Bahan Ajar:

1. Penyebaran biota perairan

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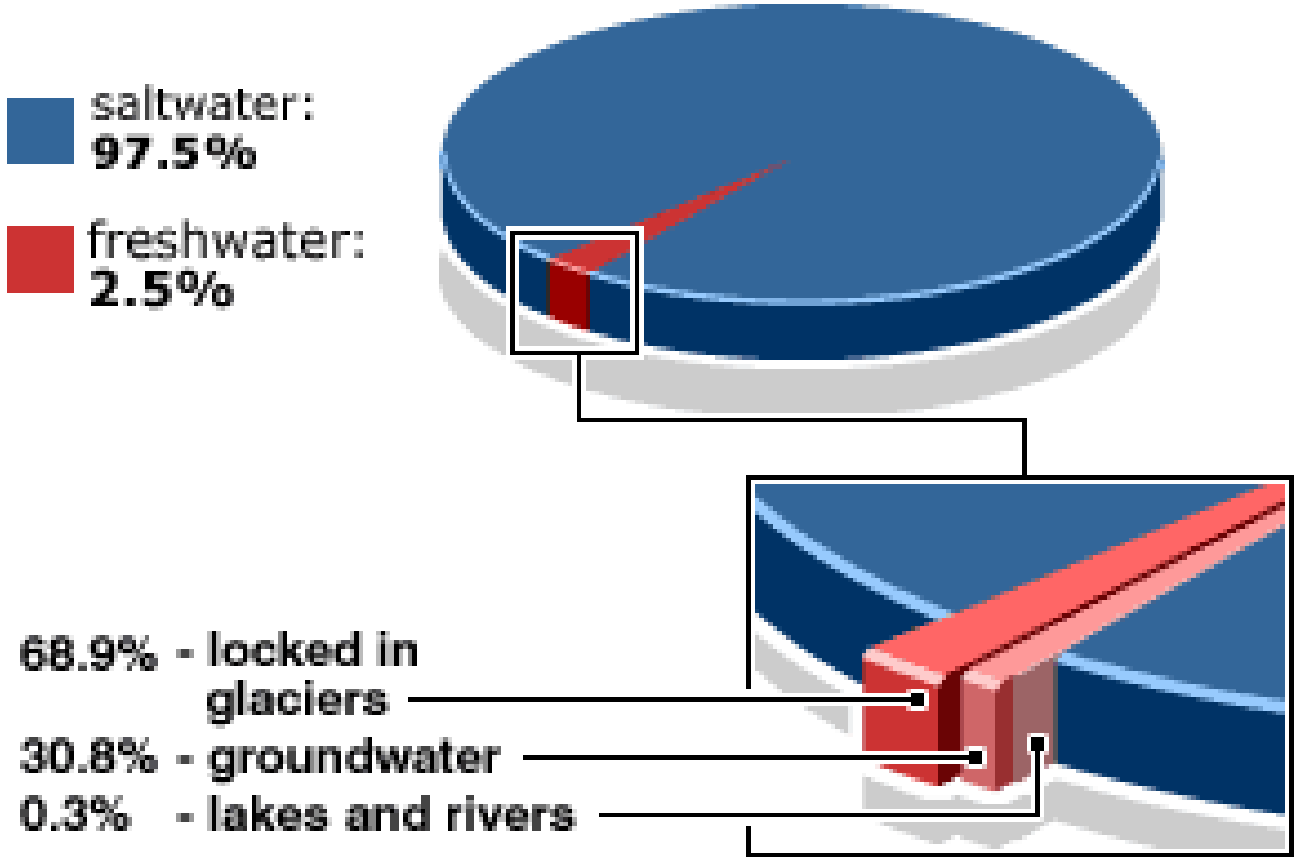
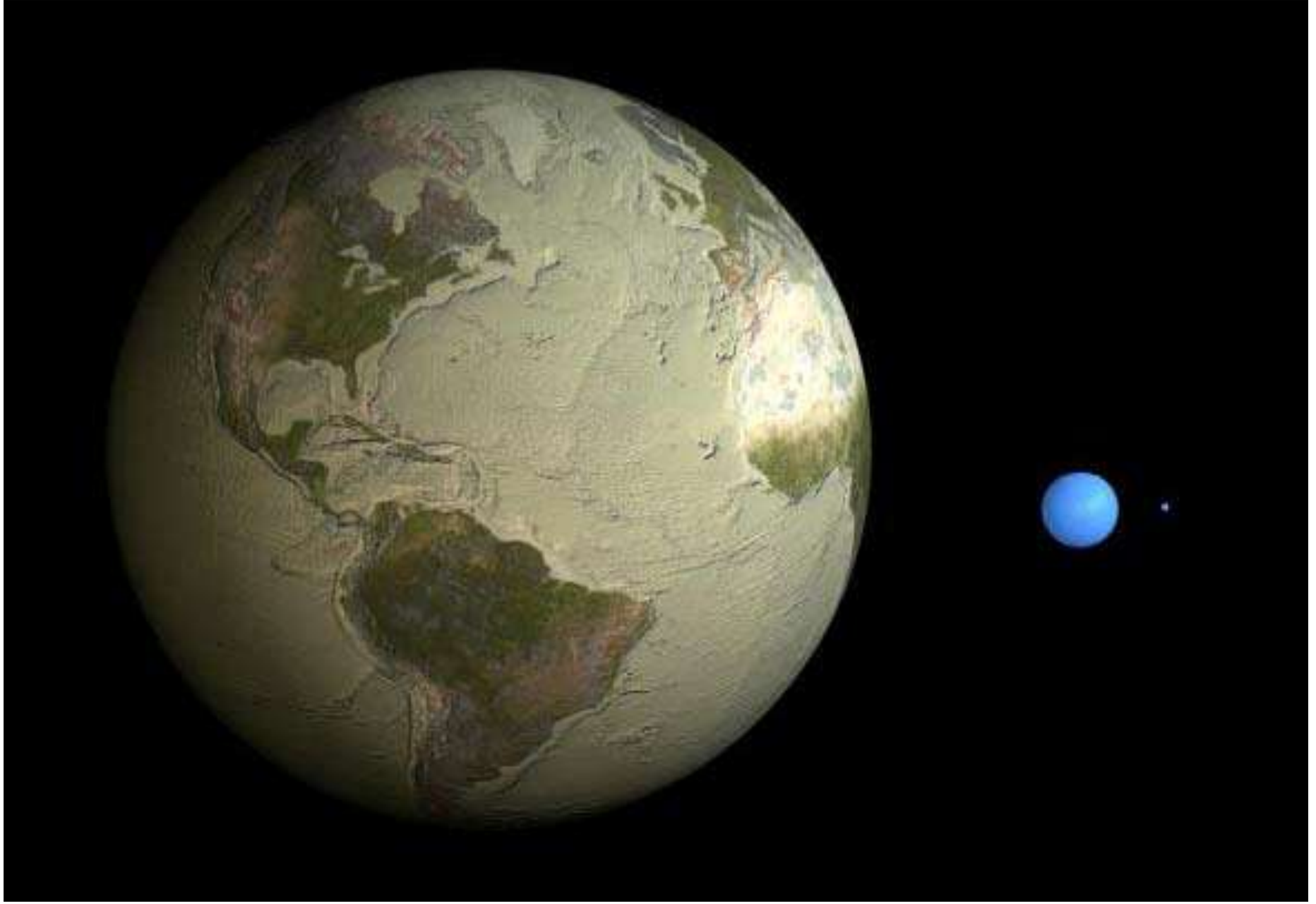
Manajemen Sumberdaya Perairan (SKS: 3)

