Mindy Tarling
October 29, 2004
Period 1

EL NINO

EL NINO IS A WEATHER PATTERN THAT AFECTS PLACES ALL OVER THE WORLD. IT MAKES PLACES LIKE THE US AND PERU HAVE A LOT MORE RAINFALL THAT NORMAL, AND PLACES IN THE WEST PACIFIC (LIKE AUSTRALIA) HAVE A DROUGHT. TO TRY TO FIND OU WHEN THE NEXT EL NINO OR EL NINA IS COMING NOAA PEOPLE HAVE SET BUOYS AROU TO THE WORLD TO MEASURE, TEMPERATUE, CURRENTS AND WINDS. THEY SEND BACK DAT THAT HAVE FOUND ONE A DAY. WHEN THERE ISN'T AN EL NINO THE TRADE WIND BLOW TOWRDS THE WEST IN THE PACIFIC, WHICH MAKES THE WARM WATER IN THE WEST PACI PILE UP SO IT DOESN'T REACH THE EAST SIDE. THIS MAKES THE WATER ABOUT HALF A M HIGHER IN INDONESIA THAN IN THE EQUATOR. WHEN THERE IS AN EL NINO THE TRAD WINDS SLOW DOWN OR STOP IN THE CENTER OR THE WEST SIDES, CAUSING THE THERMOCLIEN IN THE WEST TO GO UP AND IN THE EAST GO DOWN. THE RAIN FOLLOWS WARM WATER TOWRDS THE EAST, WHICH HELPS FLOOD PERU AND DROUGHT INDONESIA AUSTRALIA. SO AS YOU CAN SEE EL NINO CAN AFFECT A LOT MORE PLACES THEY YOU W THINK.

MINDY TARLING PERIOD 1 NOVEMBER 15,2

SAND

SAND, ALONG WITH GRAVEL, SILT, AND CLAY ARE KNOWN AS SEDIMENT. AND ARE MADE BY THE MECHANICAL AND CHEMICAL BREAKDOWN OF ROCKS. THEY ARE DISSAGGREGATED FROM AN RIGINAL ROCK, THE SAND IS ERODED AND MOVED BY WIND, WATER, AND. THEY END UP IN RIVERS OR LAKES, OR AS SAND DUNES. MOSTLY THEY GO THE OCEAN OR SEA. THEN IT CAN HARDEN AND BECOME SEDIMENATARY ROCK. THE SAN AROUND, FOR EXAMPLE, VOLCANIC ICLANDS, WILL HAVE VOLCANINC FRAGMENTS AND GLASS AND OTHER MINERALS. SAND ON THE BEACHES OF SOUTHERN CALIFORNIA IS MA MADE UP OF QUARTZ, MAYBE SOME FELDSPAR. WHEN THERE IS NO SEDIMENTARY ROCK CLOSE, THE SAND IS MADE UP OF ORAGNIC MATERIAL, SHEELLS (OR PARTS OF SHELLS), CORAL, OR SKELETONS OF SMALL PLANKTONIC ORGANISIMS. SAND OS FORMED BY FREEZI OR THAWING, WHICH MAKES THE ROCKS, BREAK UP. WAVE ACTION, GROUND MOTION, ABRASION OF WATER, CAN ALSO CAUSE SAND TO FORM. SAND IS GROUPED BY BEING EITHER NEAR OR FAR FROM ITS ORIGIN, HIGH OR LOW ENERGY, AND WHETHER IT W ERODED BY WATER OR WIND. ALSO, WHATHER IT CAME FROM AN ISLAND, OR A CONTINE FORAMINIFERA ARE A SINGLE-CELLED PROSTISTA WITH SHELLS (OR TESTS). THEIR SHELLS ARE MNAY CHAMBERS THAT ARE ADDED ON WHEN THEY GROW, AND THEIR SHELLS

Mindy Tarling
October 29, 2004
Period 1

BE MADE FROM ORGANIC COMPOUNDS, SAND GRAINS, OR OTHER PARTICLES CEMENTED TOGETHER. THEY CAN BE ALMOST 20 CENTIMETERS LONG. THEY'RE IMPORTANT BECAUSE THEY MAKE UP 90% OF OUR OXYGEN, AND WIHTOUT IT WE WOULD DIE. SO, THEY'RE KIN A NECESSITY TO LIFE.

Punalya Big Island	Antelope Island	Knollwood Beach	San Quinton	S
Black, gray	White	Pink, peach	White, gray, black, brown	Green, c
1mm	1/2 mm	1/2 mm	1 mm	
1 mm	1/2 mm	1/2 mm	1 mm	
Sharp	Smooth	Sharp	Sharp	
Shiny	Dull	Shiny	Full	
Well	Poorly	Poorly	Poorly	
Glass, volcanic rocks	Rocks	Glass gems	Rocks	

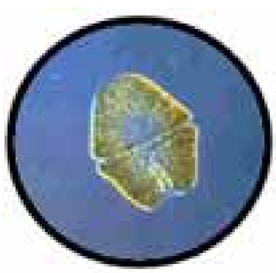
Journal #10

The color of the ocean is blue because it reflects the colors of the clouds and the population of phytoplankton in it. Phytoplankton are microscopic plants that live in the ocean. There are many species of phytoplankton, each of which has a characteristic shape. Collectively, phytoplanktons grow abundantly in oceans around the world and are the foundation of the marine food chain. Small fish, and some species of whales, eat them as food. Larger fish then eat the smaller fish. Humans catch and eat many of these larger fish. Since phytoplanktons depend upon certain conditions for growth, they are a good indicator of change in their environment. For these reasons, and because they also exert a global-scale influence on climate, phytoplankton are of primary interest to oceanographers and Earth scientists around the world.

