergency.

First Aid Kit

The minimum first aid kit should contain the following items:

- Telephone numbers of emergency personnel such as the police and an ambulance service.
- Several band-aids for minor cuts.
- Antibacterial or alcohol wipes.
- First aid creme or ointment.
- Several gauze pads 3 or 4 inches square for deep wounds with excessive bleeding.
- Acetaminophen for relieving pain and reducing fever.
- A needle for removing splinters.
- A first aid manual which outlines diagnosis and treatment procedures.
- A single-edged razor blade for minor surgery, cutting tape to size, and shaving areas before taping.
- A 2-inch roll of gauze bandage for large cuts.
- A triangular bandage for large wounds.
- A large compress bandage to hold dressings in place.
- A 3-inch wide elastic bandage for sprains and applying pressure to bleeding wounds.
- If a participant is sensitive to bee stings, include their doctor-prescribed antihistamine.

Be Prepared Like Maude the Marsh Mucker!



Coastal Wetland Habitats

The Salt Marsh

Georgia and South Carolina combined contains one third of the total amount of salt marsh on the East Coast. Georgia's coastline is approximately 100 miles. The salt marsh is a unique habitat that occurs between the barrier islands and the mainland, and is characterized by expansive grasslands, mudflats, and meandering tidal creeks. In coastal Georgia we have a large tidal range of 6-9 ft. Twice per day, tidal creeks flood and ebb, nourishing the salt marsh environment. Salt marshes are valuable because they protect the mainland by absorbing the impact of storms. Salt marshes also help in filtering out harmful pollutants that occur from one source (point pollution), or from many sources (nonpoint source pollution) (Mitsch and Gosselink, 1986). People often ask how a wetland can absorb toxins. A chemical or pollutant is absorbed into the mud but also is absorbed through the pores of smooth cordgrass (*Spartina alterniflora*) and stored for a period of time within the plants body! (Long, and Mason, 1983).

Saltmarsh on Tybee and Cumberland Islands (Alan Power, MAREX).

Salt marshes and tidal creeks are important nursery grounds, providing a habitat for larval fish and shellfish such as mullet, silverside, sea bass, oysters and mussels. In addition, this productive and nutrient laden environment provides much needed organic matter for bacteria to carryout important transformations of naturally occurring chemical compounds into valuable nutrients (Johnson et al., 1974) that act as fertilizers for phytoplankton (free floating unicellular plants). Many organisms depend on phytoplankton, from the microscopic zooplankton to the larger filter feeding animals including sea squirts, barnacles, clams, and mussels.

Oyster Reef, Wilmington Island (Alan Power, MAREX)

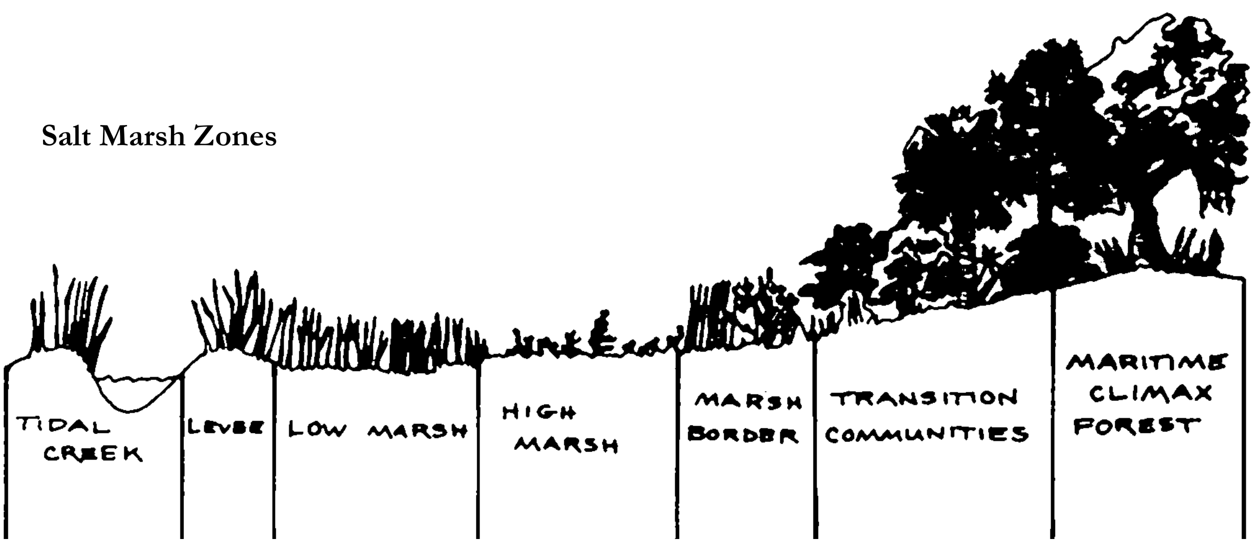
Oysters are another filter feeder and one of the most prominent members of the salt marsh community. They are in fact described as "keystone" species, which means they are critical in maintaining the health of this ecosystem. After spawning, oysters begin their lives in the water column as free-floating larvae. When oysters settle and attach to a hard surface they metamorphose into an immobile organism called a spat. The spat or small oysters will often grow in clusters on other oysters, in tidal creeks, on jetties, and on pilings or docks. When oysters grow in clumps along tidal creeks they are called oyster bars or oyster reefs (O'Beirn et al., 1994). If you closely examine the crevices of an oyster reef you will find a myriad of organisms, such as, mussels, crabs, fish, polychaete worms and amphipods. Oyster reefs are called "Essential Fish Habitat" which means that many commercially and ecologically important species depend on the reef habitat to successfully reproduce and survive. Oysters filter food particles such as plankton and detritus from the water. Oysters are excellent at removing toxins, metals, nutrients, and harmful bacteria, thus improving water quality. As these amazing mollusks feed, one healthy oyster can pump up to 5 liters or 1.3 gallons of seawater through its body in one hour. The more oysters we have in our creeks and estuaries, the cleaner our waters. Oyster reefs also protect the marsh from being eroded by waves and boat wakes by absorbing the energy of these waves before they can wash away the mud from around the roots of the *Spartina* grass.

Other common organisms found in the salt marsh and associated mud flats are fiddler crabs, mud snails, periwinkles, blue crabs, quahogs, shrimp, whelks, insects, killifish, mummichogs, wading birds, waterfowl, and shore birds (Wiegert, and Freeman, 1990).

Egrets, Tybee Island (Mary Sweeney Reeves, MAREX)

The salt marsh can be divided into several zones. The low and high marsh zones will be our primary focus. The low marsh is lowest in elevation and closer to the tidal creek and is the area that is flushed daily with water during high tide. Smooth Cordgrass (*Spartina alterniflora)* grows highest in areas that are closest to creeks because of the frequent flushing of water when the tide floods. Plants that grow in the area furthest from the tidal creek and at a higher elevation are classified as high marsh plants. Plants in this zone are Glasswort (*Salicornia sp.*), Saltwort (*Batis maritimea*) Salt Grass (*Distichlis spicata*), Needle Rush (*Juncus roemerianus*), Saltmeadow Cordgrass (*Spartina patens)*, Sea Oxeye Daisy (*Borrichia frutescens*), Marsh Elder (*Iva frutescens*) and Eastern Red Cedar (*Juniperus virginiana*). Because inundation of water occurs less often in the high marsh, salt tends to accumulate in the soil, thus stunting the growth of *Spartina alterniflora* (Wiegert and Freeman, 1990). There are other regions of the marsh where salt tends to accumulate. These regions are known as salt pans. Here the concentration of salt in the soil is so high nothing will grow (Johnson et al., 1974).

Salt Marsh Zones



Surprisingly, a large percentage of the mud and clays in our coastal marshes come from areas inland. This clay source, also known as the red clay Georgia is famous for, is located in the fields of the southern piedmont. If we traced the travels of a red clay particle from the southern piedmont to the coast, the clay particle would have a long adventurous trip.

The clay particle begins inland as a part of a stream bank. Heavy rains will wash out the bank of the creek causing the clay to erode away. Over many years the clay/water particle will venture down fresh water rivers as suspended material, and eventually enter into brackish water (a mixture of fresh and salt water) found in estuaries. While in fresh water, clay, which has a negative charge, will naturally repel other clay particles. There are many types of salts found in coastal waters (e.g. sodium, chloride, magnesium, calcium, potassium, sulfate, bromide and bicarbonates). These salts have negative or positive charges called ions. A positively charged salt will react and cancel the negative charge of a clay particle. Therefore, when clay particles flow into more saline waters they will bind to other clays and eventually this "particle-group" (flocculate) will grow heavy, sink to the bottom, and become an important part of our marsh ecosystem.

The silts and clays fall out of suspension onto the leeward side or protected side of the islands. Notice while visiting any coastal Georgia Islands that salt marsh formation generally occurs on the western side of the island. The clays and sediments then build up mounds and piles that stick up above high tide lines. Smooth Cord Grass (*Spartina alterniflora*) eventually colonizes these areas. The accumulated mud with marsh grass begins its evolution into an ecosystem known as the salt marsh. Processes of sediment build up (accretion) or sediment washing away (erosion) help shape the salt marshes of Coastal Georgia.

Coastal Sediment Deposition (Mary Richards, Skio)

In the salt marsh, the mud is no longer red, instead it is black; this is due to a lack of oxygen in the soil and a chemical process called reduction. Reduction involves naturally occurring anaerobic bacteria which are present in the mud. The bacteria have the capability to break down one common seawater salt ion called sulfate (SO_4) by using the oxygen and changing the sulfate into hydrogen sulfide (H_2S). This process is how the anaerobic bacteria utilize oxygen during a process called respiration. All things must respire in order to live. The rotten egg aroma prevalent in coastal marshes during low tide is the hydrogen sulfide produced through this reaction.

The key to the importance of the marsh as an ecosystem lies in the plants that live and die there and the bacteria associated with the mud. One important function of the marsh grass is to help hold the mud together and to provide organic matter (detritus) to the coastal ecosystems. The bacteria in the mud and in the marsh utilize the detritus, the naturally occurring chemical compounds, and nutrients such as nitrogen in the water and recycle them to another form. Nutrients such as nitrogen help with fertilizing the plants and algae keeping the marsh system balanced and fruitful.

The Coastal Marshlands Protection Act provides the Georgia Department of Natural Resource's Coastal Resources Division with the authority to protect tidal wetlands. For more information on the Marshland Protection Act contact the Coastal Resources Division of Georgia DNR (912) 264-7218 or visit the website (http://crd.dnr.state.ga.us/content/displaycontent.asp?txtDocument=85). Fourteen plants recognized in the Marshlands Protection Act are used by the Georgia DNR to delineate jurisdictional tidal wetlands from upland areas (http://crd.dnr.state.ga.us/content/displaycontent.asp?txtDocument=317).

The Beach

Georgia's thirteen major barrier islands contain about 90 miles of sandy beaches. The beach is another coastal "wetland" you may choose to monitor. Beaches are continually being shaped and changed by ocean currents, waves and wind. Coastal development, dredging, beach renourishment, and other human impacts also play a role in shaping our beaches and dunes. The beach may be divided into three zones; shore by the water's edge, the wrack line where decaying marsh grass and other organic matter builds up, and the sand dunes which are mounds of sand held together by grasses and other plants.

Cumberland Island Dunes (Alan Power, MAREX)

Dune formation is a process dependent on the transport of dead marsh grass (*Spartina alterniflora*) from the marsh to the upper beach area or wrack line. The dead marsh grass deposited at the wrack line traps sand as it is deposited by wind and water. The mixture of the dead grass, sand, and moisture creates a soil mixture rich with organic matter; suitable for plant growth. Seeds from salt tolerant plants are deposited along the wrack line and upper beach where they establish roots. The plants grow trapping beach sand thus forming a primary dune. In Georgia, Sea Oats (*Uniola paniculata*) are the most important species because they are mostly responsible for the creation of the primary dunes. Sea Oats tolerate salty water, windy conditions, and have the ability to thrive in harsh conditions. Sea Oats build small sand dunes by trapping sand with the expanding rhizomes thus stabilizing loose sandy soil. These grasses are so valuable to Georgia that if anyone harms them on any of the coastal beach dunes they will be fined heavily.

As the primary dune gets larger, it will either decrease in size from natural or man made processes (erosion) or increase in size (accretion) (Johnson et al., 1974). More plants will colonize and the dune will eventually form a more diverse plant community and become a dune meadow, with plants such as Pennywort (*Hydrocotyl bonariensis*), Yucca (*Yucca aloifolia*), Camphorweed (*Heterotheca subaxillaris*), and Dune Primrose (*Oenothera humifusa*). In addition the dune system helps in providing a buffer for the mainland from the ocean winds and storms. By monitoring the size of dunes and the types of plants that grow in the dunes, you can record the rate of erosion/accretion over time.

Backshore Vegetation, Cumberland Island (Alan Power, MAREX)

Some of the animals commonly observed at the beach include ghost crabs, gulls, hermit crabs, jellyfish, mole crabs, sea-whips, olive shells, whelk egg strings, sand dollars, horseshoe crabs, sponges, dolphins, and various fish including bass, trout and catfish.

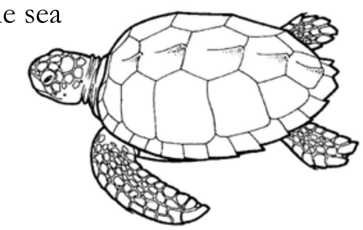
Ghost Crab, Wassaw Island (Alan Power, MAREX)

In addition, five species of sea turtles are found in Georgia's waters. Between May and August the threatened loggerhead sea turtle, and at times the leatherback sea turtle swims toward the coastal islands and beaches. These turtles leave the water and dig a nest on the beach to lay 100-150 eggs.

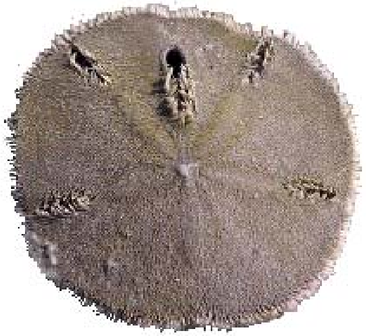
Turtle, Offshore Georgia (Mary Richards, Skio)

State and Federal laws protect all species of sea turtles, principally through the Endangered Species Act. The Department of Natural Resource's Nongame-Endangered Wildlife Program coordinates sea turtle conservation efforts along the coast. They would like for the general public to assist by reporting all sightings to (478) 994-1438. To report a dead or injured turtle, or sea turtle harassment, call (800) 2-SAVE-ME. If the sea turtle is tagged please include the tag color and number in the report if possible. For more information, please visit the website http://georgiawildlife.dnr.state.ga.us/ and click on non-game plants and animals. They also offer the following tips:

- Never disturb a sea turtle that is crawling to or from the sea
- Observe nesting females only from a distance
- Never attempt to ride a sea turtle
- Do not shine lights in a sea turtle's eyes or take flash photography
- Avoid or reduce beach lighting at night



The coastal sand dunes, beaches, sandbars, and shoals comprise a vital natural resource system, known as the sandsharing system. This system acts as a buffer to protect personal property and natural resources from the damaging effects of floods, winds, tides, and erosion. The Shore Protection Act is the primary legal authority for protection and management of Georgia's sandsharing system. Its jurisdiction includes the submerged shoreline lands out to the three mile limit of State ownership, the sand beaches to ordinary high water mark, and the "dynamic dune field", which is defined as the dynamic area of the beach and sand dunes. The ocean boundary of the dynamic dune field extends to the ordinary high water mark, and the landward boundary of the dynamic dune field is the first occurrence of either a live native tree 20 feet in height or greater, or a structure existing on July 1, 1979. This law protects the sea oats and dunes, and it is illegal to disturb them. For more information, contact the Ecological Services Section of the Georgia Department of Natural Resources at (912) 264-7218 or visit the following website http://crd.dnr.state.ga.us/content/displaycontent.asp?txtDocument=84.



Please Do Not Collect Live Sand Dollars

Most visitors to the beach do not realize that **taking live sand dollars threatens the species and is in fact illegal in many parts of the United States**. Unfortunately, most are taken by beachgoers during the summer months when sand dollars are reproducing. So many sand dollars have been taken from **Tybee Beach that the average size has decreased in comparison to populations on Georgia's other barrier islands**.

If you plan on beachcombing, please help to conserve local populations by only collecting white shells.

Scientific name: *Mellita isometra*
Common name: Five-slotted Sand Dollar or Keyhole Urchin
Phylum: Echinodermata which means "spiny skinned".
Size: Round, flat, & growing to about 100 mm in diameter.
Color (living): Purple & velvety due to tiny spines & tube feet that are used in respiration, feeding & movement.
Color (non-living): White test (shell), without spines and tube feet.
Habitat: Found primarily on the beach margin and thus susceptible to collection pressures.
Diet: Microscopic diatoms and detritus.
Reproduction: Gametes are released into the water where the larvae swim for a period before metamorphosing.
Association: Small crabs (*Dissodactylus mellitae*) are ectosymbionts (i.e. they live on the surface of sand dollars).
Predators: Fish, crabs, whelks, seastars, birds.
Other Threats: Storms, high temperatures during low tide, and low food abundance during the summer months.
Human Threats: Pollution, dredging, beach renourishment, trawling fisheries, and the ornamental trade.

JEKYLL ISLAND 4-H CENTER · Skidaway Institute of Oceanography · Public Service & Outreach · MAREX The University of Georgia Marine Extension Service · GEORGIA SOUTHERN UNIVERSITY · SINERR · BURTON 4-H CENTER

Chapter Two

Wetland Registration, Watershed Survey & Map Assessment

Registration Form

Watershed Survey & Map Assessment

How to Determine Your Latitude & Longitude

Coastal Georgia Adopt-A-Wetland Registration Form

University of Georgia MAREX
Adopt-A-Wetland Program
20 Ocean Science Circle
Savannah, GA 31411-1011

Complete the following form for each wetland you monitor and return to the above address. We will also file a copy with the GA Environmental Protection Division office in order to include your efforts in the statewide database.

This form is to register a (circle one or more than one if necessary (e.g. tidal creek and marsh):

SALTMARSH BEACH RIVER ESTUARY

Latitude: ______________________ Longitude: ______________________

Group Name: ____

Official Name of Site You Are Monitoring: ___________________________________

Level of Monitoring (Circle One/More): Chemical Biological Visual

Lead Coordinator/Contact: ____________________ Today's Date: __________

Complete Mailing Address: ____

Phone Number(s): ________________ E-mail Address: ________________________

For Official Use Only

Group has biological kit ☐ Group has chemical kit ☐

1. Describe the location of your monitoring site (i.e. 30 feet downstream of Johnny Mercer Blvd. crossing Betz Creek on Wilmington Island).

2. What is the name of your monitoring group? (i.e. Scout Troop 101, Friends of Hayworth Park, Dukes Creek Ducklings)?

3. What are the goals you hope to accomplish with the Adopt-A-Wetland program?

4. What equipment or supplies do you need to achieve your goals?

5. Where will you send the data you collect?

6. Name the QA/QC data collectors in your group.

COASTAL GEORGIA ADOPT-A-WETLAND
Watershed Survey and Map Assessment

University of Georgia MAREX
Adopt-A-Wetland Program
20 Ocean Science Circle
Savannah, GA 31411-1011

To be conducted at least once a year and returned to the above address.

Adopt-A-Wetland Group Name: ____

Investigator(s):____
____
____
____

Water Body Name: ______________________ County(ies):______________________

Picture/photo documentation? Yes No

Date: _____________________ Time: _______________________

I. CREATE A MAP OF YOUR WETLAND

You can download a map from www.topozone.com. See instructions on page 35.

II. LAND USES/ACTIVITIES AND IMPERVIOUS COVER

a. Comments on general waterbody and watershed characteristics: (e.g. date and size of fish kills, increased rate of erosion evident, litter most evident after storms). Fish kills should be immediately reported to DNR Wildlife Resources Division.

b. Summarize notable changes that have taken place since last year (if this is your second year conducting the Watershed Survey).

c. Identify land uses and activities near your monitoring site, which have the highest potential to impact water bodies:

Check all boxes that apply, describe the location of the activity(ies) under the Notes on Location & Frequency of Activities and also mark the locations on your map. If you do not know some of the information below, write DK under Notes.

Land Disturbance		Notes on Location & Frequency of Activity
Erosion caused by land development or construction	☐	______________________
Docks, piers, jetties	☐	______________________
Large or extensive gullies	☐	______________________
Unpaved roads near or crossing streams	☐	______________________
Commercial forestry activities including harvesting and site-preparation	☐	______________________
Extensive areas of creek bank failure or channel enlargement	☐	______________________
Agricultural Activities		
Croplands	☐	______________________
Pastures with cattle access to water bodies	☐	______________________
Confined animal (cattle or swine) feeding operations and concentration of animals	☐	______________________
Animal waste stabilizations ponds	☐	______________________
Poultry houses	☐	______________________
Highways and Parking Areas		
Shopping center & commercial areas	☐	______________________
Interstate highways and interchanges	☐	______________________
Major highways and arterial streets	☐	______________________
Other extensive vehicle parking areas	☐	______________________
Mining		
Quarry	☐	______________________

Leisure Activities

Golf course ☐ ____________

Marina's ☐ ____________

Recreational Fishing ☐ ____________

Boating/Jet skis ☐ ____________

Swimming ☐ ____________

Other ☐ ____________

Transportation and Vehicle Services

Truck/car cleaning services ☐ ____________

Automobile repair facilities ☐ ____________

Auto dealers ☐ ____________

Rail or container transfer yards ☐ ____________

Shipping or fishing port ☐ ____________

Marinas with boat fuel/repair/painting ☐ ____________

Business & Industry, General

Exterior storage or material exchange ☐ ____________

Activities with poor housekeeping practices indicated by stains leading to creek or storm drains or on-site disposal of waste materials ☐ ____________

Heavy industries such as textiles & carpet, pulp & paper, metal & vehicle production ☐ ____________

Dry cleaners or outside chemical storage ☐ ____________

Special Issues

Fertilizer production plants ☐ ____________

Feed preparation plants ☐ ______________________________

Meat and poultry slaughtering or processing plants ☐ ______________________________

Construction Materials

Wood treatment plants ☐ ______________________________

Concrete and asphalt batch plants ☐ ______________________________

Waste Recycling, Movement & Disposal

Junk and auto salvage yards ☐ ______________________________

Solid waste transfer stations ☐ ______________________________

Landfills and dumps (old & active) ☐ ______________________________

Recycling centers ☐ ______________________________

Illicit Waste Discharges*

Sanitary sewer leaks or failure ☐ ______________________________

Overflowing sanitary sewer manholes due to clogging or hydraulic overloading ☐ ______________________________

Bypasses at treatment plants or relief valves in hydraulically overloaded sanitary sewer lines ☐ ______________________________

Domestic or industrial discharges ☐ ______________________________

Extensive areas with aged/malfunctioning septic tanks ☐ ______________________________

Dry-weather flows from pipes (with detectable indication of pollution) ☐ ______________________________

Signs of illegal dumping ☐ ______________________________

* If found (most likely during watershed surveys), these activities should be immediately reported to the local government or the EPD regional office.

How to Determine Your Latitude and Longitude

You will need to know how to determine the latitude and longitude of your site so that others can find the exact location. To locate the coordinates, you will need to work with a topographic map and have access to the web. The best-quality maps we have found on the web are available at www.topozone.com. Scroll down to the bottom of the screen and type the official name of your waterbody in the area designated "Place Name." If you are working with an unnamed tributary to a larger stream, type in the name of the larger stream. Select your state (GA) on the pull-down menu, and click "Search." This should bring up a list of all sites with that name. Select your site by clicking on the link, which will take you to a topographic map of the area. Locate your exact data collection point as closely as possible and click on it, using the green arrows at the edges of the map to change the view if necessary. A small red mark should appear where you click, allowing you to keep track of your site. Now go to the top of the map and click on the 1:100,000 scale option, which will zoom in on the red mark. Adjust its position if necessary. At the bottom of the map, three coordinate format options will appear. Select the one labeled "DD.DDDD" for decimal degrees. The latitude and longitude of your site and the name of the quadrangle will appear above the map. Print this map for your records, noting the scale, coordinates, quadrangle, and date of production, which may be obtained by clicking "map/photo" in the upper right corner of the screen. Send a copy of this map to your Adopt-A-Wetland coordinator.

Chapter Three

Visual Monitoring

Monitoring Protocol
Visual Survey Worksheets

Visual Survey, Skidaway Island (Alan Power, MAREX)

Visual Monitoring

Visual Monitoring represents the first level of activity in Coastal Georgia's Adopt-A-Wetland volunteer monitoring program. The activities are basic but are also very important. As you become the "Wetland Watcher", it is through your eyes that we can see problems that may occur in our valuable coastal wetlands. Visual surveys are usually performed four times per year in a healthy wetland. However, when monitoring a dead marsh site, we encourage you to perform the survey once per month. Remember to always conduct the visual survey at the same stage of the tidal cycle each time.

Monitoring Protocol

This protocol provides directions on performing a visual survey. Use the worksheet on pages 39-40 to record important information about vegetation, soils and hydrology in your wetland.

Water Appearance

Fill a clean, clear container with water from your adopted wetland site. Hold the container up to the sun and determine the color. Odor should also be easy to detect from the container, and sometimes you will not notice an odor at all.

Photo Documentation

When monitoring a healthy wetland you should take a photograph of your site four times per year. However, since changes may occur rapidly, please include a photo each month when monitoring a marsh that appears stressed. Please try to take the photo at the same spot each time (you may want to mark the site). If possible also take the photograph at the same tidal cycle (i.e. low or high tide).

Impaired Habitat Indicators

Sometimes human activities nearby will adversely affect a wetland. Check all the boxes in the impaired habitat indicator section of your survey sheet that apply to your site.

Wetland Condition/Appearance

In this context, wetland condition refers to the health of specific plants that grow in the wetland. Marsh grass and other plants naturally go through seasonal changes. The general pattern is that the marsh grass turns brown in the winter but greens with new growth during the spring and fall. We expect browning in the winter, however if the color stays brown all year round we may have reason to become concerned. Also pay close attention to an abundance or absence of organisms (snails, crabs, or fish).

Soil Survey

The presence of large areas without plants (except for salt pans) may be a warning sign that something is not right. These areas of the marsh will consist mostly of mud. If possible mark the perimeter of the muddy area with PVC, sticks, or flags. Each time you monitor your site note whether the muddy area without plants is increasing or decreasing. Dip your finger into the mud or scrape the surface of the sediment in your marsh and observe characteristics of the sediment/mud. Check all the appropriate boxes on your survey sheet.

Visual Survey, Ossabaw Island (Ellie Covington, MAREX)

Adopt-A-Wetland Visual Survey

AAW Group Name _______________________________ **County** ___________________

Group ID Number______________________ **Site ID Number**___________________

Investigators____

Wetland Name_____________________**Date** __________________**Time** ______________

Picture/Photo Documentation? Yes No

Amount of Rain ___________________ Inches in Last ___________________ Hours/Days

☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

Present Conditions: ☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

☐ Partly Cloudy ☐ Overcast ☐ Clear/Sunny

Site Description: (e.g. Salt Marsh, Beach, Estuary) __________________________________

Is Waterway Influenced by Tides? Yes No

If Yes, Tide was: ☐ High ☐ Outgoing ☐ Low ☐ Incoming

Water Surface: ☐ Calm ☐ Ripples ☐ Waves ☐ Whitecaps

Impaired Habitat Indicators: ☐ Foam ☐ Bubbles ☐ Oil ☐ Scum

☐ Dead Organisms_________________☐ Erosion_________________________

☐ Trash Present___________________☐ Vegetative Debris_________________

☐ Dumping______________________ ☐ Excessive Algae__________________

☐ Dredging______________________ ☐ Dock/ Pier Present_______________

☐ Artificial Water Control (groin, jetty, dyke, etc)__________________________

Water Color: ☐ Clear ☐ Muddy ☐ Milky Gray ☐ Green

☐ Brown ☐ Tan ☐ Other___________________________

Odor: ☐ Gas ☐ Oil ☐ Chlorine ☐ Rotten Eggs

☐ Sewage ☐ Chemical ☐ Other___________________________

Wetland Condition/Appearance:

☐ Marsh Grass Green ☐ Marsh Grass Brown ☐ Other____________________

☐ Marsh Surface Mostly Mud/ If so is mud area increasing or decreasing? __________________

Invertebrate Survey:

☐ Many White Snails (Periwinkles) ☐ Many Black Snails (Mudsnails)

☐ Few Periwinkles ☐ Few Mud Snails ☐ Dead Fish Present

☐ Dead Blue Crabs Present ☐ Other Dead Organisms______________________

☐ Fiddler Crabs Present ☐ Fiddler Crabs Absent ☐ Crab holes present, #_______

☐ Ribbed Mussels Present ☐ Ribbed Mussels Absent ☐ Dead Ribbed Mussels

Mud/Soil Survey:

☐ Black on Surface ☐ Reddish Brown Color ☐ Brown on Surface

☐ Black Surface Streaks ☐ Mostly Brown Color ☐ Green on Surface

☐ Other____

Mud Moisture Content:

☐ Totally Dry ☐ Wet ☐ Damp

Mud Texture: ☐ Clay/Mud (sticks to finger) ☐ Sand (larger particles, not stick to finger)

Additional Comments/Observations:

Chapter Four

Biological Monitoring

Mucking, Skidaway Island (Alan Power, MAREX)

Biological Monitoring

Biomonitoring provides information on changes in the plant and animal communities that may occur in our wetlands. Any changes to these environments will be reflected in the quantity/quality of plants or the types of animals present. There are various biological survey methods available to monitor your adopted site depending on the type of site you may have. After becoming quality assurance/quality control (QA/QC) certified, your group will be given all the necessary equipment to conduct the biological surveys.

Biomonitoring

Our monitoring protocol concentrates on macroinvertebrate (large visible animals without a backbone) and vegetative sampling. Some common types of macroinvertebrates, include oysters, mussels, snails, crabs, and worms. Some common plants, which may be found at your site, include smooth cordgrass, needle rush, sea oxeye daisy, sea lavender, and sea oats. Macroinvertebrates and wetland plants are good indicators of wetland quality because:

Marsh Periwinkle (Becci Curry, St. Mary's Elementary)

- They are affected by the physical, chemical and biological conditions of the wetland.
- They cannot escape pollution and show effects of short and long-term pollution events.
- They are an important part of the food web, representing a broad range of trophic levels.
- They are relatively easy to collect and identify with inexpensive materials.

