ECOHAB: *Karenia*

DEFINITIONS AND TERMINOLOGY

Atmospheric deposition
Occurs when material falls from the atmosphere and are deposited onto the earth and sea surface, primarily due to wind forcing. Iron associated with dust from the Sahara Desert in Africa can be transported across the Atlantic Ocean and be deposited in the Gulf of Mexico, where it may become available to algae. Nitrogen and phosphorus attached to particles derived from agricultural, urban, and industrial emissions may also be deposited at the ocean surface, most often from local sources.

Autotrophic
Refers to organisms that are capable of producing complex organic compounds using inorganic compounds as a source of elements (e.g., CO_2, nitrate, ammonium, phosphate, sulfate, trace elements). To accomplish the synthesis of compounds, autotrophs use energy derived from either light (photosynthesis) or chemicals (chemosynthesis) and are termed photoautotrophs or chemoautotrophs respectively (see **Phototrophic** and **Chemotrophic**).

Benthic flux
The movement of nutrients from the sea floor or bottom (the benthos) into the water column above.

Bloom
A dense aggregation of algal cells above normal (background) concentrations. For *Karenia brevis*, a bloom occurs after concentrations have reached 100,000 cells per liter; shellfish beds are closed to harvesting when concentrations are measured above 5,000 cells per liter.

Coastal
Relating to the relatively shallow waters located at or adjacent to coastlines. Coastal waters may extend as far as 15 miles from the mainland.

Chlorophyll *a*
Chlorophyll *a* is a dominant pigment of chlorophyll (an essential compound in the process of photosynthesis). Measuring the amount of chlorophyll *a* present in the water is a quick and accurate way to quantify photosynthetic algal biomass in a sample and is usually determined through chlorophyll *a* fluorometry (see **Chlorophyll *a* fluorometry**).

Chlorophyll *a* fluorometry

Chlorophyll *a* fluorometry is the measurement of fluorescence in chlorophyll *a* cells. Fluorescence is when light harvesting pigments (such as chlorophyll a) re-emit absorbed light at a lower wavelength to prevent damage to the pigment from excessive energy. A beam of light is used to excite the electrons in the molecules of certain compounds, such as chlorophyll *a*, causing them to emit measurable light. The intensity and wavelength of the emitted light provides an indirect measure of the amount of chlorophyll *a* present.

Chemotrophic

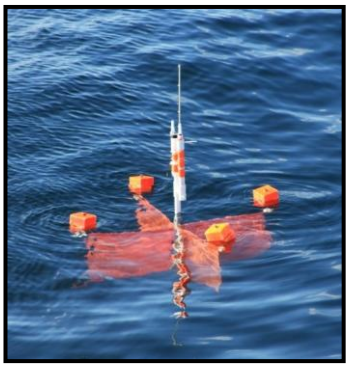
Use of chemical energy to fuel cellular reactions and processes.

CTD

Named for the parameters it commonly measures, Conductivity (salinity), Temperature, and Depth; the CTD is an instrument crucial to shipboard oceanographic research. A CTD is usually incorporated with Niskin sampling bottles (see **Niskin bottle**) on a device called a sampling rosette. As the rosette is lowered and raised through the water column temperature and salinity data are recorded in real time. At desired depths the Niskin bottles can be closed remotely. (View videos of CTD deployment, CTD upcast, and CTD recovery.)

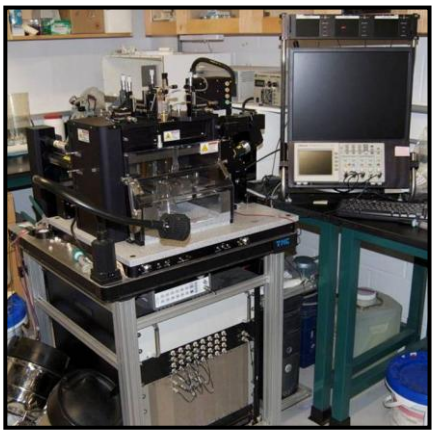
Drogue

A drogue, or surface drifter, is used by oceanographers to track the movement of water or particles in the water (such as red tide cells) over time. The surface drifter used in the ECOHAB project has four water sails attached to a polyvinyl chloride (PVC) core and is configured in a pattern developed by Professor Russ Davis of Scripps Institute of Oceanography, La Jolla, California, for the Coastal Ocean Dynamics Experiment (CODE) conducted off the coast of California in the 1980s. The drifter is deployed in a bloom, and its position is recorded at 15-minute intervals when a signal is received by a global positioning system (GPS) unit located on the ship. The positions are transmitted through a very high frequency (VHF) radio link with an effective range of 5 to 7 nautical miles. The positions can also be downloaded from the drifter after the unit is retrieved at the end of an experiment. Sampling at the drifter location over time allows scientists to track the same parcel of water.



Estuarine
Relating to waters with both riverine and marine origins. Estuaries are semi-closed bodies of water that are flushed by waters from the open marine environment and also receive significant freshwater input from rivers and streams.

