EDUCATOR'S MANUAL

- **FIELD WORK: onboard R/V AEGAEO**
- **BIOGEOCHEM LABS: HCMR**

EDUCATIONAL GUIDE

OCEANOGRAPHIC CRUISE…

ANDROMEDA I-Schools and scientists onboard R/V AEGAEO

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Contents

Foreword

The current cruise, carried out under the international thematic network for Environmental Education " My school voyages with PERSEUS" - PERSEUS @ School network will be held from 6 to 9 March 2014 . Twenty students from 10 junior high and high schools, 15 teachers, 20 researchers and 22 crew members of R / V board "AEGAEO" will take part in this cruise.

The purpose of this research cruise (called ANDROMEDA I - Schools and scientists onboard the R/V AEGAEO) is to make students aware that scientific research is not simply the task of a few, but rather the result of teamwork of scientists from different disciplines such as oceanographers, engineers, biologists, geologists, statisticians, sailors, etc. Additionally, the mission will develop the children's interest in marine sciences, while they will put into practice real group work to achieve good results. Finally, the work of the HCMR and the PERSEUS project will be further promoted to the general public.

This document acts as a "Supplement to the teacher" and refers to the work performed on R/V AEGAEO and the Hellenic Centre for Marine Research (HCMR) .

TEAM A

PART A: FIELD WORK

DATE: Friday 7 March 2014

Field work and oceanographic data analyses

Seawater samples and measurements of important physical, chemical and biological parameters for understanding the functioning of the marine ecosystem

Brief Description: Oceanographic mission in the Saronikos Gulf with R/V "AEGAEO" concerning the functioning of marine ecosystems and the consequences of natural and human pressures on them.

ACTIVITY PLAN

Aim

The **aim** of the educational activity is to inform the participating teachers and students about the functioning of marine ecosystems and the consequences of natural and human pressures on them.

Objectives

The **objectives** of the cruise are:

- Seawater sampling
- Measurements of physical, chemical, and biological parameters
- Understanding of the marine ecosystem functioning
- Sample analysis
- Processing of measurements at the HCMR labs in Anavyssos
- Teamwork
- Practicing decision-taking

- Raising awareness on marine litter issues

Equipment

The R/V "AEGAEO". A **short tour of the ship and its deck will be given,** where participants will learn about the important role played by the ship to the success of the mission. Also, participants will be guided through the rescue and safety equipment and on what they need to know while onboard.

Equipment onboard the R/V "AEGAEO", necessary for sampling and measurements: Rosette sampler (sampling water system) - CTD (conductivity gauge, temperature and depth), spectrophotometer, automatic pipette, gas chromatograph, chemical reagents, filtration devices, planktonic net, dissecting and sampling bottles.

Equipment at the Biogeochemistry Lab of the HCMR's Institute of Oceanography *(www.hcmr.gr).*

Oceanographic Cruise Scenario

On **Friday, 7 March 2014**, a one day educational trip will be held onboard the oceanographic vessel "AEGAEO" of the Hellenic Centre for Marine Research. The ship will sail from the port of Lavrio and take samples at 5 stations from the region of Lavrio to the bay of Epidaurus. The vessel, after sampling, will return in Lavrio. During the cruise, physical data and water samples will be collected in order to determine chemical and biological oceanography parameters.

The participating teachers and students will be divided into 5 groups of 3-4. Each team will undertake a research project (water sampling, measurements of physical parameters, determination of dissolved oxygen and phosphate, measurement of dissolved methane, measurement of hydrocarbon pollution, bacteria-phytoplankton and zooplankton).

The teams will change subject at each station. That way, when the research mission at the 5 sampling stations is completed, the five teams will have passed through all the modules and will have gained a comprehensive picture of the research work done in oceanographic cruises and the parameters which are applicable in order to understand the functioning of the marine ecosystem.

Study Area

The area to be studied during the educational cruise is the **Saronic Gulf**, a region studied by the HCMR for the past 30 years. The sampling stations (points) are shown in Figure 1.

Emphasis will be given on the bay of Epidaurus (ED5), where more natural, rather than anthropogenic pressures have created a unique environment with very low concentrations of oxygen (hypoxia) in the deeper layers. More specifically, the deep waters in the area of Epidaurus have been isolated since 1992, while the average renewal time is 5 years, resulting in a gradual reduction of the dissolved oxygen content.

