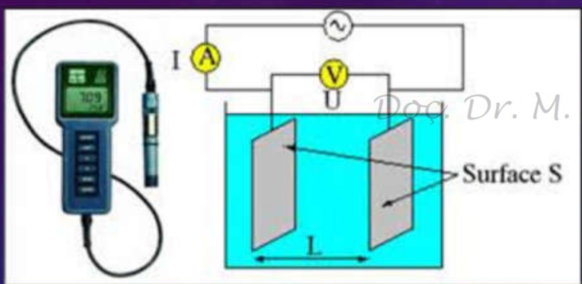
Electrical conductivity

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. Compounds that dissolve into ions are also known as electrolytes (anions and cations). The more ions that are present, the higher the conductivity of water. Likewise, the fewer ions that are in the water, the less conductive it is. Distilled or deionized water can act as an insulator due to its very low conductivity value. Sea water, on the other hand, has a very high conductivity.

µS/cm

Type	Electrical Conductivity (µS/cm)
Pure Water	0.05
Distilled Water	1
Rain or Snow	2 - 100
Surface / Ground Water	50 - 50,000
Seawater	50,000

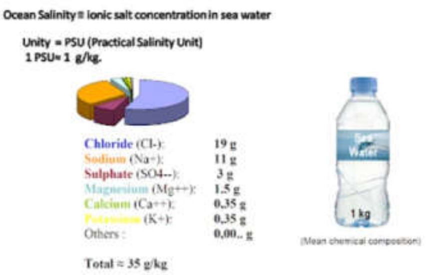


Water Class	EC	Salinity Significance
Excellent	<250	Water of low salinity is generally composed of higher proportions of calcium, magnesium and bicarbonate ions.
Good	250 - 750	Moderately saline water, having varying ionic concentrations
Permissible	750 -2250	High saline waters consist mostly of sodium and chloride ions
Doubtful	>2250	Water containing high concentration of sodium, bicarbonate and carbonate ions have high pH.

Salinity

The term salinity refers to the amount of dissolved salts that are present in water. Sodium and chloride are the predominant ions in seawater, and the concentrations of magnesium, calcium, and sulfate ions are also substantial. In other terms; salinity refers to the amount (as grams) of total amount of anions and cations in 1 liter of water.

Naturally occurring waters vary in salinity from the almost pure water, devoid of salts, in snowmelt to the saturated solutions in salt lakes such as the Dead Sea. Salinity in the oceans is constant but is more variable along the coast where seawater is diluted with freshwater from runoff or from the emptying of rivers.



~60% of total solids in seawater is chloride

The historical definition of salinity was based on chloride concentration which could be determined by titration. This calculation used the following equation:

SALINITY = 1.80655*Chlorinity (ppt or g/kg)

This method is only acceptable for seawater, as it is limited in estuaries, brackish and freshwater sources. While salinity and chlorinity are proportional in seawater, equations based on this are not accurate in freshwater or when chlorinity ratios change.

Salinity can be determined through the amount of chloride ion (plus the chlorine equivalent of the bromine and iodine), called as chlorinity, which is measured using titration with silver nitrate (Knudsen et al., 1902)

The relationship between salinity and chlorinity is based on laboratory measurements of sea water samples collected from different regions of the world ocean and was given in 1969 by UNESCO as