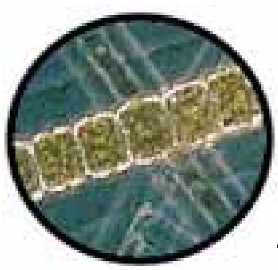
Different species of phytoplankton come in many different shapes and sizes. But they all get their green color from chlorophyll, the pigment they use during photosynthesis. (Left photo courtesy of the SeaWiFS Project. Center and right photos courtesy of D.W. Coats.)

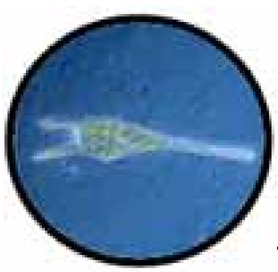
The life and death of phytoplankton

Like their land-based relatives, phytoplanktons require sunlight, water, and nutrients for growth. Because sunlight is most abundant at and near the sea surface, phytoplanktons remain at or near the surface. Also like terrestrial plants, phytoplanktons contain the pigment chlorophyll, which gives them their greenish color. Chlorophyll is used by plants for photosynthesis, in which sunlight is used as an energy source to fuse water molecules and carbon dioxide into carbohydrates—plant food. Phytoplankton (and land plants) use carbohydrates as "building blocks" to grow; fish and humans consume plants to get these same carbohydrates.



What is Phytoplankton?

 The life and death of phytoplankton

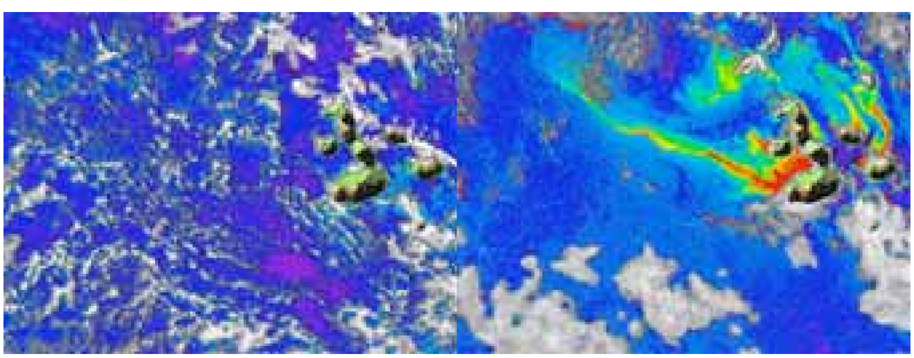
 The atmosphere is a rich source of carbon dioxide, as millions of tons of this gas settle into the ocean every year. However, phytoplanktons still require other nutrients, such as iron, to survive. When surface waters are cold, deeper depths are allowed to upwell, bringing these essential nutrients toward the surface where the phytoplankton may use them. However, when surface waters are warm (as during an El Niño), they do not allow the colder, deeper currents to upwell and effectively block the flow of life-sustaining nutrients. As phytoplankton starve, so too do the fish and mammals that depend upon them for food. Even in ideal conditions an individual phytoplankton only lives for about a day or two. When it dies, it sinks to the bottom. Consequently, over geological time, the ocean has become the primary storage sink for atmospheric carbon dioxide. About 90 percent of the world's total carbon content has settled to the bottom of the ocean, primarily in the form of dead biomass. As previously stated, phytoplankton use carbon dioxide for photosynthesis. The larger the world's phytoplankton population, the more carbon dioxide gets pulled from the atmosphere, hence, the lower the average temperature due to lower volumes of this greenhouse gas. Scientists have found that given populations of phytoplankton can double its numbers on the order of once per day. In other words, phytoplankton respond very rapidly to changes in their environment. Large populations of this organism, sustained over long periods of time, could significantly lower atmospheric carbon dioxide levels and, in turn, lower average temperatures.

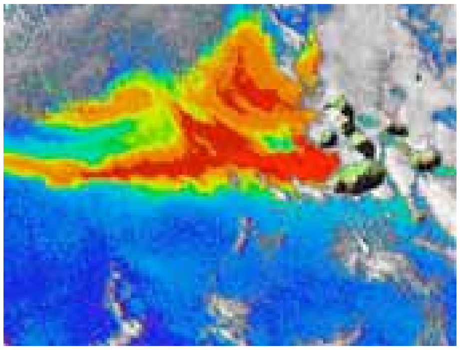
Phytoplankton as indicators of change

As described above, phytoplankton depend upon sunlight, water, and nutrients to survive. Physical or chemical variance in any of these ingredients over time for a given region will affect the phytoplankton concentrations there. Populations of this marine plant will grow or diminish rapidly in response to changes in its environment. Changes in the trends for a given phytoplankton population—such as its density, areal distribution, and rate of population growth or diminishment—will alert Earth scientists that environmental conditions are changing there. Then, by comparing these phytoplankton trends to other measurements—such as temperature—scientists can learn more about how phytoplankton may be contributing to, and affected by, climatic and environmental change.