In 2005 , the HCMR recorded total anoxia conditions (zero oxygen values) near the bottom of Epidaurus, while samples taken in 2012-2013 confirmed that the deep waters (300-420m) are still isolated and characterized by oxygen values of <1 mL / L and very high nutrient

values. The process of oxygenation of deep waters, the effect of climate change and the effects of deep mixing of the water column in the functioning of the ecosystem will be discussed and analysed. The cruise will address the issue of deep water oxygenation in the Gulf of Epidaurus in 2014.

Tasks and Oceanographic data analysis

• PHYSICS

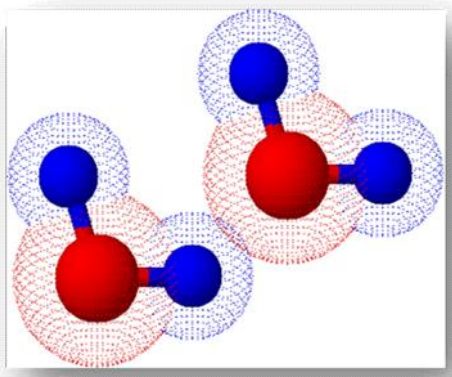
The physical data will comprise records of temperature and salinity (salt content) at all depths of the water column. Additionally, water clarity will be measured throughout the column.

These measurements will be made electronically with the CTD instrument (Conductivity-Temperature-Depth/Conductivity-Temperature-Depth). The CTD has sensors that will be deployed from the surface to the bottom and back to the surface.

Tasks and Oceanographic data analysis

• CHEMISTRY

Dissolved oxygen is the key element for sustaining life and balance in aquatic systems . The solubility and the concentration in seawater vary and distributions vary considerably depending on climatic conditions, depth, biological activity etc. The physicochemical processes that take place in the euphotic zone determine how the concentrations of dissolved oxygen may vary. The oxidation of increased amounts of organic matter near the bottom can lead to a drastic reduction of the dissolved oxygen concentration (hypoxia), to the point where in some extreme cases the values are almost zero (anoxia). The lack of oxygen, among others, creates reducing conditions which lead to the formation of gases such as methane and hydrogen sulfide.



Nutrient are compounds of phosphorus, nitrogen and silicon and are essentially phytoplankton "food" in the sea. The main compounds of inorganic nitrogen in the marine environment are nitrates, nitrites and ammonium salts. Of the phosphorus compounds, the main ones are diacid, monoacid phosphate and simple phosphates, while the silicon compounds are mainly silicates. A large influx of nutrients into the aquatic system can lead to *eutrophication*.

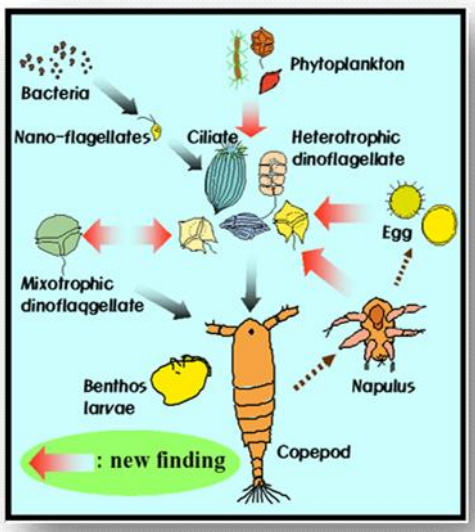
Oil pollution (ie. hydrocarbon pollution) is mainly related to oil spills in the marine environment, but there are other sources whether natural or manmade.

In the oceanographic cruise, water samples will be taken using the bottle type system NISKIN, fitted on the Rosette system, at selected depths in the water column for determination of dissolved oxygen, dissolved methane, nutrients and hydrocarbons.

Samples for analysis of nitrates and nitrites will be collected in glass vials, while samples for analysis of phosphate will be kept in special cylinders.

The determination of dissolved oxygen concentrations and dissolved methane will take place on R/V AEGAEO immediately after sampling. The measurement of oxygen will be done with the Winkler method, while methane will be measured by the gas chromatograph which is onboard the vessel. The phosphate concentrations will also be measured onboard after sampling. The appropriate chemical reagents will be added to the collected samples and the phosphate concentration will be measured using a spectrophotometer Perkin Elmer 25 Lambda, located at the Laboratory of R/V AEGAEO. For the determination of the hydrocarbons, a suitable organic solvent will be added to the samples immediately after sampling and the analysis will take place on the following day in the HCMR laboratories.