$$S_A (‰) = 1.80655 \times \text{Chlorinity} (‰)$$

S_A is called as "Absolute Salinity", unit: ppt

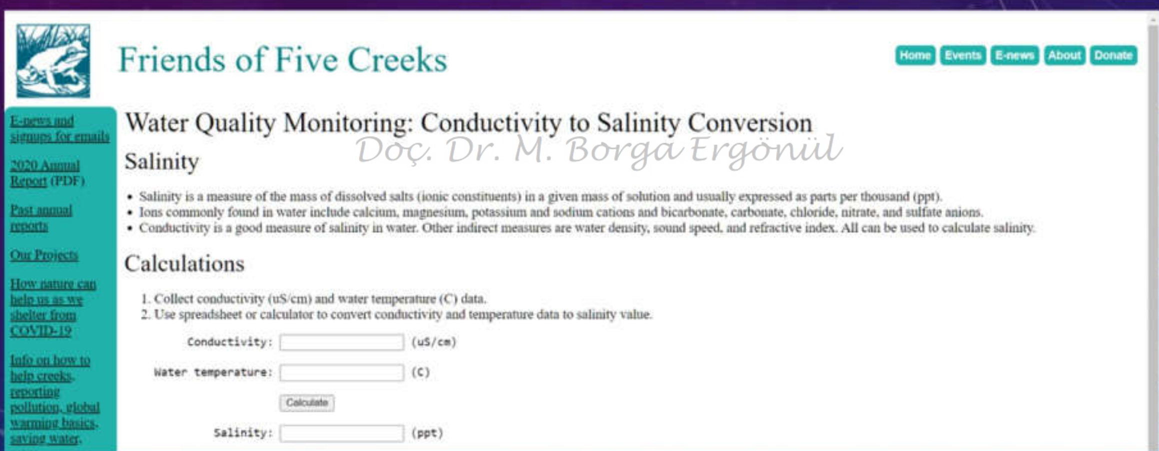
Total resolved material is hard to measure routinely in sea-water (e.g., evaporation of sea-water sample to dryness)

In practice, some properties of sea water are used to estimate salinity.

Method #1: Salinity is determined by measurements of a substitution quantity since it is contributed by its components in a fixed ratio.

Method #2: Salinity is inferred from measurements of sea water's electrical conductivity.

Salinity = EC x (0.55 to 0.70)



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Water Quality Monitoring: Conductivity to Salinity Conversion

Salinity

- Salinity is a measure of the mass of dissolved salts (ionic constituents) in a given mass of solution and usually expressed as parts per thousand (ppt).
- Ions commonly found in water include calcium, magnesium, potassium and sodium cations and bicarbonate, carbonate, chloride, nitrate, and sulfate anions.
- Conductivity is a good measure of salinity in water. Other indirect measures are water density, sound speed, and refractive index. All can be used to calculate salinity.

Calculations

1. Collect conductivity (uS/cm) and water temperature (C) data.
2. Use spreadsheet or calculator to convert conductivity and temperature data to salinity value.

Conductivity: (uS/cm)

Water temperature: (C)

Calculate

Salinity: (ppt)

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Electrical Conductivity of Lake Water as Environmental Monitoring – A Case Study of Rudrasagar Lake

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Abstract : *The development in water quality monitoring has improved considerably during the last few years ,partly because of engineers and scientists using new and sophisticated instruments .The spatial and temporal structure of lake hydrodynamic processes can able to control the lake water quality monitoring very much. One of the most important thermo physical properties of lake water is its electrical conductivity (EC) and this maintains almost a linear relationship with total Dissolved solids (TDS) in case of Rudrasagar, a natural lake in western Tripura. Recent studies on Rudrasagar lake suggest that there exists a good correlation between these two parameters and also both of these increase with depth. The objective of this study is to investigate the temporal and spatial variation of EC which may be a good indicator of water quality monitoring and also of environmental monitoring of the lake surrounding. Seasonal variation of these two parameters EC and TDS has also been analyzed here for following the seasonal trend of water quality. Time- relevant information about water quality monitoring and its availability to residents of lake area is very much significant in this regard.*

Keywords: *Electrical conductivity (EC), Rudrasagar Lake, Total Dissolved Solid (TDS).*

