



## EXAMINATION IN BI 2060 – MARINE ECOLOGY

### Subject teacher:

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**Date:** 30.05.2012  
**Time:** 09.00 – 13.00 (4 hours)  
**Points:** 7.5  
**Permitted aids:** Calculator HP30S and Citizen SR-270X

**Language: English**

**Number of pages: 9**

**Enclosure pages: 2**

**Grades to be announced on: 18.06.2012**

**ENGLISH –  
ALL QUESTIONS COUNT EQUALLY. FORM FOR ANSWERING IS ENCLOSED IN  
LAST PAGES**

**All questions have only one correct answer alternative. Give your answer in the table below by crossing the correct cell in the table. If you later on intend to change your answer, draw a circle around the cross and make a new cross.**

**The evaluation will be made manually. Correct answer gives one point. Wrong answer and no answer give zero points. If more than one alternative is given, this will result in zero points. Therefore, indicate always only one answer alternative.**

**1. Light. Which statement is NOT true?**

- A: Cosine-corrected and scalar irradiance measurements show different values under water
- B: Irradiance is radiation hitting a surface, given per unit area
- C: Radiance is radiation emitted by a light source
- D: Scalar irradiance is measured using a flat sensor
- E: The least accurate estimate of irradiance is provided by the Secchi disc

**2. Light. Which statement is true?**

- A: The sea surface reflects most light when the sun elevation is high and the sea surface is rough
- B: Light rays are not refracted when they hit the sea surface at an oblique angle
- C: In a homogeneous water column light is attenuated linearly with increasing depth
- D: Water absorbs infrared light efficiently
- E: Because of the cosine effect, irradiance at the sea surface is larger under a low than high sun

**3. Light. Which statement is NOT true?**

- A: Colour is produced by the brain after light has been absorbed by the retina
- B: Red colour comes from light with short wavelength
- C: Blue colour comes from light with much energy per photon
- D: Certain animals, among them some insects, can see ultraviolet light as a colour
- E: The human colour perception comprises wavelengths from 380-700 nanometers

**4. Light. What statement is NOT true?**

- A: The speed of light *in vacuo* is about 300 000 km per second
- B: The speed of light is lower in air and water than *in vacuo*
- C: Refraction occurs in boundaries between mediums with different speed of light; for example, between air and water
- D: Air is colourless, and the blue colour of the sky is caused by Rayleigh scattering
- E: Water is colourless, so the blue colour of oceanic water is only caused by mirroring of the sky

**5. Sound. Which statement is true?**

- A: The speed of sound is the product of its frequency and the density of the medium in which sound propagates
- B: The speed of sound is smaller in air than in liquids
- C: The speed of sound is smallest in solids
- D: Sound exists in water because water is non-compressible
- E: Sound in air and water forms transverse waves

**6. Sound. Which statement is NOT true?**

- A: Sound in air near the sea surface propagates at a speed of about 330 m per second
- B: The speed of sound is smaller in outer space than *in vacuo*
- C: An audiogram shows the capacity of hearing by humans and animals at different wavelengths
- D: The widest frequency spectrum for hearing is known from whales
- E: A decibel is a tenth of a Bel

**7. Pigments. Which statement is true?**

- A: Chlorophyll *a* is coupled directly to the reaction centers of photosynthesis
- B: Chlorophylls and carotenoids are water-soluble
- C: Phycobilins are important in diatoms
- D: Remote sensing of chlorophyll from satellites is based on backradiation of red relative to green light
- E: Astaxanthin is typical for green plants

**8. Global distribution of chlorophyll/phytoplankton. Which statement is NOT true?**

- A: Chlorophyll concentrations in the large subtropical gyres in the oceans are very low
- B: Equatorial oceanic belts exhibit high chlorophyll concentrations on their eastern side because of strong upwelling
- C: Non-corrected satellite images from Norwegian coastal waters largely exhibit high chlorophyll concentrations because of high content of yellow matter in the water
- D: Most of the Southern Ocean is characterized by small concentrations of chlorophyll
- E: There are larger concentrations of chlorophyll in the Barents Sea than in the Bering Sea