Tasks and Oceanographic data analysis • ***BIOLOGY***



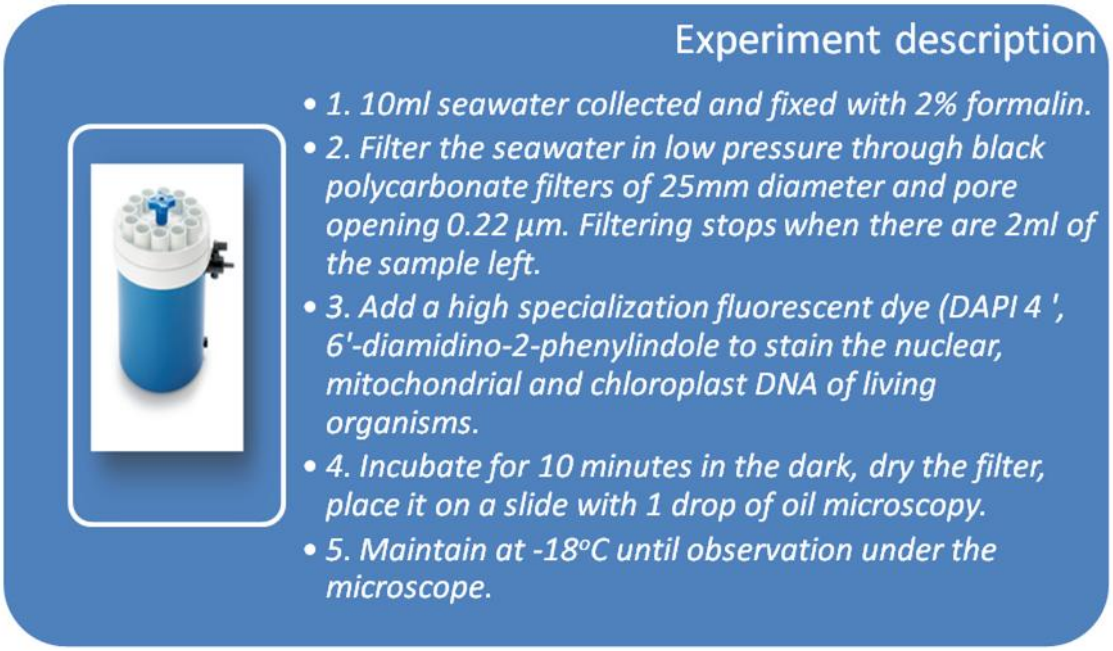
Most of the biological activity in the sea is based on microscopic organisms, which contribute to more than 90% of biomass in marine organisms. For example **there are 100 million times more bacteria in the sea than stars that we observe in the universe.**

This invisible - to the naked eye - microbial world (*prokaryotes and unicellular eukaryotes*) is actively involved in the marine food web where all organisms are connected and interact through trophic relationships.

Bacteria • ***BIOLOGY***

They play an important role in the aquatic food web. Bacteria recycle carbon to the sea, through the degradation of organic matter. They have the ability to use food as dissolved organic material and become the "first course" in the food chain for the next higher level organisms, which are in turn consumed at higher trophic levels.

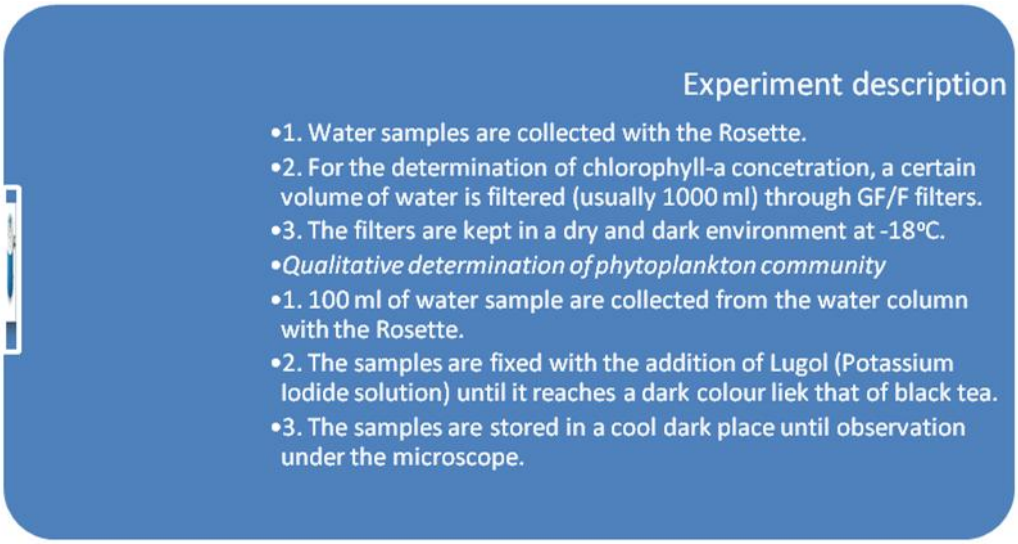
The total abundance of bacteria will be measured by fluorescence microscopy on filters where an amount of seawater has been pre-assembled.