Diversity of Organisms in Estuarine Communities

Biodiversity is a measure of the diversity or the number of species occurring in a community. A community is a naturally occurring group of different species of organisms that live together and interact as a unit. A salt marsh community may contain animals such as the fiddler crab, periwinkles, coffee bean snails, marsh clams, mussels, mud crabs, and stone crabs. Species diversity depends on species richness and species evenness. Species richness is the number of species present, while evenness refers to the distribution of individuals among the species (i.e. if all species are equally abundant then evenness is high).

A high diversity would mean that there are many equally abundant species whereas a low diversity would indicate few equally abundant species or many species with an unequal abundance. However, there are other factors, which affect the numbers of species in coastal and marine habitats. General animal population dynamics influenced by environmental factors and species strategies are inherent in nature. We have broken down some of these population factors and the effects on the diversity of the coastal communities.

General Population Growth and Carrying Capacity in Natural Communities

The population growth of a species relates to an organisms reproductive potential and environmental factors within the habitat. Typically, population growth occurs in an S or sigmoid curve. To illustrate this curve we present the following example using an algal reproduction graph (page 44) which has been adapted from Wilson and Bossert (1971). Monthly algae cell densities and/or seasonal algal population growth (y axis) in a tidal pool or creek are plotted over the course of a year (x axis). There are several steps to the typical S growth curve. Between January and April when nutrients are limited and the temperatures are low there is little to no algae cell production. During the spring warming temperatures and an increase in nutrient loading causes the algal population to increase. This growth period is labeled "exponential growth" or (r) in the graph. Typically, during the summer, there is an increase in nutrients including the nitrates and phosphates from lawn fertilizers, golf courses, and farms (also known as non-point source pollution). The abundance of these nutrients will cause algae to reproduce rapidly followed by a slowing trend and a "leveling off" when the population approaches its carrying capacity (K). Carrying capacity occurs when nutrients are at optimum levels and death equals algal production.

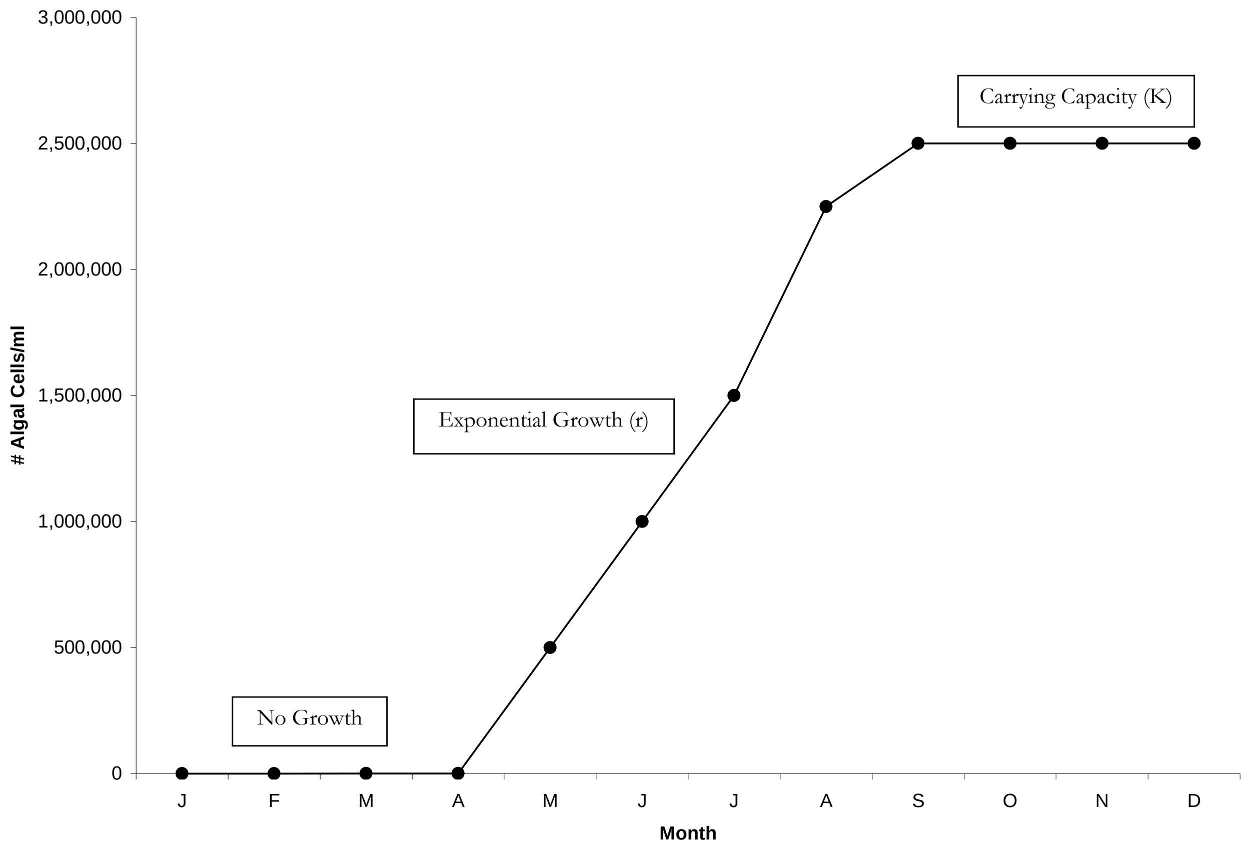


Figure Legend: Graph illustrating a Sigmoid (S) population growth curve by describing algae population growth (monthly algal cell count per milliliter) over the course of a year in estuarine systems.

As depicted in the example above, the letters r and K represent the components of a population growth curve derived by a formula. In order to understand population dynamics we must break apart the building blocks of the population curve and plug in the r and K values. The logistic equation for the Sigmoid or S population curve as defined by Wilson and Bossert (1971) is:

$$\frac{rN(K-N)}{K}$$

defined as:

N = number of individuals
t = units of time
r = constant rate of population increase (births greater than deaths)
K = Carrying capacity of the environment.

Density-Dependent versus Density-Independent Factors

Other factors can enter the population equation in natural environments or in biological communities. The growth of an animal population strives to reach stability or carrying capacity (K). However, in natural systems populations encounter forces (known as density-dependent or density-independent factors) which will affect density and growth. Density-dependent factors are internal forces that operate within the population. For example, infections, diseases, or stress related health problems can occur within an oyster population. In another instance, too many individuals of a species will cause lack of space, and low resources creating competition and/or stress within the population. These problems (density-dependent forces) occur only when the density of a population reaches a critical level (Hickman *et. al.* 1984).

Density-independent factors occur outside of the population, examples include drastic changes that are environmental in nature. For instance extreme weather changes, unusually cold weather, hurricanes or drought conditions are examples of density independent forces acting against a population. One example of a density independent factor on the coast was the severe drought causing a gradual increase in salinity from 1998-2004. High salinities caused soil salinities to increase resulting in large areas of marsh die-off from 2002-2004. Since heavier rains commenced in 2004 the coastal Georgia salt marshes have recovered.

Comparison of r and K Selected Species

Biologists have categorized animals on adaptations they have developed to deal with density-independent or density-dependent situations that arise and effect populations. K-selected species are animals or species whose populations can survive controls that are density-dependent in nature. Conversely, r-selected species are animal populations that have developed adaptations that are density-independent in nature (Hickman *et. al.* 1984). Density-dependent or density-independent factors will effect all populations.

In the table below, notice the general characteristics of r-strategy species and K-strategy species.

r-selected species	**K-selected species**
Mature rapidly	Mature slowly
Short lived	Long lived
Many offspring	Few offspring
Little to no care at birth	Care for young at birth
Considered pests due to high densities	May become threatened or endangered
Opportunistic	Have stabilized populations
Few juveniles become adults	Young usually reach maturity
Small size	Large size
Examples: fiddler crabs, frogs	Whales, birds

If we imagine a scale with r-species on one end and K species on the other many animals would fall on either end of the scale. However, many animal species can show traits of both r-selected strategies and K-selected strategies causing them to fall in between r or K on the scale (adapted from continuum concept in Hickman *et. al.* 1984). In the example below turtles and whelks are relatively long-lived, offer little care for their many offspring, and few young reach maturity.

r-selected	mixed r and K selected	K-selected
mud snails	sea turtles	whales
skeleton shrimp	whelks	dolphins
fiddler crabs		

Diversity in a Salt Marsh

Estuaries and salt marshes are the transition zone between fresh and salt water. The composition of plants and animals in the marsh depends on various environmental conditions such as salinity, temperature, tidal fluctuations, dissolved oxygen levels, turbidity, depth, substrate, and pollution. If we dissected and examined the diversity of a salt marsh, we would find various communities and habitats. For instance, salinity, flooding, and anaerobic soil conditions affect the plant communities within the marsh. Smooth cord grass (*Spartina alterniflora*) is most adapted to these harsh environmental conditions, so this species is the most common. Areas of high marsh and brackish water also give rise to the Black Needle rush (*Juncus roemerianus*). In areas where water sits for a long period, and evaporation rate is high a layer of salt accumulates on the soil. This area (known as a salt pan) is where no plants can grow due to very high soil salinities. In some zones of the high marsh, the salinities are too high to support growth of Smooth Cord grass. Other plant species that can tolerate higher salinities include glasswort (*Salicornia spp.*) and salt grass (*Distichilis spicata*).

Similar elevation zones within the salt marsh exist for animal communities. The higher elevations of the marsh (near the marsh-forest edge) support shrubs, and trees, providing cover for sparrows, marsh wrens, and marsh hawks. Additionally, the higher elevations of the marsh are the location of the "wrack line" where piles of dead marsh grass accumulate and where spiders and amphipods reside.

The muddy marsh bottom supports algae consumed by the coffee bean snail (*Melampus bidentatus*) and olive nerite (*Neritina usnea*). Other muddy marsh bottom inhabitants include the mud snails (*Nassarius obsoletus*), fiddler crabs (*Uca spp.*), mud crabs *(Rhithropanopeus harrisii*), various species of tanaids, isopods, oligochaetes, polychaetes (worms) such as *Capitella capitata, Neanthes succinea* and *Streblospio benedicti.* Most of these species feed on sediment/detritus plus associated bacteria and protozoans. Bivalves on the marsh floor, which filter feed algae, bacteria, include the ribbed mussel (*Geukensia demissa*), Carolina marsh clam (*Polymesoda caroliniana*) and oysters (*Crassostrea virginica*). The marsh periwinkle, *Littorina littorina* graze on the blades of the salt marsh grass (*Spartina alterniflora*).

Few species (but high abundance of animals in each species) live in the salt marsh. However, species composition can fluctuate with the seasons. Generally, peak densities of marsh fauna occur in the spring or fall, with lowest animal density occurring during the summer due to predation and competition. Typically, biodiversity is low in the salt marsh and animal populations are usually r-selected species.

Diversity of Estuarine Mud Flats

One of the unique areas to visit in coastal Georgia is a mud flat. Mud flats are another habitat supporting populations and communities of estuarine invertebrates and fish. They are located at the edges of the salt marsh extending out into the creeks and rivers. These areas are made of varying combinations of clays, silts, or sand. Although few species dwell in this zone, the density of animals present in the mud are high. Polychaetes and mud snails are generally the main organism found in the mud. However, there are various assortments of predators also found usually at high tide such as blue crabs (*Callinectes sapidus*), grass shrimp (*Palaemonetes pugio*), penaed shrimp (*Penaeus aztecus, P. setiferus*) silversides (*Menidia spp*) and killifish (*Fundulus spp*). As the tide recedes before a low tide, many fish (e.g. skates, rays, and flat fish such as flounders, small sharks, and red drum) will congregate on the shallow waters of a mud flat feeding on many of the animals in the area. Additional species found on a typical coastal Georgia mud flat include: *Spiophanes bombyx* (mud worm); *Scolecolepides viridis* (mud worm); *Oxyurostylis smithi* (Sharp-Tailed Cumacean); *Solen viridis* (Little Green Razor Clam); *Ilyanassa obsoleta* (mud snail); and *Pinnixa cf. chaetopterana* (commensal crab).

Distribution and numbers vary according to the season with the lowest numbers or organisms occurring during the summer possibly due to high predation and high water temperatures and associated low oxygen levels (Hackney *et. al.* 1992).

Diversity of an Oyster Reef

Oyster reefs in coastal Georgia are common however; they were even more prevalent in the early 19th and 20th centuries. Over fishing,mis-management, disease, and poor water quality have taken a tremendous toll on the oyster population. Oyster reefs in Georgia are located along tidal creeks and in estuarine rivers where they grow best between the high and low tide line (intertidally). The common species is the eastern oyster/American oyster (*Crassostrea virginica*). Oyster reefs support a myriad of species and can be quite a diverse community supporting from 20 to up to 300 different species. Oyster reefs and associated species provide major food sources for numerous invertebrate and fish species making it a valuable habitat to estuarine communities. For this reason oysters are termed “keystone species”.

Common species on an oyster reef include several species of mud crabs (*Panopeus obesus*, *P. simpsoni*, and *Eurypanopeus depressus*) which feed on oysters and small crustaceans. Filter feeders such as the hooked mussel, ribbed mussel, barnacles, and sponges attach to oyster shells. Several species of worms are present between shell crannies of the oyster reef, the most common worm being *Neanthes succine.* However, other worms that are present in this habitat include *Polydora websteri*, *Heteromastus filiformis* and *Streblospio benedicti.* Fish are often found in oyster reef communities some of these include gobies (*Gobiosoma spp*.), blennies (*Chasmodes spp*, *Hypleurochilus spp*., *Hypsoblennius spp*), skilletfish (*Gobiesox strumosus*), and toadfish (*Opsanus spp*). Predators include whelks, flatworms, crabs, skates, rays, black drum, and the American oystercatcher (Hackney *et. al.* 1992). The oyster reef community and the associated species are major food sources making it a valuable habitat to estuarine communities.

How is Diversity Measured?

A diversity index is often calculated to describe the diversity of animals present in a community. These indices typically concern the measure of order or disorder within the ecosystem. The way it works is we ask the question: How difficult would it be to predict the species of the next individual collected from the community? The degree of uncertainty associated with this prediction is a measurement of diversity. If we feel confident in naming the next species collected from a sample, the uncertainty number or diversity index is low (i.e. there are so few species present that it would be relatively easy to predict the next species sampled). When the diversity index value is high, the uncertainty value is high, making it more difficult to predict the next species collected (i.e. there are so many different species present that the odds of guessing the next one collected are very low). One of the simplest and most widely used diversity indices is the "Shannon-Wiener Index" (H') which takes species richness (number of species present) and species evenness (relative abundance of each species present) into consideration. An example of how to calculate this index is provided on page 64. The Shannon-Wiener index formula (Smith and Smith, 2003) is:

$$H' = -\sum_{i=1} Pi \ln Pi \quad \text{OR} = -\text{sum of } [(P_i)(\text{Natural Log})(P_i)] \text{ for each species present}$$

Where Pi is the relative abundance (or proportion) of each species = ni/N
ni = number of individuals in species i
N = total number of individuals in all species
S = number of species.

Invasive Species

Invasive species are organisms that live outside of their native range and have a detrimental effect on natural ecosystems, economies and human health. Some of the more commonly known aquatic invasive species in recent times include the zebra mussel, the green porcelain crab, and the Atlantic lion fish. Invasives usually proliferate very aggressively and can often displace native species and introduce new diseases. Usually the introduction of an invasive species is accidental; such as, the discharge of ballast water containing larval stages of invasive species from large ships near coastal waters, or accidental transport of invasive species from an improperly cleaned boat hull or bilge water from another region. However, in the southeastern U.S. region the release of ornamental fish from home aquaria is becoming a very common pathway.

The green mussel (*Perna viridis*) is native to tropical and subtropical waters of the Indo-Pacific, from the Persian Gulf to S.W. Pacific; and from southern Japan to Papa New Guinea. The first green mussel in the United States was reported in Tampa Bay in 1999. It is believed that larvae were released from ballast water in cargo ships. In early 2003, a separate introduction occurred on the East Coast specifically near St. Augustine, possibly from beach renourishment equipment that had been shipped from the Tampa region. During the spring of 2003 the Georgia Department of Natural Resources observed green mussels on offshore buoys marking artificial reefs. The first inshore specimen in Georgia was found in Brunswick during the fall of 2003. Since then they have been discovered throughout coastal Georgia, as far north as the Savannah River and also at the south end of Tybee Island (Power et al., 2004). In coastal Georgia green mussels are usually found in late summer and early fall, and thrive in sub-tidal depths (below the high and low tide line) but can also be found in the low intertidal zone, such as on the jetties at Tybee Island. The intertidal green mussel population does not survive over winter in Georgia because it appears to be at its northern most water temperature tolerance. However, the mussels living in the inshore sub-tidal zones and offshore on the artificial reefs have survived and will continue to re-seed inshore areas. Green mussels have the potential to be the salt water's counterpart of the zebra mussel. The zebra mussel occurs in freshwater throughout much of the United States, but is not yet found in Georgia. The zebra mussel is responsible for clogging industrial pipes and fouling boat hulls and has also caused ecological problems. One zebra mussel can filter 1 quart per day. With mussel densities in the millions, they can filter an entire lake in a single day. The zebra mussel has displaced native clams and even colonized and grown on the backs of crayfishes and the shells of turtles.

If the green mussel population increased, they could compete with and displace other native filter feeders such as oysters and native mussels. Green mussels commonly mature in 2-3 months and can spawn all year long in Thailand. After spawning, the larvae drift in the water column for up to two weeks before metamorphosing and settling onto hard surface. They have been reported to reach up to 11 inches in length and can live for up to three years. Green mussels are so prolific in certain areas they reach densities of 35,000 m^2 depriving other marine organisms of adequate food and oxygen.

If we have a mild winter, green mussel populations may increase, become established, and thrive here in the future. We are tracking green mussels to determine their prevalence in the coastal Georgia area. If you see a green mussel please call the University of Georgia Marine Extension Service at 912-598-2348.

Green Mussels, *Perna viridis* (Alan Power, MAREX)

Have You Seen Me?

The green mussel *Perna viridis* is an invasive species from the Indo Pacific region. It was introduced to Georgia during 2003. If found please record as much of the following information as possible and send to:

Dr. Alan Power
University of Georgia Marine Extension Service
20 Ocean Science Circle, Savannah, GA 31411
Telephone: (912) 598 2348; Fax: (912) 598 2399; Email: alanpowr@uga.edu

Date: ______________________________

Location (GPS if available): ______________________________

Number of Living/Dead Mussels: ______________________________

Attached to: ______________________________

Approximate Depth: ______________________________

Water Temperature & Salinity: ______________________________

Shell Length(s): ______________________________
____
____
____

Collectors Name & Contact: ______________________________
____
____
____
____

1785
The University of Georgia
Marine Extension Service

Public Service & Outreach

Photo Credit: Dr. Richard Gleeson
Guana Tolomato Matanzas National Estuarine Research Reserve

Sea Grant Georgia

Sapelo Island National Estuarine Research Reserve

Monitoring Protocol

1. Salt Marsh Bioassessment

If choosing a marsh site, please select technique A, B, or C but if you would like you can do more than one.

A. D-Net Survey (every 3 months)

Based on methods described in: Biomonitoring and Management of North American Freshwater Wetlands (Rader et al., 2001).

What you will need:

1. long rope and 2 PVC poles
2. yard stick or meter stick (1)
3. Adopt-A-Wetland Manual
4. buckets (2-3)
5. dishes or pans to sort the organisms
6. D-Net

Marsh Monitoring, Ossabaw Island (Ellie Covington, MAREX)

i) Set up the transect during a high tide in the high marsh or marsh border. A total of 5 survey stations should be selected for each transect. Calculate your total distance from high to low marsh and divide by 5 to determine the distance between survey stations. Remember to enter the marsh as far as you can safely go.

ii) Mark off a 1-meter section of the transect at each survey station. At each station hold the D-Net parallel to the line of your transect. Sweep the D-Net along the sediment surface of the marsh, scraping the mud and organic debris in the process. Perform sweeping motions 5 times along one side of the 1-meter section of the transect. Repeat the same procedure on the direct opposite side.

iii) When you finish sweep netting at each station, sort through the debris, separate, count, and identify the organisms. Combine all of the organisms from each survey station along the transect into one sample. Record the information on biological survey worksheets (pages 59, 62, 63).

iv) Groups can then calculate the diversity index for macroinvertebrates by completing the Biological Diversity Index Worksheet on page 65.

v) Mark the beginning of the transect in the high marsh area with a PVC pole and always return to the same site every 3 months for biological monitoring.

B. Box Survey (every 3 months)

Based on methods described in: A Study Approach to the Georgia Coast Profile of a Salt Marsh. T. Schoettle. University of Georgia Marine Extension Service Publication. Study Unit II. Supported by Georgia Sea Grant College Program (Grant # NA30AA-D-00091).

Reef Survey, Little Cabbage Island (Anne Lindsay Frick, MAREX)

What you will need:

1. long rope and 2 PVC poles
2. yard sticks or meter sticks (5)
3. calculator
4. Adopt-A-Wetland Manual
5. buckets (2-3), and sorting pans

i) Begin in the high marsh or marsh border. A total of 5 survey stations should be selected along a transect. Station number one should be closest to the high marsh, followed by the other stations extending out into the marsh. Calculate your total distance from high to low marsh and divide by 5 to determine the distance between survey stations. Remember to enter the marsh only as far as you can safely go.

ii) By using meter sticks or yard sticks make boxes along the transect. The box will be the area where you will work from so be careful not to step inside and disturb the area.

iii) When at each station, sort through the debris, separate, count, and identify the organisms. Count all organisms including clams, mussels, snails, crabs and crab holes that you find in the box. Include organisms you find on the grass or vegetation, as long as they are in the box. Identify and combine all of the living organisms from each box and record the data on the box survey data sheet, as it pertains to the station number (page 62). Groups can calculate the diversity index by completing the Biological Diversity Index Worksheet on page 65.

iv) Identify the different kinds of plants in each survey box and count the total number of individual plants of each kind and record on Box Survey Data Sheet (e.g. 20 *Spartina* grasses and 23 Needle Rush) on page 62.

v) Measure the height of 15 individual Spartina grasses and calculate the average for each survey station. Record the height information on Spartina Height Data Sheet on page 63.

C. Hester-Dendy Survey (once per month)

Based on methods described in: Standard Methods Ed. (Eaton *et al.*, 1995).

What you will need:

1. Hester-Dendy Colonizing Plates
2. buckets (2)

3. pliers

4. knife for scraping plates

5. rope to suspend plates from

6. small dishes or pans to sort organisms

7. magnifying glass would be helpful

8. kitchen strainer

9. good lamp/lighting

10. Coastal Georgia Adopt-A-Wetland Manual


Hester Dendy (Ellie Covington, MAREX)

i) Place the colonizing plates approximately six inches to one foot under the surface of the water (measure from the top loop of the plates and the surface of the water).

ii) Allow the plates to suspend in the water for one month. If left in the water too long, too many organisms will colonize which makes it difficult to sort.

iii) When the appropriate time has elapsed, retrieve the plates and take them to an area with proper lighting so you can sort them according to groups.

iv) Use the pliers to loosen the nut on the bottom of the samplers, pull all of the plates apart and scrape both sides of each plate. Collect all of the debris into a bucket of salt water. If the water is too dirty, sift the water and debris through a sieve. A metal kitchen strainer with a fine mesh works well.

v) Sort all of the organisms that look alike, for example, all of the snails go in one dish/pan, crabs in another. This process may take a while but you will improve your skills each time you collect.

vi) By using the identification guide in the back of the manual, identify organisms and record on the biological form on page 60. Release any living organisms back into the river or tidal creek.

vii) Advanced groups can calculate the diversity index on page 65 for macroinvertebrates by completing the Biological Diversity Index Worksheet in the manual.

viii) To re-assemble the Hester-Dendy colonizing plates: you should have 24 spacers and 14 disks; starting from the "eye loop" (top) put 9 disks separated by 1 spacer each, separate disk 10 by 2 spacers, 11-12 disks by 3 spacers, and 13-14 by 4 spacers. When fully assembled secure with the washer and wing nut.

2. Beach Bioassessment

Please chose A, B, or C, but if you like you can do all three.

A. Hester-Dendy Survey

If there is a dock piling or similar structure you can use to suspend the Hester-Dendy plate sampler from, use this technique by following the instructions provided above.

B. Seine Survey (every 3 months)

Seining is a commonly practiced technique wherein a net is drawn through the water to capture the organisms.

Beach Monitoring, Jekyll Island (Mary Sweeney Reeves MAREX)

What you will need:

1. seine
2. buckets (3)
3. Adopt-A-Wetland manual
4. yard stick (to measure depth)

i) At the beach when approaching the surf, always stay at a safe depth - preferably 3 feet. Sweep through the shallow water with a 10-20-foot seine for approximately 2-3 minutes. **Repeat this procedure 3 times.**

ii) Identify fish and invertebrates by using the identification guide and record your results in the worksheets on page 60.

iii) Groups can calculate the diversity index by using the Diversity Worksheet (page 65).

C. Dune Measurement (every 3 months)

What you will need:

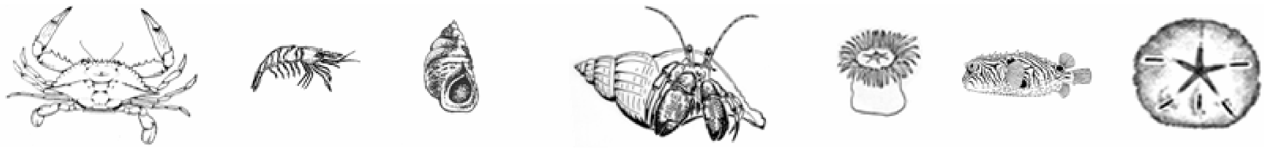
1. markers (PVC pipe, surveyor flags, stakes, etc.)
2. measuring tape
3. dune data sheet

Cumberland Island Dunes (Alan Power, MAREX)

i) Mark the perimeter of the dune where elevation begins with markers. Place markers at regular intervals along the sides of the dune (e.g. dune length is 2 m, place markers (4) every 50 cm). Surveyor flags, PVC pipe, or stakes work well to make your line.

ii) Measure length of dune, (parallel to the ocean) record results on worksheet (page 66), and leave markers for future measurements.

iii) After 3 months, measure dune perimeter and see if sand movement has occurred over (accretion) or away (erosion) from markers.



COASTAL GEORGIA ADOPT-A-WETLAND BIOLOGICAL MONITORING FORM

AAW Group Name ________________________ County __________________________

Group ID Number AAW-G-____________ Site ID Number AAW-S-______________

Investigators ____

____

Wetland Name ___________________ Date _______________ Time ______________

Rain in Last 24 Hours? Yes/No Amount of Rain _____ Inches in Last _____ hours/days

☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

Present Conditions: ☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

☐ Partly Cloudy ☐ Overcast ☐ Clear/Sunny

Site Location Description (e.g. Salt Marsh, Tidal Creek, Beach) ________________________

Sampling Technique: ☐ D-Net ☐ Box Survey

☐ Seine ☐ Hester-Dendy/How long in water?_______

Notes: ____

____

____

____

Submit Form To: Adopt-A-Wetland Program ● University of Georgia Marine Extension Service ● 20 Ocean Science Circle ● Savannah ● GA 31411 ● Fax: (912) 598-2399 ● msweeney@uga.edu

GROUP NAME: **SITE NAME:** **DATE:**

Coastal Adopt-A-Wetland Biological Community Sampling Form

Method of collection (Please Circle One): 1. Hester-Dendy Plates 2. Seine

Phylum Mollusca	**Phylum Arthropoda**	**Phylum Ecinodermata**
Class Gastropoda (Snails & Slugs)	*Class Cirrepedia (Barnacles)*	*Class Holothuroidea (Sea Cucumbers)*
Oyster Drill	Barnacle	Sea Cucumber
Mud Snail	*Class Malacostraca (Crabs, Shrimp)*	*Class Asteroidea (Sea Stars)*
Knobbed Whelk	Fiddler Crab (sand, mud, brackish sp.)	Sea Star
Lightning Whelk	Mud Crab	*Class Echinoidea (Sea Urchins, Sand Dollars)*
Channeled Whelk	Blue Crab	Key Hole Urchin (Sand Dollar)
Tulip Snail	Hermit Crab	Sea Urchin
Dove Snail	Stone Crab	*Class Ophiuroidea (Brittle Stars)*
Rock Snail	Porcelain Crab	Brittle Star
Keyhole Limpet	Spider Crab	**Phylum Annelida**
Nudibranch	Calico Crab	*Class Polychaeta (Worms)*
Lettered Olive	Speckeled Crab	Worm
Class Bivalvia (Mussels, Clams, Oysters)	*Class Merostomata (Horseshoe crabs)*	*Class Hirudinea (Leeches)*
Ribbed Mussel	Horseshoe Crab	Leech
Hooked Mussel	*Class Pycnogonita (Sea Spiders)*	
Scorched Mussel	Sea Spider	
Paper Mussel		
Hard Clam	**Phylum Cnidaria**	
Surf Clam	*Class Anthozoa (Anemones)*	
Oyster	Anemone	
Ark	Sea Whip	
Jacknife clam	Sea Pansy	
Coquina	Other	
Marsh clam	*Class Scyphozoa (Jellyfish)*	
Dwarf Surf clam	Jellyfish	
Phylum Porifera	Other	
Class Demospongiae (Sponges)		
Redbeard Sponge	**Phylum Ctenophora**	
Basket Sponge	*Class Tentaculata (Comb Jellies)*	
Finger Sponge	Comb Jellies	**Total Number of All Kinds:**
Boring Sponge	Other	**Total Number of All Individuals:**

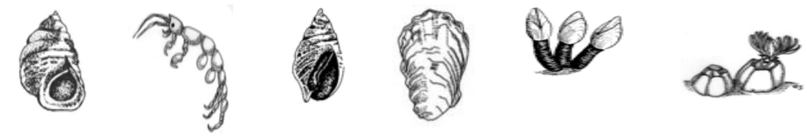
GROUP NAME: **SITE NAME:** **DATE:**

Coastal Adopt-A-Wetland Biological Community Sampling Form

Method of collection (Please Circle One): 1. Hester-Dendy Plates 2. Seine

Phylum Chordata	Lined Seahorse	Spanish Mackerel
Class Ascidiacea (Tunicates, Sea Squirts)	Lookdown	Spot
Sea Squirt	Mosquitofish	Spotted Hake
Sea Grape	Mummichog	Spotted Seatrout
Sea Pork	Naked Goby	Star Drum
Other	Northern Needlefish	Striped Anchovy
Class Osteichthyes (Bony Fishes)	Northern Pipefish	Striped Blenny
American Eel	Northern Puffer	Striped Burrfish
Atlantic Bumper	Northern Sea Robin	Striped Killifish
Atlantic Croaker	Ocellated Flounder	Striped Mullet
Atlantic Cutlass fish	Oyster Toadfish	Striped Sea Robin
Atlantic Menhaden	Pigfish	Summer Flounder
Atlantic Silverside	Pinfish	Tarpon
Atlantic Spadefish	Planeheaded Filefish	Weakfish
Atlantic Thread Herring	Red Drum	White Mullet
Bay Anchovy	Rock Sea Bass	Whiting
Big Head Sea Robin	Sailfin Molly	Windowpane
Black Drum	Sand Perch	Other
Black Sea Bass	Sea Catfish	
Blackcheek Tonguefish	Sharksucker	**Class Elasmobranchiomorphi**
Bluefish	Sheepshead	Atlantic Sharp Nose Shark
Butterfish	Sheepshead Killifish	Atlantic Stingray
Crevalle Jack	Silver Jenny (Mojarra)	Bonnet Head Shark
Feather Blenny	Silver Perch	Clearnose Skate
Florida Pompano	Silver Seatrout	Lemon Shark
Gafftopsail Catfish	Skillet Fish	Sandbar Shark
Goby	Smooth Puffer	Smooth butterfly Ray
Gray Snapper	Southern Flounder	Southern Stingray
Hogchoker	Southern Harvestfish	Other
Inshore Lizardfish	Southern Sennet	**Total Number of All Kinds:**
Ladyfish	Southern Stargazer	**Total Number of All Individuals:**

Box Survey Data



Date:
AAW Group Name:
Length of Transect (ft or m):
Identify the types and numbers of animals and plants in each survey station
(for help in identification please see Macroinvertebrate and Plant Identification keys in the Appendix of this manual).