Tablo 5: Kıtaiçi Yerüstü Su Kaynaklarının Sınıflarına Göre Kalite Kriterleri

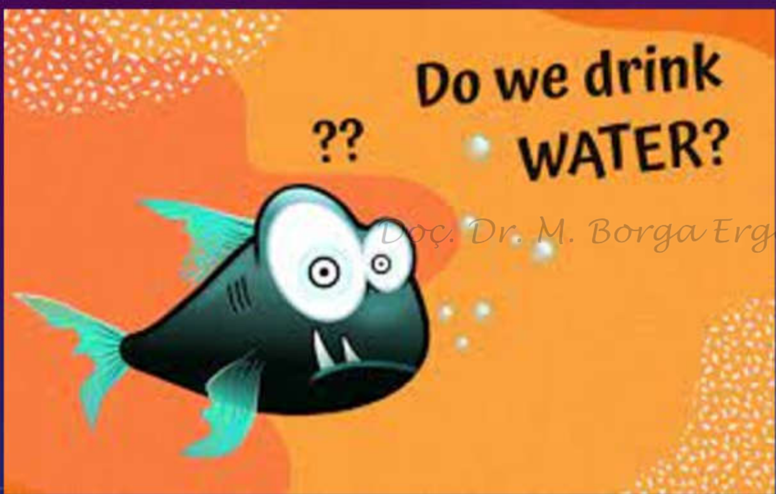
Su Kalite Parametreleri	Su Kalite Sınıfları (a)			
	I	II	III	IV
Genel Şartlar				
Sıcaklık (°C)	≤ 25	≤ 25	≤ 30	> 30
Renk (m^{-1})	RES 436 nm: ≤ 1,5 RES 525 nm: ≤ 1,2 RES 620 nm: ≤ 0,8	RES 436 nm: 3 RES 525 nm: 2,4 RES 620 nm: 1,7	RES 436 nm: 4,3 RES 525 nm: 3,7 RES 620 nm: 2,5	RES 436 nm: >4,3 RES 525 nm: >3,7 RES 620 nm: >2,5
pH	6,5-8,5	6,5-8,5	6,0-9,0	< 6,0 veya > 9,0
İletkenlik (µS/cm)	< 400	1000	3000	> 3000
Yağ ve Gres	Yüzer halde yağ, katran gibi sıvı maddeler, çöp ve benzeri katı maddeler ile köpük bulunamaz.			-
(A) Oksijenlendirme Parametreleri				
Oksijen doygunluğu (%) (b)	>90	70	40	< 40
Çözünmüş oksijen (mg O_2/L) (b)	> 8	6	3	< 3
Kimyasal oksijen ihtiyacı (KOİ) (mg/L)	< 25	50	70	> 70
Biyokimyasal oksijen ihtiyacı ($BOİ_5$) (mg/L)	< 4	8	20	> 20

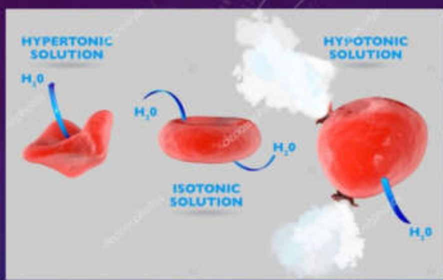
Stenohaline vs. Euryhaline

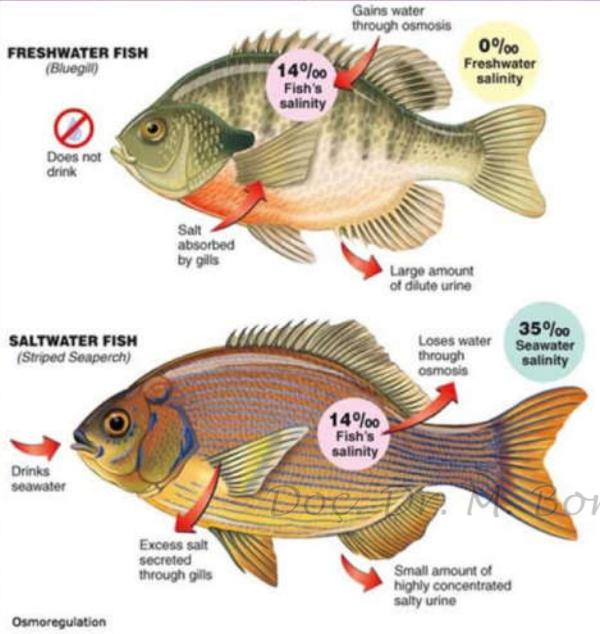
- Stenohaline – organisms that ***can't*** tolerate wide salinity changes
- Some can tolerate only high salinity
  -Examples – corals, reef fishes; prefer SW 30‰
- Some can tolerate only low salinity
  -Examples – frogs, goldfish, prefer FW 0‰

- Euryhaline – organisms that ***can*** tolerate wide salinity changes – these are best for an estuary, can live anywhere in it!
  -Examples – clams, oysters, crabs, some fish

A paranthesis here:







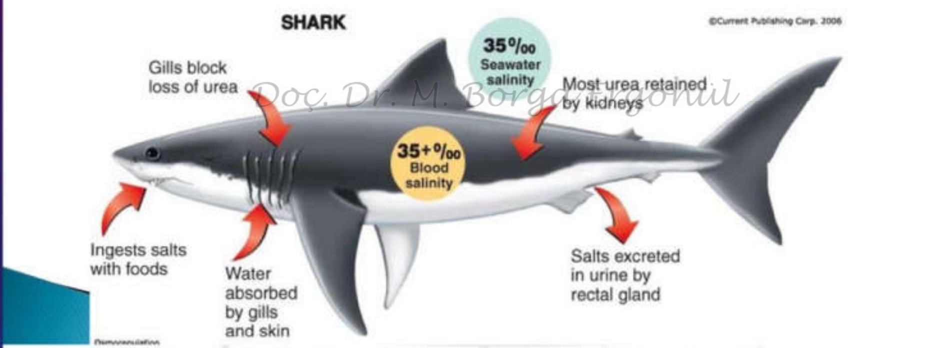
Freshwater fish absorb water from their environment and do not need to drink water.

Saltwater fish lose water to their environment and must drink seawater and secrete salt through their gills.

Osmoconformers

- Marine organisms that have their internal salinity rise and fall along with the water salinity are **osmoconformers**.
  - Ex: invertebrates and cartilaginous fish

most of them are euryhaline species



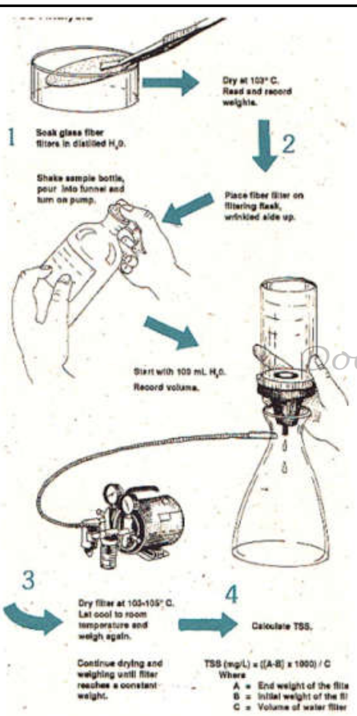
Often this involves taking in ions (salts) but sharks also accumulate high levels of urea which increases the concentration of solutes in their body.

Total Dissolved Solids

Water is a good solvent and picks up impurities easily. Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and some small amounts of organic matter that are dissolved in water.

TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process, and the nature of the piping or hardware used to convey the water.

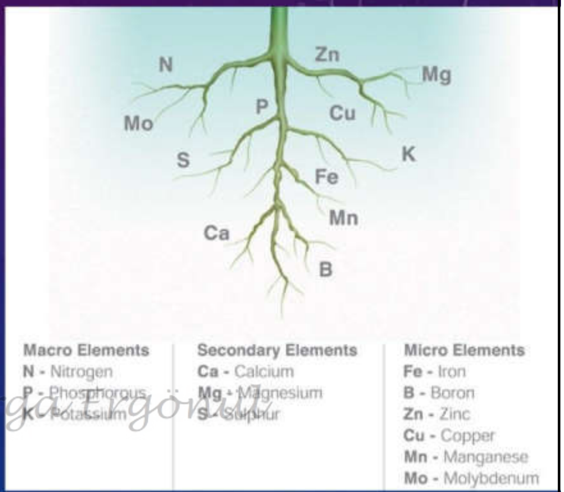
Level of TDS (milligrams per litre)	Rating
Less than 300	Excellent
300 - 600	Good
600 - 900	Fair
900 - 1,200	Poor
Above 1,200	Unacceptable