Phytoplankton • ***BIOLOGY***

.... Measurement of chlorophyll-a as an indicator of phytoplankton biomass

The concentration of chlorophyll-a in the marine environment is used as an indicator to estimate the phytoplankton biomass and is also a parameter used to determine the environmental quality and trophic status of the marine environment.



Zooplankton • *BIOLOGY*

Mesozooplankton plays a key role in the formation and functioning of the pelagic food web. It determines the flow of carbon in the water column, through its interactions with the upper and lower trophic levels, and the benthic community. Quantitative estimates of zooplankton (*biomass and abundance*) are considered important information regarding the trophic state of the ecosystem (*oligotrophic , mesotrophic, eutrophic*). The composition of zooplankton species assemblages is an important indication of the structure of the food web and the food pathways that exist in a specific area.

Experiment description

- For the study of zooplankton, water samples will be collected with vertical towing nets WP2 (resource gauze 200 microns diameter and rim 57 cm) in the water layer as 0 and 100 m with tow speed between 0,8 and 1,2 m sec-1. In order for our observations to be independent of the daily vertical migration of zooplankton, the sampling will take place during the day. Upon collection of the samples, immediate fixation of the total sample with 4% formaldehyde solution neutralized with borax will be perfomed. There will also be similar sampling during the cruise, allowing to study mesozooplankton alive under the stereoscope for the purpose of observing the different colors and movements groups/species of mesozooplankton.

Analyses in the Biogeochemistry Lab

The following day, Saturday 8 March 8 2014, the groups that particpated in the educational cruise on Thursday will gather in the HCMR laboratories in Anavyssos, to carry out the analysis and processing of physical, chemical and biological oceanography parameters taken during the cruise from Lavrion to Epidaurus. The treatment will involve, as a first step, quality control of measurements and the combinational description of these through appropriate graphic illustrations.

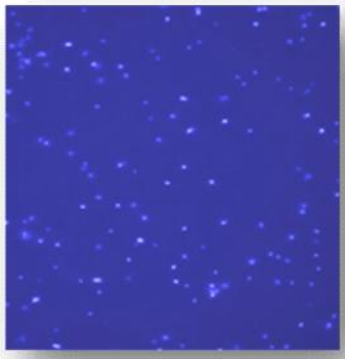
The analyses for the determination of nitrates and nitrites will take place in the ISO 17025 accredited laboratory nutrient unit at the biogeochemical laboratory of the HCMR, with an automatic nutrients analyzer SEAL autoanalyzer III, according to standard methods, while analyses for the determination of hydrocarbons will be conducted in the also accredited organic chemistry laboratory unit system using gas chromatography - mass spectrometry.

The young researchers will learn about the measurement process and the function of instruments.

They will prepare the analyzer for analysis, plan the actual analysis, prepare the standard solutions of known concentration and then analyze their samples. Finally they will process their results and proceed to discuss them.

Bacteria • In the microbial ecology lab

-The preparation is observed under an epifluorescence microscope (magnification x1000), in the wavelength range 330-385nm (UV). At least 300 bacteria counted in total in each filter.



-Results are recorded on an Excel sheet.

-Using the appropriate formula the number of bacteria counted in the various fields in the microscope is converted to actual water concentration number (cells/ml)

-Create a chart-distribution of bacteria at different stations.