Station 1	#	Station 2	#	Station 3	#	Station 4	#	Station 5	#
Atlantic Ribbed Mussel		Atlantic Ribbed Mussel		Atlantic Ribbed Mussel		Atlantic Ribbed Mussel		Atlantic Ribbed Mussel	
Eastern Oyster		Eastern Oyster		Eastern Oyster		Eastern Oyster		Eastern Oyster	
Periwinkle Snail		Periwinkle Snail		Periwinkle Snail		Periwinkle Snail		Periwinkle Snail	
Mud Snail		Mud Snail		Mud Snail		Mud Snail		Mud Snail	
Coffeebean Snail		Coffeebean Snail		Coffeebean Snail		Coffeebean Snail		Coffeebean Snail	
Amphipod		Amphipod		Amphipod		Amphipod		Amphipod	
Fiddler Crabs		Fiddler Crabs		Fiddler Crabs		Fiddler Crabs		Fiddler Crabs	
Crab Holes (> ¼ inch)		Crab Holes (> ¼ inch)		Crab Holes (> ¼ inch)		Crab Holes (> ¼ inch)		Crab Holes (> ¼ inch)	
Cordgrass (*Spartina*)		Cordgrass (*Spartina*)		Cordgrass (*Spartina*)		Cordgrass (*Spartina*)		Cordgrass (*Spartina*)	
Needlerush (*Juncus*)		Needlerush (*Juncus*)		Needlerush (*Juncus*)		Needlerush (*Juncus*)		Needlerush (*Juncus*)	
Seaweed		Seaweed		Seaweed		Seaweed		Seaweed	

☺Helpful hint: If there are too many grasses in the box you can estimate the number of grasses.

Cordgrass (*Spartina*) Height Data Sheet for Box Survey

Date: AAW Group Name:

Measure height of 15 *Spartina* plants in each survey station and choose color (green, yellow, brown) for each stem measured then calculate the average.

Spartina Sample #	Station #1		Station #2		Station #3		Station #4		Station #5	
	Ht	Color	Ht	Color	Ht	Color	Ht	Color	Ht	Color
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
Sum										
Average Height (Sum÷15)										

Optional
Please estimate the number of blades of *Spartina* in your stations and circle the appropriate color option.

Station 1		Station 2		Station 3		Station 4		Station 5	
< 10	Green	< 10	Green	< 10	Green	< 10	Green	< 10	Green
20-50	Yellow	20-50	Yellow	20-50	Yellow	20-50	Yellow	20-50	Yellow
> 50	Brown	> 50	Brown	> 50	Brown	> 50	Brown	> 50	Brown

Shannon-Wiener Biological Diversity Index (H') Worksheet

$H' = -\sum_{i=1} Pi \ln Pi$ OR = - sum of [(P_i)(Natural Log)(P_i)] for each species present

Where Pi is the relative abundance (proportion) of each species = ni/N
ni = number of individuals in species i
N = total number of individuals in all species
S = number of species

A	**B**	**C**	**D**	**E**	**F**
Species **(i)**	# Individuals of all Species **(ni)**	Total Number of Individuals of all Species **(N)** **= sum Column A**	Relative Abundance Of Each Species **(Pi)** **= Column B/C**	Natural log of Relative Abundances **(ln Pi)** **= ln Column D**	Relative Abundances Times Their Natural log **(Pi ln Pi)** **= Column (D)(E)**
Mud Crab	2	39	0.05	-2.99	-0.15
Worn	3	39	0.08	-2.53	-0.20
Periwinkle	10	39	0.25	-1.39	-0.35
Blue Crab	23	39	0.59	-0.53	-0.31
Whelk	1	39	0.02	-3.91	-0.08

Sum of or Column F = -1.09
Multiply by -1 to make positive = **Shannon-Wiener Index Diversity Index** = 1.09

Diversity Scale

1	2	3	4	5
Not Diverse	→	Moderately Diverse	→	Diverse

Conclusion: Community Not Diverse

Shannon-Wiener Biological Diversity Index (H') Worksheet

$H' = -\sum_{i=1}^{S} P_i \ln P_i$ OR = - sum of [(P_i)(Natural Log)(P_i)] for each species present

Where Pi is the relative abundance (proportion) of each species = ni/N
ni = number of individuals in species i
N = total number of individuals in all species
S = number of species

1. Circle type of monitoring: Box Survey, Colonizing plates, D-Net, and Seine
2. Habitat type (i.e. oyster reef, salt marsh):
3. Calculate the diversity index for your sample by completing the worksheet below.

A	**B**	**C**	**D**	**E**	**F**
Species **(i)**	# Individuals of Each Species **(ni)**	Total Number of Individuals in all Species **(N)** **= sum Column A**	Relative Abundance Of Each Species **(Pi)** **= Column B/C**	Natural log of Relative Abundances **(ln Pi)** **= ln Column D**	Relative Abundances Times Their Natural log **(Pi ln Pi)** **= Column (D)(E)**

Sum of Column F = ____________
Multiply by -1 to make positive = **Shannon-Wiener Index Diversity Index** = ______________________

Diversity Scale

1	2	3	4	5
Not Diverse	→	Moderately Diverse	→	Diverse

Dune Measurement:

AAW Group Name:

Date: ______________ Dune length (m): _________________

Comments/ Observations:

Does your dune appear to be moving? If so, in which direction (North, South, East, West)?

Is the dune eroding or accreting?

Other signs of impact (footprints, trash, etc.)

Any change in vegetation?

Additional notes:

Chapter Five
Physical/Chemical Monitoring

St. Marys Group (Becci Curry, St. Mary's Elementary)

Physical/Chemical Parameters
Physical/Chemical Monitoring Protocol
Physical/Chemical Survey Worksheets

St. Marys Group (Mary Sweeney Reeves, MAREX)

Physical/Chemical Monitoring

Physical/Chemical monitoring is conducted once a month at the same location. This level of monitoring is used to gather information about specific water quality characteristics. Regular monitoring helps assure that your information can be compared with changes over time. In tidally influenced locations be sure to note the direction of the tide (incoming/outgoing), and conduct sampling at the same tidal stage each month. At extremely low tides there may not be water present for sampling so check tide charts before going to your site. Also, chemical testing during or immediately after a rain may produce very different results than during dry conditions. Therefore it is very important to record weather conditions. If conditions are unsafe for any reason, DO NOT SAMPLE.

Several physical/chemical conditions may be tested at your site including temperature, pH, dissolved oxygen (DO), salinity, turbidity, and settleable solids. After attending a training session and becoming QA/QC certified your group will be given all necessary equipment to conduct these tests. Be sure to follow all instructions and follow safety guidelines when conducting chemical analysis.

Physical/Chemical Parameters

Temperature

Temperature has an effect on the chemical and biological processes of an aquatic system. Temperature will affect the dissolved oxygen levels, density of water, the distribution of organisms, and the metabolic processes of organisms. Temperature differences between surface and bottom waters can produce vertical currents, which will transport or mix nutrients and oxygen throughout the water column.

Changes in temperature occur with depth, these changes result from cooling and warming temperatures during the seasons. In the warm summer months, warmer water is on the surface with cooler water at lower depths. When temperatures begin to cool as in late autumn, the surface water becomes cool and dense and sinks to the bottom. This mixing of the surface and bottom layers of water will cause nutrients to disperse from the bottom to the surface. The dispersed surface nutrients act as fertilizers for phytoplankton. Phytoplankton, in this case, are free-floating microscopic aquatic plants drifting in surface areas of the water. Phytoplankton blooms usually occur in warmer temperatures during the Spring, Summer, or Fall (Ohrel and Register, 1993).

Water temperature is also influenced by wind, storms and currents created by tides. The water movement created by current or wind causes a higher rate of mixing within the entire water column. Tributaries such as rivers or shallow tidal creeks, which are heated quickly, may influence temperature as they flow into the estuary or tidal creek. Also, water temperature may be increased by discharges of water used for cooling purposes or by runoff from heated surfaces such as roads, roofs, and parking lots. Also, cold underground water sources (i.e. springs) and the shade provided by overhanging vegetation could lower water temperatures in some areas.

pH

We measure the pH of water to determine if it is acidic or basic (alkaline). Chemically speaking "p" in pH refers to the "potential" of the H+ ion. There can be a high concentration of H+ ions or a high concentration of OH- ions. The higher concentration of H+ ions causes the sample to have a lower pH (acidic). The higher concentration of OH- ions in a sample will cause the pH value to be basic (above 7) (Wetzel and Likens, 2000). The pH measurements are recorded on a scale from 0 to 14, with 7.0 considered neutral. Solutions with pH below 7.0 are considered acidic; those between 7.0 and 14.0 are considered bases. The pH scale is logarithmic, so every one-unit change in pH represents a ten-fold change in acidity. In other words, pH 6 is ten times more acidic than pH 7; pH 5 is one hundred times more acidic than pH 7. pH values of some common substances:

PH	Example	
0.5	Battery Acid	ACIDIC
2.0	Lemon Juice	
5.9	Rainwater	
7.0	Distilled Water	NEUTRAL
8.0	Salt Water	
11.2	Ammonia	BASIC
12.9	Bleach	

Chemical/physical characteristics in the water or substrate can influence the pH. Monitoring the pH of water gives us an indication of the health of our estuaries and creeks. As a thermometer is to human health, telling us when we are sick, the pH tells us if something is unhealthy about our aquatic systems. An abnormal pH reading indicates if the system is chemically out of balance. Additionally, the pH range of any coastal wetland may be highly variable depending on several factors such as rainfall, plant/bacteria growth, temperature or salinity. Salinity concentrations in waters affect the pH along the coast. The pH and salinity follow a pattern from fresh water river input to offshore areas. Coastal areas with freshwater influence (low salinity zones) will have a pH range of 7.0 to 7.5 and in areas of higher salinities (offshore), pH ranges between 8.0 and 8.6 (Ohrel and Register, 1993).

The buffering capabilities from carbonates and bicarbonates in the seawater will increase pH values. Biological activity can suddenly increase or decrease water chemistries causing shifts in pH values. Rapidly growing algae will produce oxygen and remove carbon dioxide (CO_2) from the water during photosynthesis resulting in an increase of pH. Conversely, decomposition of organic matter or respiration in plants and animals will use up oxygen but increase CO_2 levels in the water thus, lowering the pH values.

Abnormally low or high pH values can adversely affect egg hatching, stress fish and insects, or cause fish kills (Meadows and Campbell, 1978). Other human factors influencing pH readings outside the normal range include mine drainage sites, atmospheric deposition or industrial point discharges. Serious problems occur in coastal waterways when the pH falls below five or increases above 9 (Ohrel and Register, 1993).

Soil and Sediment pH

The salt marsh is known for the acres and acres of *Spartina* grass which during the fall and winter, browns and dies back just as the deciduous leaves on trees. The winter marsh browning is normal and produces a large amount of dead grass or organic matter. The organic matter lies on the marsh floor decomposing, during decomposition bacteria breaks down the dead grass giving off carbon dioxide (CO_2). The increased CO production lowers the pH of the sediment. Generally, the pH of sediment in estuaries, tidal creeks, and salt marshes reflect that of the water above. In salt water the pH can be 7 to 8.5, and is generally the same in the sediments. However, there are slight fluctuations daily due to processes such as photosynthesis and respiration. Throughout the day algae in the sediments photosynthesizes increasing oxygen production, which increases the pH of the soil. During the night respiration increases carbon dioxide which shifts the pH lower. Sediment pH can fluctuate from 9 or 10 during the day time to 7 or 8 during late evenings. Although the pH fluctuations vary according to algae densities, shade from marsh grass, and season, the shifts may be more noticeable according to conditions of the area (Pomeroy, 1959).

Dissolved Oxygen

Dissolved oxygen (DO) is the most critical factor in determining the health of an aquatic system. Dissolved oxygen is the measurement of the oxygen content in the water. Sources of oxygen in aquatic systems include atmospheric diffusion, plant/algae photosynthesis, currents and wave action. Oxygen is required for respiration in animals and plants. Oxygen is also used for decomposition of organic matter.

Shifts in DO are related to the time of day, season, and temperature. There is a higher oxygen production during the day when algae is producing oxygen through photosynthesis. During the night when there is no light source photosynthesis stops, but respiration continues thus shifting oxygen levels lower than during the day.

Another factor that influences oxygen levels is salinity. Water with high salinity holds less oxygen than water with lower salinity levels. In addition, temperature affects dissolved oxygen levels. Cooler water contains more oxygen than warmer water. For instance in the cooler months the dissolved oxygen levels can increase up to 8 or 9 ppm. Conversely, the warmer waters during the summer months cannot hold oxygen as readily so levels decrease to 4 ppm and some areas as low as 3 ppm. An ecosystem with low oxygen levels can be further stressed when excessive nutrients from fertilizer runoff are added into the tidal creek or estuary. Nutrients can trigger an algal bloom which will increase oxygen temporarily, but when the algae die problems may occur. Respiration and decomposition during the algae die-off will further deplete oxygen levels causing stress on aquatic life. In general, low oxygen levels indicate a stressed aquatic environment. When a system is further stressed by an input of pollutants, sewage, or organic matter, decomposition of these materials will seriously deplete oxygen levels (Ohrel and Register, 1993).

Low oxygen levels are occurring in a "Dead Zone" at the mouth of the Mississippi River in the Gulf of Mexico and increasing in occurrence along the eastern seaboard. These low oxygen levels worsen in the summer, the high temperatures and depleting oxygen levels cause the dead zone to increase in size. The dead zone is possibly a result of industries, farms, and residential areas that collectively use fertilizers. Fertilizers are carried by inland streams, eventually washing into water-ways. Eventually the fertilizer is concentrated and transported to the coast. As the concentration of certain fertilizers/nutrients increase on the coast, it causes an algae bloom. A bloom is a large concentration of microscopic algae (enough that it will discolor the coastal waters). The bloom becomes so densely packed that the algae population crashes. The algal population crash causes a sudden burst of decomposition, which involves bacteria breaking down algal cells. The problem arises at this point as oxygen is used in this process causing severe oxygen depletion.

☺Helpful Hint: Try to use organic and or time-release fertilizers in your garden.

These types of fertilizers cause less stress on the coastal environment.

Salinity

Everyone wonders why the ocean water is salty. Imagine the ocean as a "sink", where material carried by the creeks and rivers collects. Over time and seasons, through heavy rains and wind, the rocks and mountains slowly wear away. Many of these small particles or minerals come from chunks of mountains and rock. Over time, they are transported via the waterways and are deposited in the ocean or "sink". So most of this material dissolved in the water had its origin further inland. While looking closely at the transported materials present in the ocean there are a combination of minerals, elements, and salts. Examples of these elements and/or dissolved salts are chloride, sodium, sulfate, magnesium, calcium and potassium. These dissolved salts in the water make up the total salinity concentration. Approximately 85% of the salts in seawater comes from a combination of sodium and chloride (Na is 30.6%) and (Cl 55%) which makes up table salt NaCl. The remaining of dissolved salt constituents include magnesium (Mg 3.7%), sulfate ($S0_4$ 7.7%), Potassium (K 1.1%), Calcium (Ca 1.2%) and Silica (Si) (Coulombe, 1992). Organisms such as those with shells (phylum mollusca) for example, clams and snails, absorb calcium from the seawater to incorporate and build their strong shells. Microscopic algae or diatoms absorb silica from the seawater to build their glasslike floating bodies (Greene, 2004). The total salts or salinity is measured in parts per thousand seawater has an overall average salinity of 35 ppt, or for every 1000 pounds of water there is 35 pounds of salt (Thurman, 1987).

Salinity concentrations increase as you go toward the ocean. You can think of salinity concentration in zones. A freshwater river will enter the coastal area and may have little to no salinity ranging from 0.5 to 5 ppt. The freshwater then mixes with salt water and becomes part of the estuary. An estuary is defined as a place where salt and fresh water mix. Salinities in an estuary will vary from 5 to 18 ppt closest to the freshwater input, to 18 to 30 ppt or higher when closer to the open ocean (Ohrel and Register, 1993).

Salinities fluctuate with weather conditions, tides, and river flow. In coastal Georgia a drought occurred from 1998 to 2004, the decreased rainfall amounts affected the salinities which in turn stressed coastal environments and habitats. During the 6 year drought period the salinities were consistently high and in some estuaries and rivers salinities were regularly as high as the open ocean (35 ppt). Salt water is a somewhat hostile environment for animals and plants to inhabit. High salinities often cause diseases in oysters (MSX and dermo) (O'Beirn *et al*., 1994) and it is widely believed that high salinities contributed to the loss of approximately 1000 acres of salt marsh in coastal Georgia during 2002-2004 (Georgia Coastal Resources Division). These "dead-marsh" sites appear to be recovering now that we are no longer under drought conditions.

Some organisms can adapt well to fluctuating salinities. They might move to other areas, burrow into the sediment, alter their osmotic pressure by producing more or less urine, or drinking more or less fresh water. Some organisms that can adapt to changing salinities include blue crabs, oysters, shrimp, mussels, and mullet. Salt marsh plants must endure high salinities in the marsh soils so the few species that live in the marsh have certain adaptations. For instance, one species that dominates the salt marsh is the Smooth Cord grass or *Spartina alterniflora*. Smooth Cord grass has an adaptation (similar to desert plants) in that they can conserve water by adjusting the osmotic vascular pressure. By maintaining a high concentrate of other organic solutes found in marsh soils and discharging excess salts through tiny salt glands or pores located on the blades of the leaves. In fact, if you visit a salt marsh and closely observe the smooth cord grass, you can see the salt crystals on the leaf blade excreted by the salt glands.

A refractometer measures the physical characteristics of seawater and in this case dissolved solids or salts. The refraction or bending light angle is measured with a refractometer. More specifically salinity in water is determined by how light interacts with a sample when a drop is placed on a prism. Refraction is the change in direction of a light pathway when passing through two mediums (i.e. air and water) with different densities (Thurman, 1987).

A sample with high salinity concentrations also has high density properties which cause light to move from water to air at a slower rate. However, this same sample also has high refraction properties or "light bending abilities", thus giving us higher salinity readings. When peering through the eye piece there are two scales that measures salinity 1) parts per thousand (ppt) located on the right in most refractometers and 2) density which is on the left side of the field of view. We use the ppt scale when determining the salinity of a sample.

Settleable Solids

Settleable solids include all suspended particles in the water. These particles naturally occur in coastal water however at times an overload of sediment/particles may cause problems in estuaries and tidal creeks. Examples of solids entering a river or creek include sewage or erosion from development on tidal creeks or rivers. Excess solids in water block sunlight throughout the water column prohibiting the growth of aquatic plants and can clog fish and macroinvertebrate gills. Sediment can also carry harmful substances such as bacteria, metals, fertilizers, and pesticides from garden runoff. Settleable solids and turbidity tests give indications of sediment load in the water (Ohrel and Register, 1993). A settleable solids test is a quantitative method to determine if there is an overload of sediment or other solids in the water. The settleable solids test is not the same as turbidity because a settleable solids test only measures larger, heavier particles that settle out in an Imhoff cone after a 45 minute time period.

Turbidity

Turbidity is a measurement of water clarity (clearness). Seasons, weather conditions, algal blooms, and amount of suspended particles in the water can affect turbidity or water clarity. Turbidity includes all particles in a sample. Phytoplankton, detritus, silt/clay particles, and other organic matter can affect the turbidity of water. The higher the turbidity in the water, the less light penetrates into the lower depths causing a decrease in phytoplankton growth. As phytoplankton densities decrease in the water column, the rate of photosynthesis will slow causing oxygen levels to decrease (Ohrel and Register, 1993).

Physical/Chemical Monitoring Protocol

Temperature

Equipment: Thermometer/ water sampling bottle or bucket (optional)

Procedure:

1. Record the air temperature first by placing the thermometer in a shady area.
2. Water temperature may be taken from the water directly or from a large sample container (if done quickly so the temperature does not change).
3. Record the information on the physical/chemical worksheet (p.81).

☺Helpful Hint: Over time, if the solution in the glass of your thermometer divides, put it in a refrigerator for 1 hour. This will cause the alcohol solution to collect.

pH

Equipment: pH pen (sometimes will break down after using for 1 year). Please call if the pH pen you are using is not working properly. The pH pens provided can also give the water temperature.

Procedure: To test pH in your water sample you follow these simple directions. For more information refer to the directions that comes with the instrument or call the Adopt-A-Wetland office.

Calibrating the Ph pen

The pH pen needs to be calibrated monthly. We only use the one point calibration (only use the 7.0 buffer) for salt water. To calibrate press and hold the on/mode button until **OFF** on the lower display is replaced by **CAL**. Immediately release the button. The display enters the calibration mode displaying "**pH 7.01 USE.**" Dip the pH pen in the 7.0 pH buffer. After 1 second, the meter responds, if the correct buffer is detected then its value is shown on the display (pH 7.0 or 7.01) and **REC** appears in the lower part of the display. There is a clock illustration on the upper left of the screen. Wait until the clock disappears then press the on/mode button, at this point, the buffer is accepted. After the calibration point has been accepted the on/mode button must be pressed in order to return to the normal mode.

1. To get a pH reading from your sample, remove cap from the electrode, press "On/Mode" button to turn on the pH pen the display screen will be visible followed by a percent indication of the remaining battery life (E.G. **% 100 Batt**).
2. Dip the electrode into the sample while stirring it slowly. Measurement is taken when the stability symbol (looks like a clock) in the top left corner of the display screen disappears.
3. Note the pH or you can press "Hold/Con" to freeze the reading. Record the pH value on your data sheet.
4. Press "On/Mode" to turn the tester off.
5. Rinse electrode with tap water, but **do not dry**. Keep a damp sponge in the cap moist with the storage solution.

Dissolved Oxygen

Equipment: Dissolved Oxygen test kit

Procedure: Also see instructions enclosed with LaMotte kit.

1. Submerse entire water collection bottle until all bubbles are out of the bottle, while bottle is still submersed, cap it and tighten lid.
2. When adding solutions to water sample, don't touch the tip of the chemical bottle to the water sample.
3. Uncap bottle cap of the water sample and add 8 drops of Manganous Sulfate and 8 drops of Alkaline Potassium Iodide.
4. Cap bottle and invert several times then do not disturb sample. Allow the precipitate to settle to the bottom of the bottle.

5. When the brown precipitate has settled past the shoulder of the bottle, you are ready for the next step. This may take up to 20 minutes.
6. Add 8 drops of Sulfuric Acid; **be extra careful with this solution**.
7. Cap and gently invert the bottle. The color will be an amber color, like apple juice.
8. Invert bottle until there are few to no brown particles remaining.
9. Pour mixture from bottle into the titrating tube, up to 20 milliliters then add 8 drops of starch indicator solution.
10. Color will turn dark blue. Fill syringe up to the 0 mark with Sodium Thiosulfate, make sure you eliminate all bubbles.
11. Slowly add 1 drop at a time and gently swirl sample; color should turn from dark blue to clear. When sample turns clear note the level of liquid left in your syringe as your dissolved oxygen amount (ppm) in your sample. Note: Do not add too much Sodium Thiosulfate. Discard any left over chemicals in the waste bottle.
12. Record the information on the physical/chemical worksheet (p.81).

Water Salinity

<u>Equipment:</u> Refractometer

<u>Procedure:</u>

1. Lift lid on refractometer that protects the glass prism.
2. Place one or 2 large drops of sample onto the glass and close the lid.
3. Look through the eye piece and focus your view of the scale inside. Read the line where the blue color meets the white color in the field of view..
4. Read the scale on the right hand side that shows parts per thousand or ppt ‰.
5. Rinse glass with tap water, blot dry with a paper towel, and store in case.

6. Record the information on the physical/chemical worksheet (p. 81).
7. The refractometer periodically needs to be calibrated. Call the Marine Extension Service for questions or help (912)-598-2348.

Soil Salinity

Equipment: Refractometer

Procedure:

1. Dig a hole to a depth of 15 cm deep and allow the hole to fill with water. Note: You can use a pvc pipe marked off at 15 cm to get water from this depth also.
2. As the water fills the hole/pvc pipe, use a small dipper or cup to retrieve a water sample.
3. Allow sediment to settle to the bottom of the cup.
4. Use a dropper to obtain a small amount of water and place water drops on the glass surface of the refractometer.
5. Follow the directions for using the refractometer.
6. Record information on physical/chemical worksheet (p. 81).

Settleable Solids

Equipment: Imhoff cone & stand

Procedure:

1. Pour one liter of sample water into cone.
2. Let cone stand at least 45 minutes.
3. Record level of solids.

☺Helpful Hint: You only have to do the settleable solid test once and it's best to start it first since it has to sit for 45 minutes.

Turbidity

Equipment: Secchi disk

Procedure**:**

1. Calibrate your line by first attaching the line to the Secchi disk. Mark the line every 10 cm by using a permanent marker and measuring tape. While standing at your site (bridge, boat, or dock) lower the Secchi disk into the water until it disappears. If possible, look for a shady spot to increase visibility. It is important that the disk travels vertically through the water column and is not "swung out" by the current. Attach weights if necessary to prevent current pull.
2. Raise the disk slowly up and down several times until you find the point that the disk vanishes. Mark the spot on the line where it enters into the water.
3. Calculate the depth at which the disk disappeared. This measurement is referred to as Secchi disk depth. If disk goes all the way to bottom of water before disappearing the Secchi depth is greater than the water depth and should be noted on the form.
4. Record the information on the physical/chemical worksheet (p.81).

COASTAL GEORGIA ADOPT-A-WETLAND PHYSICAL/CHEMICAL MONITORING FORM

AAW Group Name ______________________ County ______________________
Group ID Number ______________________ Site ID Number ______________________
Investigators ______________________
Wetland Name ______________________ Date ______________ Time ______________
Site Location Description (e.g. Tidal Creek, Beach, Estuary, Salt Marsh)______________________

Rain in Last 24 Hours? Yes/No Amount of Rain _____ Inches in Last _____ hours/days
☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain
Present Conditions: ☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain
☐ Partly Cloudy ☐ Overcast ☐ Clear/Sunny

Is Waterway Influenced by Tides? Yes/No
If Yes, Tide was: ☐ High ☐ Outgoing ☐ Low ☐ Incoming
Water Surface Conditions: ☐ Calm ☐ Ripples ☐ Waves ☐ White caps
Impaired Habitat Indicators: ☐ Foam ☐ Bubbles ☐ Oil ☐ Scum
☐ Dead Organisms____________ ☐ Erosion______________ ☐ Trash Present______________
☐ Vegetative Debris____________ ☐ Dumping______________ ☐ Excessive Algae______________
Water Color: ☐ Clear ☐ Muddy ☐ Milky Gray ☐ Green ☐ Brown
☐ Tan ☐ Other______________________
Odor: ☐ Gas ☐ Oil ☐ Chlorine ☐ Rotten Eggs ☐ Sewage
☐ Chemical ☐ Other______________________

Physical and Chemical Tests

Basic Tests:	Sample 1	Sample 2		Average	
Air Temperature	________	________	(°C/°F)	______	(°C/°F)
Water Temperature	________	________	(°C/°F)	______	(°C/°F)
Sampling Depth	________	________	(cm)	______	(cm)
pH	________	________	(1-14)	______	(1-14)
Dissolved Oxygen	________	________	(mg/l or ppm)	______	(mg/l)
Water Salinity	________	________	(ppt)	______	(ppt)
Secchi Disk Depth/	________	________	(cm)	______	(cm)
Settleable Solids	________	________	(ml/l)	______	(ml/l)

Additional Tests, Observations and Comments:______________________
____
____
____
____

Submit Form To: Adopt-A-Wetland Program ● University of Georgia Marine Extension Service ● 20 Ocean Science Circle ● Savannah ● GA 31411 ● Fax: (912) 598-2399 ● msweeney@uga.edu

Chapter Six

Problems in Your Adopted Wetland?