Quis

Seberapa banyak proporsi air tawar di bumi kita?? .....

Distribusi air di bumi

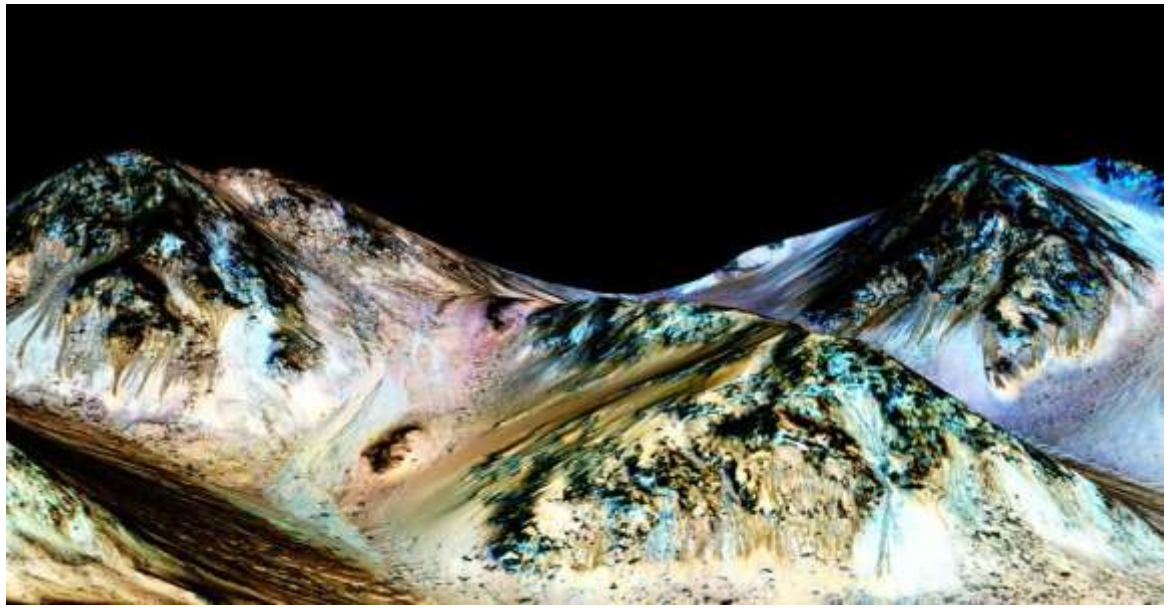




1,386,000,000 cubic kilometers (km3) of water on Earth

Hal penting yang perlu diketahui

- Setiap tetes air di bumi ini sangat mungkin memiliki mokroorganisme di dalamnya
- Motonya dalam pencarian mahluk hidup adalah: “***follow the water***”
- Tapi mengapa air begitu penting untuk mahluk hidup?????



Faktor penentu penyebaran biota akuatik

1. Kualitas air

Mencari kondisi yang sesuai untuk eksistensi sesuai fase hidupnya (suhu air, oksigen terlarut dll.)

2. Ketersediaan makanan

Menghindari kompetisi dalam mencari makan

3. Pola migrasi

Pola migrasi alami sesuai dengan fase dalam siklus hidupnya, terkait erat pula dengan kualitas air dan ketersediaan makanan

Kualitas air

1. Temperature

Suhu Tubuh

Endotherm – animals that produce their own body heat ("warm blooded")
Ectotherm – animals that gain heat through the environment ("cold blooded")

	Endothermic	Ectothermic
Homeothermic Suhu konstan	Mostly birds and mammals, although the tuna and some other large fish come close.	Some tropical reptiles and possibly dinosaurs come close; of course, this box should include organisms occurring deep in the ocean or even in deep lakes.
Poikilothermic Suhu menyesuaikan	Some birds and mammals (those that allow their body temperature to vary during certain time periods) as well as many insects and some other invertebrates.	Most fish, amphibians, and reptiles as well as most invertebrates.