To human eyes, the ocean appears as shades of blue; sometimes blue-green. From outer space, satellite sensors can distinguish even slight variations in color to which our eyes are not sensitive. Different shades of ocean color reveals the presence of differing concentrations of sediments, organic materials, or even phytoplankton—all of which can be measured by satellites.

Due to their pigment—chlorophyll—phytoplankton preferentially absorb the red and blue portions of the light spectrum (for photosynthesis) and reflect green light. So, the ocean over regions with high concentrations of phytoplankton will appear as certain shades, from blue-green to green, depending upon the type and density of the phytoplankton and the population there.





This sequence of SeaWiFS ocean color imagery shows the impact of the recent El Niño on the productivity of phytoplankton around the Galapagos Islands in the Pacific Ocean. The top left image was taken during the height of the 1997-98 El Niño, while the bottom right image was taken during the more recent La Niña. Note the gradually flourishing bloom of phytoplankton as the surface waters cool, allowing the deeper, more nutrient-rich waters to upwell. (Courtesy of the SeaWiFS Project)

Phytoplankton converts nutrients into plant material through photosynthesis. During photosynthesis they use the nutrients in the ocean and with the energy of the sun convert it to plant material. Plant material is a vital part in the food chain, everything depends on it.

The ocean appears blue-green because they are lower in phytoplankton than in an area that appears more red, orange or yellow. It appears deep blue when they are even lower amounts of phytoplankton. It appears black when there are barely any phytoplanktons.

Chlorophyll A absorbs blue, violet, and reflects green

Chlorophyll B absorbs blue, orange, and reflects yellow and green

A higher population in phytoplankton causes an area higher in population. The more phytoplankton there is the more nutrients there are for fish and other sea animals to love off of.

Phytoplankton population depends on ocean currents, temperature, nutrients, sunlight, and water depth.

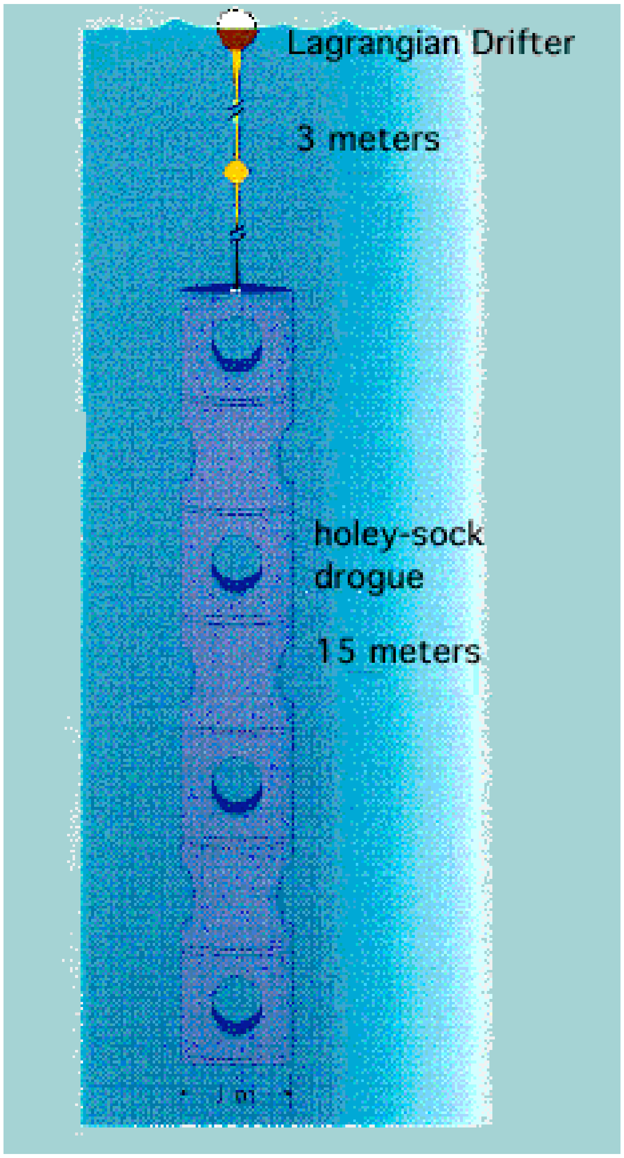
The various depths they live at are form the surface to 100 meters. They prefer to live more at the surface though.

The coastal areas on the ocean tend to have more productivity than in mid-ocean. They both have relative amounts of phytoplankton though, but still coastal areas have much more. Productgivity in the equator tends to be normal, not very high, but now very low and mid-atlantic is about the same, but a little lower. The eastern coastline of northa nd south America has areas og ver high populationa nd areas of very low, where in the equator it tends to stay lower. The western coastline of Asia is ver full of life, it has very very high popultion of pytoplankto, cpmaored to the equaot that has much less.