Saltmarsh Aerial, Coastal Georgia (Lee Sutton, MAREX)

Dead/Dying Marsh
Major Pollution Event
GCRC Marsh Die Back Monitoring
Marsh Restoration
GCRC Monitoring Worksheet
Who To Call List

Marsh Die Off (Delegal Dippers)

Dead or Dying Marsh

By Jan MacKinnon, Georgia DNR, Coastal Resources Division (January 2006)

In March 2002 areas of dying coastal saltmarshes were reported to Coastal Resources Division (CRD). Marsh grasses (*Spartina alterniflora* and *Juncus roemerianus*) were confirmed as dying, resulting in open mudflats. The affected areas initially reported in Liberty County covered several miles of creek side die-off as well as several acres of receding marsh along the Jerico River.

To date, dead and dying marsh has been reported in all six coastal counties, from the St. Marys River in Camden County to Tybee Island in Chatham County (Fig. 1). The Division has consulted other states that have experienced similar marsh epidemics (i.e. South Carolina, Louisiana), but the cause(s) in Georgia have not yet been determined. Currently, it has been estimated that 1000 acres of marsh have been affected, with the vast majority of this being in Liberty County.

The symptoms of the affected marsh include a sequence of color changes that occur over time. First a green/brown color combination in the grass occurs, where brown indicates stressed parts of the plants. The marsh may transition into a brown color where all grasses in an area are affected. If the problem continues then the marsh grass will become rigid, break off in some areas and appear as "stubble". After the grass dies mud will dominate the area rather than the grass.

CRD has collaborated with scientists from the Savannah State University, Sapelo Island National Estuarine Research Reserve, Grays Reef National Marine Sanctuary, Georgia Sea Grant, the US Army Corps of Engineers, the University of Georgia Marine Extension Service, the University of Georgia Marine Institute, and the Skidaway Institute of Oceanography via the Georgia Coastal Research Council (Research Council), to collect data from the dying marsh sites. Samples have been analyzed for soil and interstitial salinities, the detection of fungi and/or abnormal bacteria, and pH. Other than higher than normal salinities (and not high enough to denude the amount of marshes lost), no abnormal readings have been detected. Also, greenhouse trials were conducted to determine the effects of freshwater and variation in soils. To date, greenhouse sampling results have shown no difference in the *Spartina* plants grown in dead and healthy marsh soils. *Spartina* leaves reveal no abnormal species counts; however, root and rhizome analyses are ongoing.

Division and Research Council scientists have developed a standardized methodology for quarterly field sampling. Also, Savannah State has established a working lab for testing vegetation samples. Researchers will continue field sampling to monitor and evaluate changes in salinities and vegetation.

CRD is cataloging all reports of dying marshes through aerial and on-the-ground photo documentation as well as responding to concerned citizens. CRD has coordinated public education efforts through press releases to the local media. In addition, we are working with the University of Georgia Marine Extension Center to plan and implement GIS classifications in order to delineate and track dieback areas. Scientists from the Research Council have applied for various grants to address aspects of the marsh dieback such as monitoring, transplant experiments, and plant tissue analysis.

The marsh die-off affects a vital area of our state and has implications for wildlife, fisheries and water quality; navigation; and flood control. Under the Georgia Coastal Marshlands Protection Act (O.C.G.A. 12-5-280 et seq.), the State recognizes that "the coastal marshlands of Georgia comprise a vital natural resource system. The estuarine area…is the habitat of many species of marine life and wildlife and, without the food supplied by the marshlands, such marine life and wildlife cannot survive. The estuarine marshlands of coastal Georgia are among the richest providers of nutrients in the world. Such marshlands provide a nursery for commercially and recreationally important species of shellfish and other wildlife, provide a great buffer against flooding and erosion, and help control and disseminate pollutants. The coastal marshlands provide a natural recreation resource which has become vitally linked to the economy of Georgia's coastal zone and to that of the entire state. This…system is costly, if not impossible, to reconstruct or rehabilitate once adversely affected…" The results of these investigations into the dead marsh issue have long-term implications for the preservation of Georgia's estuaries and the health of Georgia's coastal economy. Please continue to look for updates regarding the progress made on the marsh dieback issue at www.marsci.uga.edu\coastalcouncil

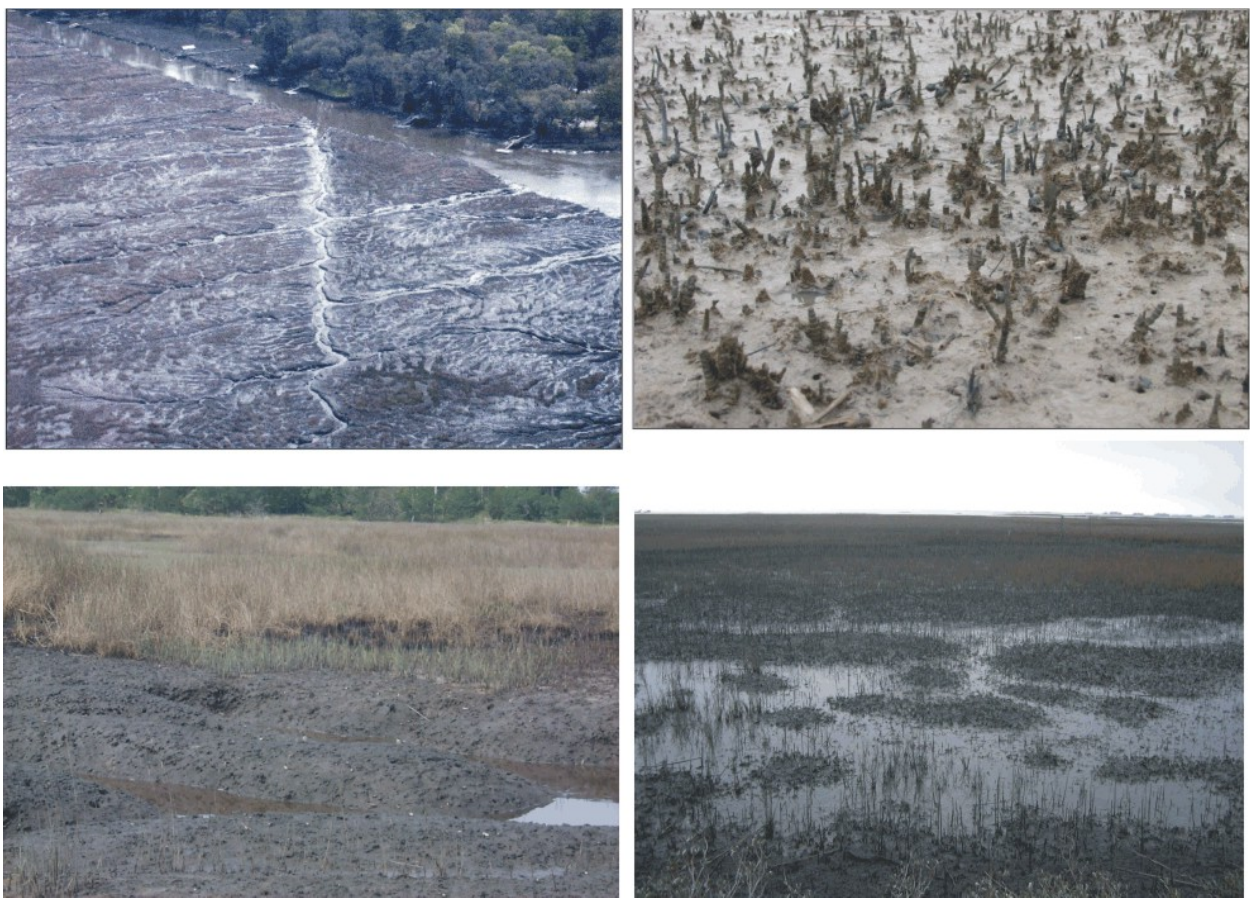


Photo credits; A – Jan MacKinnon, B – Mac Rawson, C – Mac Rawson, D -.Matt Ogburn

Fig. 1: Examples of salt marsh die-off in coastal Georgia: (A) aerial photograph of a die-off area near the Jerico River; (B) a close-up of rhizome "stubble"; (C) example of eroding area in Liberty County; (D) area with standing water at Sapelo Island National Estuarine Research Reserve.

Efforts to address marsh dieback in Georgia

- In October 2002 a team from the Georgia Coastal Ecosystems Long Term Ecological Research program sampled sites near the Jerico River in conjunction with staff of the Coastal Resources Division of the Georgia Department of Natural Resources (CRD-DNR). There was no evidence of increased salinity in the dieback areas, nor was it obvious that the densities of snails and crabs were related to die-off (their report is available at http://www.marsci.uga.edu/coastalcouncil/marshsummarylter2.pdf).

- Drs. Mary Ann Moran (UGA Dept of Marine Sciences), Steve Newell (UGA Marine Institute) and David Porter (UGA Dept of Plant Biology) analyzed samples of affected plants for bacterial and fungal community composition.

- Dr. Merryl Alber (UGA Dept of Marine Sciences) conducted greenhouse trials with material collected from a dieback site and found that rhizomes from dieback areas could not re-sprout when watered, but that healthy salt marsh plants (*Spartina alterniflora*) could grow in soil from both healthy and "dead" marsh areas. In addition, Mr. Matthew Ogburn, a graduate student in M. Alber's laboratory, conducted a transplant study in the field with both *S. alterniflora* and *Juncus romerianus* from May-Oct 2003. This research demonstrated that healthy plants can survive in dieback areas as well as in reference sites. The study was done at the Sapelo Island National Estuarine Research Reserve as well as at Melon Bluff Plantation in Liberty County.

- Dr. Chandra Franklin (Sav. State Univ., Dept of Natural Science and Mathematics) and Jan Mackinnon (CRD-DNR) received funding from GA Sea Grant and the M.K. Pentecost Ecology Fund to perform morphological, anatomical and cytological analyses of plants from marsh dieback sites. Their results suggest that rhizomes from dieback sites are not viable, and even healthy-looking rhizomes may be affected.

- The GCRC has established a standardized marsh monitoring protocol to monitor both healthy and affected sites. The marsh monitoring subcommittee is working with CRD to coordinate sampling at dieback sites along the coast. Eight sites are being monitored quarterly for specific biological, physical and chemical parameters. Data from this effort are available on the web at http://www.marsci.uga.edu/coastalcouncil/marsh_data2.htm.

- A SSU-UGA team also surveyed 18 dieback areas in the summer of 2003. Aside from the vegetative dieback, they found no difference between dieback and reference sites and no obvious relationship between severity of the dieback and potential causal factors (e.g. herbivory, elevation, soil chemistry, salinity).

- CRD-DNR conducted regular aerial surveys of the coast from 2002 – 2005. All photographs have been catalogued and are used to track dieback. For more information, contact Jan Mackinnon at CRD (912) 264-7218).

- Representatives of the Marine Extension Service, NMFS Marine Sanctuary Program at Gray's Reef, CRD-DNR and Sapelo Island National Estuarine Research Reserve formed a remote sensing collaboration. The group leveraged funding for the acquisition and analysis of aerial imagery to identify areas in different stages of dieback and track vegetation patterns over time.

- The University of Georgia at Tifton has sampled the Jerico and Brunswick areas for the presence of herbicides. Twenty-four compounds were analyzed in these samples. All results from this sampling were negative.

- The GCRC organized a workshop on marsh dieback with colleagues from Louisiana, where marsh dieback has also generated tremendous concern. The workshop was supported with funds from Georgia Sea Grant, Louisiana Sea Grant, Georgia DNR (CRD) and Sapelo Island NERR - Coastal Training Program, and occurred February 3-4 in Savannah. Workshop information is available at http://www.marsci.uga.edu/coastalcouncil/dieback_workshop.htm.

- The Georgia Coastal Research Council has continued to meet periodically to coordinate field sampling, streamline data collection, and receive feedback regarding the dieback issue. The Council will be meeting again in August. All meetings notes and presentations are posted on the Georgia Coastal Research Council's web page at http://www.marsci.uga.edu/coastalcouncil

- Results to date have indicated possible drought-induced chemical changes in the soil that could have triggered a chain of events that resulted in the death of plants in dead marsh sites. Clogged xylem vessels (water-conducting tissue in plants) found in the rhizomes of plants from dead marsh sites suggest the possible deposition of heavy metals such as iron. The current working theory is that, drought induced changes in the soil increased the mobility of heavy metals resulting in higher absorption and deposition of metals in xylem tissue causing plant death.

What You Can Do

We need you as the "wetland watcher" to observe the marsh and look for "browning", "thinning", dying grass or muddy areas. These color changes indicate signs of stress. If your adopted wetland begins to show signs of stress it is important to monitor the changes that occur using the following protocol:

1. Notify your Adopt-A-Wetland Coordinator (see "Who to Call List" on page 92).
2. Perform **monthly** chemical tests to collect water quality data near your wetland (you will need to go through chemical training if you have not already done so).
3. Perform **monthly** visual surveys (refer to the Adopt-A-Wetland visual survey in this manual).
4. Photograph your marsh once a month.
5. If possible, mark the perimeter of the muddy area of the marsh. We only suggest this if the marsh is in a safe and easy to access location.

Major Pollution Event

In the event of any major pollution (e.g. oil spills, toxic or hazardous waste spills, septic tank leaks, fish or wildlife kills etc.) groups should notify their AAW coordinator immediately and refer to the "Who to Call List" in this manual for the appropriate agency. AAW also has a Coastal Response Team of volunteers who are available to assist the GA Department of Natural Resources during emergencies such as oil spills, bird kills, phytoplankton blooms or other coastal emergencies. If you would like to sign up for the Coastal Response Team call 912-598-2348.

Georgia Coastal Research Council (GCRC) Marsh Die-Back Monitoring

The GCRC (http://alpha.marsci.uga.edu/coastalcouncil/) has developed a marsh monitoring protocol suitable for advanced AAW volunteers who are interested in participating in their marsh die-back research. Should AAW volunteers decide to partake in this venture they should first collect biological and chemical data according to the procedures outlined previously for the AAW program. In addition, there are several different parameters required by the GCRC protocol (e.g. three transects in dead marsh site, and three in a healthy control site, various sized quadrats, and measuring various plant size categories). For more information please refer to the worksheet (p. 91), and call your Adopt-A-Wetland coordinator (912)-598-2348 or the Georgia Department of Natural Resources (GADNR) (912)-262-3048.

Marsh Restoration

Restoration of a marsh by definition is the "re-establishment of previously existing wetland or other aquatic resource character and function(s) at a site where they have ceased to exist or exist only in a substantially degraded state" (Niedowski, 2000). The increased precipitation and the end of the drought in Georgia has caused many of the marsh die-off areas to recover. As of the summer of 2005, much of the marsh is a lush green; however, we continue monitoring the salt marsh for other die-off episodes, a population explosion of marine organisms, pollution events, oil spills or invasive species.

The GADNR and the GCRC have discussed the possibility of restoring some of the coastal dead marsh sites. The current thinking is that restoration should be postponed at least until the sites have been monitored for an adequate period of time. Therefore, restoration procedures have not yet been determined. In the event that marsh restoration commences in the future, we would like to invite experienced AAW volunteers to adopt a dead marsh site, to monitor this site using both the AAW protocol and the GCRC protocol, and eventually participate in the planting of new marsh grass.

Georgia Research Council Marsh Sampling Data Sheet

Date _____________ Time _____________ Low tide at _________

Lat. & Long. (GPS coord. if avail.)_________________________________

Locality ____

Transect #____ Quadrat #____ Quadrat size _______ Photo # ________

Investigators ____

VEGETATION:

Spartina	***Juncus***
# Live > 15 cm _____________	**# Live > 15 cm _____________**
# Live < 15 cm _____________	**# Live < 15 cm _____________**
# Dead stems _____________	**# Dead stems _____________**
Height of 5 tallest: ______ , ______ ______ , ______ , ______	**Height of 5 tallest: ______ , ______, ______, ______, ______**

Observations on leaf color within the quadrat (green, brown, chlorotic, purple):

____

FAUNA:

Periwinkles **quadrat size ______ # >10 mm ____# <10 mm ____any dead? _____**

Mud snails **quadrat size ______# live _______any dead? _____**

Other snails **quadrat size _______ type? __________ # live ____any dead? ____**

Crabs **quadrat size _______ # holes > 5 mm diameter ____any dead? ____**

Mussels **(0.5 x 0.5 m quadrat) # live _______ any dead? _______**

Other observations of fauna____

____

GENERAL:

Is there a clear transition area along this transect? [ ] Yes [ ] No

If yes, approx. how far is this quadrat from the transition zone?_______

Other observations (soil firmness, presence of sulfide, other smells, conditions**):**

____

POREWATER: (please refer to protocol text for instructions**)**

Soil temp ______ Salinity _______ pH _______ Eh _______

Other ____________________________

Coastal Georgia Adopt-A-Wetland
"Who to Call" List

Program Questions

Adopt A Wetland	Marine Extension Service	Mary Sweeny-Reeves	912-598-2348
Adopt-A-Stream	Atlanta Adopt A Stream	Allison Hughes	404-675-1635
Adopt-A-Stream	Coastal AAS Training Center	Dr. Joe Richardson	912-596-5362
AAS Chatham Coordinator	Metropolitan Planning Commission	Jackie Jackson	912-651-1454

GA Department of Natural Resources Emergency Operation Center (during or after hours)

Most or all coastal emergencies including bird/fish kills, oil spills, pollution problems, whale/manatee/turtle sightings/harassment/deaths: **1-800-241-4113**

Direct Lines to Departments/Agencies:

Fish Kills/Marsh Die-off/problems during day hrs

Coastal Resources Division in Brunswick	912-264-7218
Wildlife Resources Division in Richmond Hill	912-264-7212

Oil or Chemical Spills National Hot Line on all Waterways

United States Coast Guard Hot Line	1-800-424-8802

Toxic or Hazardous Spills (day hrs)

GA DNR Environmental Response Division Emergency Response	1-800-241-4113

Sewer/Septic Leaks (day hrs)

Chatham Co.		912-651-6565
Glynn Co.		912-267-5570
Chatham Co.	Health Dept.	912-356-2160
Glynn Co.	Health Dept.	912-264-0298
Effingham Co.	Health Dept.	912-754-6484

Underground Storage Tank Leaks (day hrs)

Environmental Protection Division, Georgia Dep. Nat. Res.	912-353-3225

Erosion and Sedimentation (day hrs)

Construction & Development	912-353-3225
Agriculture, US Dep. Agriculture	912-754-3812

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Appendices

Macroinvertebrate Identification Key

Plant Identification Key

Fish Identification Key

AAW Evaluation Form

Useful Websites

Useful Books on Coastal Wetlands

Common Mollusks of Georgia

Other Common Marine Invertebrates of Georgia

Common Fishes of Georgia

Invasive Aquatic Species in Georgia

Key to Macroinvertebrates found in Coastal Georgia

A. Soft Body Contained In A Thick Hard Shell
(Phylum Mollusca)

OR

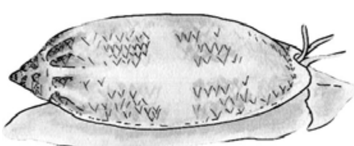
B. Body Not Soft/Not In Thick Hard Shell
(Phylum Arthropoda or Porifera)
See Page 98

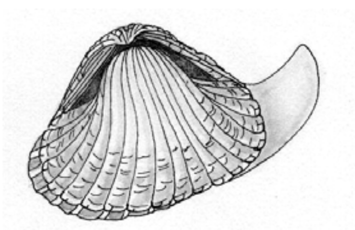
OR

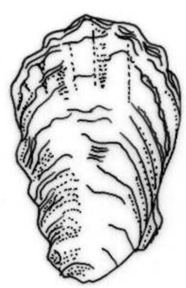
C. Soft Body But Not Inside Hard Shell
(Phyla Annelida/Echinodermata/Cnidarian/Ctenophora/Chordata)
See Page 112-114

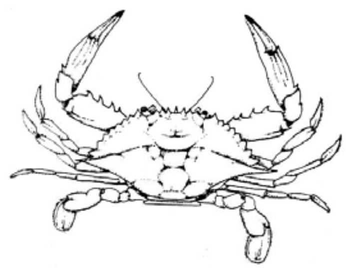
Body inside of a single shell
(Class Gastropoda)
See Page 101

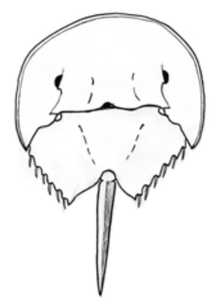
Body inside of 2 equal shells
(Class Bivalvia)
See Page 102

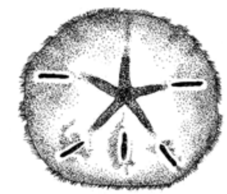


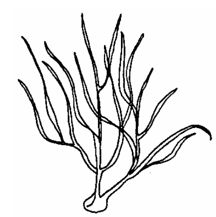


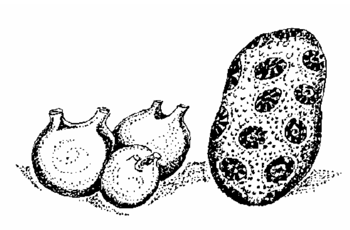


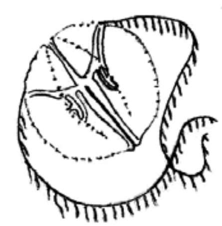


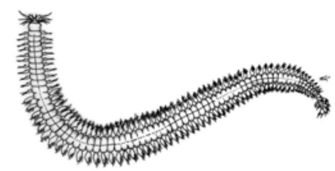












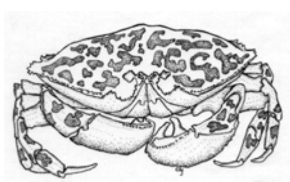
Body Is Not Soft Or Not In Thick Hard Shell

Animals With
Segmented Legs
And Obvious Joints
(Phylum Arthropoda)

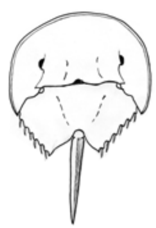
Shell-like, Oval Shaped With Plates,
Attached To Debris, Pilings Or Docks
(Phylum Arthropoda) See Page 105

Odd Shaped Body With Small
Holes (pores). Skin Is Rough
(Phylum Porifera) See Page 107

2 Pairs Of Antennae, More
Than 3 Pairs Of Legs
(Subphylum Crustacea)
See Page 104



Class Merostomata
(Horseshoe Crabs)
See Page 106



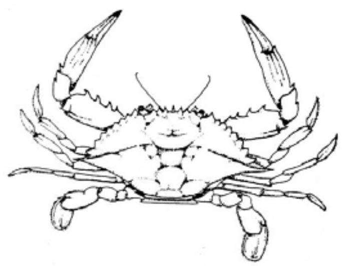
Class Pycnogonida
(Sea Spiders)
See Page 106

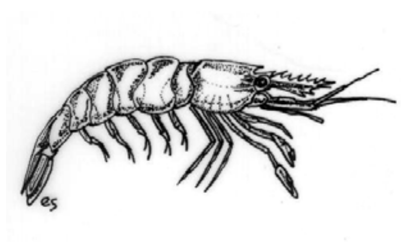
Class Insecta
One Pair Of Antennae,
3 Pairs Of Legs
See Page 106

Body Is Not Soft Or Not In a Thick Hard Shell
(Subphylum Crustacea)

Flattened Laterally
(Sideways) So It
Looks Like The Legs
Are Located On One
Side Of Body
(Order Amphipoda)
See Page 105

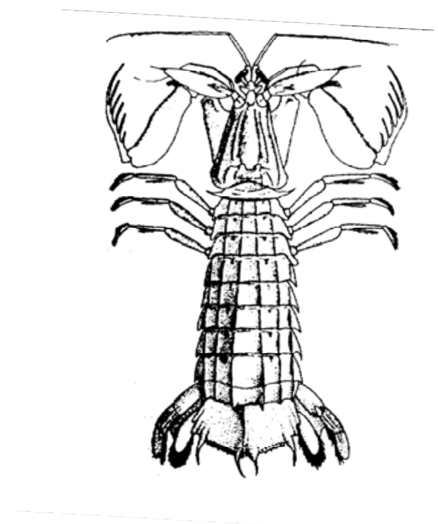
5 Pairs Of Legs
Head And Thoracic Segments
Fused Together Forming Thin Shell
Pinchers Present In Some
(e.g. Crab,Shrimp, Hermit Crab, Crayfish)
See Pages 104





7 Pairs Of Legs, Body
Flattened. (Order Isopoda)

Head Is Jointed,
Eyes And Antennae
Are Movable
Order Stomatopoda
(e.g. Mantis Shrimp)

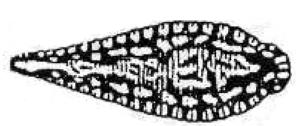


Soft Body Not In a Hard Shell

Soft Body, Elongated, Thin Shape, Worm-like (Phylum Annelida) See Page 108

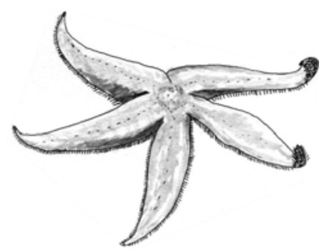
Segmented Worms With Small Appendages & Antennae (Class Polychaeta)

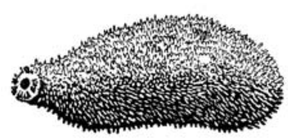
Segmented Flat Worms With Rounded Anterior And Posterior Ends (Suckers) (Class Hirudinea)



OR

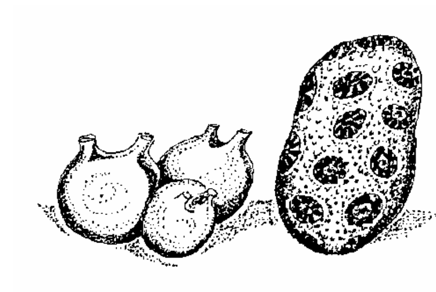
Odd Shaped Body, Skin Rough, Some Covered In Spines, Small Opening (mouth) On Bottom Side (e.g. Sea Cucumber, Sea Star) (Phylum Echinodermata) See Page 109





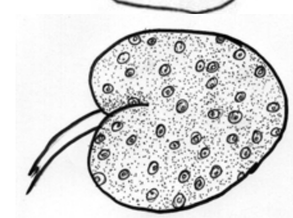
OR

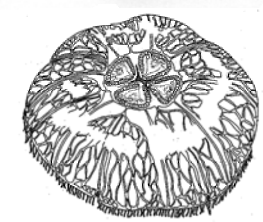
Odd Shape, Skin Rough & Fleshy, Most have 2 Openings, No Stinging Cells (e.g. Sea Squirts, Sea Pork) (Phylum Chordata, Subphylum Urochordata) See Page 111



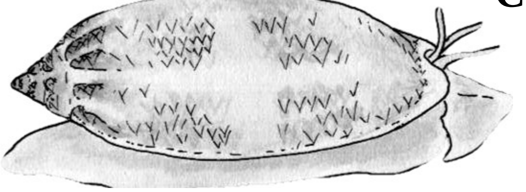
OR

Soft Bodied, Stout Shape, Often Attached to Shell/ Dock/ Piling), Tentacles With Stinging Cells On One End (e.g. Sea Anemone, Jellyfish) (Phylum Cnidaria or Ctenophora) See Pages 110-111

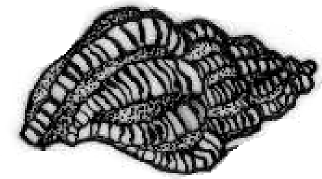




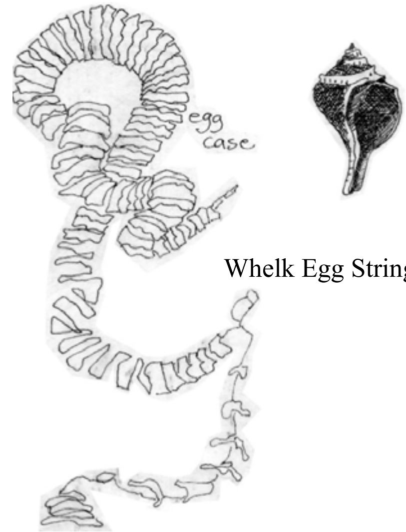
Phylum Mollusca
Class Gastropoda



Olive Snail
Oliva sayana



Atlantic Oyster Drill
Urosalpinx cinerea

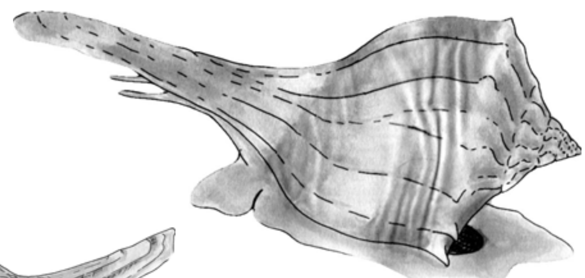


Whelk Egg String

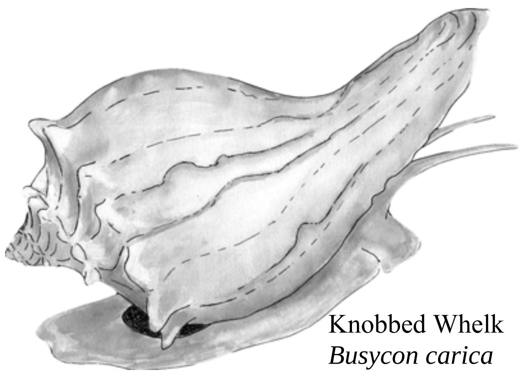
Mud Snail
Ilyanassa obsoleta

Coffee Bean Snail
Melampus bidentatus

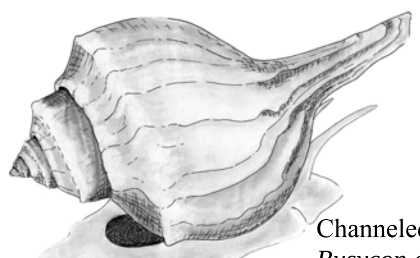
Periwinkle Snail
Littorina irrorata



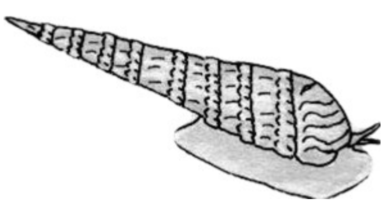
Lightning Whelk
Busycon sinistrum



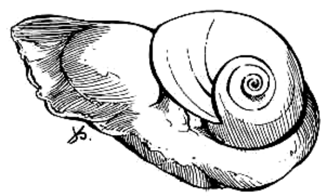
Knobbed Whelk
Busycon carica



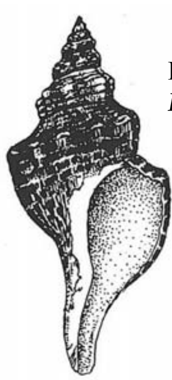
Channeled Whelk
Busycon canaliculatum



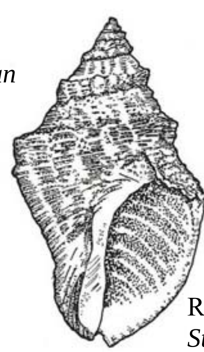
Auger
Terebra dislocata



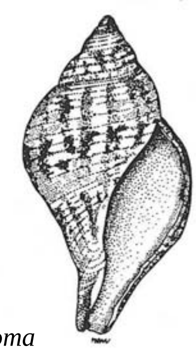
Moon Snail
Neverita duplicata



Florida Horse Conch
Pleuroploca gigantean

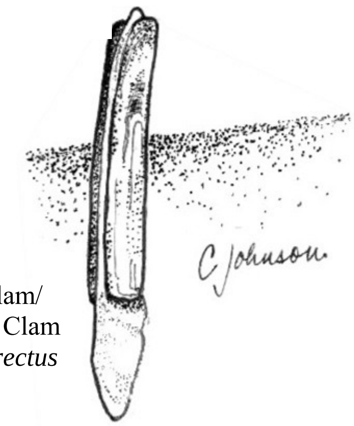


Rock Shell
Stramonita haemastoma

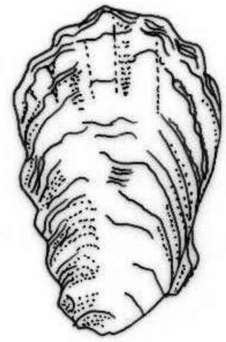


True Tulip
Fasciolaria tulipa

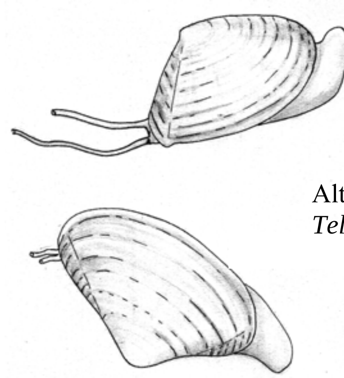
Phylum Mollusca
Class Bivalvia



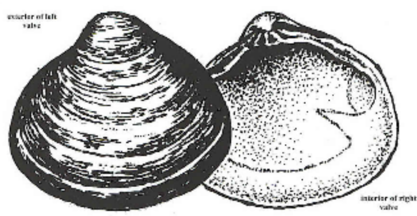
Razor Clam/
Jacknife Clam
Ensis directus