**9. Algal groups. Which statement is NOT true?**

- A: Thecate dinoflagellates possess a silicate shell
- B: In diatoms, only the male sexual cells possess flagella
- C: The zygote of diatoms becomes an auxospore after having formed a shell
- D: Coccolithophorids form a subgroup of Prymnesiophyceae
- E: Coccolithophorid blooms (of *Emiliana*, for example) are common in Norwegian coastal waters

**10. Photosynthesis. Which statement is true?**

- A: Photosynthesis is driven by PSI
- B: Photosynthesis *vs.* Irradiance (P *vs.* E) curves form a parabola for the photosynthetic rate *vs.* Irradiance
- C: A decrease in the growth rate in very strong light is known as photoinhibition
- D: Photoacclimation maximizes the change in growth rate when the light conditions are changed
- E: Photoacclimation does not alter the chlorophyll *a* contents of cells

**11. Growth of phytoplankton. Which statement is NOT true?**

- A: Algae growing at a constant rate are in their exponential growth phase
- B: An algal culture passes through a lag, log, stationary and death phase
- C: A minimum factor acts directly upon the growth rate
- D: The growth rate is dependent of the supply of nutrients
- E: The growth rate is generally not affected by the day length

**12. Ecology. Which statement is true?**

- A: Iron-limited growth of phytoplankton is often observed in the North Atlantic
- B: Very deep vertical mixing is positive for the growth of phytoplankton
- C: A loss rate is necessary input in Sverdrup's model for critical depth
- D: The critical depth is the depth below which the total photosynthetic rate equals the total loss rate in the water column
- E: Increase in irradiance towards summer shifts the critical depth higher up in the water column

**13. Ecology. What hinders large supply of plant nutrients from deep layers to the surface layer?**

- A: Turbulent mixing induced by currents that meet
- B: Banks and islands that induce turbulent mixing
- C: Stabilization of the surface layer induced by low salinity and/or increase in temperature
- D: Tides
- E: Upwelling

**14. Plankton ecology. Which statement is true?**

- A: The world's largest marine primary productivity is found along the Norwegian coast
- B: Late spring phytoplankton blooms in Norwegian fjords are caused by stabilization of the surface layer, which in turn is caused by much clear-sky weather
- C: The growth season of phytoplankton in Norwegian fjords begins in February-April and lasts until November
- D: The duration of the growth season is determined by tidal cycles
- E: Multiyear ice in the Arctic Ocean usually lacks a flora on its underside

**15. Primary production. Which statement is NOT true?**

- A: New production is based on nutrients supplied inside the defined system
- B: New production is especially low in the central, warm ocean gyres
- C: The fraction of new production of total primary production is largest early in the spring bloom
- D: Generally, the primary production in the sea is small where regenerative production is dominating
- E: Tropical rainforest combines high total primary production with small new production

**16. Primary production. What statement is true?**

- A: The acronym HAB means Habitat Agglutinating Biota
- B: Both seawater and algae have an average N:P ratio of 26 (mol per mol)
- C: Poisonous naked dinoflagellates and prymnesiophytes do not release toxins into the water
- D: Paralytic Shellfish Poisoning (PSP) in Norway is associated with occurrence of the dinoflagellate, *Alexandrium tamarense*
- E: In northern Europe, freshwater is richer than seawater in phosphate

**17. Which mechanism is not an interaction mechanism in ecology?**

- A: Competition
- B: Territoriality
- C: Commensalism
- D: Predation
- E: Functionality

**18. Which statement is wrong?**

- A: A community in ecology consists of all populations that lives and interact
- B: An extended ecological hierarchy include the system from ecosphere to organism levels
- C: Ecological 3D models and so-called ROVs are in increasing degree used in marine research
- D: More than 50% of the ocean surface is oceans deeper than 4000 meter
- E: The ecosystem consists of many communities of organisms and their abiotic environment

**19. Which statement about marine biogeography is not correct?**

- A: Gradients, or so-called ecoclines, and the properties of the organisms are the most important driving forces for the distribution of organisms in the oceans
- B: The biodiversity of the oceans can among others be understood based on knowledge on important ecoclines
- C: Temperature is the most important ecocline of the oceans
- D: The oceans have traditionally been divided based on climatic conditions where the polar ocean is one of the oceans
- E: Biogeography describes the distribution of organisms related to geography