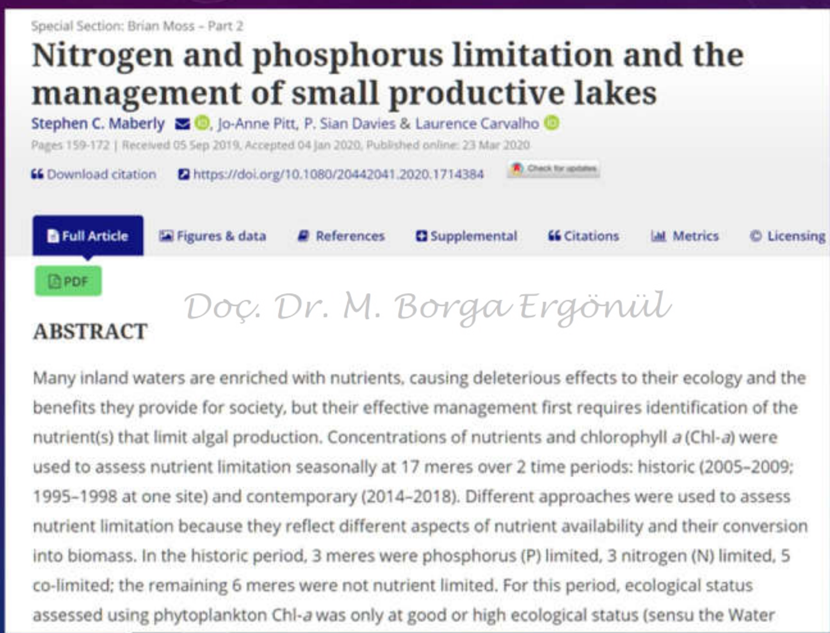


The total dissolved solids is determined by filtering a measured volume of sample through a standard glass fiber filter. The filtrate is then placed in a drying oven at a temperature of 105 °C. After the sample dries the weight of the filter paper is recorded.

Nitrogen and Phosphorus

Plants require 17 -18 different minerals to live. When one of these nutrients is missing or in short supply, it is considered a limiting nutrient. Phosphorous and nitrogen are usually limiting nutrients because plants require large amounts of them on a daily basis. However, micronutrients like iron and boron can be limiting nutrients if they are scarce even adequate amounts of nitrogen and phosphorous exist.





Special Section: Brian Moss – Part 2

Nitrogen and phosphorus limitation and the management of small productive lakes

Stephen C. Maberly, Jo-Anne Pitt, P. Sian Davies & Laurence Carvalho

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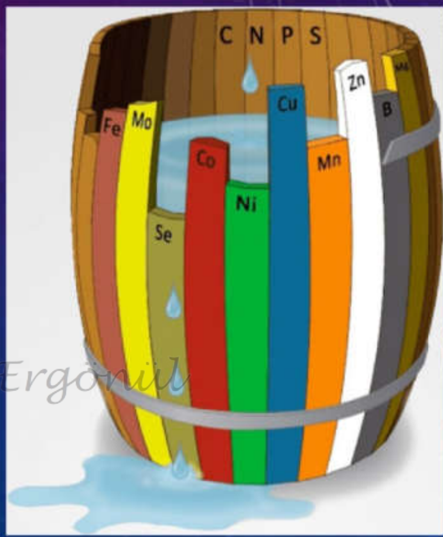
ABSTRACT

Many inland waters are enriched with nutrients, causing deleterious effects to their ecology and the benefits they provide for society, but their effective management first requires identification of the nutrient(s) that limit algal production. Concentrations of nutrients and chlorophyll *a* (Chl-*a*) were used to assess nutrient limitation seasonally at 17 meres over 2 time periods: historic (2005–2009; 1995–1998 at one site) and contemporary (2014–2018). Different approaches were used to assess nutrient limitation because they reflect different aspects of nutrient availability and their conversion into biomass. In the historic period, 3 meres were phosphorus (P) limited, 3 nitrogen (N) limited, 5 co-limited; the remaining 6 meres were not nutrient limited. For this period, ecological status assessed using phytoplankton Chl-*a* was only at good or high ecological status (sensu the Water