Eastern Oyster
Crassostrea virginica

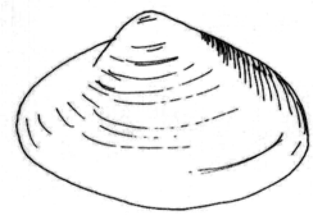


Alternate Tellin
Tellina alternata

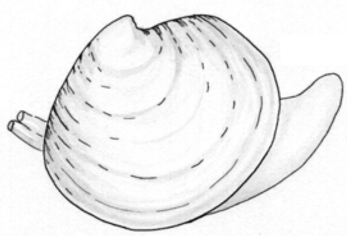


Carolina Marsh Clam
Polymesoda caroliniana

Northern Quahog
Mercenaria mercenaria

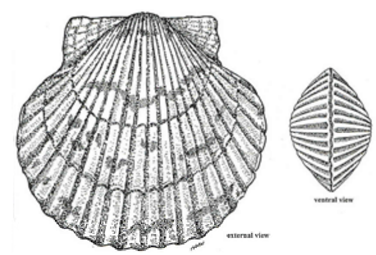


Southern Surf Clam
Spisula ravaneli

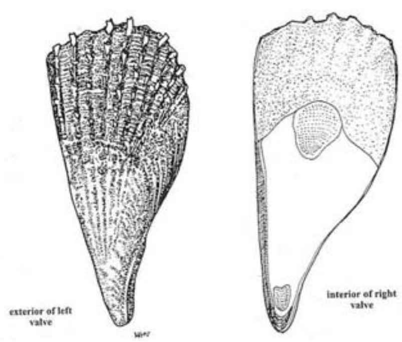


Disk Clam
Dosinia discus

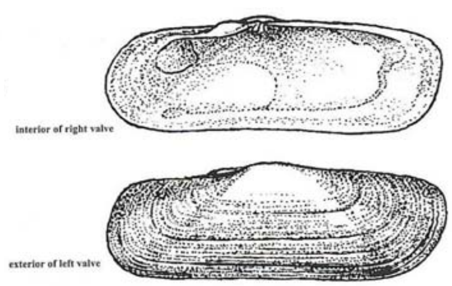
Atlantic Bay Scallop
Argopecten irradians



Calico Scallop
Argopecten gibbus



Pen Shell
Atrina rigida

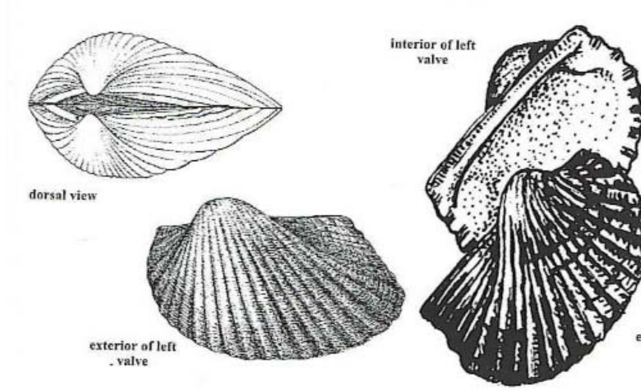


Stout Tagelus
Tagelus plebeius

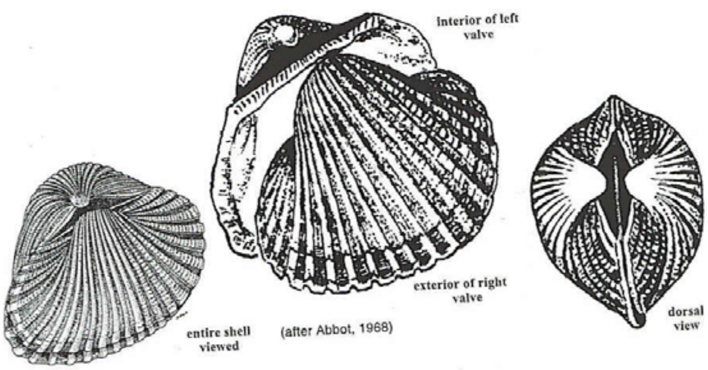
Angel Wing
Cyrtopleura costata

Class Bivalvia Continued

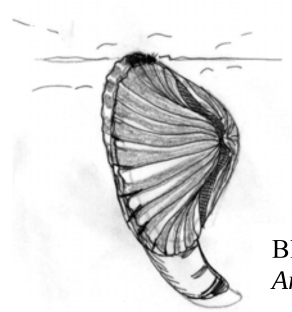
Ponderous Ark
Noetia ponderosa



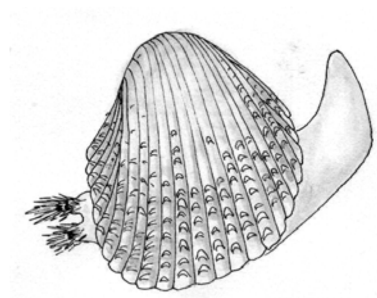
Eared Ark
Anadara notabilis



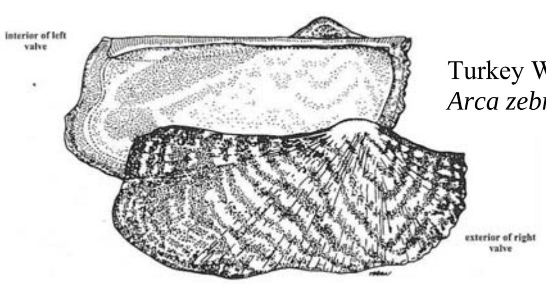
Incongrous Ark
Scapharca brasiliana



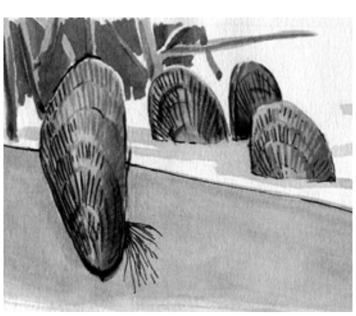
Blood Ark
Anadara ovalis



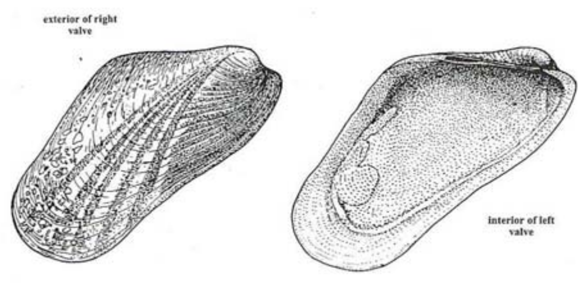
Giant Atlantic Cockle
Dinocardium robustum



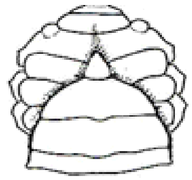
Turkey Wing
Arca zebra



Atlantic Ribbed Mussels
Geukensia demissa

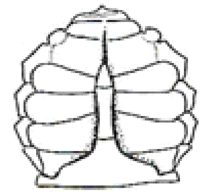


American Horsemussel
Modiolus americanus

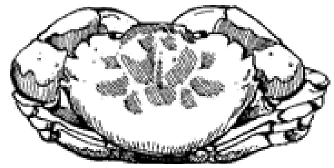
Female 

Thoracic Sternites

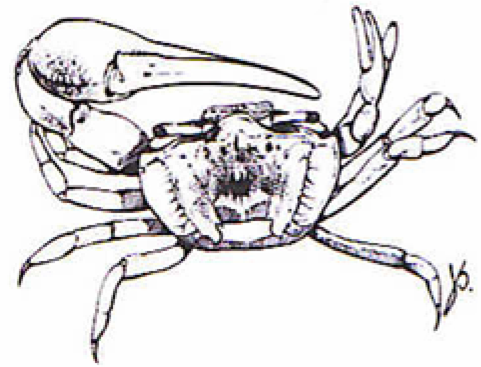
Phylum Arthropoda
Subphylum Crustacea

 **Male**

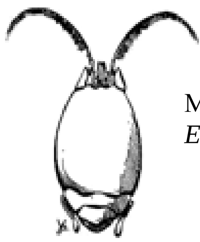
Thoracic Sternites



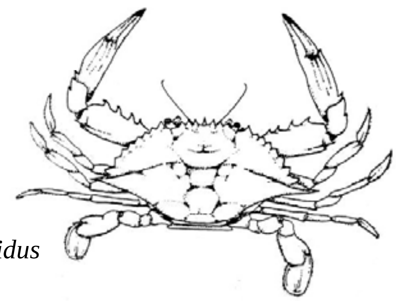
Mud Crab
Panopeus herbstii



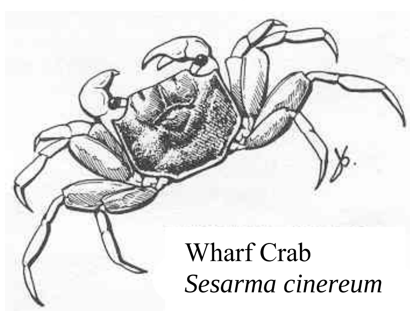
Sand Fiddler Crab (Uca pugilator) = Purple Shell
Mud Fiddler Crab (Uca pugnax) = Brown/yellowish Shell
Brackish Water Fiddler Crab (Uca minax) = Brown Shell, Larger Size, Red Joints



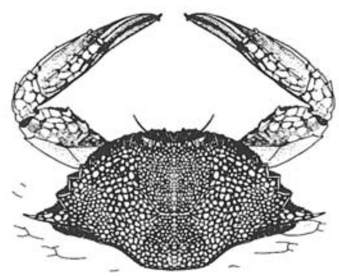
Mole Crab
Emerita talpoida



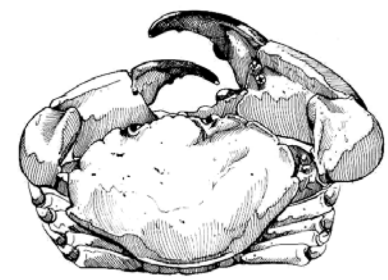
Blue Crab
Callinectes sapidus



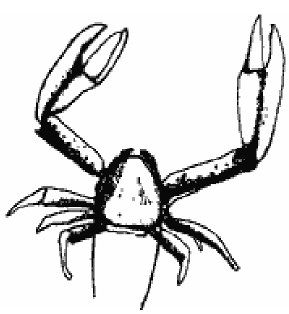
Wharf Crab
Sesarma cinereum



Speckled Swimcrab
Arenaeus cribarius

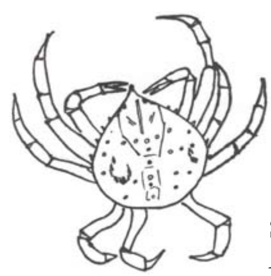


Stone Crab
Menippe mercenaria



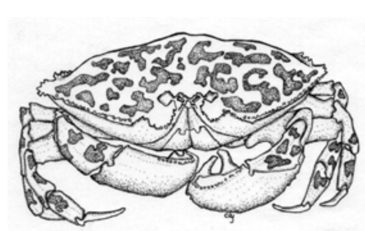
Green Porcelain Crab
Petrolisthes armatus

Striped Hermit Crab
Clibanarius vittatus



Spider Crab
Libinia dubia

Lady Crab
Ovalipes ocellatus



Calico Crab
Hepatus epheliticus

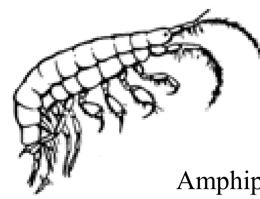
Ghost Crab
Ocypode cordimana

Phylum Arthropoda
Subphylum Crustacea

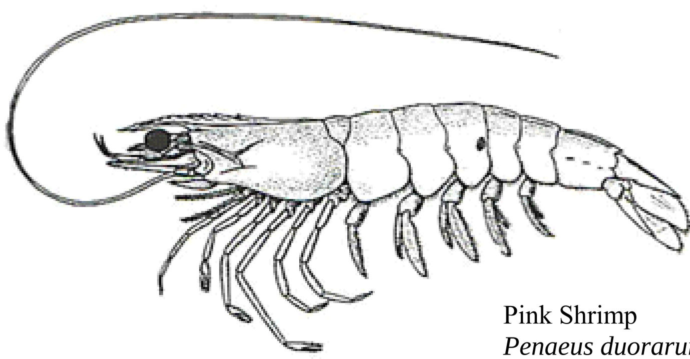
Fragile Barnacle
Chthamalus fragilis

Goose Barnacles
Lepas anatifera

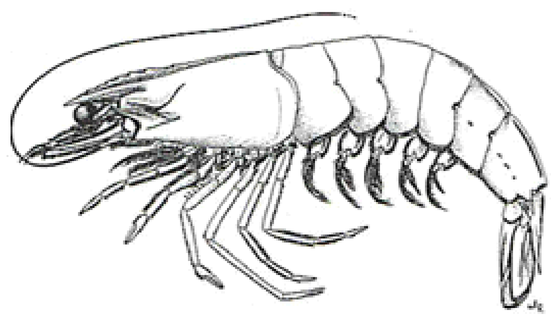
Skeleton Shrimp
Caprella penantis



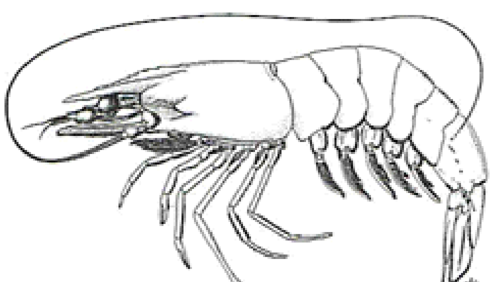
Amphipod



Pink Shrimp
Penaeus duorarum



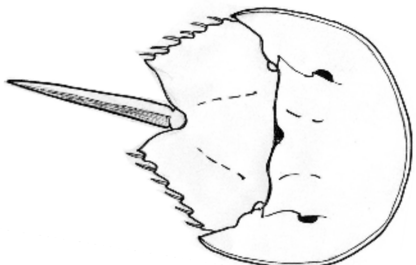
White Shrimp
Litopenaeus setiferus



Brown shrimp
Farfantepenaeus aztecus

Phylum Arthropoda

Class Merostomata



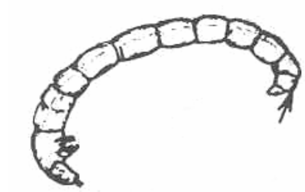
Horseshoe Crab
Limulus polyphemus

Class Pycnogonida

Pycnogonid
Sea Spider

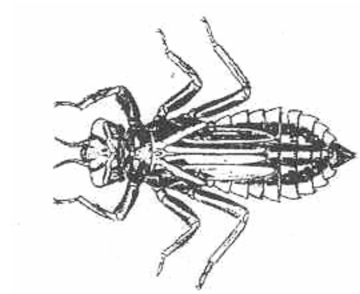
Class Insecta

Midge Fly Larva

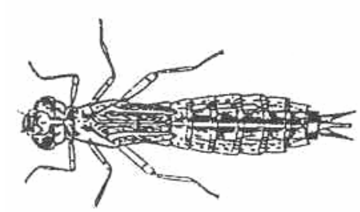


Mayfly Nymph

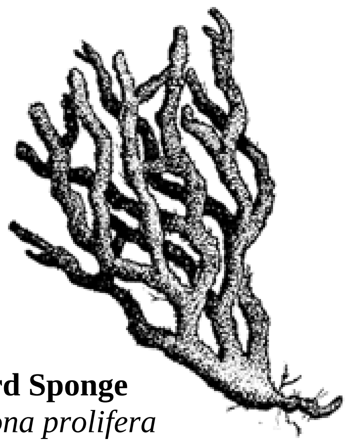
Damselfly



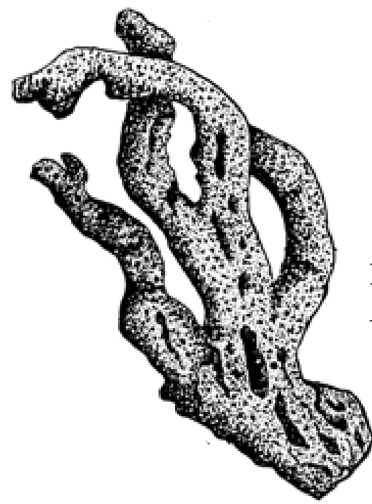
Dragonfly



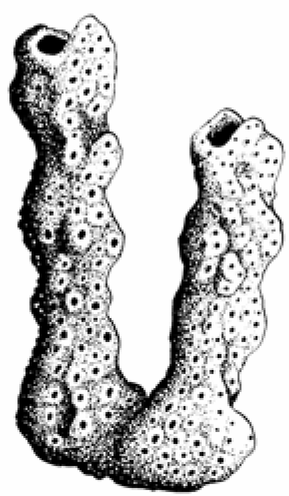
Phylum Porifera

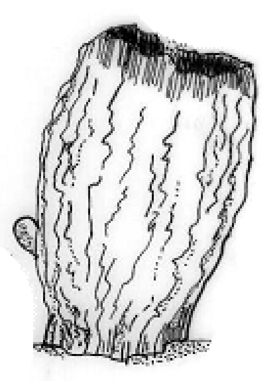


Redbeard Sponge
Microciona prolifera



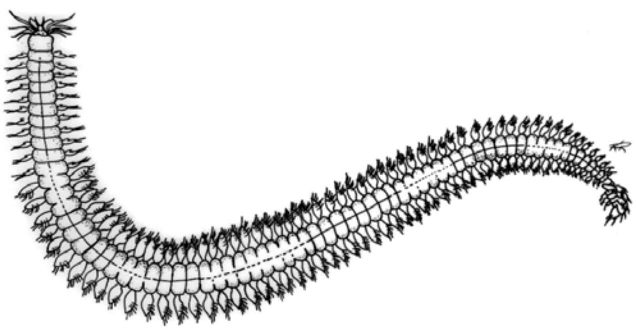
Finger Sponge
Haliclona oculata



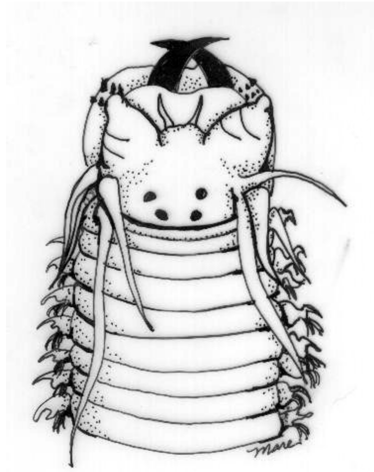


Vase Sponges
Scypha sp.

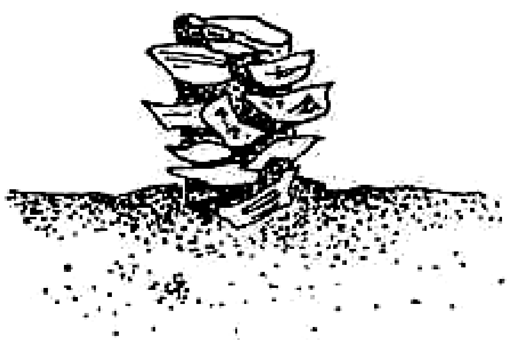
Phylum Annelida
Class Polychaetae



Polychaetae Worm

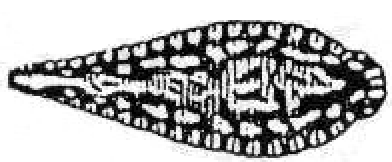


Polychaetae Worm
Head (close up)



Polychaetae worm tube

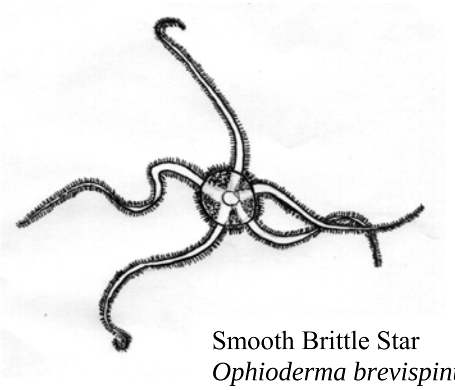
Class Hirudinea



Leech

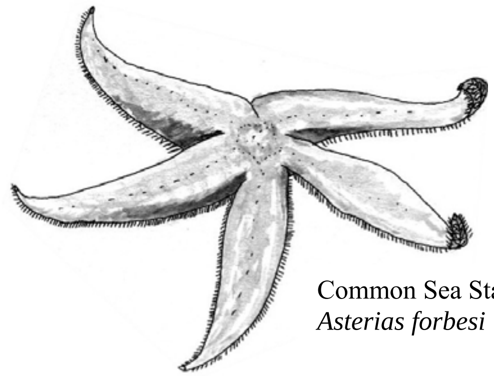
Phylum Echinodermata

Class Ophiuroidea



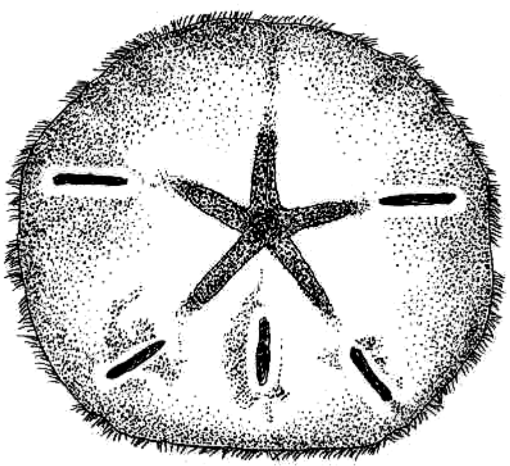
Smooth Brittle Star
Ophioderma brevispinum

Class Asteroidea



Common Sea Star
Asterias forbesi

Class Echinoidea



Sand Dollar or Keyhole Urchin
Mellita quinquiesperforata

Urchin Teste

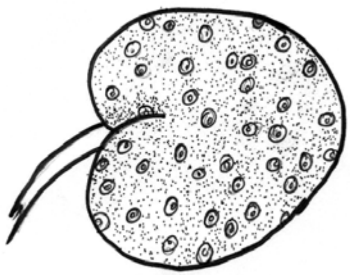
Sea Urchin
Lytechinus variegatus

Class Holothuroidea

Sea Cucumber
Sclerodactyla briareus

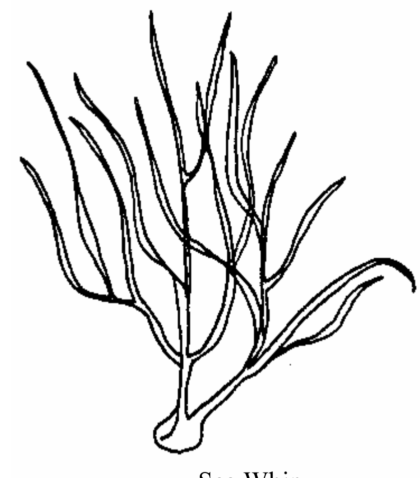
Phylum Cnidarian

Class Anthozoa



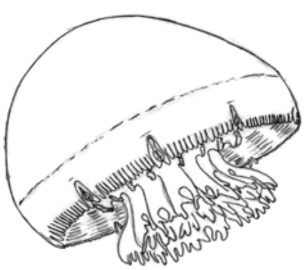
Sea Pansy
Renilla reniformis

Brown Anemone
Aiptasia pallida



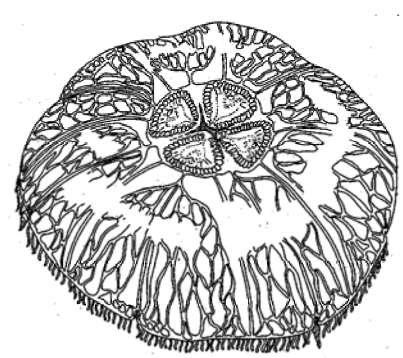
Sea Whip
Leptogorgia virgulata

Class Scyphozoa



Cannonball Jellyfish
Stomolophus meleagris

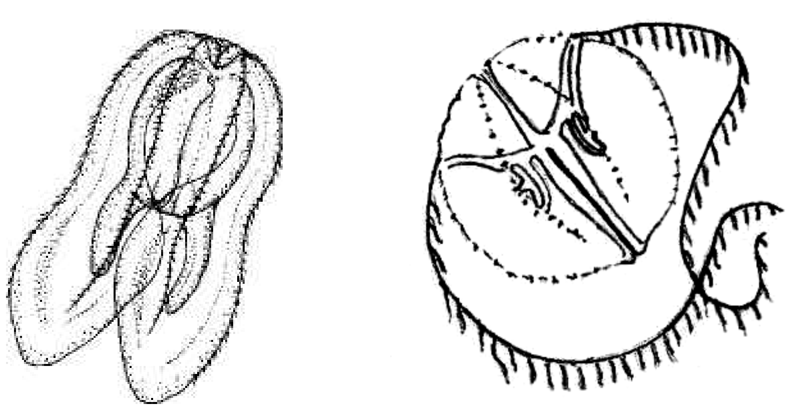
Sea Nettle
Chrysaora quinquecirrha



Moon Jellyfish
Aurelia aurita

Phylum Ctenophora

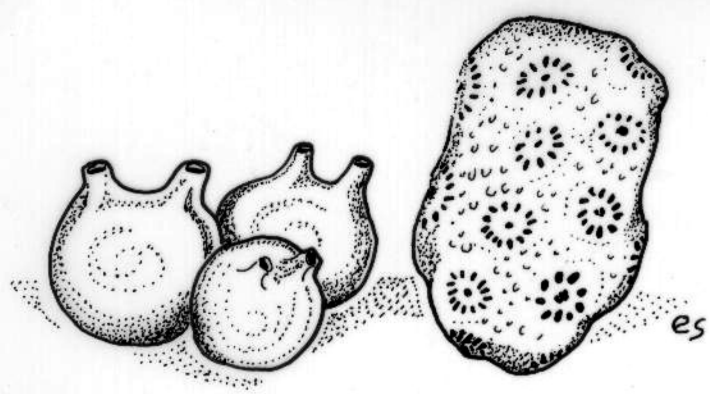
Class Tentaculata



Comb Jellies

Phylum Chordata

Subphylum Urochordata



Rough Sea Squirts
Styela plicata

Sea Pork
Aplidium constellatum

Keys to Plants Found in Coastal Georgia

Kingdom Plantae

Division

Magnoliophyta (Flowering Plants)

Coniferophyta (Gymnosperms)

Class

Liliopsida (Monocotyledons)

Leaf veins parallel,
flower parts in 3 or multiples of,
vascular stem bundles scattered
see pages 104-105

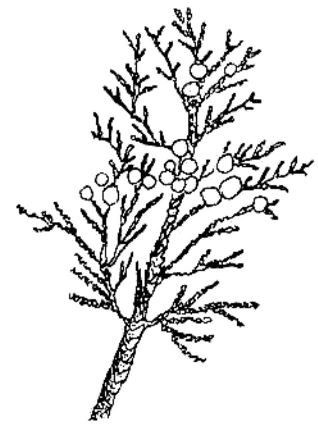
Cabbage Palm

Magnoliopsida (Dicotyledons)

Leaf veins net-like,
flower parts in 5 or multiples of
vascular stem bundles circular
see pages 106-107

Sea Oxeye
Daisy

Pinopsida



Red Cedar

Liliopsida (Monocotyledons)

Family: Poaceae (grasses)

Broomsedge
Andropogon virginicus

Salt Meadow Cordgrass
Spartina patens

Smooth Cordgrass
Spartina alterniflora

Bitter Panic Grass
Panicum amarum

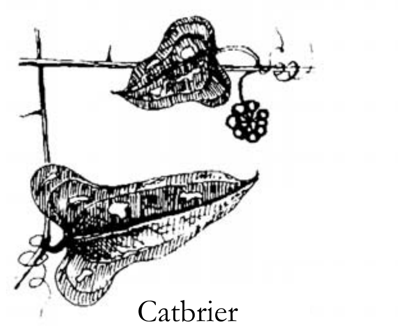
Salt Grass
Distichlis spicata

Sandspur
Cenchrus tribuloides

Sea Oats
Uniola paniculata

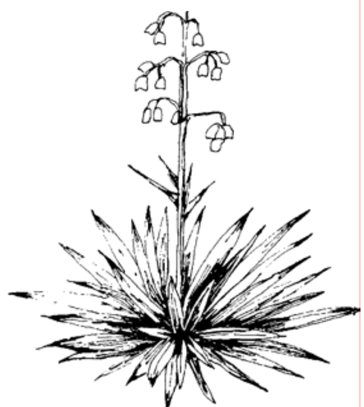
Liliopsida (Monocotyledons)

Spike-Rush
Eleocharis vivipara



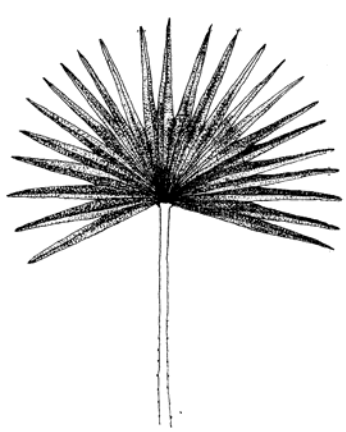
Catbrier
Smilax sp.