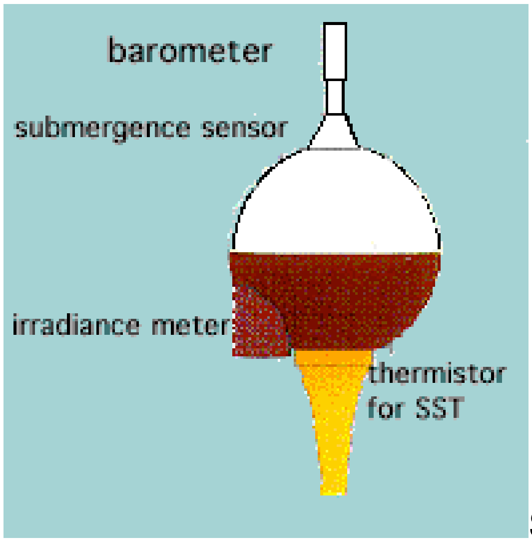
Journal # 11

Structure of a Drifter Buoy

These drifter buoys are Global Lagrangian Drifters. Released into the ocean, the buoys float with the currents and take measurements of the water with built-in instruments. They are tracked by satellites in orbit far above Earth and transmit data several times a day. The Global Drifter Center at NOAA/AOML in Miami, Florida, collects the data from all the oceanographers using these drifters to study the ocean. We get this data from them and reformat it for use in these drifter activities.



Lagrangian Drifter
3 meters
holey-sock
drogue
15 meters



Ships and airplanes can drop these low cost (approximately $4500) and durable buoys into the sea. When released by ships, they have a 98% survival rate; from the air, survival drops to 78%. About half of the drifters lose their ability to communicate with the satellite, for one reason or another, after 440 days. Another way to say this is that the half-life of the buoys is 440 days. However, many of the buoys last for much longer and to transmit their information for more than two years.

The floater at the top sits at the surface of the water and holds an antenna for sending data to a satellite above. The long (45 feet) "holey sock" that is well under the surface acts as a drogue and causes the ocean currents to take the buoy along instead of the surface wind. The buoy also holds electronic instruments for measuring sea surface temperature (SST), submergence, irradiance (for sunlight) and barometric pressure. At the top of the holey sock is another meter for measuring temperature and conductivity.

Drifting buoy data includes the buoy position, date, time and in most cases includes many variables such as surface and subsurface water temperature, air pressure, air temperature, wind speed and wind direction.

MEDS is the world data centre for drifting buoys (Responsible National Oceanographic Data Centre - RNODC). As part of its role, MEDS acquires, processes, quality controls and archives real-time drifting buoy messages reporting over the Global Telecommunications System (GTS) as well as delayed mode data acquired from other sources. Over 200,000 new records are captured monthly from the GTS.

Ocean drifters are specifically designed to track the movement of water (currents) within the sea. To do this, they must be carefully constructed and tested to ensure that the movement of the drifter coincides with the flow of water and not that of the wind. There are three main sections on a drifter: 1) a float package, 2) a cable and 3) a drogue.

Float Package

The float or surface buoy on an ocean drifter serves several purposes. It provides buoyancy for the drogue and sensors, and protects the sensor and transmitter electronics from getting wet.

The transmitter on a drifter transmits data to satellites that determine the buoy's position and relay the data to an ARGOS ground station. The raw drifter data is then sent to a data assembly center where it is processed and distributed. The surface float may also house instruments (sensors) which measure (sense) sea surface temperature, pressure (barometer), ocean color (irradiance), and submergence. A submergence sensor is used to determine if the sail-like drogue is still attached. When the sensor indicates frequent submergence the drogue is present (weight in waves causes submergence). When submergence rarely occurs, it suggests that the drogue has been lost.

Cable

A strong cable is used to attach the float package to a sail-like drogue. If more buoyancy is needed then a subsurface float or buoy can be added to the cable. Temperature and salinity sensors can also be attached to the cable. Using noise below the oceans surface scientists have also found a neat way to measure wind. A hydrophone (underwater listening device) is attached to the cable of a drifter. The greater the wind speed, the louder the noise heard by the hydrophone. Using this relationship, wind speed over the drifters can be estimated with a hydrophone.

Drogue

A drogue is a device on a drifter that acts like an underwater sail. When pushed by an ocean current, the drogue helps a drifter move with the flow of water. Without a drogue, drifters do not depict ocean currents accurately, but become subject to wind and wave action.

Argo is a global array of 3,000 free-drifting profiling floats that will measure the temperature and salinity of the upper 2000 m of the ocean. This will allow, for the first time, continuous monitoring of the temperature, salinity, and velocity of the upper ocean, with all data being relayed and made publicly available within hours after collection. Because over 90% of the observed increase in heat content of the air/land/sea climate system over the past 50 years occurred in the ocean [Levitus et al., 2001], Argo will effectively monitor the pulse of the global heat balance. It will improve our understanding of the ocean's role in climate, as well as spawning an enormous range of valuable ocean applications.

Argo deployments began in 2000 by mid 2004 the array is over 40% complete. Todays tally of floats is shown in the figure above.

Argo is a major contributor to the WCRP's Climate Variability and Predictability Experiment (CLIVAR) project and to the Global Ocean Data Assimilation Experiment (GODAE). The Argo array is part of the Global Climate Observing System/Global Ocean Observing System GCOS/ GOOS)
Global Drifter Center at NOAA/AOML use the info
An ocean current can be defined as any continuous flow of water along a definite path in the ocean. The flow may occur at the surface or far below it. The flow may be vertical or parallel to the surface. The circulation of these water masses in motion can be categorized as either wind driven or thermohaline. Thermohaline currents are vertical and are caused by changes in temperature and salinity. They account for the thorough mixing of the deep masses of ocean water.