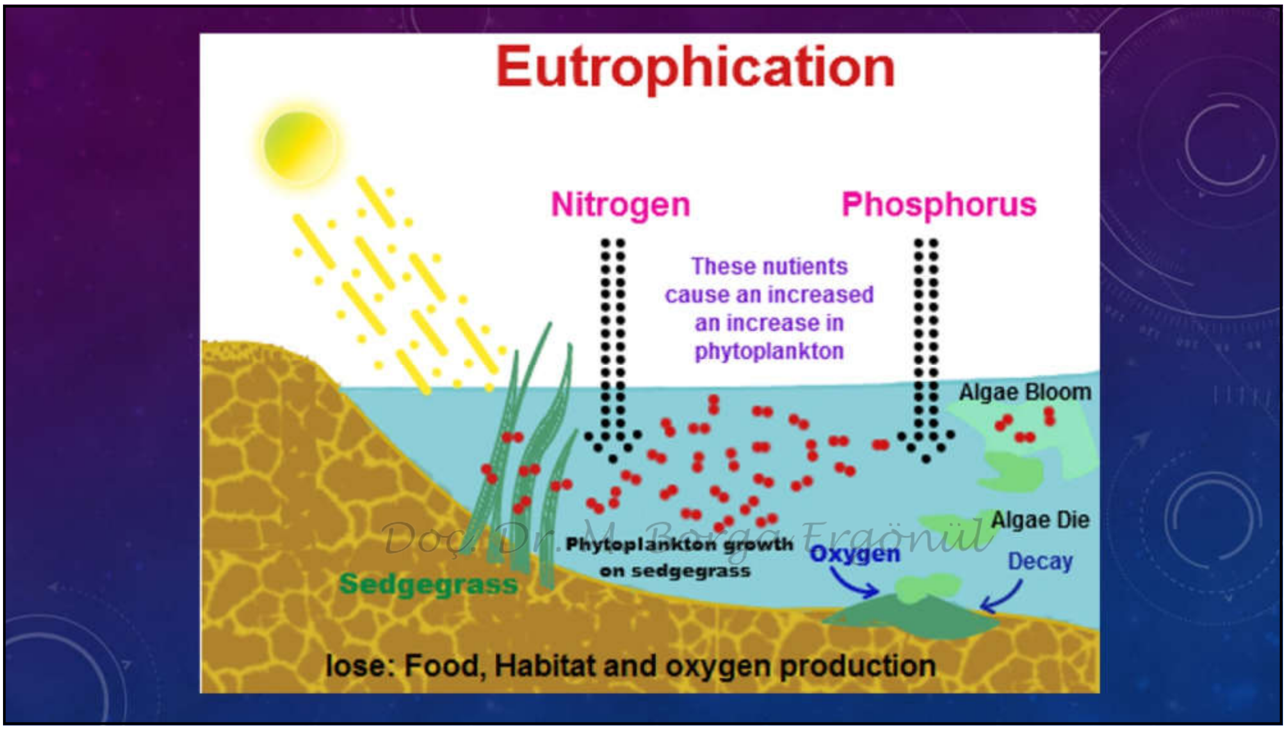
In the 19th century, the German scientist Justus von Liebig formulated the "Law of the Minimum," which states that if one of the essential plant nutrients is deficient, plant growth will be poor even when all other essential nutrients are abundant.

Liebig used the image of a barrel with unequal staves to explain how plant growth is limited by the element in shortest supply, just as the level of water in the barrel is limited by the shortest stave.



Phosphorus (P) and nitrogen (N) are the primary nutrients that in excessive amounts pollute our lakes, streams, and wetlands. Nitrogen is essential to the production of plant and animal tissue. It is used primarily by plants and animals to synthesize protein. Nitrogen enters the ecosystem in several chemical forms and also occurs in other dissolved or particulate forms, such as tissues of living and dead organisms.

Phosphorus is a vital nutrient for converting sunlight into usable energy, and essential to cellular growth and reproduction. Under natural conditions phosphorus is typically scarce in water. Phosphorus occurs in dissolved organic and inorganic forms or attached to sediment particles. Phosphates, the inorganic form, are preferred for plant growth, but other forms can be used when phosphates are unavailable. Phosphorus builds up in the sediments of a lake. When it remains in the sediments it is generally not available for use by algae; however, various chemical and biological processes can allow sediment phosphorus to be released back into the water


Eutrophication
Nitrogen
Phosphorus
These nutients cause an increased an increase in phytoplankton
Algae Bloom
Algae Die
Phytoplankton growth on sedgegrass
Oxygen
Decay
Sedgegrass
lose: Food, Habitat and oxygen production