**20. Which statement about the different zones of the ocean is wrong?**

- A: The zone inside the continental shelf is mentioned as oceanic and the zone outside is mentioned as neritic
- B: The pelagic zone extends from the open ocean to the low tide depth of the littoral zone
- C: The mesopelagic zone extends from 200 to 1000 meter depth
- D: The benthic abyssal zone extends from 4000 to 6000 meter depth
- E: The photic zone is the upper part or the entire epipelagic zone

**21. Which statement on biodiversity is correct?**

- A: The number of species in an ecosystem is alone decisive for a normal function of the ecosystem
- B: Species rich ecosystems will normally not lose much of its functions if one species becomes extinct
- C: Biodiversity is most relevant for terrestrial ecosystems
- D: Most phyla are dominated by macrobes, or multicellular organisms)
- E: The species term is little relevant for bacteria and biodiversity is therefore not much relevant for bacteria as well

**22. Which statement on ecosystems and organisms are wrong?**

- A: Ecosystem structure says something about species richness in the ecosystem
- B: Nauston are organisms that lives associated with the water surface
- C: Organisms that are closely related taxonomically constitute a functional group in ecology
- D: Ecosystem function says something about the activity of the organisms in the ecosystem
- E: Nano-plankton is organisms of size 2-20  $\mu\text{m}$

- 23. Which statement about feed intake, metabolism and growth processes of heterotrophic organisms are wrong?**
- A: Nutrient uptake, respiration and growth are the most important processes of marine animals
  - B: Growth efficiency (GE) is defined as growth per feed intake
  - C: Assimilated food corresponds to digested food that are taken up in the intestine of animals
  - D: Trophic means the process of nutrition, the process of eating
  - E: The assimilation efficiency (AE) is defined as assimilation per feed intake
- 24. Which statement on nutrition of organisms is correct?**
- A: Organisms can be divided in producers, consumers and decomposers based on their mode of nutrition
  - B: Herbivore organisms consumes mainly bacteria and cyanobacteria
  - C: A food web is strictly a simplification of a more complex food chain
  - D: Omnivore organisms are often mentioned as detritivore
  - E: Herbivore organisms are only found among zooplankton
- 25. Which statement about the heterotrophic plankton is wrong?**
- A: Meroplankton is so-called temporary plankton
  - B: Heterotrophic nano-flagellates are small (4-8  $\mu\text{m}$ ) single-celled organisms without pigments
  - C: Organisms in the group Archaea can live under very extreme conditions
  - D: Antarctic krill is a key species of the zooplankton in the southern hemisphere
  - E: Amphipods are crustaceans that are particularly abundant in trophic waters
- 26. Which statement on the process from feed intake to growth is not true?**
- A: Holling (1959) has described three different functional responses to increased food concentration
  - B: Large organisms can normally eat larger prey
  - C: Filtration of particles from the water and pinocytosis are common mechanisms of feed intake among plankton
  - D: Width and length of a prey affects how easily it may be consumed by a predator
  - E: Large copepods grows normally faster than small
- 27. Which statement about growth courses is correct?**
- A: It is an advantage for bacterial nutrient uptake to be attached to a particle instead of being free living, suspended in the water
  - B: A growth course where the number of cells increases proportionally with time is mentioned as exponential
  - C: The specific growth rate of a population is highest when the biomass is close to the maximum
  - D: The maximum biomass of a population is normally mentioned as the carrying capacity of the population
  - E: The numbers of cells are reduced during the stationary phase of growth

**28. Which statement on natural systems is wrong?**

- A: The zooplankton is normally growth limited by low food amount and low nutritional value of the food
- B: We may estimate the net growth rate of a population based on biomass measurements in a natural system
- C: Predation, sedimentation and mixing with deep water represents the most important loss processes of microalgae
- D: The growth rate of phytoplankton in the ocean is controlled by light intensity
- E: The biomass of both autotrophic and heterotrophic organisms varies strongly with time

**29. Which statement on global fisheries is wrong?**

- A: The world's fish production in the last century was estimated to something in between 22 and 2000 million tonnes per year
- B: John Ryther estimated the production to 240 million tonnes of which 100 million tonnes were harvestable
- C: John Ryther found that open ocean had food chains with up to seven trophic levels
- D: John Ryther found that the province mentioned as coastal waters showed higher specific potential of production than the province mentioned as open ocean
- E: John Ryther defined a province mentioned as open ocean that constituted 90% of the global sea surface