What causes Ocean Currents

Wind driven circulation is set into motion by moving air masses, with the motion being confined primarily to horizontal movement in the upper waters of the oceans. Currents carry enormous amounts of warm water away from the equator and currents return equal amounts of cold water. Current flow can affect temperatures, biotic systems, and climate.

The Coriolis Effect

Surface ocean currents are deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere, due to the Coriolis effect. The Coriolis effect holds that because the Earth is spinning, surface waters move in a clockwise direction in the Northern Hemisphere and in a counterclockwise direction in the Southern Hemisphere.

Direction of Currents Worldwide

Surface ocean currents are mainly wind-driven and occur in all of the world's oceans. Examples of large surface currents that move across vast expanses of ocean are the Gulf Stream, the North Atlantic Current, the California Current, the Atlantic South Equatorial Current, and the Westwind Drift. The currents eventually come into contact with the continents which deflect them, creating giant oceanic current circles known as gyres.

Currents in the North Pacific

These are the major currents that affect the North Pacific Ocean and create the North Pacific gyre. As with all ocean currents in the Northern Hemisphere, the water is colder on the eastern side and warmer on the west.

Why is this?

Currents off the
Oregon Coast

There are two important currents off the Oregon coast.

The California current is wide and slow, flowing south year-round about ten miles off shore.

The Davidson current is narrow and fast moving, flowing northward just off-shore. It is seasonal and is generated by strong winter storms.

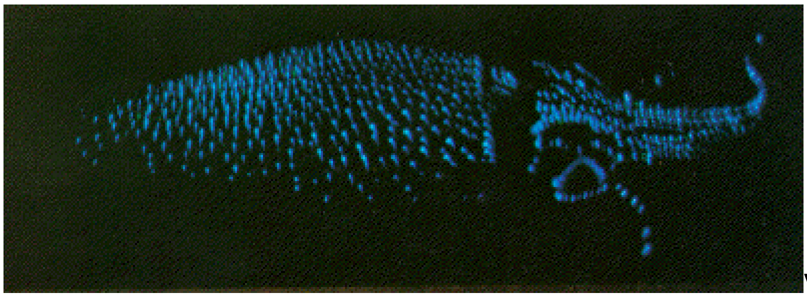
www.meds-sdmm.dfo-mpo.gc.ca
www.drifters.doe.gov
http://66.102.7.104/search?q=cache:2_2voy79RS4J:hmsc.oregonstate.edu/education/teachers/curricula/chasing/Chasing_the_Buoys.ppt+fisherman+and+surface+drifter+buoys%3F&hl=en&ie=UTF-8
http://vathena.arc.nasa.gov/curric/oceans/drifters/drifters.html

Journal # 12

bi·o·lu·mi·nes·cence (P)Pronunciation Key(b-lm-nsns)
n.
Emission of visible light by living organisms such as the firefly and various fish, fungi, and bacteria.

Most bioluminescent organisms use molecular oxygen, O_2, to oxidize their luciferins. I am particularly interested in this relationship, in terms of both the evolution, and physiological control, of bioluminescence.

In my research EPR oximetry techniques are being applied to measure oxygen levels in bioluminescent organisms in vivo, providing useful information that can be combined with measures of light emission to better understand the relationships between oxygen and bioluminescence. Similarly, bioluminescence is being used as a highly sensitive technique for measuring oxygen in vivo.
There are living lights in the ocean. They are beautiful, fascinating and critical to the very existence of most marine life. They are also little known and little appreciated, because so few people have the opportunity to see them with their own eyes. The images on this web site provide a rare glimpse of this remarkable phenomenon.



Visible light made by living creatures is known as bioluminescence. Fireflies are bioluminescent. So are a few other land dwellers, like some earthworms, centipedes and fungi. But on land, bioluminescence is rare. By contrast, in the oceans, bioluminescence is very, very common. In fact, it would be difficult to find any place in the ocean where bioluminescence doesn't exist.

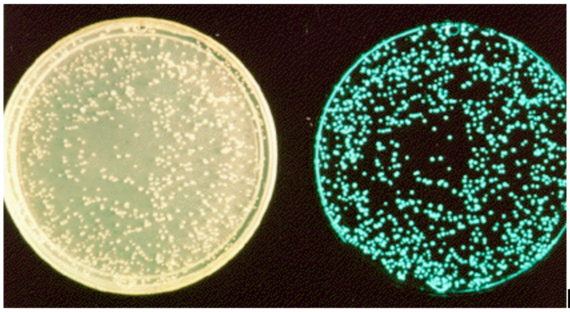
In the Bioluminescence Department at Harbor Branch Oceanographic Institution we are studying how bioluminescence helps animals to survive in the ocean and how measurements of bioluminescence can be used to address one of the greatest challenges in marine ecology, which is: How do we study the associations between organisms in a three dimensional fluid environment which is constantly changing? Because bioluminescence is so common in the marine environment, measurements of bioluminescence can provide a rapid means of determining where animals are, how they associate with each other and how their distribution patterns are affected by such variables as light, temperature, salinity and pollution.