PHYTOPLANKTON • In the phytoplankton lab

-The filters are placed into tubes containing 10ml 90% acetone solution (extraction)

-Fluorescence is measured after a period of 24h with the fluorometer TURNER AU-10.

- Results are recorded on an Excel sheet.

-Using the appropriate formula we convert the values into real concentration in water (μg/l)

- Create a chart-distribution of chlorophyll at different stations and the 3 respective depths.

-The collected samples are placed for settling in Utermohl tubes.

-After a period of 24h the samples are observed under an inverted microscope.

- Take photos of the characteristic species with the image analysis system camera.

ZOOPLANKTON • In the zooplankton lab

Quantitative and qualitative analysis of zooplankton samples ie measurement of abundance (number of atoms in cubic meter) and identification of groups and species of zooplankton will be carried out. Using a stereoscope type OLYMPUS SZX12 and specially adapted microscope image analysis system, organisms will be recognized at the group and species using special classification keys.

Determining the number of species (*species richness, S*) and the assessment of various diversity indices (*diversity indices*) are important in ecological studies . These parameters indicate the situation in which there is a biotic community and an increase them would increase the complexity (*increase of links*) of the ecosystem. The estimation of these will take place with the special statistical software package PRIMER (**P**lymouth **R**outines **I**n **M**ultivariate **E**cological **R**esearch).

Evaluation:

Activity evaluation sheet (for students and teachers).

Deliverables:

- Presentation of students' work on the last day of the cruise
- Photos and videos from all activities.
- Completed Evaluation sheets (from students and teachers)

Future actions:

Material for potential photography exhibition and educational presentations.
Material for potential presentation of students' work labor on the school network websites.

SCIENTIFIC QUESTIONS TEAM A

How do the physical characteristics of seawater (salinity and temperature) vary in coastal areas depending on depth and on the different seasons of the year?

The temperature of the sea in a coastal area is similar to the atmosphere's temperature depending on the season, while salinity depends on evaporation, rain and that rivers that may discharge into the sea near the area under question. During winter, because of the intense cooling and winds, water mixing takes place and so the temperature and salinity do not change much with depth. In the summer months, the upper 50-60 meters of the water column is heated quickly so we have more warm water in the first ~ 50-60 meters from the surface and cooler water in deeper layers. In this way, an invisible thin layer that separates the hot from the cold waters is generated. This layer is called the seasonal thermocline.

What is the oxygen distribution in the water column? When do we see lack of oxygen (hypoxia-anoxia) and what are its consequences on the marine environment?

Dissolved oxygen is the key element for sustaining life and balance in aquatic systems. The solubility and the concentration in seawater depends on weather conditions, depth, biological activity etc. Generally, on the surface layer, the concentration of dissolved oxygen is high and can reach up to 100 %, depending on the prevailing temperature and pressure. The physicochemical and biological processes in the euphotic zone (i.e. the depth to which the sunlight can reach) determine the manner and the amount of variations in the concentrations of dissolved oxygen. An increase in temperature leads to reduced oxygen solubility. When there is no mixing in the water column, the oxidation of large amounts of organic matter near the bottom can lead to a drastic reduction of the concentration of dissolved oxygen (hypoxia), to the point where in extreme cases the values are zero. In this case we have anoxic or anoxic

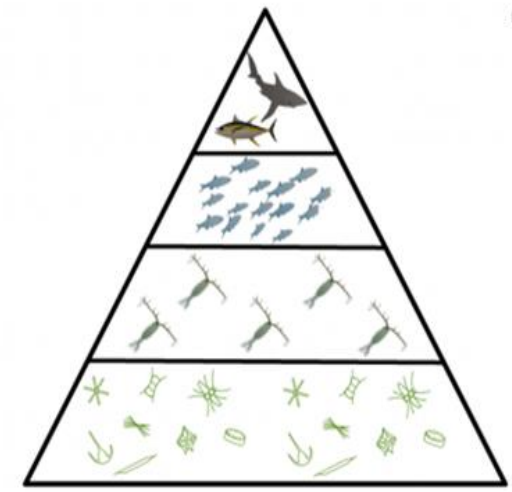
conditions. Marine organisms cannot survive under these conditions, while the reducing conditions created lead to the formation of gases such as hydrogen sulfide and methane with a characteristic strong odor. Anoxic conditions exist in the Black Sea, just below 100-120 meters. Due to the lack of oxygen in these conditions, anything under this layer remains intact.