**30. Which statement about upwelling areas is wrong?**

- A: Wind and earth rotation are important driving forces for upwelling of deep water
- B: Coriolis is a driving mechanism for equatorial upwelling
- C: Fish production in upwelling areas is proportional to the rate of the upwelling
- D: Peruvian anchovy is the world's largest fish resource and it is mainly harvested in an upwelling area
- E: Upwelling areas can be observed by satellites from space

**31. Which statement about aquaculture and release of nutrients is wrong?**

- A: EU's water framework directive regulates emissions from the aquaculture industry
- B: Inorganic nutrients like ammonium and phosphate can affect the phytoplankton
- C: Particles from defecation and feed losses sink to the seafloor and in Norway the influence on the environment is monitored by the authorities
- D: Nutrients that are released tend to disappear because they are assimilated in the food chain and diluted by sea currents
- E: It may take as much as two days before an increased emission of nutrients results in a higher biomass of phytoplankton

**32. The world's total fish catch has stagnated in the last decades. Which factor is not a cause for this?**

- A: During the last 50 years the world's fishing fleet has become much more effective.
- B: The political ranking of priorities has often overruled the scientific recommended quotas.
- C: The use of too large mesh width in fishing nets.
- D: The price and demand from the consumer market has led to dumping of less valuable species, which in turn has led to an overfishing on these species.
- E: The resources management has often not put sufficient weight on the interactions between key species in an ecosystem.

- 33. One of these species belongs to the class of jawless fish (Agnatha), which one?**
- A: Eel (*Anguilla anguilla*)
  - B: Cod (*Gadus morhua*)
  - C: Ratfish/ghost shark (*Chimaera monstrosa*)
  - D: Hagfish (*Myxine glutinosa*)
  - E: Salmon (*Salmo salar*)
- 34. In the 1960ies an important Atlantic fish stock, which also were important in a global view, collapsed because of prolonged overfishing. Which fish stock was it?**
- A: Norwegian Spring Spawning Herring (*Clupea harengus*)
  - B: North Sea Mackerel (*Scomber scombrus*)
  - C: Red Fish (*Sebastes marinus*)
  - D: Newfoundland Cod (*Gadus morhua*)
  - E: Alaska Pollock (*Theragra chalcogramma*)
- 35. Production technology in the aquaculture industry has had an increasing development. Which one of these alternatives is not correct?**
- A: Sea water pens/open pens are exposed to strong natural forces.
  - B: Ocean pens/closed pens are less exposed to wave strain.
  - C: Land based fish farms often use recirculated water.
  - D: Ocean pens cause the same stress on the environment as sea water pens when regarding pollution by excess feed.
  - E: Land based fish farms are protected against algae blooms, predators and escapes.
- 36. Which of the following statement is correct?**
- A: Considering the situation today, farmed salmon is a sustainable alternative for the consumers who want to protect the wild pelagic fish.
  - B: Since 2000 Thailand has been the biggest aquaculture producer worldwide.
  - C: The production of Crustaceans as a group has had the highest increase in aquaculture.
  - D: When the world is seen as a whole, the number of persons employed in aquaculture has far overdone the number employed in fisheries.
  - E: Aquaculture is considered to be a possible solution to the increasing demand for protein worldwide.
- 37. When genes from an external source enter a local population it is called introgression. An example is when escaped farmed fish successfully spawn with the wild fish. Which alternative is NOT correct when dealing with the genetic effects of introgression?**
- A: The recipient will be more and more like the donor genetically.
  - B: If the donor is genetically altered and has lost genetic variability, this will eventually also apply to the recipient population.
  - C: Natural selection will have a certain self-cleaning effect on the wild stock.
  - D: When the donor and recipient belong to the same species an introgression will always cause an increase in genetic diversity.
  - E: If the donor population is genetically modified organisms; they will transfer their genetic material to the recipient population.