LIVING LIGHTS

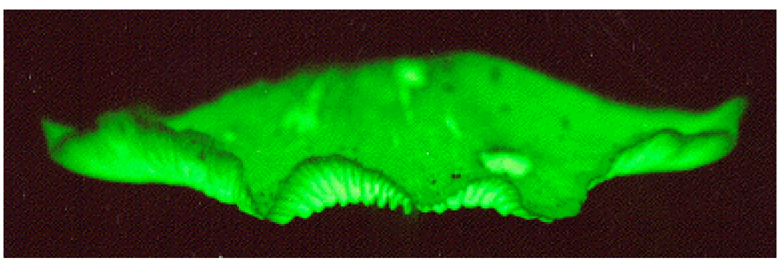
In some places in the ocean bioluminescent creatures are so abundant that any disturbance such as a boat, a fish or, as you see here, even a hand passing through the water can produce a shimmering light show. Click on the menu above to see some of the most common sources of bioluminescence in the ocean.

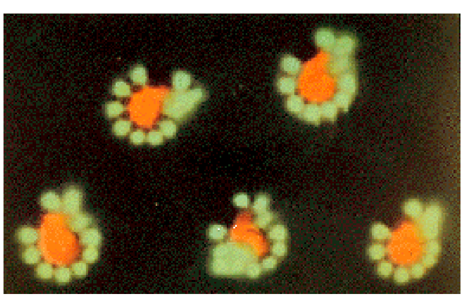
There are so many bioluminescent creatures in the ocean, because their ability to make light helps them to survive. Some use their light to help them find food, some use it to help them find mates, some use it to defend themselves against predators and some, like this Viperfish, use light for all these purposes. Click on the menu above to learn more
about these different uses of bioluminescence.
The following questions were posted on the Discovery Channel Web Page following the airing of "Ocean Currents", which included footage shot during a Bioluminescence Department research cruise to the Gulf of Mexico. The answers were provided by E. Widder and T. Frank.

WHICH OCEAN ANIMALS ARE BIOLUMINESCENT?

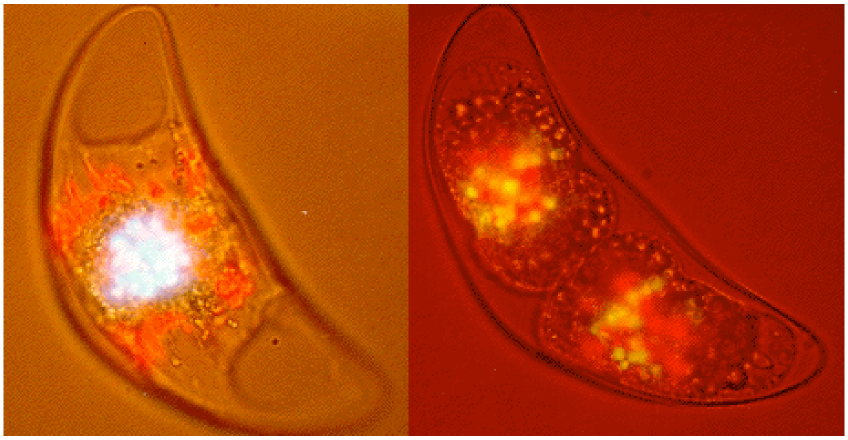


Because bioluminescence is rare on land, people sometimes assume that the same thing must be true in the oceans. It's not. Some of the must abundant creatures on our planet are bioluminescent oceanic inhabitants. For example, the most abundant vertebrate on earth is a little bioluminescent fish called the benttooth bristlemouth (Cylcothone spp.). There are also enormous numbers of lanternfish (Myctophidae), squid, decapod shrimp (such as the oplophorids and sergestids) krill, copepods, ostracods, amphipods and gelatinous zooplankton. The list is very long and growing longer. Until recently the only way to study the life in the oceans was to bring the animals up into our world in nets. This destroyed many of the most fragile creatures like the jellies and exhausted the bioluminescent capacities of most of the others. However, as we gain greater access to the oceans with submersibles and remote operated vehicles (ROVs) we are discovering many animals have the capacity to make light. The most recent published list of all known bioluminescent creatures, both on land and in the sea, is "Systematic distribution of bioluminescence in living organisms" by Peter J. Herring published in the Journal of Bioluminescence and Chemiluminescence vol. 1 pp 147-163 (1987).





Pyrocystis Lunula. below



Calcareous Algae (3)
Coral
Euphyllia (3)
Goniopora (3)
Mycedium (3)
Manicina areolata (5)
Meandrina meandrites (5)
Echinoderms
Crinoids (3)
Clavelina picta (5)
Anemones
Solenopodium (3)
Condylactis gigantiea (5)
Phymanthus crucifer (5)
Molluscs (Inorganic Shells)
Acteonidae: (8)
Acteon eloiseae
Pupa solidula
Angariidae: (8)
Angaria sphaerula
Angaria vicdani
Angaria atrata
Angaria melanacantha
Atyidae (Haminoeidae): (8)
Atys naucum
Atys cylindricum
Bullidae: (8)
Bulla ampulla
Bulla gouldiana
Bulla punctulata
Bulla occidentalis
Bulla striata
Bulla tenuissima
Cypraeidae: (8)
Cypraea mappa
Cypraea venusta
Cypraea cinerea
Cypraea pulchra