What is marine pollution caused by hydrocarbons?

Hydrocarbons are the major constituent of oil, some of which are formed by processes that may be either natural or manmade. Hydrocarbons at sea arrive from various terrestrial runoff (rivers, ducts, canals, etc.), by deposition from the atmosphere and from maritime transport, including ship accidents and oil extraction processes. Hydrocarbons undergo various processes in the water (oxidation, evaporation, emulsification, degradation by microorganisms etc.) and those who finally remain accumulate in suspended matter and sediments.

Why are the vertical mixing and the thermocline so important in the distribution of chlorophyll and nutrients in the water column?

Mixing done in winter facilitates the transfer of nutrients and chlorophyll to the surface, while during summer more chlorophyll is located just below (deeper) than the thermocline. Vertical mixing moves the oxygen into the deeper layers.



What is the marine food web?

A food web is characterized as the complex relationship of the food chain in each organism at class level. A balanced food web is important in any marine ecosystem and is an indicator of the quality of the marine environment. At the base of the food web are prokaryotic and eukaryotic unicellular organisms whose abundance and diversity affect that of higher organisms such as zooplankton and fish. The abundance of bacteria and planktonic algae is influenced by the concentrations of nutrients in the water. Increased concentrations of nitrogen and phosphorus lead to increased concentrations of phytoplankton. All organisms involved in the marine

food web are interlinked and interact through trophic relationships.

Who eats what?

Starting from bacteria and going up the food chain...Bacteria recycle carbon in the sea, through the degradation of organic matter. They have the ability to use food as dissolved organic material and to become "first course" in the food chain for the organisms one level up, which are in turn consumed at higher trophic levels.
Phytoplankton uses the nutrients and through the photosynthesis process (carbon dioxide and light) it increases its biomass. The phytoplankton biomass used as a primary food source by other organisms such as zooplankton which in turn are fed upon by plankton-eating fish, which eventually become food for larger fish.

What factors affect the food webs and how are these affected by human activities?

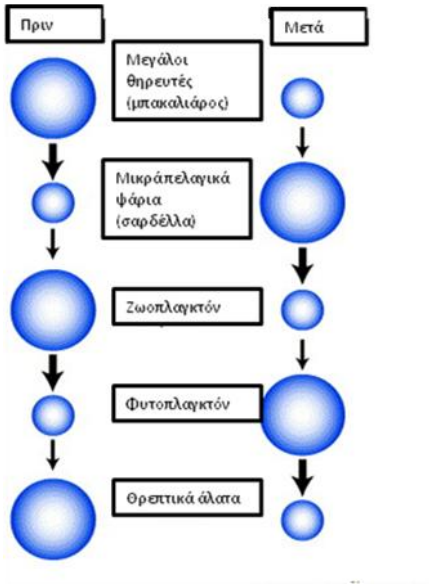
Food webs are characterized by the number of trophic levels and the biomass of the teams present in each trophic level. Thus, nutrient availability affects the biomass of phytoplankton, which in turn affects the zooplankton biomass etc.

if there are many predators In a food web, there is far greater reduction of the biomass of prey organisms compared with another food web comprising fewer predators, as intensity of predation is decreased.

Human activities can change the structure of food webs in many ways:

1. Intensive cultivation of land without provision for runoff of pesticides and other chemicals and the absence or improper management of wastewater from sewers and industries, leading to increased concentration of chemical nutrients in the aquatic environment and eutrophication.

2. Climate change, whose effects are becoming increasingly apparent in marine ecosystems: e.g. temperature and sea level rise, sea ice decline, while the chemical, physical and biological characteristics of the sea are changing (ocean acidification).

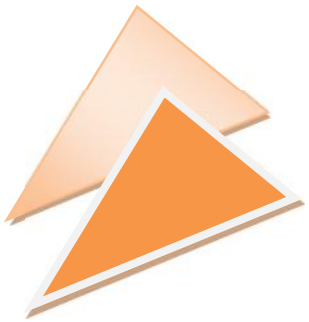


3. Uncontrolled exploitation of marine resources such as overfishing, destructive fishing practices, etc.

4. The entry and spread of alien species can completely change the characteristics of entire ecosystems.

How do scientists study marine organisms in order to explore the structure and function of the marine food web?