Terminologi

- *Stenotherm –able to only tolerate a narrow temperature range*

- *Eurytherm –able to tolerate a broad temperature range*

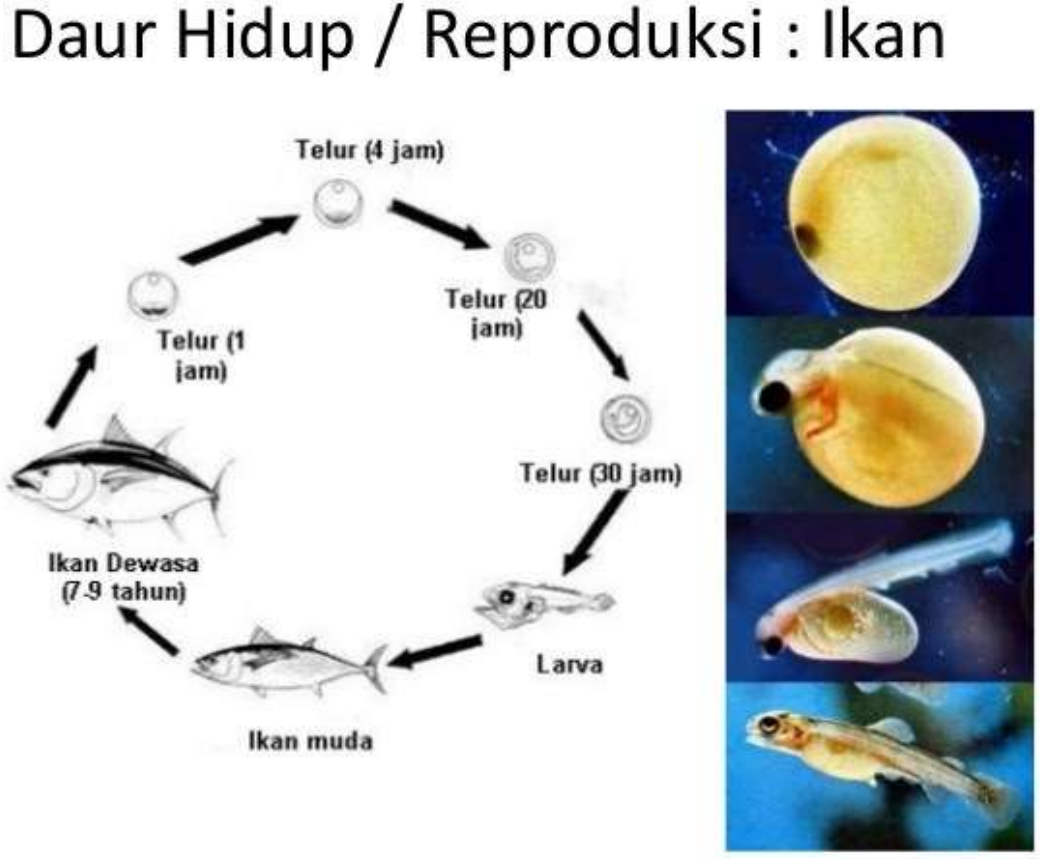
Ikan dan suhu air

- *Temperature is the "ecological master factor" for fish* (Brett, 1971)
- Sebagian besar ***ectoterms*** – tergantung pada suhu/sumber panas lingkungannya untuk meregulasi suhu tubuhnya (berdarah dingin)
- Dampak **suhu ekstrim** pada ikan: dampak langsung, tidak langsung, mengganggu siklus hidup, kalah berkompetisi dengan spesies yang toleran, semua dampak sekunder dari suhu air
- Ukuran ikan: semakin besar semakin tahan terhadap perubahan suhu ekstrim → more thermal inertia/buffering capacity

Brett, J. R. (1971). Energetic responses of salmon to temperature. A study of some thermal relations in thephysiology a nd freshwater ecology of sockeye salmon (*Oncorhynchus nerka). Am. Zool. 11, 99-113.*

Ikan dan suhu air

- Fase dalam siklus hidupnya (masing-masing memiliki preferensi suhu air tertentu)



Water temperatures (°F) associated with optimum conditions for various fishes by species and life stages