Cypraea subviridis
Cypraea isabella
Cypraea isabellamexicana
Cypraea lurida
Cypraea pantherina
Fissurellidae: (8)
Fissurella scutella
Fissurella dubia
Fissurella mutabilis
Fissurellidea bimaculata
Megathura crenulata
Hydatinidae: (8)
Micromelo undatus
Micromelo guamensis
Aplustrum amplustre
Marginellidae: (8)
Marginella angustata
Marginella denticulata
Marginella helmatina
Marginella piperata
Marginella reeveana
Marginella senegalensis
Marginella zeyheri
Marginella floccata
Marginella rosea
Marginella adansoni
Marginella nebulosa
Muricidae: (8)
Aspella cunninghami
Murex elongatus
Nucella lapillus
Nucella lamellosa
Ceratostoma foliatum
Neritidae: (8)
Nerita lineata - "most specimens negative, but a few with dull red fluorescence."
Neritodryas dubia
Neritina waigiensis
Ovulidae: (8)
Calpurnus verrucosus
Ovula costellata
Phasianellidae: (8)
Phasianella ventricosa
Phasianella australis
Stomatellidae: (8)
Stomatella planulata
Pseudostomatella papyracea
Strombidae: (8)
Tibia insulaechorab
Triviidae: (8)
Trivia merces
Trivia nix
Trivia pulex
Trivia exigua
Trivia monacha
Trivia ovulata
Trivia pediculus
Trivia solandri
Erato columbella
Erato scabriusculus

Erato voluta
Erato denticulatus
Trochidae: (8)
Clanculus puniceus
Clanculus pharaonius
Clanculus undatus
Clanculus margaritarius
Monodonta articulata
Tegula regina
Tegula viridula
Umbonium vestiarium
Umbonium giganteum
Gibbula umbilicalis
Monodonta dama
Phasianotrochus eximius
Trochus niloticus
Tectus conus
Tectus pyramis
Turbinidae: (8)
Bolma girgyllus
Bolma modesta
Bolma guttata
Bolma erectospinosa
Homalopoma sanguinea
Homalopoma lurida
Guildfordia triumphans
Guildfordia yoka
Astraea rugosa
Volutidae: (8)
Lyria cylleniformis - "most specimens negative, but a few with light to medium pink flush."
Dentaliidae: (8)
Dentalium aprinum
Dentalium elephantinum
Limidae: (8)
Lima lima
Acesta rathbuni
Ctenoides ales - ("Ctenoides philippinarum shows no fluorescence.")
Malleidae: (8)
Malleus albus
Malleus malleus
Pteriidae: (8)
Pteria sterna
Pteria penguin
Pinctada imbricata
Veneridae: (8)
Clausinella fasciata
Venus affinis
Crustaceans
Crangon septemspinosa (5)
Scorpions:
Androctonus australis (7)
Androctonus aeneas (7)
Buthus occitanus (7)
Centruroides spp. (1)
Euscorpius italicus (1)
Hadogenes spp. (1)
Hadrurus hirsutus (7)
Heterometrus spp (1)
Leiurus quinqestriatus (1)

Microbuthus litoralis (1)
Oiclus purvesii (7)
Opisthophthalmus spp. (1)
Palamnaeus fulvipes (7)
Pandinus imperator (7) (10)
Pandinus exitialis (7)
Parabuthus hunteri (7)
Scorpio maurus (1), (7)
Tityus trinitatis (7)
Uroplectes formosus (7)
Solpugids (1)
Ammotrechella stimpsoni (7)
Galeodes granti (7)
Rhagodes spp. (7)
Rhagodessa melanocephala (7)
Solpuga hostilis (7)
Palpigrads (1)
Whip-scorpions:
Damon variegatus (1)
Spiders:
Harpactura spp. (1)
Millipedes:
Doratogonas setosus (1)
Spaerotherium giganteum (1)
Motyxia spp. (4)
Centipedes:
Cormocephalus spp. (1)
Beetles:
Hipporhinus furris (1)
Sternocera orissa (1)
Genyodonta flavomaculta (1)
Ceratorhynchus derbiana (1)
Glyptoscelis squamulata (6)
Crickets:
Liogryllus bimaculatus (1)
Dragonflies:
Cordulegaster spp. (1)
Termites:
Reticulitermes tibialis (1)
Paraneotermes simplicicornis (1)
Butterflies:
Sphingicampa hubbardi (caterpillar) (1)
Reptiles:
Western Banded Geckos (1)
Corn Snake (Elaphe gutatta guttata), anerythristic x amelanistic cross (2)
Corn Snake (amelanistic) x Great Plains Rat Snake cross (2)
Fungi:
Aspergillus flavis (1)
Dentinum repandum (9)
Naematoloma fasciculare (9)

MBARI midwater scientists have observed a range of animals wielding light: fragile shimmering comb jellies, medusae casting off glowing tentacles, lanternfishes shining bioluminescent photophores, fang-toothed fish dangling lures that harbor light-making bacteria, and many others. An MBARI scientist published the first scientific paper to describe, from in situ submersible observations, how the deep-sea animal Enypniastes eximia, a swimming sea cucumber, produces and uses its light. Close observations of the midwater squids Chiroteuthis (the swordfish squid) and Galiteuthis (the cockatoo squid) have shown that they use bioluminescence as camouflage.