Scientists studying food webs by collecting samples from different organisms (bacteria, phytoplankton and zooplankton to fish). Oceanographers using research ships collect samples from different depths and under different environmental conditions e.g. temperature, oxygen, salinity and with different methods, e.g. plankton nets, seawater filtration devices, etc., to study the biomass of organisms at each trophic level, the diversity of organisms (biodiversity) and the predator-prey relationships.



TEAM B

FIELD WORK

DATE: Saturday 8 March 2014

Underwater Remotely Operated Vehicle Activities for Scientific Use

Recording seabed biodiversity and marine litter

Objective - Brief Description: *Tour and training of Secondary Education (mostly high school), the Oceanographic vessel AEGAEO, the use of robotic vehicles for underwater recording of animals and plants on the seabed wreck as well as recording solid marine litter.*

ACTIVITY PLAN

Aim

The **aim** of this educational activity is for participating teachers and students to become informed about the use of robotic vehicles to record the biodiversity of the seabed and the natural and human pressures (waste) laid upon them through the use of video cameras.

Objectives

The objectives of the mission are to record, with the use of video cameras for robotic vehicles:

• The marine fauna and flora

• Traces of human activity on the seabed (Waste Water: type & quantity)

• The contribution of marine litter in the alteration of natural habitats and to:

- to work in groups

- to practice decision-making
- to raise awareness on marine litter issues

Means-equipment

The oceanographic vessel "AEGAEO". A tour of the ship and the deck will take place where participants will learn about the important role played by the ship to the success of the mission. Also, they will learn about the rescue and safety equipment and what they need to know while on it.

The robotic vehicles. The MaxRoverII, or Falcon and Seabotix. All children can sit for at least 1-2 minutes at the controls of the vehicle, and leaving the ship they will all have a certificate of participation as a student pilot of robotic vehicles.

Two GoProII cameras to take one photo per minute on the site handling the ROV, and in the operating area of the cable. (This will provide the opportunity to create a photo stream video, which will play the photos to be used on the websites of the International Network for Environmental Education: "My school voyages with PERSEUS"-PERSEUS @ school network hosted on the websites of the PERSEUS Department of Environmental Education Athens and HCMR:
http://www.perseus-net.eu/site/content.php
http://dide-a-ath.att.sch.gr/perival/
www.hcmr.gr

Necessary materials

- PERSEUS T-shirts for attendants
- Name badge for students
- Stationery
- Trainee Pilot Certificates
- Hardback notebooks
- Pencils, pens etc.
- DVDs, for photos and videos.

Σενάριο «παιχνιδιού» της αποστολής "Game" Mission Scenario

Από την στιγμή που θα ξεκινήσει το πλοίο, μέχρι να αγκυροβολήσει σε κατάλληλο μέρος, με πλούσιο βυθό *(40 με 50 μέτρα βάθος),* θα χωρίσουμε τα παιδιά σε 4 ομάδες *(με μια γρήγορη κλήρωση με χρωματιστά μανταλάκια σε 4 χρώματα)* που θα βρίσκονται σε μία αδιαφανή σακούλα.
Κάθε ομάδα θα διαθέτει **ασύρματο, Log sheets**, και **υπεύθυνο μέλος της ομάδας μας**. *(Όλα τα μέλη της ομάδας θα περάσουν από όλους τους σταθμούς).*
From the moment the ship sets sail, until it anchors in one place with a rich seabed (40-50m deep), the students will be divided into four groups (with a quick DYI draw of colored pegs that are in an opaque bag).
Each group will have a wireless internet connection, log sheets, and a member of our team. (All members of the team will go through all the stations).

Stations:

1) ROV Operators

Children will handle the ROV, sonar etc. They will have a log sheet, which in the upper left edge will have a plan of the ship onto a canvas-squares numbered. This canvas will be the equivalent of longitude and latitude, and on it all our recordings will be noted.
Example: We may say that "the ROV will move from 4 square to square 5 ", or that "found two mullets, three sponges and 2 bottles in square 4".

2) Cable Operators

Children will handle the ROV cable ROV. We will record the commands from the pilots, or the bridge and how many metres of cable are out. Safety helmets and life jackets should be worn at all times.

3) Species record station

Children will make scientific observation and record what they see in the appropriate box so that "statistical" treatment can be applied afterwards. This includes averages, maxima and minima.
Example: An representative result could be "found 0.5 bottles per box, with a maximum concentration of 3 bottles / box and the minimum zero bottles."
To make the record more "scientific", it would be good to have colour copies, one page long, with the ten species we expect to encounter in the field. Something like a key, but only on one page.