- 38. Hardy-Weinberg's law says that in a statistical ideal population of diploid individuals, the proportions of the genotypes are determined by the allele frequencies at a locus according to the binomial (or multinomial) formula. In a population of 100 individuals, a polymorph locus has two alleles A and B. The genotype distribution in the population is AA:35, AB:50 and BB:15. What is the frequency of allele A?**
- A: 0,600
  - B: 0,327
  - C: 0,825
  - D: 0,200
  - E: 1,200
- 39. Which one of these marine biotopes is most prone for anthropogenic disturbance?**
- A: Estuarine areas
  - B: The deep seabed
  - C: The world's large oceans
  - D: The continental slopes
  - E: The sea ice in the Antarctic
- 40. Which statement is not correct?**
- A: Organic stress on the sea bottom will lead to reduced species diversity.
  - B: Certain stages during deoxygenating of the sea bottom favor opportunistic species.
  - C: Reduced oxygenation on the sea bottom will reduce the population number in all species.
  - D: A hydro-electric power station situated far from the sea can still affect marine habitats and ecosystems.
  - E: When organic particles (mud) cover coral reefs it can have a damaging effect.
- 41. In which one of these nektonic groups will oil spill lead to the highest mortality considering the short term in situ situation?**
- A: Catadromous fish species
  - B: Demersal fish species
  - C: Seabirds
  - D: Cartilaginous fish
  - E: Whales
- 42. Oil spills in high latitude and in polar areas are considered to cause more serious and long lasting negative impacts than in midlatitudes. One of the following oil spill catastrophes happened in such a sensitive area, which one?**
- A: Amoco Cadiz
  - B: Exxon Valdez
  - C: Deepwater Horizon
  - D: Torrey Canyon
  - E: ABT Summer

**43. Which alternative is not correct?**

- A: The need to conserve can be caused by habitat degradation/fragmentation, climate change, over-exploitation, introduction of alien species and/or pollution.
- B: Conservation biology has the aim to protect species, their habitats, and ecosystems from extinction.
- C: Conservation biology is multidisciplinary and makes use of sciences, economics, and the practice of natural resource management
- D: Conservation biologist need to develop effective tools for predicting changes in biodiversity
- E: Conservation biology is most effective if one focuses only on ecosystem within national borders and do not seek international solutions.

**44. Which situation can loss of biodiversity at the species level not cause?**

- A: An ecosystem shift where one ore a few species become very frequent, which will have an opposite effect on the frequency of other species in the ecosystem.
- B: An ecosystem is a robust system where a loss of general biodiversity gives an increased positive effect on the species diversity.
- C: An ecosystem shift can have a cascading effect down the food chain.
- D: A lower biodiversity can lead to a lower resilience in the ecosystem.
- E: Restoring a loss of biodiversity, which has caused a shift in the ecosystem, is very difficult.

**45. Which alternative is NOT regarded as a way to prevent/solve loss of biodiversity?**

- A: Increased awareness.
- B: Eco labeling; for the consumer to take appropriate choices.
- C: If the legislation was relaxed the market forces will automatically handle the problems regarding loss of biodiversity.
- D: Enough funding for applied science.
- E: Strong legislation which are enforced.

**46. The textbook treats the subject «discounting the future». Which alternative is NOT correct?**

- A: The discounting rates used in the fisheries are usually put at a level that makes it more economical to get a profit today rather than get a bigger profit in the future.
- B: Discounting rates are used to estimate the relative value of a product, in this case fish, to see how the value of the catch develops into the future.
- C: When all societal and ecological factors are taken into account, it is the shortsighted perspective which is the overall most profitable choise for all parts of the fishery.
- D: A single person will choose profit today rather than preservation and higher profit later.
- E: This is the formula used in the textbook to calculate the value of a catch using discounting rates.

$$PV(V_t) = \frac{V_t}{1 + \delta^t}$$

$t = t$  years in the future

$PV(V_t)$  = the present value  $PV$  of income  $V$ ,  $t$  years into the future

$V_t$  = income  $V$ ,  $t$  years into the future

$\delta^t$  = the discount rate square  $t$

**Exam Bi 2060 - Marine ecology, 30<sup>th</sup> of May, 2012**

**- Candidate number:** \_\_\_\_\_

| <b>Question\answer</b> | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> | <b>E</b> |
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– Candidate number: \_\_\_\_\_

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