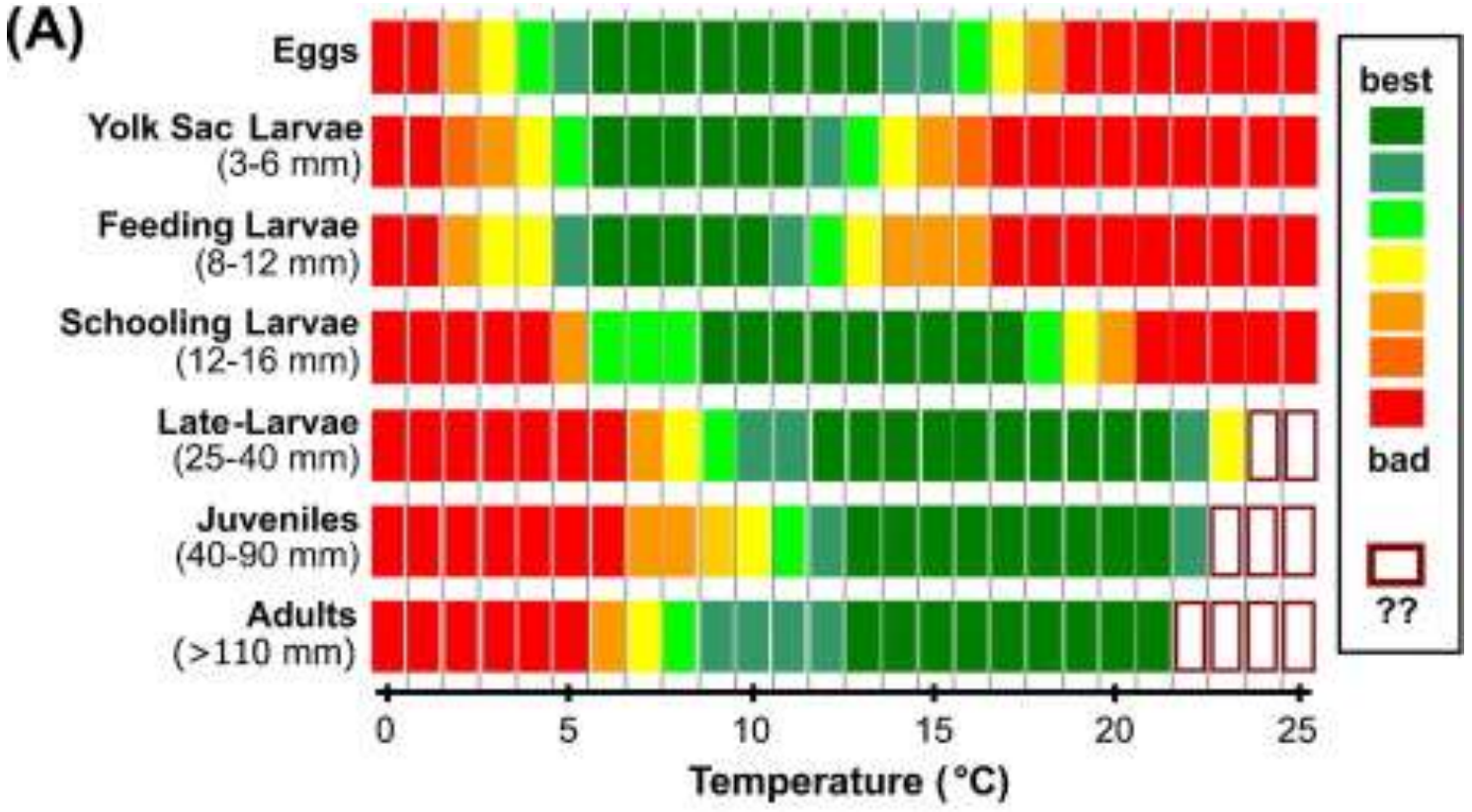
Species	---Fry-- low	high	---Juv-- low	high	-Adult-- low	high	Comments
Bass, Largemouth	80.6	87.8	75.2	87.8	75.2	87.8	
Bass, Spotted	73.4	78.8	73.2	78.8	73.4	78.8	narrow limits
Bass, Striped	59.0	68.0	71.6	82.4	64.0	75.0	
Bass, White	50.0	89.0	54.0	86.0	54.0	86.0	
Buffalo, Bigmouth					86.0	93.2	
Buffalo, Smallmouth	75.2	86.0	75.2	86.0	71.6	75.2	
Bullhead, Black	64.4	84.2	64.4	84.2	64.4	84.2	all ages?
Carp	71.6	82.4	71.6	82.4	68.0	78.8	
Catfish, Channel	82.4	84.2			82.4	85.1	
Chub, Creek	64.4	75.2	64.4	75.2	64.4	75.2	all ages
Dace, Longnose	57.2	66.2	57.2	66.2	57.2	66.2	
Fallfish	50.0	68.0	50.0	68.0	50.0	68.0	
Grayling, Arctic	42.8	62.6			46.4	60.8	riverine
Paddlefish					44.6	88.0	
Perch, Yellow	69.8	73.4	69.8	73.4	69.8	73.4	
Pike, Northern	66.2	78.8	66.2	78.8	66.2	78.8	epilimnion
Salmon, Atlantic	no information						
Salmon, Chinook	44.6	57.2	44.6	57.2			
Salmon, Chum	40.0	56.0			43.0	55.0	spawning
Salmon, Pink	36.0	61.0			45.0	60.0	spawning