Needlerush
Juncus roemerianus



Yucca or Spanish
Bayonet
Yucca aloifolia

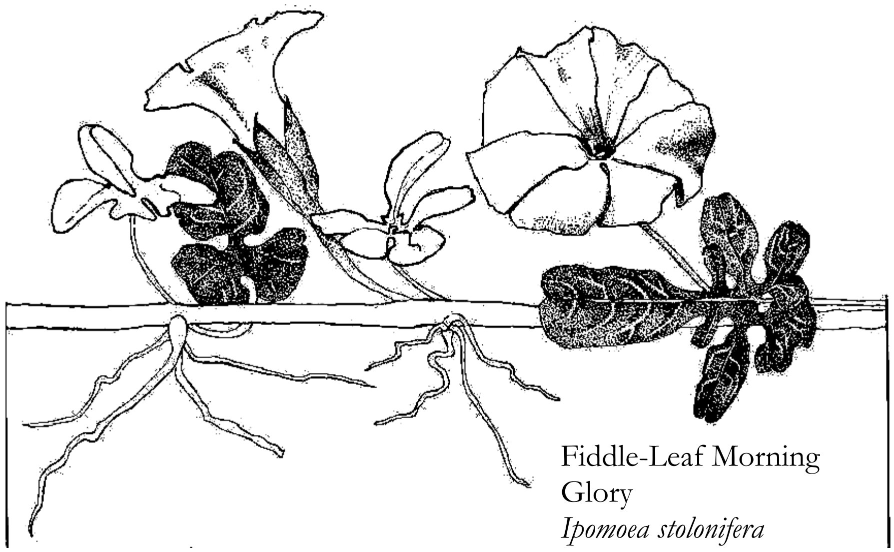
Cattail
Typha sp.



Saw Palmetto
Serenoa repens

Cabbage Palm
Sabal palmetto

Magnoliopsida (Dicotyledons)

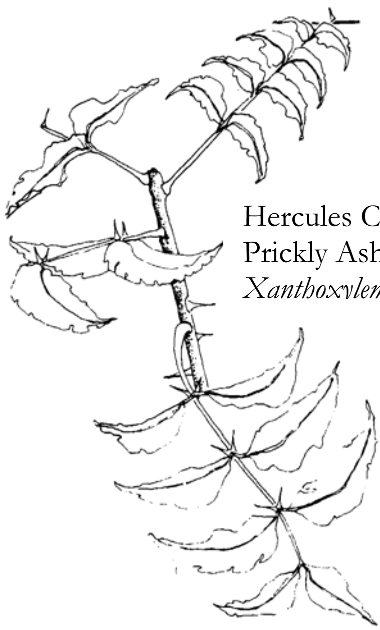


Fiddle-Leaf Morning Glory
Ipomoea stolonifera

Marsh Elder
Iva frutescens

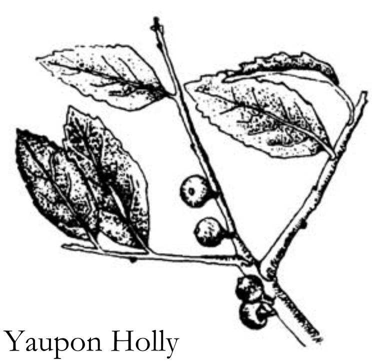
Spanish Moss
Tillandsia usneoides

Sea Oxeye
Borrichia fruitescens



Hercules Club or
Prickly Ash
Xanthoxylem clava-hero

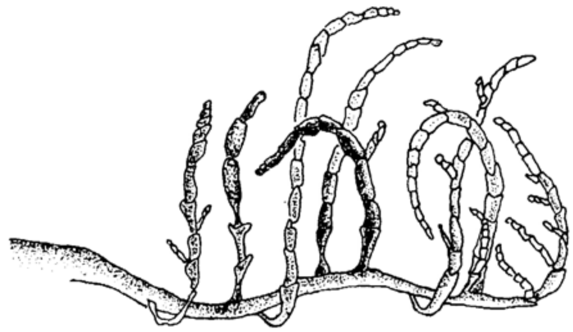
Dog Fennel
Eupatorium capillifolium



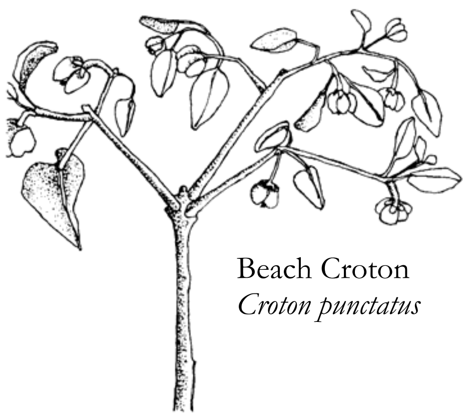
Yaupon Holly
Ilex vomitoria

Magnoliopsida (Dicotyledons)

Live Oak
Quercus virginiana



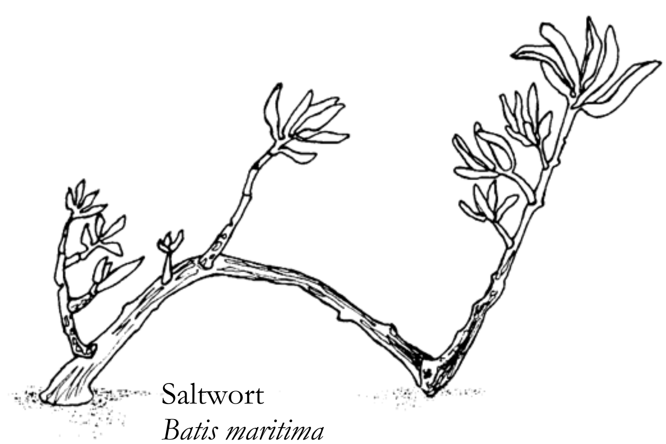
Glasswort
Salicornia virginica, S. bigelovii, S. europaea



Beach Croton
Croton punctatus

Wax Myrtle
Myrica cerifera

Russian Thistle
Salsola kali



Saltwort
Batis maritima

Wetland Vegetation By Zones

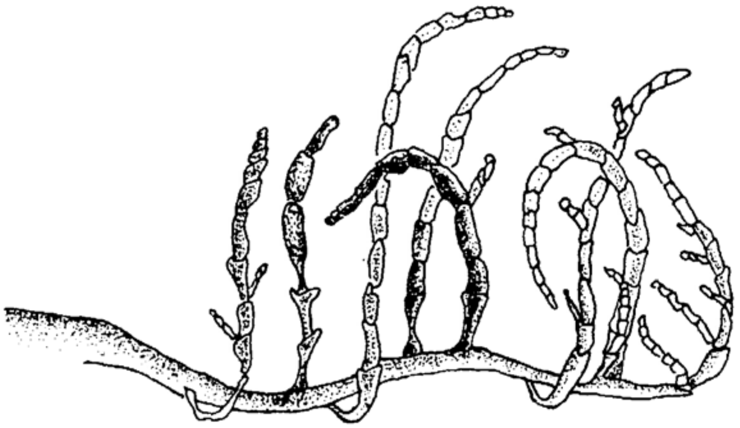
Saltmarsh
Low Marsh Zone
High Marsh Zone
Marsh Border
Upper Marsh Border & Transitional Zone

Beach
Upper Beach Zone
Primary Dunes
Dune Meadows

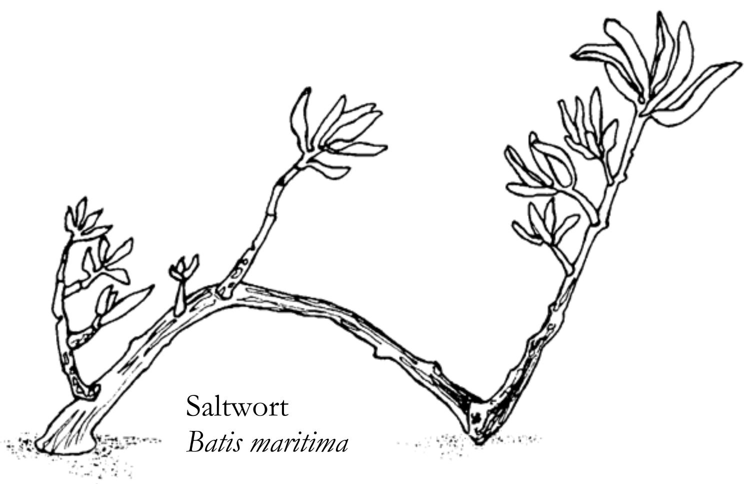
Low Marsh Zone Vegetation

Smooth Cord Grass: broad leaf blade, plant size varies.

High Marsh Zone Vegetation



Glasswort
Salicornia virginica, S. bigelovii, S. europaea



Saltwort
Batis maritima

Salt Grass
Distichlis spicata

Glasswort or Pickle weed: succulent plant with tiny bract-like leaves.
Salt Grass: leaf blades in one plane, summer-fall (beach meadows).
Saltwort: succulent leaf, prostrate woody stem.

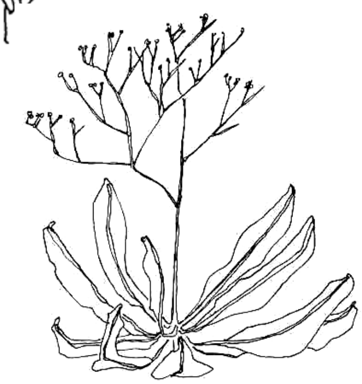
Marsh Border

Needle Rush
Juncus roemerianus

Marsh Aster
Aster tenuifolius

Sea Oxeye
Borrichia fruitescens

Orach
Atriplex patula



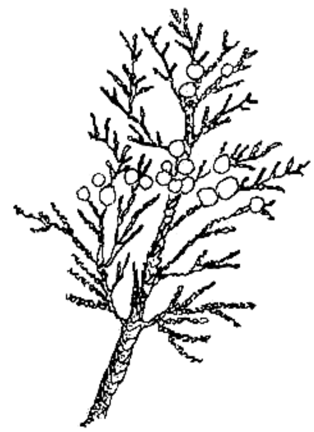
Sea Lavender
Limonium carolinianum

Marsh Aster: small sparsely arranged lavender or white aster flowers with yellow centers, fall.
Needle Rush: long tubular leaves with sharp points, painful to walkers.
Sea Oxeye: succulent leaf, yellow aster flower, spiny burr, summer.
Sea Lavender: small sparsely arranged purple flowers, basal leaves, fall.
Orach: similar to orach on beaches (A. arenaria) but smaller leaves.

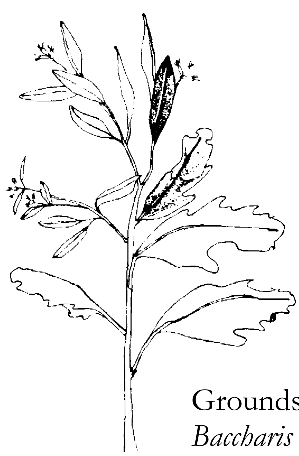
Upper Marsh Border and Transition Zone

Marsh Elder
Iva frutescens

Cabbage Palm
Sabal palmetto



Red Cedar
Juniperus virginiana



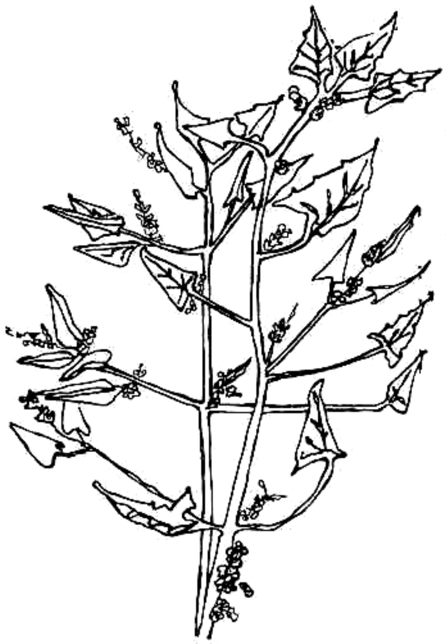
Groundsel-Tree
Baccharis halimifolia

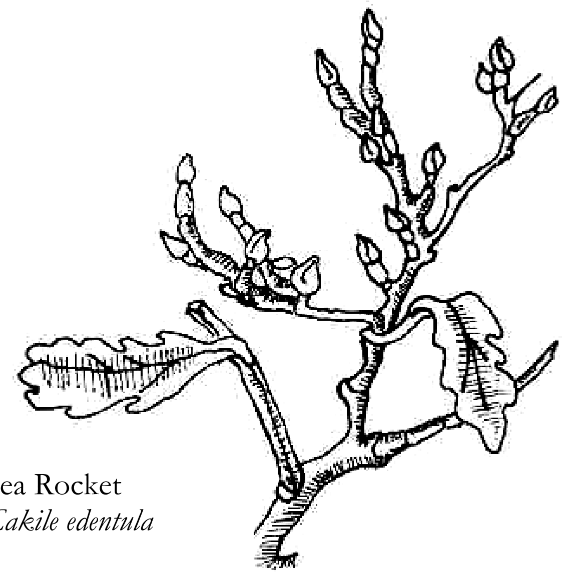
Saltcedar or Tamarisk
Tamarix gallica

Red Cedar: short needles, blue berry-like cones, juniper tree.
Cabbage Palm: similar to saw palmetto of the forest but pinnately.
Marsh Elder: serrated leaves, tiny flowers or seeds at end of stems, leaves not as fleshy as beach elder.
Groundsel-tree or Cotton Bush: irregularly-shaped leaves, cotton-like seed tufts in the fall, shrub.
Saltcedar or Tamarisk: small tree or shrub, similar to red cedar but paler green and more delicate, tiny pink flowers at tips of stems, summer.

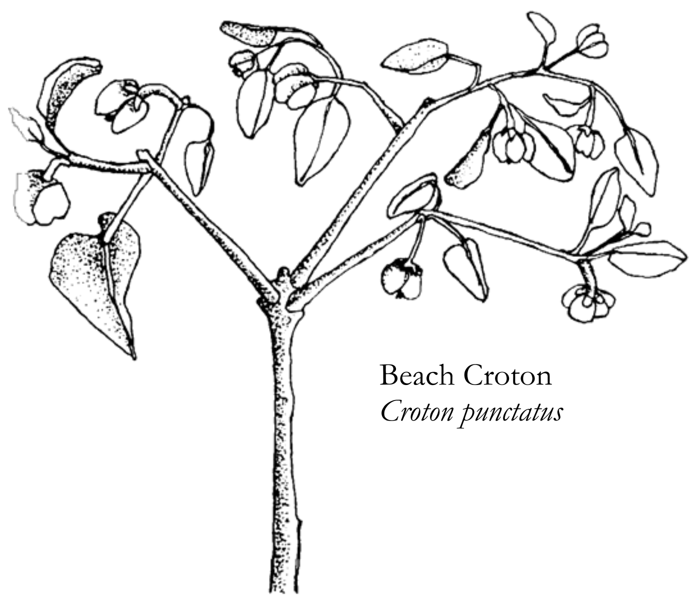
Upper Beach Zone Vegetation

Orach
Atriplex arenaria





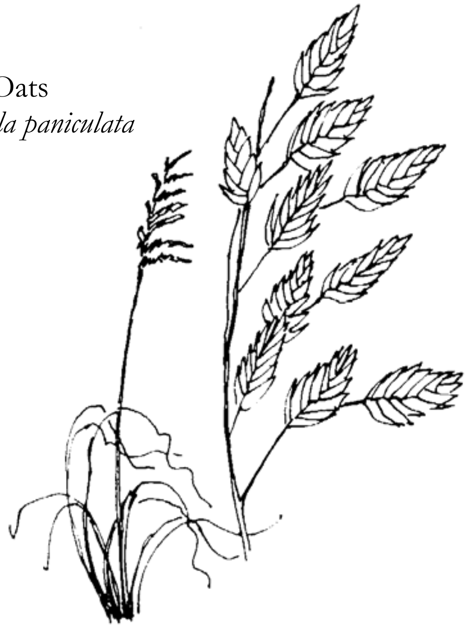
Sea Rocket
Cakile edentula



Beach Croton
Croton punctatus

Orach: succulent gray-green leaf, red stem, summer
Beach Croton: dusky gray-green leaves and stem, round fruit, spring
Sea Rocket: succulent plant, two-section fruit, dies in summer, spring

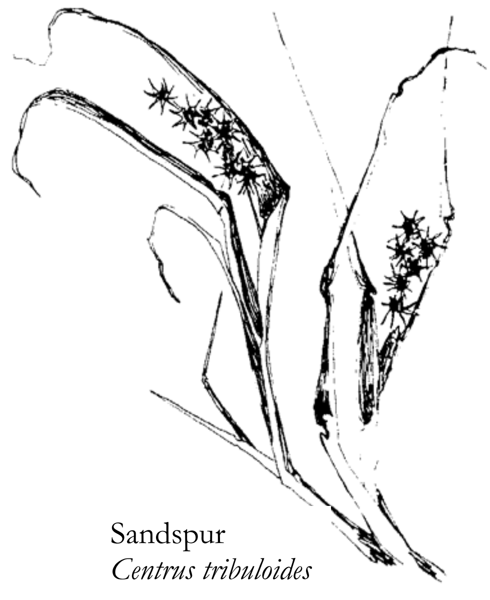
Primary Dunes



Sea Oats
Uniola paniculata

Bitter Panic Grass
Panicum amarum

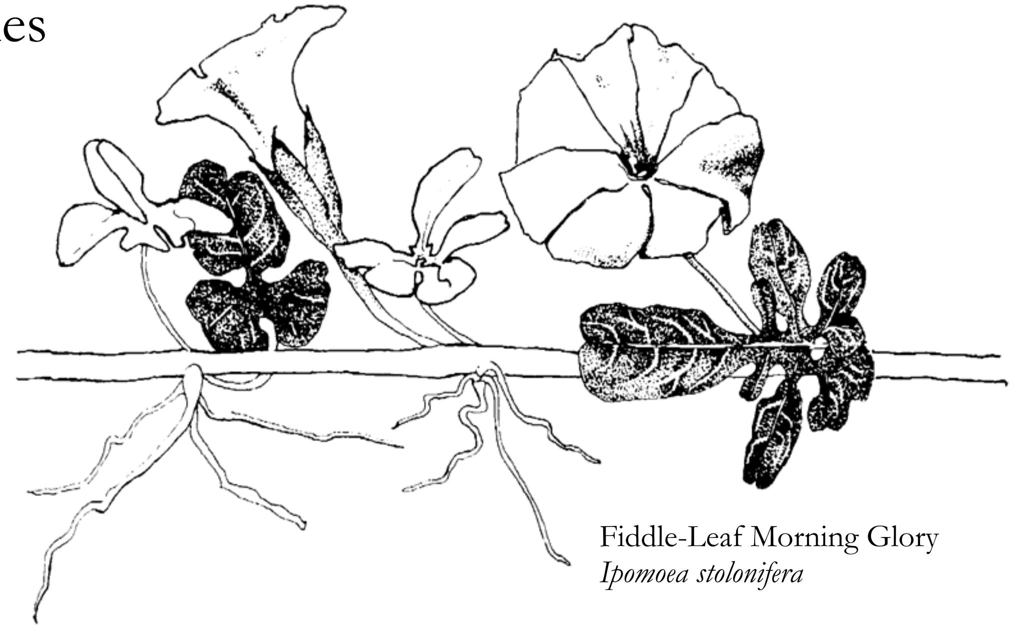
Beach Elder
Iva imbricata



Sandspur
Centrus tribuloides

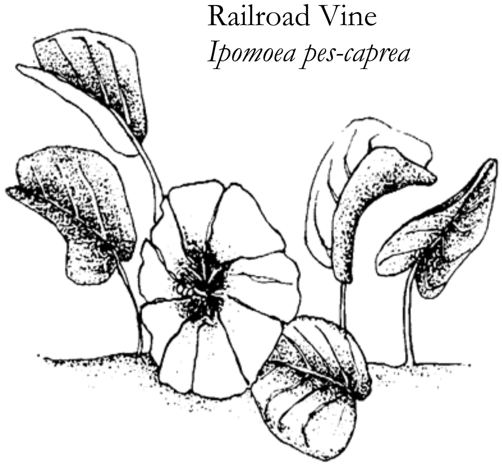
Sea Oats: seed head on tall stalk, curly leaf blade, summer-fall.
Sandspur: prostrate, sharp painful burr, fall.
Beach Elder: succulent leaf, woody stem, summer.
Bitter Panic Grass: broad, alternate leaf blades on the stalk, summer.

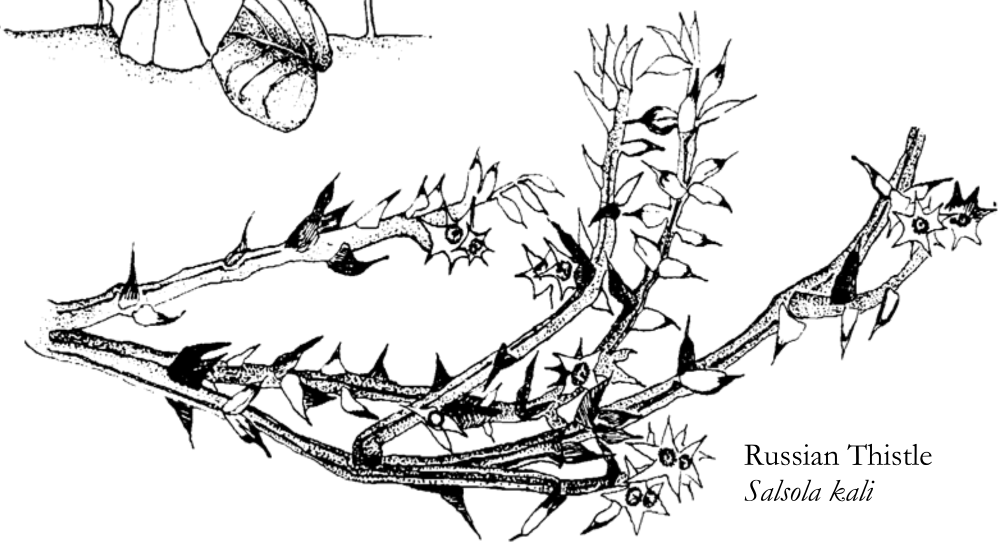
Primary Dunes Continued



Fiddle-Leaf Morning Glory
Ipomoea stolonifera

Railroad Vine
Ipomoea pes-caprea

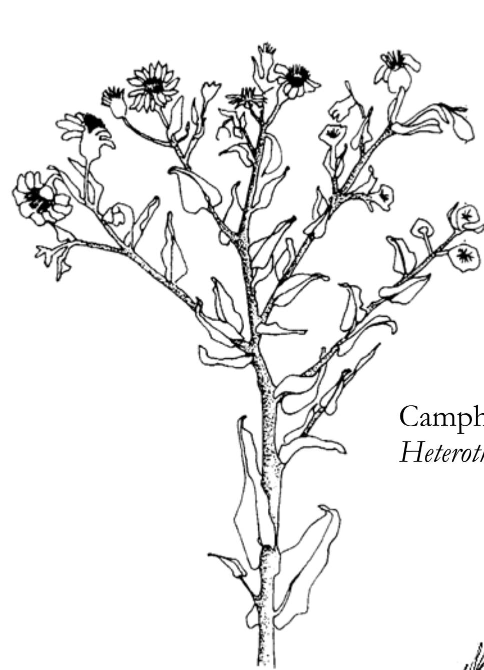




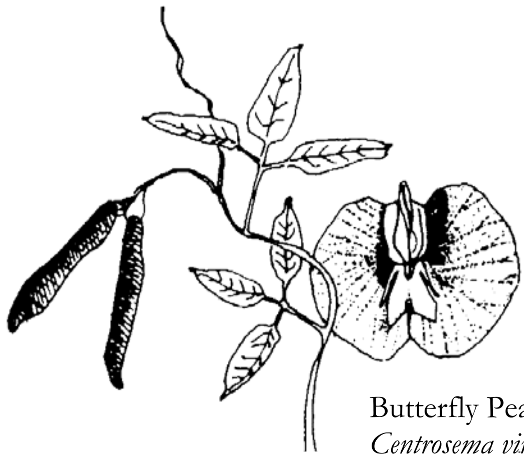
Russian Thistle
Salsola kali

Fiddle-Leaf Morning Glory: succulent leaf, large with flower, vine, summer-fall.
Railroad Vine: large purple flower, vine, fall.
Russian Thistle: succulent leaf with spine, small prickly flowers, summer.

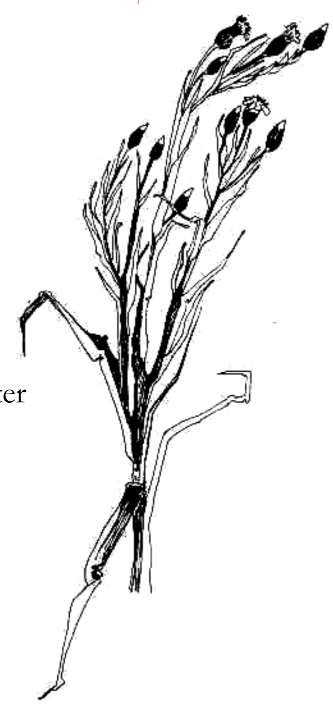
Dune Meadows



Camphorweed
Heterotheca subaxillaris

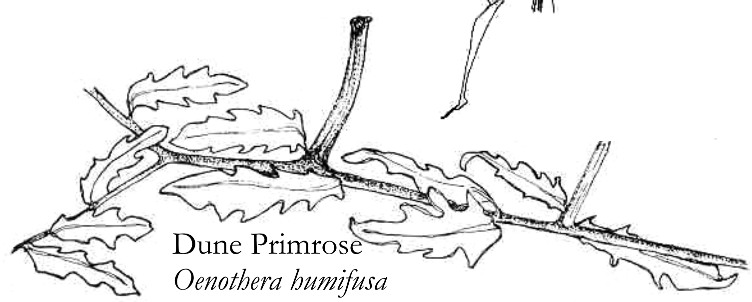


Butterfly Pea
Centrosema virginianum
Clitoria mariana



Grass-Leaf GoldenAster
Heterotheca graminifolia

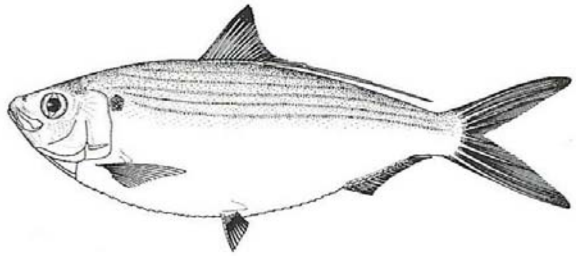
Wild Bean
Strophostyles umbrellata



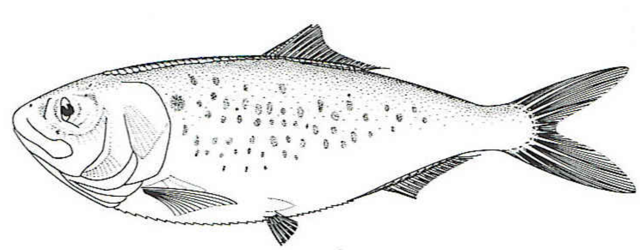
Dune Primrose
Oenothera humifusa

Camphorweed: yellow aster flower, fall.
Wild Bean: small red pea flower, slender pod, vine, summer-fall.
Butterfly Pea: large purple pea flower, vine, spring-fall.
Grass-Leaf Golden Aster: yellow aster flower, grass-like leaf, summer.
Dune Primrose: prostrate, pink and yellow flower, spring and fall.