Deep in the oxygen-minimum zone, MBARI researchers have discovered another manifestation of bioluminescence in a primitive relative of the octopus and the squid, Vampyroteuthis. Little was known of this elusive animal before it was filmed by Ventana's cameras and live specimens were captured for studies at the institute's chilled-seawater lab.
Just as MBARI's extensive underwater surveys have demonstrated rich diversity in what was once thought to be a mostly lifeless realm, observations in the deep sea have also revealed surprisingly frequent illumination in a zone once thought to be devoid of light.
At night, when they can't be seen by predatory fish, many zooplankton swim to the upper layers of the ocean to feed on algae, including dinoflagellates. However, when a zooplankton attacks bioluminescent dinoflagellates, the dinoflagellates are stimulated to flash, making the zooplankton vulnerable to being eaten by a nearby fish alerted by the light. According to Michael Latz, the bioluminescence acts as an alarm when the dinoflagellate is being attacked by a zooplankton and results in fewer dinoflagellates being eaten.
So, if dinoflagellates use bioluminescence for protection, why is the light response also triggered by waves or the flow around swimming organisms? Just as a car alarm can be inadvertently triggered by an accidental bump or a heavy rain storm, dinoflagellate bioluminescence is stimulated by flow conditions that have sufficient force to set off the "alarm.

Deep Sea Bioluminescence

Deep in the ocean, where sunlight can no longer penetrate, lies an incredible world of darkness. And against all odds, this just happens to be the location of one of nature's most impressive artificial light shows. The creatures here have evolved their ow
n ways of dealing with the darkness. Through a process known as bioluminescence, they have developed the ability to use chemicals within their bodies to produce light. If you have ever seen a firefly then you have witnessed the same process in action. Bio
luminescence is mainly a marine phenomenon. It is not found in freshwater. On land, it is seen only in a few species of fungi and insects. It is the oceans where this unique ability achieves its highest form. Hundreds of species of fish and invertebrates
flash their colors in a light show that can sometimes rival the streets of Las Vegas.
Bioluminescence occurs when certain chemicals are mixed together. This effect is very similar to that in green light sticks. When the seal in the stick is broken, the two chemicals mix together and give off a soft, green glow. Most of the light created by
marine organisms is blue-green in color. This is because blue light travels best in water, and because most marine organisms are sensitive to blue light. A notable exception is the

Malacosteid family of fishes, also known as Loosejaws. These fish can pro
duce red light and can see it when others cannot. This gives them an advantage by allowing them to see their prey while without making their presence known. Marine creatures produce light with special organs called photophores. At least two chemicals are
required to produce bioluminescence. The first is known as a luciferin. This is the chemical that actually creates the light. The second chemical is called a luciferase and is the substance that actually catalyzes the chemical reaction. When these chemica
ls are mixed together in the presence of oxygen, light is produced. A by product of this process is an inert substance called oxyluciferen.
Some of these creatures give off light continually. Others flash their lights on and off by mixing their chemicals on queue or by covering their light organs with a flap of skin. The flashlight fish has a light-producing organ near its eyes that is covere
d with an eyelid-type flap. The fish can flash its light by opening and closing this flap. These creatures produce light for a variety of reasons. For some, it is a warning to stay away. For others, it is a form of camouflage. Certain species of shallow w
ater squid give off light to blend in with the moonlight. Some creatures use their light for navigation. Certain fish species use bioluminescence as a form of "night light". Some use it for communication. Certain species of crustaceans send out coded sign
als to others of their own kind during mating season. Other creatures use bioluminescence as a trap. The anglerfish uses a lighted "lure" on the top of its head to attract its prey. When the unsuspecting animal is within striking distance, the angler vacu
ums it down with a lightening-fast snap of its powerful jaws. What ever the reason for producing this dazzling light show, it remains as one of the natural world's most bizarre and spectacular facts.

Bioluminescence is the result of a Biochemical reaction.
It can also be described as a chemiluminescent reaction involving a direct conversion of chemical energy into light energy.(Burr 1985, Patel 1997 and Herring1978).

The reaction involves the following elements:
· Enzymes (Luciferase) - biological catalysts that accelerate and control the rate of chemical reactions in cells.
· Photons - packs of light energy.
· ATP - adenosine triphosphate, the energy storing molecule of all living organisms.
· Substrate (Luciferin) - a specific molecule that undergoes a chemical charge when affixed by an enzyme.
· Oxygen - as a catalyst
A simplified formula of the bioluminescent reaction:
ATP(energy) + Luciferin (substrate)+ Luciferase(enzyme) + O2(oxidizer) == == light (protons)
The bioluminescent reaction occurs in two basic stages:
(1) The reaction involves a substrate (D-Luciferin), combining with ATP, and oxygen which is controlled by the enzyme (Luciferase). Luciferins and Luciferase differ chemically in different organisms but they all require molecular energy (ATP) for the reaction.
(2) The chemical energy in stage one excites a specific molecule (The Luminescent Molecule: the combining of Luciferase and Luciferin). The excitement is caused by the increased energy level of the luminescent molecule. The result of this excitement is decay which is manifested in the form of photon emissions, which produces the light. The light given off does not depend on light or other energy taken in by the organism and is just the byproduct of the chemical reaction and is therefore cold light.
The energy in photons can vary with the frequency (color) of the light. Different types of substrates (Luciferins) in organisms produce different colors. Marine organisms emit blue light, jellyfish emit green, fireflies emit greenish yellow, railroad worms emit red , and Glow worms and fungi emit greeny bluish light (appears blue to the eye but is actually in the green light spectrum
ATP(energy) + Luciferin (substrate)+Luciferase(enzyme) + O2(oxidizer) ==
== light (protons)