Species	---Fry-- low	high	---Juv-- low	high	-Adult-- low	high	Comments
Shad, Gizzard	72.0	84.0	72.0	84.0	72.0	84.0	all the same
Shiner	68.0	71.6	68.0	71.6	68.0	71.6	
Silverside, Inland	no information						
Sturgeon	60.0	75.0			50.0	75.0	
Sucker, Longnose	53.6	53.6	53.6	53.6	53.6	53.6	
Sucker, White	80.4	80.4	66.2	75.2	65.2	75.2	
Sunfish, Green	64.4	78.8	78.8	87.8	78.8	87.8	
Sunfish, Redbreast					55.0	95.0	adult only
Trout, Brook	50.0	60.0	50.0	60.8	50.0	60.8	
Trout, Brown	43.0	59.0	43.0	75.0	54.0	72.0	
Trout, Lake (exc Gr Lakes)					44.6	59.0	hypolimnion
Trout, Rainbow	56.8	66.2	60.0	72.0	55.4	70.0	
Trout, cutthroat	51.8	59.0	51.8	59.0	51.8	59.0	all ages
Walleye			62.0	67.0	62.0	67.0	
Warmouth					73.4	80.6	

Source: U.S. Fish and Wildlife Service. Habitat Suitability Index Model

Fish may move to different areas during their life cycle due to preferred temperatures

Suhu spesifik untuk pertumbuhan (Sprattus sprattus) di laut Baltik



Peck et al. 2012. The ecophysiology of *Sprattus sprattus in the Baltic and* North Seas. *Progress in Oceanography. 103, 42-57.*

Ecological Importance of water temperature

- Effects of water temperature being ***too low or too high****:*
  - metabolic processes become slower
  - rate of plant photosynthesis slows down
  - timing of reproduction and migration for many species may be altered
  - geographic distribution of species may be altered
- Water temperature that is ***too high*** *will also:*
  - Lead to dangerously low levels of dissolved oxygen (DO)
  - Cause some compounds (e.g. ammonia) to be more toxic to aquatic life

Kualitas air

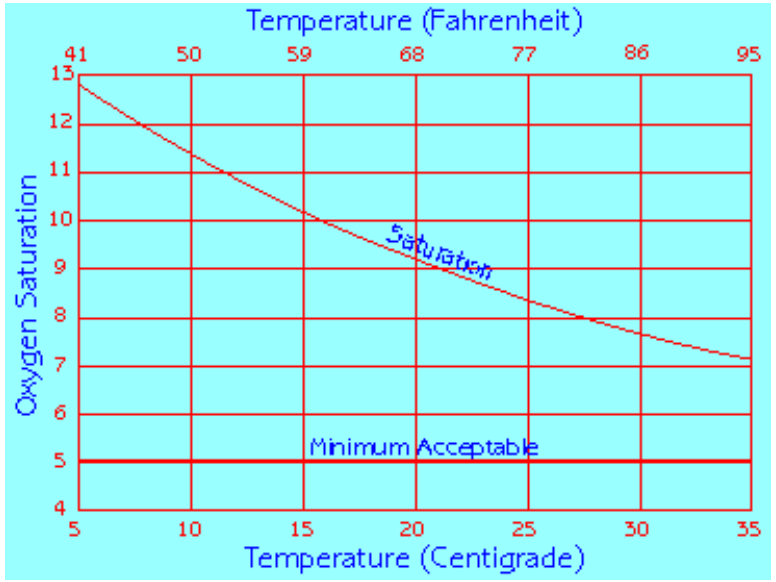
2. Oksigen terlarut (dissolved oxygen) = DO

Oksigen terlarut (sungai dan danau) merupakan fungsi dari faktor berikut yang mana?