Georgia Fish Identification Key

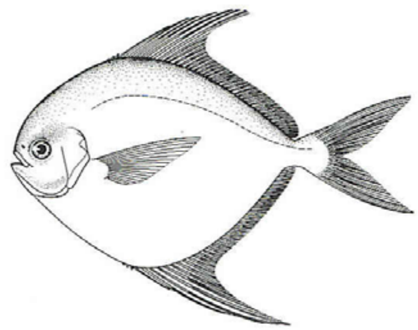


ATLANTIC THREAD HERRING
Opisthonema oglinum

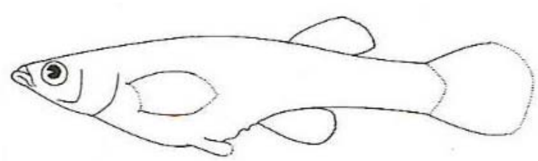


ATLANTIC MENHADEN
Brevoortia tyrannus

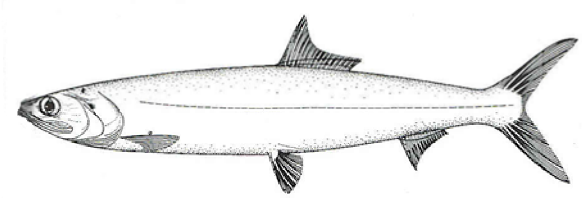
ATLANTIC NEEDLEFISH
Strongylura marina



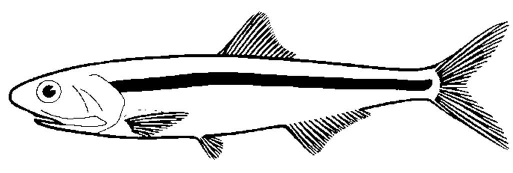
AMERICAN HARVESTFISH
Peprilus paru



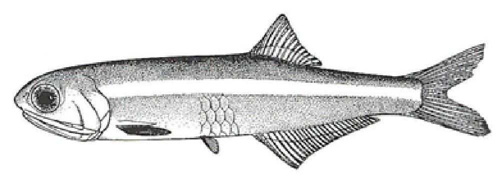
MOSQUITO FISH
Gambusia affinis



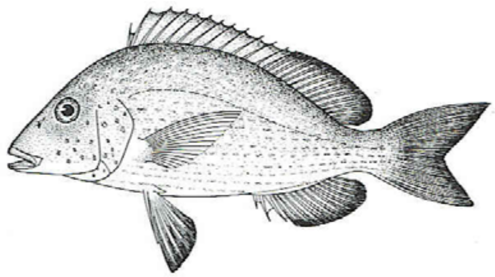
LADYFISH
Elops saurus



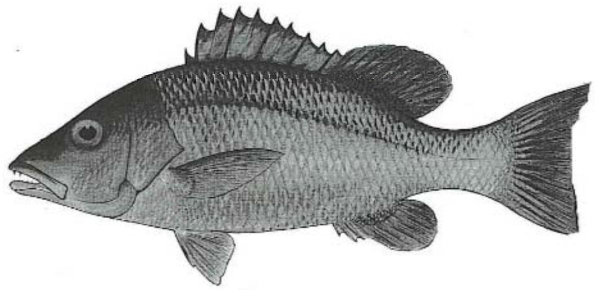
STRIPED ANCHOVY
Anchoa hepsetus



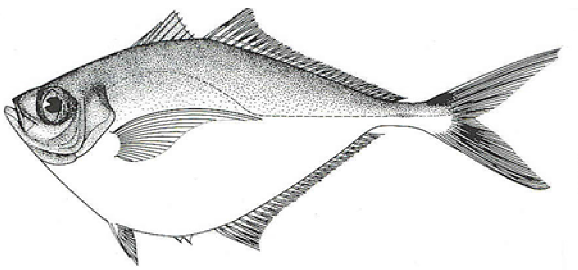
BAY ANCHOVY
Anchoa mitchilli



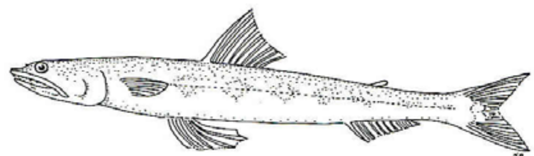
PIGFISH
Orthopristis chrysoptera



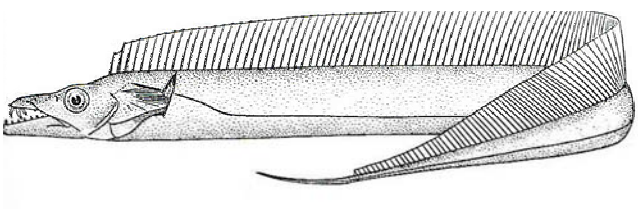
GREY SNAPPER
Lutjanus griseus



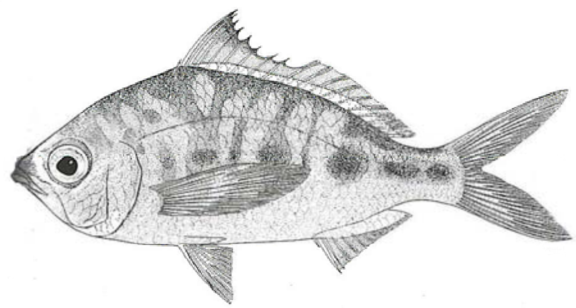
ATLANTIC BUMPER
Chloroscombrus chrysurus



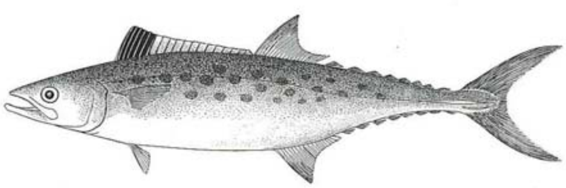
INSHORE LIZARDFISH
Synodus foetens



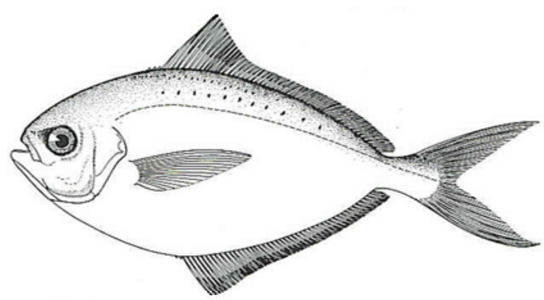
ATLANTIC CUTLASSFISH
Trichiurus lepturus



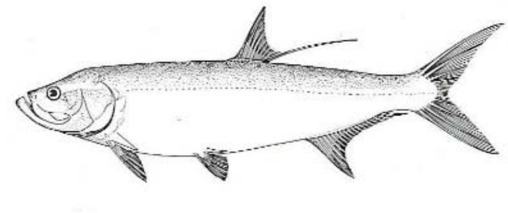
SILVER JENNY
Eucinostomus gula



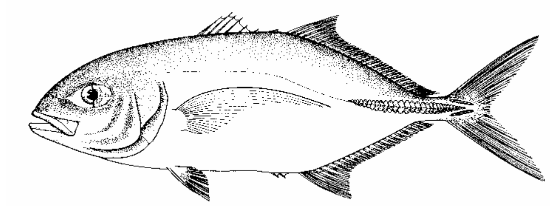
ATLANTIC SPANISH MACKEREL
Scomberomorus maculates



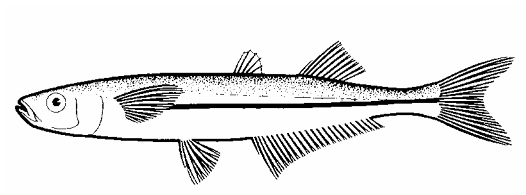
ATLANTIC BUTTERFISH
Peprilus triacanthus



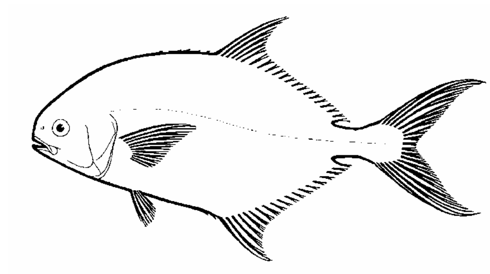
TARPON
Megalops atlanticus



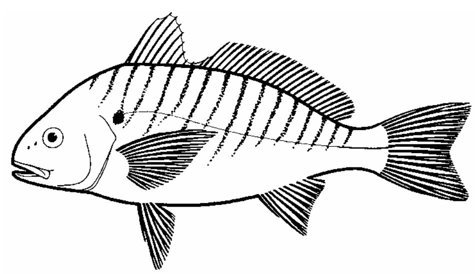
CREVALLE JACK
Caranx hippos



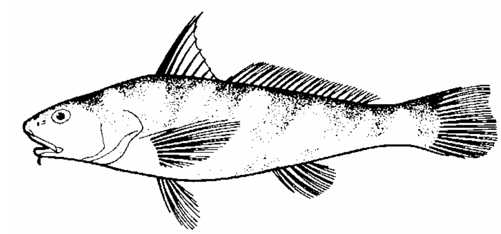
SILVERSIDE
Menidia menidia



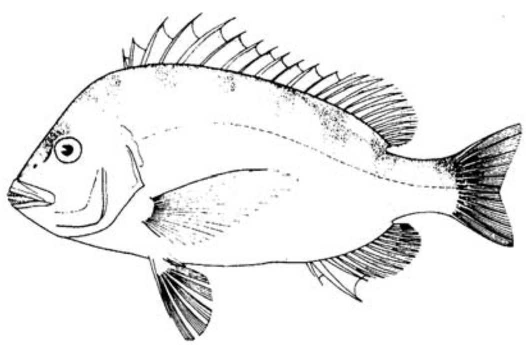
POMPANO
Trachinotus carolinus



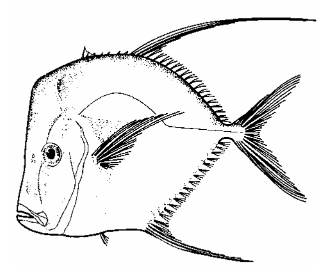
SPOT
Leiostomus xanthurus



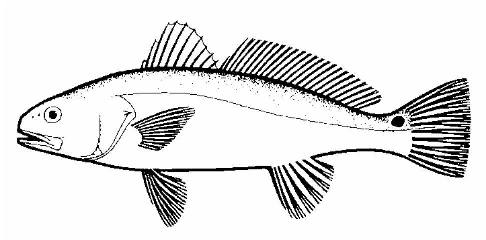
WHITING/KINGFISH
Menticirrhus americanus



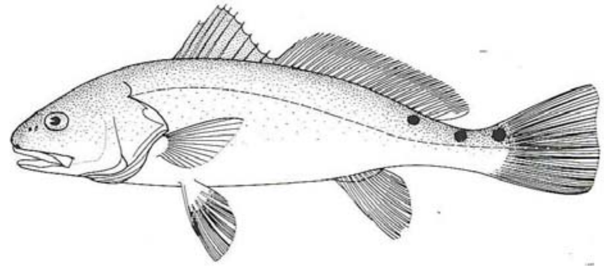
SHEEPSHEAD
Archosargus probatocephalus



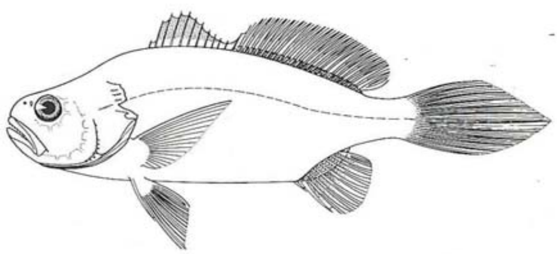
LOOKDOWN
Selene vomer



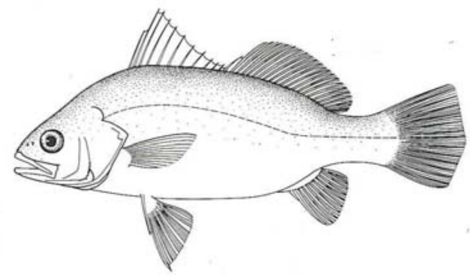
BLACK DRUM
Pogonias cromis



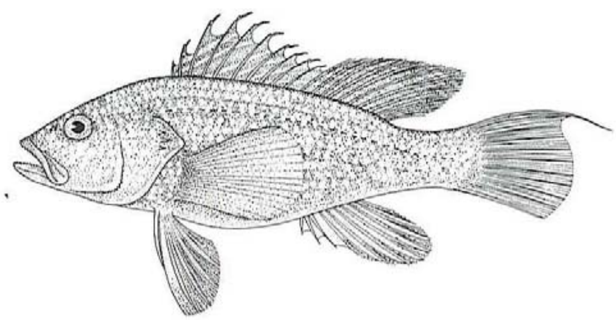
RED DRUM
Sciaenops ocellata



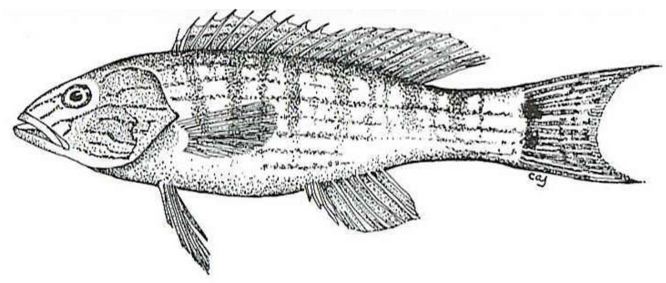
STAR DRUM
Stellifer lanceolatus



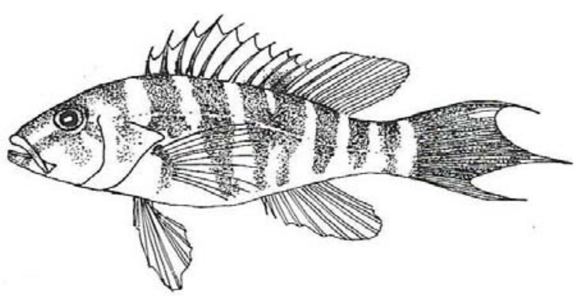
SILVER PERCH
Bairdiella chrysoura



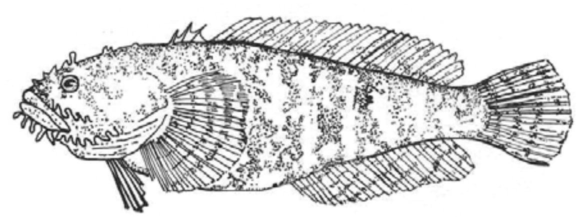
BLACK SEA BASS
Centropristis striata



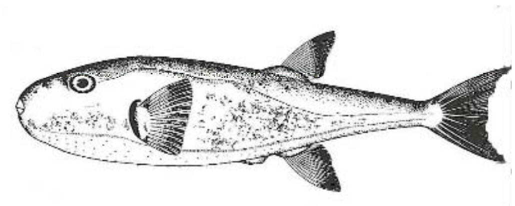
SAND PERCH
Diplectrum formosum



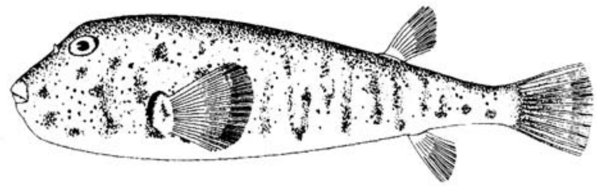
ROCK SEA BASS
Centropristis philadelphica



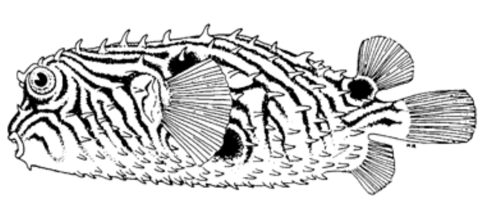
OYSTER TOADFISH
Opsanus tau



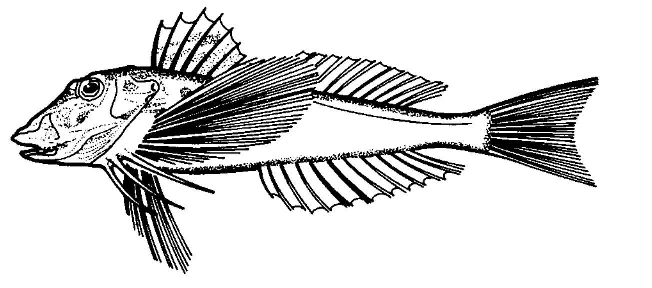
SMOOTH PUFFER
Lagocephalus laevigatus



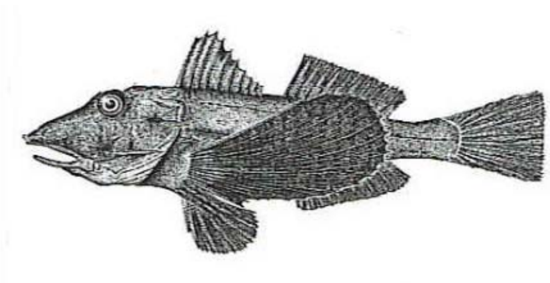
NORTHERN PUFFER
Sphoeroides maculatus



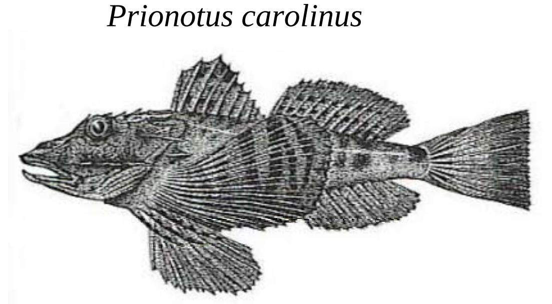
STRIPED BURRFISH
Chilomycterus schoepfi



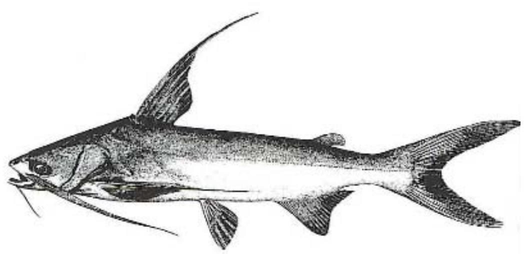
NORTHERN SEAROBIN
Prionotus carolinus



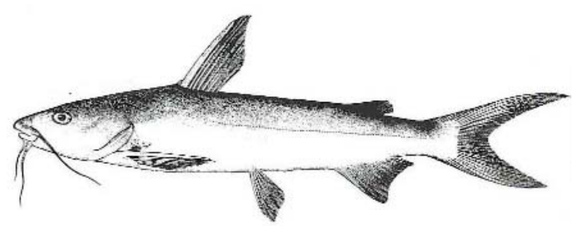
STRIPED SEAROBIN
Prionotus evolans



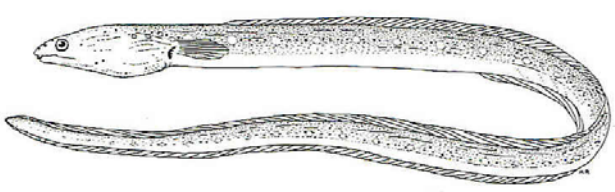
BIGHEAD SEAROBIN
Prionotus tribulus



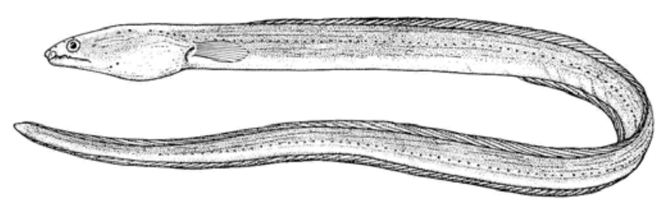
GAFFTOPSAIL SEA CATFISH
Bagre marinus



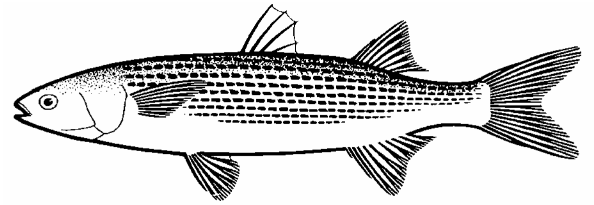
HARDHEAD SEA CATFISH
Ariopsis felis



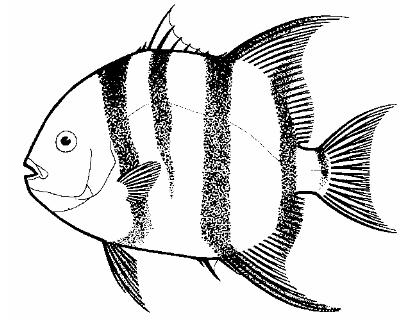
PALESPOTTED EEL
Ophichthus ocellatus



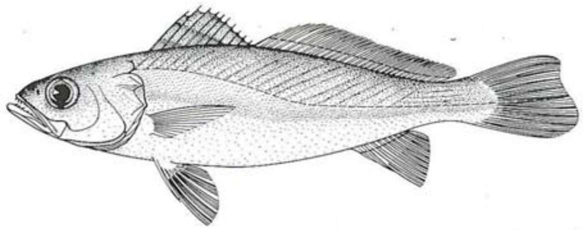
SHRIMP EEL
Ophichthus cruentifer



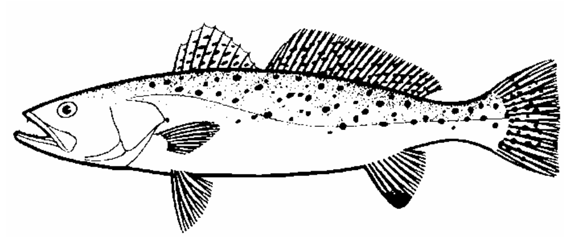
STRIPED MULLET
Mugil cephalus



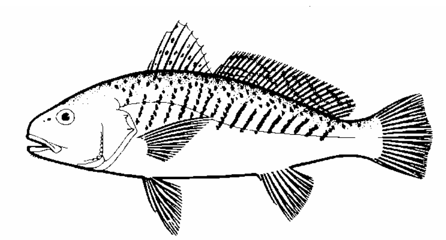
ATLANTIC SPADEFISH
Chaetodipterus faber



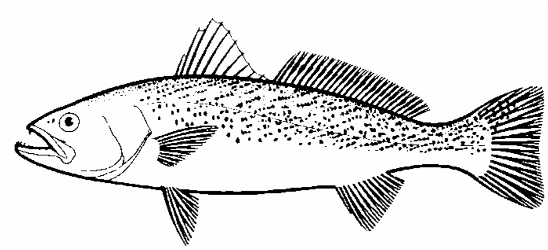
SILVER SEATROUT
Cynoscion nothus



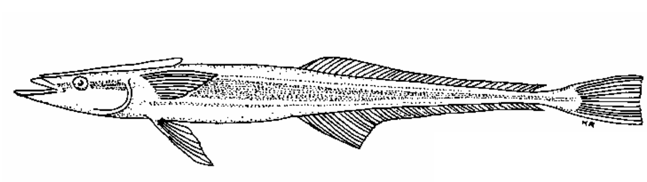
SPOTTED SEATROUT
Cynoscion nebulosus



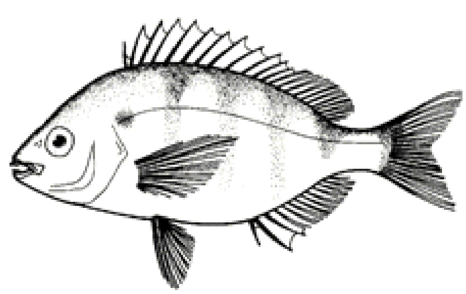
ATLANTIC CROAKER
Micropogonias undulatus



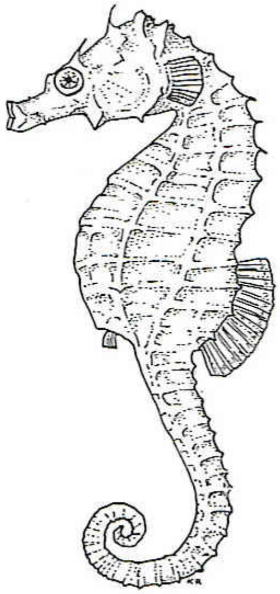
WEAKFISH
Cynoscion regalis



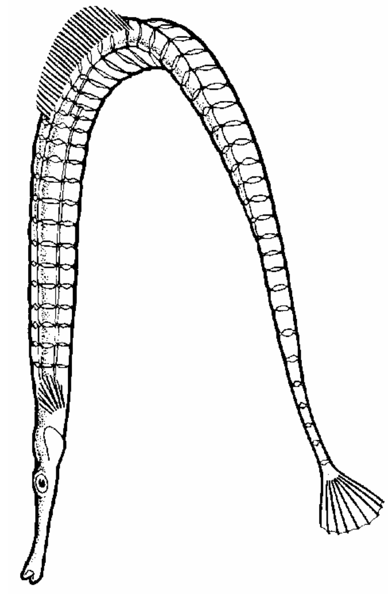
REMORA
Remora remora



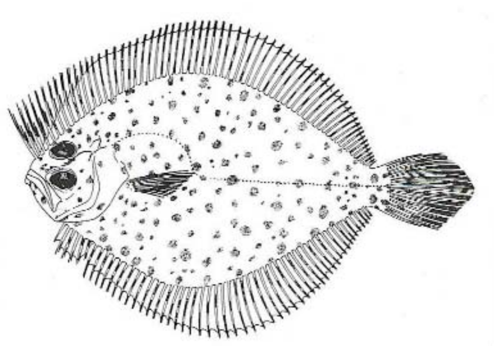
SPOTTAIL PINFISH
Diplodus holbrooki



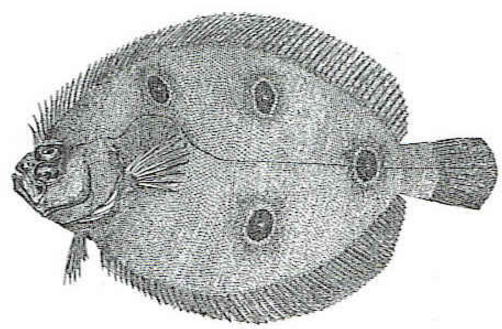
LINED SEAHORSE
Hippocampus erectus



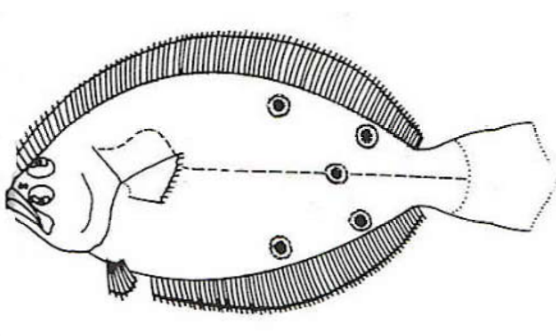
OPOSSUM PIPEFISH
Oostethus brachyurus



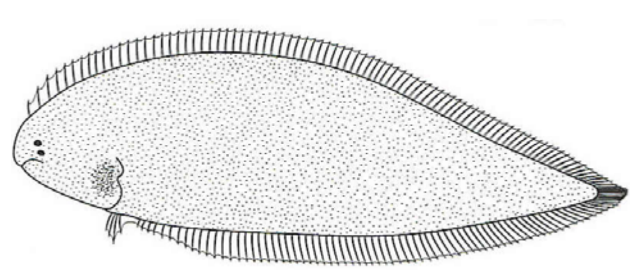
WINDOWPANE
Scophthalmus aquosus



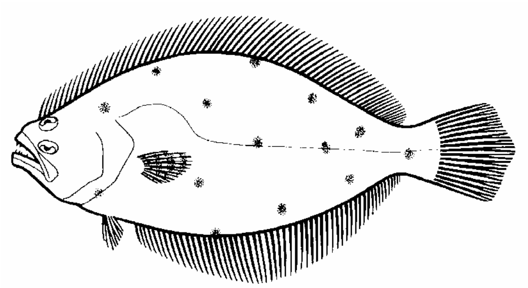
OCELLATED FLOUNDER
Ancylopsetta flounder



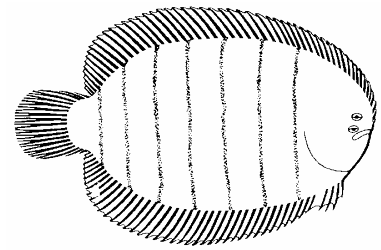
SUMMER FLOUNDER
Paralichthys dentatus



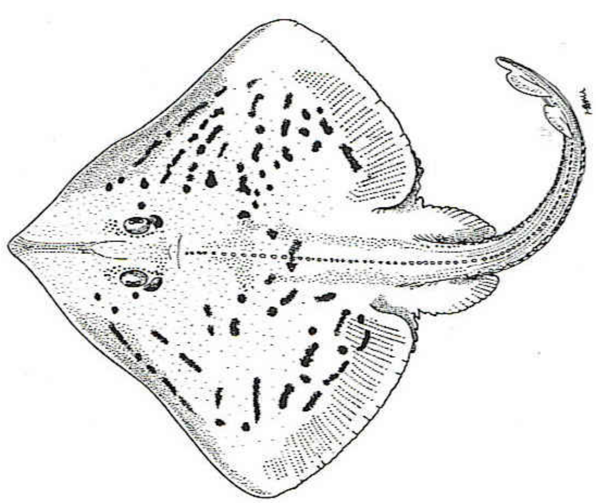
BLACKCHEEK TONGUEFISH
Symphurus plagusia



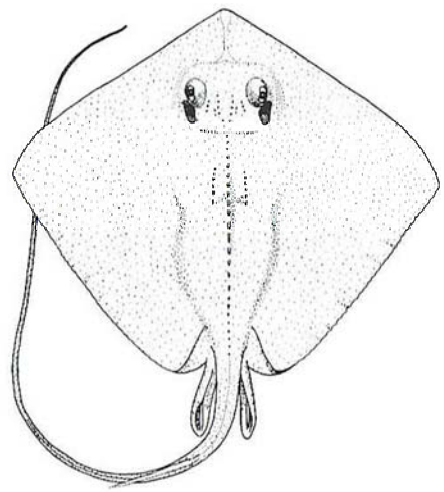
SOUTHERN FLOUNDER
Paralichthys squamilentus



