



E-AQUALEX Aquatic Sciences e-learning Toolset

WEEK 2

Section 1 Part 2 Properties of sea water



Sea water is a dynamic element whose properties change in space and time. Its movements, its physical properties (temperature, salinity, density), the dissolved gases and solids create a variety of environmental conditions significantly affecting the composition of each biological community that inhabits it.

2.1 Temperature

Sea water is heated mainly by solar energy, though geothermy and underwater volcanic activity make some smaller-scale contributions. The impact of solar radiation on sea water temperature is regulated by factors such as:

- a) **latitude**: in tropical areas, a high surface temperature is observed, while at the poles, there are regions covered by ice throughout the year. This increases the reflection of solar radiation.

- b) **depth:** cold water has a higher density than warm water and sinks down to first respective density layer where it is isolated from further heating.
- c) **season:** in temperate areas mainly, there are considerable differences in both temperature and photoperiod between the seasons; these differences are also mediated to the sea water.
- d) **local factors,** such as shallow waters, hot springs (or even industrial thermal pollution).

<http://scienceworld.wolfram.com/physics/Albedo.html>

An important phenomenon is the stratification of sea water: warm surface water is layered above water masses of lower temperatures and consequently higher density with increasing depth, while in very deep waters the temperature stabilizes around 2-4 degrees C. This stratification pattern is observed throughout the year in tropical areas and in temperate zones only during the summer. It is ended by total convection usually mediated by storms. Polar regions usually have a uniform temperature profile in the water column throughout the year. A typical diagram of density stratification in temperate waters is shown in **Figure 4** below.

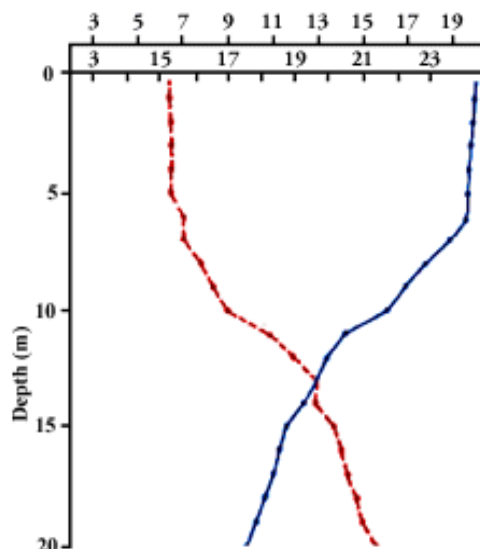


Figure 4. Stratified water in the Baltic indicated by temperature and salinity depth profile.

Water temperature greatly affects the life of marine organisms. At high temperatures, metabolism is faster, resulting in a greater demand for food and oxygen. Development and genetic maturation are also faster at higher temperatures. Organisms able to live in a wide temperature range are called eurythermic, in contrast to stenotherms, organisms which have very specific and narrow temperature demands. The thermophiles prefer high and the psychrophiles depend on low temperatures.

2.2 Salinity

Sea water includes dissolved salts and ions in different quantities, the ions of chlorine and potassium being dominant. Salinity (S) is the total quantity (in grams) of inorganic salts dissolved in 1000g of sea water. In the open ocean, salinity values at the surface are determined by the equilibrium precipitation - evaporation (see Figure 5) which shows only latitudinal variation with an average value of approximately 35‰. However, in closed seas and mainly in the coastal system, salinity variations can be quite important because of river and fresh water inputs.

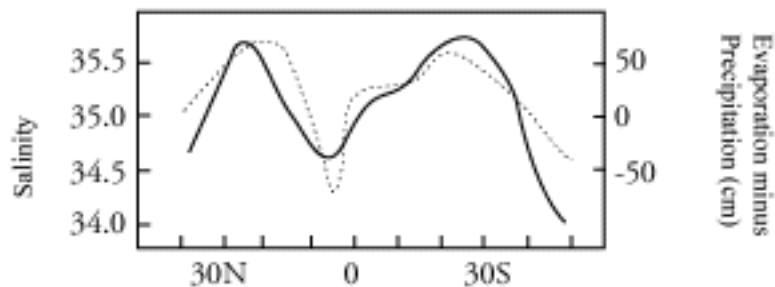


Figure 5. Latitudinal variations in surface salinity of the open ocean. Balance of evaporation and precipitation also shown.

2.3 Osmoregulation

Most marine organisms (except for bony fish, mammals, birds and reptiles) have body fluids whose osmotic pressure equals that of sea water.

Organisms that can tolerate wide salinity ranges are called euryhaline in contrast to the stenohalines which have specific salinity demands. Most fish, in common with some other marine organisms, possess osmoregulatory mechanisms to enable them to cope with environments characterized by intense salinity variations.