Epifluorescence Microscopy
A technique to visualize cells that are naturally fluorescent (emit light) or have been stained with a fluorescent dye through use of an epifluorescent microscope. This specialized microscope directs a narrow range of light wavelength onto the sample from above and then focuses the fluorescence emission (light emitted by the sample) to the oculars. A series of filters and mirrors allows for the excitation light to be distinguished from the fluorescent light.



Flow Cytometry
The measurement of physical and/or chemical characteristic of single cells located in a fluid stream. The instrument condenses a stream of sample that is injected into the center of another flowing fluid (called sheath fluid) into a stream of single cells. The resulting stream passes through a laser beam whose light is reflected or refracted by the individual cells. The light scatter passes through an array of filters and mirrors that separate and isolate specified wavelengths of light. The separated light beams are measured by a variety of light detectors and can be used to characterize cells.

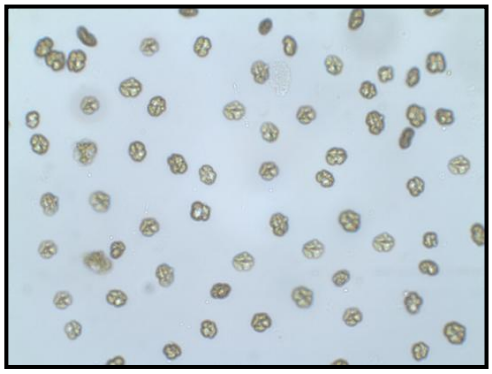
Grazing
Grazing is the predation of algal organisms on one another. Typically, a larger organism will ingest and consume the smaller as a source of nutrients.

Heterotrophic
Refers to organisms that require organic compounds (e.g., carbohydrates, proteins, lipids, or organic acids like acetate or methane) as a source of elements. Heterotrophs obtain their energy from the consumption and breakdown of complex molecules or other organisms and are thus all chemotrophs (chemoheterotrophs, see Chemotrophic). Heterotrophs ultimately rely on autotrophs for nutrition, even if they do not directly consume autotrophs.

in situ
Latin for "in position," this term refers to a biological process in the place where it occurs. Scientists may never be able to replicate in the laboratory the environmental conditions they encounter in the field; therefore, they conduct experiments or work in or around the location that the sample was taken.

Karenia brevis culture

Laboratory experiments often use cultures of organisms grown under controlled light, temperature, and nutrient conditions. Cultures of *Karenia brevis* are grown from a single cell that is isolated from a collected sample and then placed into nutrient-enriched seawater. Over time, as the cells divide, the concentration of cells increases. The culture is then maintained by periodically transferring a portion of the first culture into a new container with new enriched seawater.



Leucine and Thymidine

Common amino acids found in cells. Leucine is a common component of proteins found in bacterial cells. Thymidine is one of the four amino acids found in DNA, common to all organisms.

Lugol's solution

An iodine-based preservative for microalgae commonly used by oceanographers. When water is collected in the field, the sample is preserved in this solution and stored for later analysis.

Microbial loop

The microbial loop describes the process of how particulate and dissolved organic matter (POM/DOM) is returned to the food web in the ocean. The classical food web consists of photosynthetic algae being eaten by zooplankton, which are then eaten by a juvenile fish, and so on. Before the concept of the microbial loop was accepted, it was unclear how POM and DOM was returned to the system, or if it was returned at all. The key components in the microbial food web are bacteria, which use these sources of organic matter for growth. Bacteria can then be preyed upon by heterotrophic flagellates, which are then eaten by zooplankton. This is just one of the many pathways in the microbial food web by which bacteria can return POM and DOM to the system. Viral infection and "sloppy feeding" by zooplankton prevent some POM and DOM utilized by bacteria from returning to the classical food web.

Niskin bottle

A type of oceanographic sampling bottle that allows scientists to collect water samples remotely from any depth. A Niskin bottle is a cylindrical container with an open top and bottom. Water-tight caps (top and bottom for each bottle) are tied together with a thick and sturdy elastic band that runs inside of the cylinder. The caps can be pulled away from the cylinder, and a plastic cable at the end of the caps can be locked into a spring-operated firing mechanism. The bottle is lowered to a desired depth, the cables are released, and the tension on the elastic band causes the caps to slam shut, thereby capturing a water sample from that depth. (View video of Niskin bottle closing mechanism.)

Nitrogen fixation

A biochemical process in which nitrogen gas is converted to ammonium by organisms with specialized enzymes. Nitrogen composes approximately 80 percent of our atmosphere as a binary element, N_2. Some cyanobacteria and heterotrophic bacteria (called diazotrophs) can convert atmospheric nitrogen into ammonium, which they then use for their own cellular needs. When these organisms die, decay, or leak some of this nitrogen (mostly as dissolved organic nitrogen, or DON), nitrogen is added to often nitrogen-limited waters. This is important to some algal blooms such as a Florida red tide because the conversion of atmospheric nitrogen (which other algae cannot utilize) into a usable form provides more nutrients for bloom initiation or maintenance.