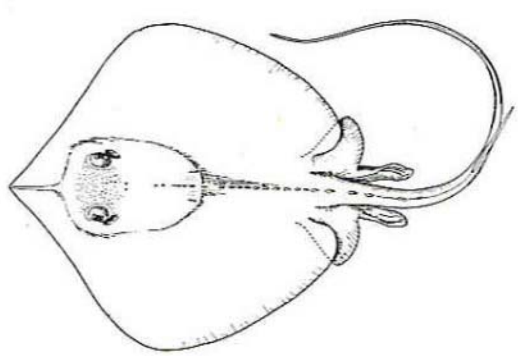
HOGCHOKER
Trinectes maculatus



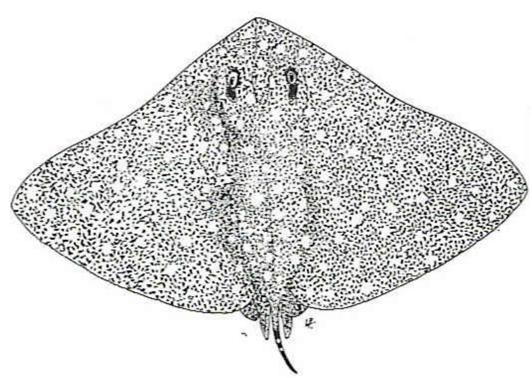
CLEARNOSE SKATE
Raja eglanteria



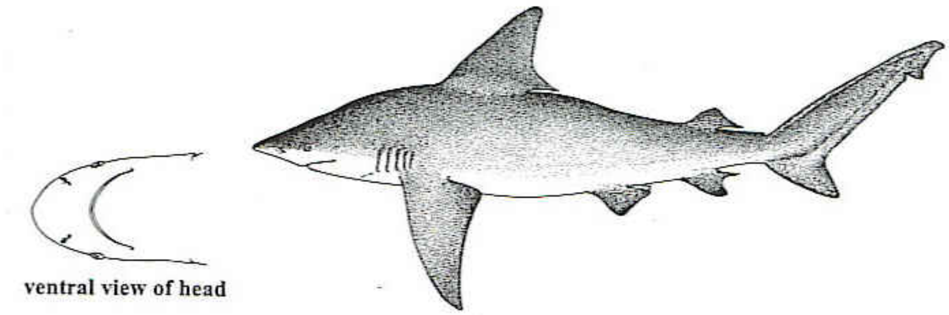
SOUTHERN STINGRAY
Dasyatis Americana



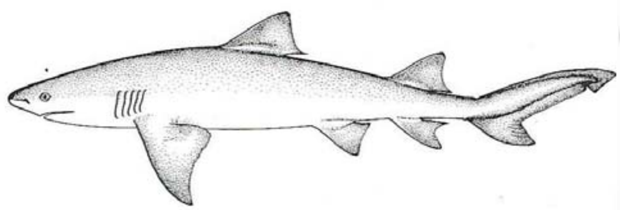
ATLANTIC STINGRAY
Dasyatis Sabina



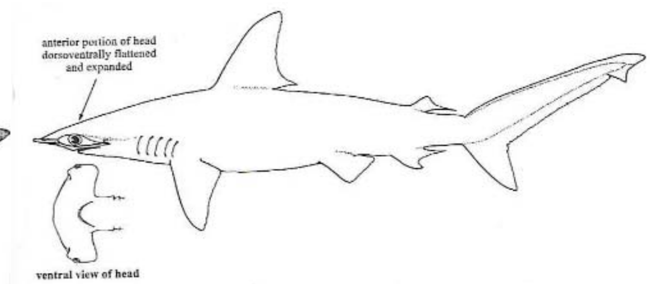
SMOOTH BUTTERFLY RAY
Gymnura micrura



SANDBAR SHARK
Carcharhunus plumbeus



LEMON SHARK
Negaprion brevirostris



BONNET HEAD SHARK
Sphyrna tiburo

Adopt-A-Wetland Program Evaluation

1. Is the chemical survey appropriate for your monitoring site?

2. Are the visual activities appropriate for your monitoring site?

3. Are the biological monitoring activities appropriate for your monitoring site?

4. Are any of the activities in the visual or biological survey too difficult?

5. Which directions in the manual are confusing?

6. Do you have any suggestions/comments concerning the monitoring program?

Please return evaluation to:
Adopt-A-Wetland Program, UGA Marine Extension Service, 20 Ocean Science Circle, Savannah, GA 31411, Fax: (912) 598-2399, Email msweeney@uga.edu

Useful Websites

Visit these website for good information/definitions on water chemistry topics

- http://wow.nrri.umn.edu/wow/under/parameters/temperature.html
- http://waterontheweb.org

Visit this website to find the taxonomic information for plants, fungi, and animals

- http://www.itis.usda.gov

Visit this website for some good information on Georgia seashells and mollusks

- http://www.arches.uga.edu/~amylyne/GSC/seashellGA.html

Visit this website for lots of information on invasive species

- http://www.sgnis.org

Visit this web site for information on animals, plants, water quality, and watersheds

- http://www.chesapeakbay.net/baybio.htm

Maryland Sea Grant website

- http://mdsg.umd.edu

Website for Volunteer Estuary Monitoring Methods Manual

- http://www.epa.gov/nep/monitor/

EPA Watershed Information

- http://www.epa.gov/owow/watershed

Georgia Adopt-A-Stream website

- http://www.riversalive.org

Conchologists of America- Conch-Net Home Page

- http://www.conchologistsofamerica.org

The Academy of Natural Sciences - Research - Patrick Center - Research Programs

- http://www.acnatsci.org/research

Earthguide - Earth Science Educational Resources

- http://earthguide.ucsd.edu

Center for Watershed Protection

- http://www.cwp.org/

Marine Protected Areas - News

- http://depts.washington.edu/mpanews/
- http://mpa.gov

Wetland Breaking News

- http://www.aswm.org/wbn

NODC Coastal Water Temperature Guide

- http://www.nodc.noaa.gov/dsdt/cwtg/

Links to information on Oyster Restoration

- http://water.dnr.state.sc.us/marine/mrri/shellfish
- http://www3.csc.noaa.gov/scoysters

Savannah-Weather from WTOC-TV, Savannah, GA.

- http://www.savannah-weather.com

For information on the Shannon-Wiener Diversity Index

- http://www.snr.missouri.edu/natr211/topics/shannon.htm

Metropolitan Planning Commission Water Resources Website

- http://www.thempc.org/

University of Georgia Shellfish Research Lab

- http://www.shellfish.uga.edu

Society of Wetland Scientists-Wetland related jobs

- http://www.sws.org

City of Savannah, Water and Sewer Bureau

- http://www.gwpca.org/cu-info/utilities/savannah.htm

Beach monitoring web site

- http://crd.dnr.state.ga.us (follow link to beaches under EDU and Outreach)

US Geological Survey

- www.usgs.gov

EPA Wetland Fact Sheets

- http://www.epa.gov/owow/wetlands/facts/contents.html

EPA's Most Frequently Asked Wetland Questions

- http://www.ehso.com/wetlands_information.htm

Useful Books on Coastal Wetlands

Aja, D. 1996. A Citizens Guide to Coastal Watershed Survey. Maine Department of Environmental Protection, Maine. 77 p.

Bahr, L.M, and W.P. Lanier. 1981. The ecology of intertidal oyster reefs of the South Atlantic coast: a community profile. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-81/15. 105pp.

Braccia, A. and Batzer, D.P. 2001. Invertebrates Associated with Woody Debris in a Southeastern U.S. Forested Floodplain Wetland. Wetlands. Vol. 21, No. 1. pp. 18-31

Coulombe, D. 1992. The Sea Side Naturalist. Fireside Publishing, New York, NY, 246 p.

Fischer, W. 1978. FAO species identification sheets for fishery purposes. Western Central Atlantic (fishing area 31). Vols. 1-7.

Gilligan, M. 1989. An illustrated field guide to the fishes of Gray's Reef National Marine Sanctuary. NOAA Technical Memorandum. Washington, D.C., 77p.

Heard, R.W. 1982. Guide to Common Tidal Marsh Invertebrates of the Northeastern Gulf of Mexico. Mississippi-Alabama Sea Grant Consortium. Reinbold Lithographing and Printing Co., Booneville, MS, 81p.

Kaplan, E.H. 1988. Peterson Field Guides, Southeastern and Caribbean Seashores. Houghton Mifflin Co., New York, NY, 425 p.

Miner, R. 1950. Field Book of Seashore Life. Van Rees Press, New York, NY. 888 p.

Mitchell, M. and Stapp, W. 1992. Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools. Thomson-Shore Printers, Dexter, Michigan. 240 p.

Niesen, T.M. 1982. The Marine Biology Coloring Book. Harper Resource, New York, NY, 115 p.

Olsen, M. Georgia's Wetland Treasures. Georgia Department of Natural Resources, Coastal Resources Division and U.S. Environmental Protection Agency publication, 218 p.

Pearce, M. 1999. Seashore Life Illustrations. Dover Publications, Mineola, NY. 32 p.

Robbins, C. R., and G.C. Ray. 1986. A Field Guide to Atlantic Coast Fishes. Houghton Mifflin Company, Boston, MA., 354p.

Ruppert, E.E. and R.S. Fox. 1988. Seashore Animals of the Southeast. University of South Carolina Press, Columbia, S.C., 428 p.

Stancioff, E. 1996. Clean Water: A Guide To Water Quality Monitoring. Maine/New Hampshire Sea Grant Marine Advisory Program & University of Maine Cooperative Extension, Orono, ME. 73 p.

Common Mollusks of Georgia

Phylum: MOLLUSCA
Class: GASTROPODA

Family	Scientific Name	Common Name
Acmaeidae	*Lottia antillarum*	Keyhole Limpet
Calyptraeidae	*Crepidula aculeata* (Gmelin, 1791)	Spiny Slipper
	Crepidula fornicata (Linnaeus, 1758)	Atlantic Slipper
	Crepidula plana (Say, 1822)	White Slipper
Columbellidae	*Anachis avara* (Say, 1822)	Greedy Dove Snail
	Columbella rusticoides	Common Dove Snail
Dentaliidae	*Dentalium laqueatum* (Verrill, 1885)	Panelled/Reticulate Tusk
Epitoniidae	*Epitonium angulatum* (Say, 1830)	Angulate Wentletrap
	Epitonium humphreysii (Kiener, 1838)	Humphrey's Wentletrap
	Epitonium rupicola (Kurtz, 1860)	Brown-Band Wentletrap
Fasciolariidae	*Fasciolaria hunteria* (Perry, 1811)	Banded Tulip
	Fasciolaria tulipa (Linnaeus, 1758)	True Tulip
	Pleuroploca gigantea (Kiener, 1840)	Florida Horse Conch
Favorinidae	*Cratena pilata*	Striped Nudibranch
Littorinidae	*Littorina irrorata* (Say, 1822)	Marsh Periwinkle
Melampodidae	*Melampus bidentatus* (Say, 1822)	Common Marsh Snail
Melongenidae	*Busycotypus canaliculatus*(Linnaeus, 1758)	Channeled Whelk
	Busycon carica (Gmelin, 1791)	Knobbed Whelk
	Busycon carica kieneri (Philippi, 1848)	Kiener's Whelk
	Busycon sinistrum (Hollister, 1958)	Lightning Whelk
	Busycotypus spiratus (Lamarck, 1816)	Pear Whelk
Muricidae	*Eupleura caudata* (Say, 1822)	Rough Oyster Drill
	Muricanthus fulvescens (Sowerby, 1834)	Giant Eastern Murex
	Phyllonotus pomum (Gmelin, 1791)	Apple Murex
Muricidae	*Thais haemastoma canaliculata* (Gray, 1839)	Southern Oyster Drill
	Thais haemastoma floridana (Conrad, 1837)	Florida Rock Shell
	Urosalpinx cinerea (Say, 1822)	Atlantic Oyster Drill
Nassariidae	*Ilyanassa obsoleta* (Say, 1822)	Eastern Mudsnail
	Nassarius trivittatus (Say, 1822)	New England Nassa
Naticidae	*Neverita duplicata* (Say, 1822)	Moon Snail/Shark Eye
	Sinum perspectivum (Say, 1831)	White Baby's Ear

Olividae	*Oliva sayana* (Ravenel, 1834)	Lettered Olive
	Olivella mutica (Link, 1807)	Variable Dwarf Olive
Pyramidellidae	*Boonea impressa* (Say, 1822)	Impressed Odostome
Terebridae	*Terebra dislocata* (Say, 1822)	Common Eastern Augur

Class: BIVALVIA

Family	**Scientific Name**	**Common Name**
Anomiidae	*Anomia simplex* (d'Orbigny, 1842)	Common Atlantic Jingle
Arcidae	*Anadara lienosa floridana* (Conrad, 1869)	Cut-Ribbed Ark
	Anadara ovalis (Brugière, 1789)	Blood Ark
	Anadara transversa (Say, 1822)	Transverse Ark
	Arca zebra (Swainson, 1833)	Turkey Wing
	Barbatia candida (Helbling, 1779)	White-Bearded Ark
	Barbatia domingensis (Lamarck, 1819)	White Miniature Ark
	Noetia ponderosa (Say, 1822)	Ponderous Ark
Cardiidae	*Dinocardium robustum* (Lightfoot, 1786)	Giant Atlantic Cockle
	Laevicardium laevigatum (Linnaeus, 1758)	Common Egg Cockle
	Laevicardium mortoni (Conrad, 1830)	Morton's Egg Cockle
	Laevicardium pictum (Ravenel, 1861)	Ravenel's/Painted Egg Cockle
	Trachycardium egmontianum (Shuttleworth, 1856)	Florida Prickly Cockle
Chamidae	*Arcinella cornuta* (Conrad, 1866)	Florida Spiny Jewelbox
Corbiculidae	*Polymesoda caroliniana* (Bosc, 1801)	Carolina Marshclam
Donacidae	*Donax variabilis* (Say, 1822)	Florida Coquina
Glycymerididae	*Glycymeris americana* (DeFrance, 1829)	Giant American Bittersweet
Lucinidae	*Divaricella quadrisulcata* (d'Orbigny, 1842)	Cross-Hatched Lucin
	Linga pensylvanica (Linnaeus, 1758)	Pennsylvania Lucine
Mactridae	*Raeta plicatella* (Lamarck, 1818)	Channeled Duckclam
	Mactra fragilis (Gmelin, 1791)	Fragile Surfclam
	Mulinia lateralis (Say, 1822)	Dwarf Surf Clam
	Spisula raveneli (Conrad, 1831)	Southern Surf Clam
	Rangia cuneata (Sowerby, 1831)	Common Rangia
	Spisula solidissima	Atlantic Surf Clam
Myidae	*Sphenia antillensis* (Dall & Simpson, 1901)	Antillean Sphenia
Mytilidae	*Amygdalum papyrium* (Conrad, 1846)	Paper Mussel
	Brachidontes exustus (Linnaeus, 158)	Scorched Mussel
	Geukensia demissa (Dillwyn, 1817)	Atlantic Ribbed Mussel

Mytilidae	*Ischadium recurvum* (Rafinisque, 1820)	Hooked Mussel
	Lioberus castaneus (Say, 1822)	Chestnut Mussel
	Modiolus americanus (Leach, 1815)	Tulip Mussel
Ostreidae	*Crassostrea virginica* (Gmelin, 1791)	American Eastern Oyster
	Ostrea equestris (Say, 1834)	Crested Oyster
Pandoridae	*Pandora trilineata* (Say, 1822)	Say's/Threeline Pandora
Pectinidae	*Aequipecten muscosus* (Wood, 1828)	Rough Scallop
	Argopecten gibbus (Linnaeus, 1758)	Atlantic Calico Scallop
	Nodipecten nodosus (Linnaeus, 1758)	Lion's Paw
	Pecten ziczac (Linnaeus, 1758)	Zigzag Scallop
	Chlamys sentis (Reeve, 1853)	Sentis/Scaly Scallop
Pholadidae	*Barnea truncata* (Say, 1822)	Fallen Angel Wing
	Cyrtopleura costata (Linnaeus, 1758)	Angel Wing
	Martesia cuneiformis (Say, 1822)	Wedge Piddock
Pinnidae	*Atrina rigida* (Lightfoot, 1786)	Rigid Penshell
	Atrina seminuda (Lamarck, 1819)	Half-naked Penshell
	Atrina serrata (Sowerby, 1825)	Saw-toothed Penshell
Pteriidae	*Pteria colymbus* (Röding, 1798)	Atlantic Wing Oyster
Semelidae	*Abra aequalis* (Say, 1822)	Atlantic Abra
	Cumingia tellinoides (Conrad, 1837)	Common Cumingia
	Semele proficua (Pulteney, 1799)	White Atlantic Semele
	Semele purpurascens (Gmelin, 1791)	Purplish Semele
Solecurtidae	*Tagelus divisus* (Spengler, 1794)	Purplish Tagelus
	Tagelus plebeius (Lightfoot, 1786)	Stout Tagelus
Solenidae	*Ensis directus* (Conrad, 1843)	Atlantic Jackknife Clam
	Solen viridis (Say, 1821)	Green Jackknife Clam
Spondylidae	*Spondylus americanus* (Hermann, 1781)	Atlantic Thorny Oyster
Tellinidae	*Macoma balthica* (Linnaeus, 1758)	Baltic Macoma
	Macoma constricta (Bruguière, 1792)	Constricted Macoma
	Tellina alternata (Say, 1822)	Alternate Tellin
	Tellina listeri (Röding, 1798)	Speckled Tellin
Veneridae	*Chione intapurpurea* (Conrad, 1849)	Lady-in-Waiting Venus
	Chione latilirata (Conrad, 1841)	Imperial Venus
	Dosinia discus (Reeve, 1850)	Disk Clam
	Macrocallista maculata (Linnaeus, 1758)	Calico Clam
	Macrocallista nimbosa (Lightfoot, 1786)	Sunray Venus
	Mercenaria campèchiensis (Gmelin, 1791)	Southern Quahog
	Mercenaria mercenaria (Linnaeus, 1758)	Northern Quahog
	*Mercenaria mercenaria (*ecolocgical form *notata*)	Northern Quahog

Other Common Marine Invertebrate Organisms of Georgia

Phylum: PORIFERA
Class: DEMOSPONGIAE (Sponges)

Family	Scientific Name	Common Name
Microcionidae	*Microciona prolifera*	Redbeard Sponge
Desmacidonidae	*Haliclona oculata*	Finger Sponge
Clionidae	*Cliona Sp.*	Boring Sponge
Homocoelidae	*Scypha Sp.*	Basket Sponge

Phylum: CNIDARIA
Class: ANTHOZOA (Anemones)

Gorgoniidae	*Leptogorgia virgulata*	Sea Whip
Renillidae	*Renilla reniformis*	Sea Pansy
Actinidae	*Actinoporus elegans*	Brown-Striped Anemone

Class: SCYPHOZOA (Jellyfish)

Stomolophidae	*Stomolophus meleagris*	Cannonball Jellyfish
Ulmaridae	*Aurelia aurita*	Moon Jellyfish
Pelagidae	*Chrysaora quinquecirrha*	Sea Nettle

Phylum: CTENOPHORA
Class: TENTACULATA (Comb Jellies)

Bolinopsidae	*Mnemiopsis mccradyi*	Comb Jelly

Phylum: ECHINODERMATA
Class HOLOTHUROIDEA (Sea Cucumbers)

Sclerodactylidae	*Sclerodactyla briareus*	Sea Cucumber

Class: ASTEROIDEA (Sea Stars)

Asteriidae	*Asterias forbesi*	Sea Star

Phylum: ANNELIDA
Class: POLYCHAETA (Worms)

Nereidae	Nereis succinea	Southern Clam Worm
Onuphidae	Diopatra cuprea	Plumed Worm
Sabellidae	Fabricia sabella	Fan Worm

Class: ECHINOIDEA (Sea Urchins, Sand Dollars)

Mellitidae	*Mellita quinquiesperforata*	Key Hole Urchin
Toxopneustidae	*Lytechinus variegates*	Sea Urchin

Class: OPHUROIDEA (Brittle Stars)

Ophiodermatidae	*Ophioderma brevispinum*	Smooth Brittle Star

Phylum: ARTHROPODA

Class: PYCNOGONITA (Sea Spiders)

Tanystylidae	*Tanystylum orbiculare*	White Sea Spider

Class: Cirripedia (Barnacles)

Cthamalidae	*Chthamalus fragilis*	Fragile Barnacle
Balanidae	*Balanus eburneus*	Ivory Barnacle
Lepadidae	*Lepas anatifera*	Goose Neck Barnacle

Class: MEROSTOMATA (Horseshoe crabs)

Limulidae	*Limulus polyphemus*	Atlantic Horseshoe Crab

Class: MALACOSTRACA (Crabs, Shrimps)

Portunidae	*Callinectes sapidus*	Blue Crab
Xanthidae	*Panopeus obesus*	Mud Crab
	Menippe mercenaria	Stone Crab
	Rhithropanopeus harrisii	White-Fingered Mud Crab
Calappidae	*Hepatus epheliticus*	Dolly Varden/Calico Crab

Leucosiidae	*Persephona punctata*	Purse Crab
Majidae	*Libinia emarginata*	Common Spider Crab
Portunidae	*Carcinus maenas* *Ovalipes ocellatus* *Arenaeus cribarius*	Green/Porcelain Crab Lady Crab Speckled Crab
Grapsidae	*Sesarma reticulatum* *Sesarma cinereum*	Marsh Crab Wharf Crab
Ocypodidae	*Uca pugnax* *Uca minax*	Mud Fiddler Crab Brackish Fiddler Crab
Ocypodidae	*Uca pugilator*	Sand Fiddler Crab
Penaeidae	*Penaeus aztecus* *Penaeus duorarum* *Penaeus setiferus*	Brown Shrimp Pink Shrimp White Shrimp
Hippolytidae	*Hippolyte sp.*	Grass Shrimp
Squillidae	*Squilla empusa*	Mantis Shrimp
Diogenidae	*Clibanarius vittatus*	Striped Hermit Crab
Hippidae	*Emerita talpoida*	Mole Crab
Gammaridae	*Gammarus palustris*	Scud amphipod
Haustoriidae	*Haustorius Canadensis*	Digger Amphipods
Caprellidae	*Caprella equilibra*	Skeleton Shrimp

Phylum: CHORDATA
Class: ASCIDIACEA (Tunicates, Sea Squirts)

Styelidae	*Styela plicata*	Rough (pleated) Sea Squirts
Molgulidae	*Molgula manhattensis*	Sea grapes
Polyclinidae	*Aplidium constellatum*	Sea Pork

Common Fishes of Georgia

Phylum: CHORDATA
Class: OSTEICHTHYES (Bony Fishes)

Family	Scientific Name	Common Name
Acipenseridae	*Acipenser brevirostrum*	Atlantic Sturgeon
Lepisosteiformes	*Lepisosteus osseus*	Longnose Gar
Elopidae	*Elops saurus*	Ladyfish
	Megalops atlanticus	Tarpon
Anguillidae	*Auguilla rostrata*	American Eel
Ophichthidae	*Ophichthus gomesi*	Shrimp eel
	Ophichthus ocellatus	Palespotted eel
Clupeidae	*Opisthonema oglinum*	Atlantic Thread Herring
	Brevoortia tyrannus	Atlantic Menhaden
Engraulidae	*Anchoa hepsetus*	Striped Anchovy
	Anchoa mitchilli	Bay Anchovy
Ariidae	*Arius felis*	Sea Catfish
	Bagre marinus	Gafftopsail Catfish
Synodontidae	*Synodus foetens*	Inshore Lizardfish
Gadidae	*Urophycis regia*	Spotted Hake
	Urophycis foridana	Southern Hake
Batrachoididae	*Opsanus tau*	Oyster Toadfish
Gobiesocidae	*Gobiesox strumosus*	Skilletfish
Belonidae	*Strongylura marina*	Atlantic Needlefish
Cyprinodontidae	*Cyprinodon variegates*	Sheepshead minnow
	Fundulus majalis	Striped Killifish
Poeciliidae	*Gambusia affinis*	Mosquitofish
	Poecilia latipinna	Sailfin Molly
Atherinidae	*Menidia menidia*	Atlantic silverside
Syngnathidae	*Hippocampus erectus*	Lined Seahorse
	Oostethus brachyurus	Northern pipefish

Triglidae	*Prionotus carolinus*	Northern Sea Robin
	Prionotus evolans	Striped Sea Robin
	Prionotus tribulus	Big Head Sea Robin
Bothidae	*Ancylopsetta quadrocellata*	Ocellated Flounder
	Scophthalmus aquosus	Windowpane
	Paralichthys dentatus	Summer Flounder
	Paralichthys squamilentus	Southern Flounder
Soleidae	*Trinectes maculates*	Hogchoker
	Symphurus plagiusa	Blackcheek Tonguefish
Balistidae	*Monacanthus hispidus*	Planeheaded Filefish
Ostraciidae	*Lactophrys quadricornis*	Scrawled Cowfish
Tetraodontidae	*Lagocephalus lagocephalus*	Smooth Puffer
	Sphoeroides maculates	Northern Puffer
	Chilomycterus schoepfi	Striped burrfish
Percichthyidae	*Morone saxatilis*	Striped Bass
Serranidae	*Centropristis Philadelphia*	Rock Sea Bass
	Centropristis striata	Black Sea Bass
	Diplectrum formosum	Sand Perch
	Mycteroperca phenax	Scamp
	Mycteroperca microlepis	Gag
Pomatomidae	*Pomatomus saltatrix*	Bluefish
Echeneidae	*Remora remora*	Sharksuckers
Carangidae	*Caranx hippos*	Crevalle Jack
	Chloroscombrus chrysurus	Atlantic Bumper
	Selene vomer	Lookdown
	Trachinotus carolinus	Florida Pompano
Lutjanidae	*Lutjanus griseus*	Gray Snapper
Gerreidae	*Eucinostomus gula*	Silver Jenny
Haemulidae	*Orthopristis chrysoptera*	Pigfish
Sparidae	*Archosargus probatocelphalus*	Sheepshead
	Diplodus holbroooki	Pinfish
Sciaenidae	*Bairdiella chrysoura*	Silver Perch
	Cynoscion nebulosus	Spotted Seatrout
	Cynoscion nothus	Silver Seatrout
	Cynoscion regalis	Weakfish
Sciaenidae	*Sciaenops ocellatus*	Red Drum
	Leiostomus xanthurus	Spot

	Larimus fasciatus	Banded Drum
	Pogonias cromis	Black Drum
	Menticirrhus americanus	Kingfish/Whiting
	Menticirrhus littoralis	Gulf Kinfish
	Micropogonias undulates	Atlantic Croaker
	Stellifer lanceolatus	Star Drum
Ephippidae	*Chaetodipterus faber*	Atlantic Spadefish
Chaetodontidae	*Chaetodon ocellatus*	Spotfin Butterflyfish
	Chaetodon sedentarius	Reef Butterflyfish
Pomacanthidae	*Holacanthus ciliaris*	Blue Angelfish
	Pomacanthus arcuatus	Gray Angelfish
Mugilidae	*Mugil cephalus*	Striped Mullet
	Mugil curema	White Mullet
Sphyraenidae	*Sphyraena picudilla*	Southern Sennet
Uranoscopidae	*Astroscopus y-graecum*	Southern Stargazer
Blenniidae	*Chasmodes bosquianus*	Striped Blenny
	Hyposoblennius hentz	Feather Blenny
Gobiidae	*Gobiosoma bose*	Naked Goby
Trichiuridae	*Trichiurus lepturus*	Atlantic Cutlass fish
Stromateidae	*Peprilus paru*	Southern Harvestfish
	Peppilus triacanthus	Butterfish
Scombridae	*Scomberomorus maculates*	Spanish Mackerel

Class: ELASMOBRANCHIOMORPHI (Sharks, Skates)

Family	**Scientific Name**	**Common Name**
Dasyatidae	*Dasyatis Sabina*	Atlantic Stingray
	Dasyatis Americana	Southern Stingray
Gymnuridae	*Gymnura micrura*	Smooth Butterfly Ray
Rajidae	*Raja eglanteria*	Clearnose Skate
Sphyrnidae	*Sphyrna tiburo*	Bonnet Head Shark
Carcharhinidae	*Negaprion brevirostris*	Lemon Shark
	Carcharhimus plumbeus	Sandbar Shark

Introduced Aquatic Species in Georgia

Group	Species	Common Name
Amphibians-Frogs	*Eleutherodactylus planirostris*	Greenhouse Frog
Amphibians-Frogs	*Osteopilus septentrionalis*	Cuban Tree Frog
Coelenterates-Hydrozoans	*Craspedacusta sowerbyii*	Freshwater Jellyfish
Crustaceans-Copepods	*Argulus japonicus*	Parasitic Copepod
Crustaceans-Shrimp	*Penaeus monodon*	Asian Tiger Shrimp
Fishes	*Astronotus ocellatus*	Oscar
Mollusks-Bivalves	*Corbicula fluminea*	Asian Clam
Mollusks-Bivalves	*Perna viridis*	Green Mussel
Mollusks-Gastropods	*Pomacea sp.*	Applesnail
Fishes	*Carassius auratus*	Goldfish
Fishes	*Clarias batrachus*	Walking Catfish
Fishes	*Ctenopharyngodon idella*	Grass Carp
Fishes	*Cyprinus carpio*	Common Carp
Fishes	*Leuciscus idus*	Ide
Fishes	*Monopterus albus*	Asian Swamp Eel
Fishes	*Oreochromis aureus*	Blue Tilapia
Fishes	*Oreochromis mossambicus*	Mozambiqua Tilapia
Fishes	*Oreochromis niloticus*	Nile Tilapia
Fishes	*Oreochromis, Sarotherodon, Tilapia sp.*	Tilapia
Fishes	*Piaractus brachypomus*	Pirapatinga, Red-bellied Pacu
Fishes	*Pterois volitans*	Lionfish
Fishes	*Salmo trutta*	Brown Trout
Fishes	*Tinca tinca*	Tench
Mammals	*Myocastor coypus*	Nutria
Plants	*Alliaria petiolata*	Garlic Mustard
Plants	*Alternanthera philoxeroides*	Alligatorweed
Plants	*Eichhornia crassipes*	Water Hyacinth
Plants	*Fallopia japonica*	Japanese Knotweed
Plants	*Hydrilla verticillata*	Hydrilla
Plants	*Imperata cylindrica*	Cogongrass
Plants	*Murdannia keisak*	Asian Spiderwort
Plants	*Myriophyllum aquaticum*	Parrotfeather
Plants	*Myriophyllum spicatum*	Eurasian Water Milfoil
Plants	*Phragmites australis*	Common Reed
Plants	*Pistia stratiotes*	Water Lettuce
Plants	*Pueraria montana*	Kudzu
Plants	*Salvinia molesta*	Giant Salvinia
Plants	*Triadica sebiferum*	Chinese Tallow Tree

Source

USGS (http://nas.er.usgs.gov/queries/StateSearch.asp) 08/11/05 & US Dept Agriculture (http://plants.usda.gov/) 10/18/05