4) Connection with the ship bridge

Children will handle all communications with the team at the bridge of the ship. We will record the commands from the pilots to the bridge, the bridge commands to pilots, how many meters of cable are out etc.

Evaluation

Evaluation sheet (for students and teachers) for the activity.

Deliverables

- Photos and videos from the entire activity.
- Certificates of attendance for the students (ROV Trainee Pilots)
- Completed Evaluation Sheets (from teachers and students)

Further developments

Materials for potential photography exhibition and educational presentations.

How is human activity associated with marine litter on the seabed?

Waste is by definition linked to human activity.

"As marine litter we define any persistent, manufactured, processed or used for human solid material rejected, deposited, abandoned or unintentionally left on the marine and coastal environment."

It is very common for waste created by humans on land, not appropriately managed, to reach many miles away to the sea floor. Therefore, the different kinds of human activity are directly related to the different sources of marine litter.

What are the main sources of marine litter?

The sources of marine litter are categorized in the following two categories:
i. The main land-based sources are: landfills, rivers and estuaries, rainwater, floods, industrial discharges, sewage networks, untreated urban waste water and any kind of tourist activity. The majority of marine litter (80%) comes from land sources.
ii. Marine sources of marine litter are: shipping, maritime transport, yachts, fishing, aquaculture, offshore mining and extraction of natural resources (oil rigs), illegal marine discharges, fishing (fishing gear discharges). From marine sources comes the remaining 20% of marine litter.

How far back does the marine litter issue go?

It may be a relatively recent (’80s),environmental problem however there are several reports that show quite the opposite. It should not surprise us that the pollution of the marine environment began in ancient times. During the Golden Age of Pericles (5th century BC), the Athenians were financing their fleet and the construction of the Acropolis from the exploitation of the silver mines in the region of Lavrio. Residues from the mining area of Lavrio, were thrown in the sea. Corresponding findings exist for the ancient port of Marseille, which flourished during the Roman period (1st century BC - 4th century AD). Findings indicate that the

residue of the ancient harbor of Marseilles was contaminated by lead, derived from metallurgical activities in the area. Finally, Jules Verne (1870) in his book "20,000 Leagues Under the Sea" (Chpt.12, "The Sargasso Sea", p. 276) makes references to floating objects coming from the Rocky Mountains and the Andes where through the Mississippi and Amazon rivers reached the ocean.

What is the contribution of marine litter to the deterioration of natural habitats?

Marine litter can directly or indirectly alter the character of natural habitats. This can be done:

i. With the change in biological and ecological behavior of individual animals: difficulty in capturing, assimilation and digestion of food, satiety (hunger), escape predators and avoid problems during playback, poor body condition, locomotion and migration.

ii. Alteration, destruction and degradation of benthic ecosystems and change the state of the substrate for soft bottoms.

iii. Disruption of the gatherings for organisms living in the sediment, altered sediment porosity and heat transfer capacity.

iv. Introduction of alien species and transport of microorganisms (potentially pathogenic) as a marine litter, through the solid matter, can serve as a means of transport.

Photo 1: Recording of marine litter with the help of the ROV in the Patraic Gulf (Source: Physical Oceanography Department, University of Patras).

Commonly found objects in the Saronic Gulf:

1. Synthetic ropes:

2. Fishing nets:

3. Fishing lines:

4. Aluminium Cans (Soft drinks and beverages)

5. Plastic bags and bottles

6. Plastic containers

ANNEX:

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

ΔΕΛΤΙΟ ΚΑΤΑΓΡΑΦΗΣ-LOGSHEET				
ΠΡΟΓΡΑΜΜΑ			ΗΜΕΡΟΜΗΝΙΑ	
ΚΑΤΑΔΥΣΗ		ΚΑΙΡΟΣ		
ΣΥΝΤΕΤΑΓΜΕΝΕΣ	Lat.		Long.	
ΠΙΛΟΤΟΣ			ΒΟΗΘΟΣ	
ΠΑΡΑΤΗΡΗΣΕΙΣ				

ΑΑ	ΩΡΑ	ΒΑΘΟΣ	ΠΕΡ. ΕΡΕΥΝΑΣ	ΚΑΤΑΓΡΑΦΗ

NOTES