Nutrient autoanalyzer

An instrument that can analyze a sample for several different nutrients simultaneously. Seawater can be pumped through the unit, and chemicals and nutrients can be analyzed and measured automatically. Chemical analyses were previously done manually in laboratories and are time consuming. Autoanalyzers substantially decrease the time and effort required for analyses as well as provide results when away from the laboratory, such as while at sea.

Nutritional physiology

The biochemical processes of how nutrients are assimilated and used by microalgae.

Offshore

Refers to waters located beyond coastal waters and the mainland. These waters are typically low in nutrients (see **Oligotrophic**) and have less plankton than estuarine and coastal waters.

Oligotrophic
Relating to seawater or fresh water with extremely low nutrient concentrations. Oligotrophic water also usually contains low concentrations of microalgae.

Photochemistry
A type of chemistry that deals with the interaction of light with other compounds. Light can interact with complex dissolved nutrients in the ocean to produce simpler, more bioavailable nutrient forms.

Phototrophic
Use of light energy to fuel cellular processes and chemical reactions.

Picoplankton
The small size size fraction of the generally used term 'plankton'. Picoplankton range from 2/1,000,000 to 2/10,000,000 of a meter long.

Plankton tow
Oceanographers tow large nets of different-sized mesh through the water at varying depths to collect different kinds of organisms (plankton). Different sizes of mesh determine which plankton species are captured and which will flow through the net. (View video of plankton net retrieval).

Polymerase Chain Reaction (PCR)
A molecular technique by which DNA is replicated (copied) multiple times. A series of enzymes make this reaction possible at high speed and temperature and replicates DNA or DNA fragments several orders of magnitude. Primers (short DNA fragments) selected by the scientist allow for specific regions or fragments of DNA to be amplified, leading to an end product consisting of several million copies of the same region(s) of DNA for use in procedures such as Terminal Restriction Fragment Length Polymorphism (see **Terminal Restriction Fragment Length Polymorphism**).

Research cruise
A scientific expedition where scientists use a research vessel to conduct a variety of scientific studies. Research vessels are either designed or outfitted specifically for different types of oceanographic research and usually have onboard sampling instruments, equipment, and laboratories to conduct experiments and observations while at sea.

Terminal Restriction Fragment Length Polymorphism (TRFLP)

A common technique for determining the composition of the bacterial community within a sample. A variety of enzymes travel along PCR products (DNA, see **Polymerase Chain Reaction**) and digest (cut into smaller fragments) it based upon the number and position of restriction sites. The digested genetic material is then separated based upon size (length): number and composition of the different fragments are used to determine the composition of bacteria within the sample.

Thermistor

Similar to a thermometer, a thermistor is an electronic resistor in which the resistance of the conductors located at the end of the probe varies in a predictable manner with changes in temperature. One advantage of using a thermistor is that measurements can be read a long distance from the actual probe and can be inserted in hard-to-reach places.

Thermocline

A large change in temperature over a relatively small change in water depth. Waters of different temperatures have different densities and, therefore, resist mixing. When this occurs, nutrients and dissolved oxygen, among other things, from the warm surface may not be mixed with colder, deeper water (and vice versa).

Trichodesmium

A genus of cyanobacteria commonly found in offshore subtropical and tropical ocean waters. The cells form long chains, called trichomes. Trichomes then can gather into colonies called "puffs" or "tuffs." Puffs and tuffs can aggregate at the surface of the water and form large brown mats that can extend for miles (also called "sailor's sawdust"). Surface blooms of *Trichodesmium* are common prior to a Florida red tide bloom.

Trophic level

Levels in the food chain of a given ecosystem. The higher the trophic level, the greater the nutritional need from lower trophic levels (autotrophs being the lowest trophic level). Approximately 10 percent of the biomass of a lower trophic level is converted into chemical energy for the next level.

Vertical migration

The behavior of some species of algae (as well as zooplankton) to swim up and down, or migrate, in the water column during different times of the day and night.

West Florida Shelf

The shallow area of western Florida extending from the coastline to the continental shelf's drop-off into deeper water.

Zooplankton

Zooplankton (from the Greek "zoo" for animal and "planktos" for drifting) are drifting animals that inhabit the pelagic zone of the ocean. Although they are capable of limited locomotion, movement depends mainly on winds and currents. Zooplankton are found in a variety of shapes, sizes, and forms and include salps, jellies, ciliates, and protozoa.

Zooplankton grazing

Many zooplankton actively graze (feed) on algal cells, including Florida red tide. One of the main groups of grazing zooplankton is copepods. These small predators are crustaceans related to shrimp, crab, and lobsters. By measuring the amount of zooplankton grazing, researchers can determine how much primary production from algal photosynthesis is being used for zooplankton growth and reproduction.