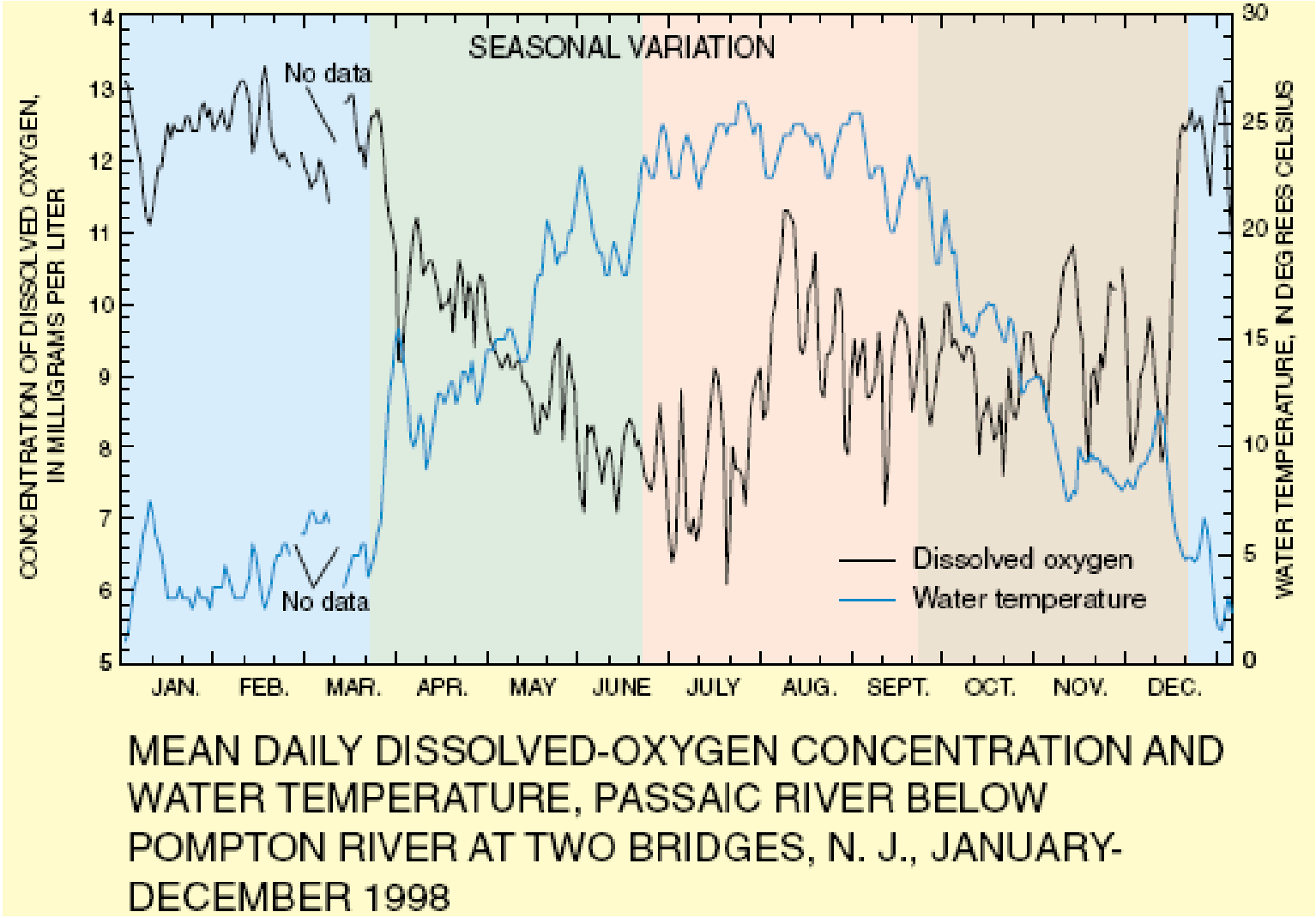
- Suhu air
- Ketinggian perairan
- Waktu (harian/tahunan)
- Kehadiran biota akuatik
- Kehadiran bahan organik

Jawabannya: Semua akan berpengaruh terhadap DO

Variasi musiman DO (Passaic River, NJ)



As water temperature increases, DO decreases



MEAN DAILY DISSOLVED-OXYGEN CONCENTRATION AND WATER TEMPERATURE, PASSAIC RIVER BELOW POMPTON RIVER AT TWO BRIDGES, N. J., JANUARY-DECEMBER 1998

Proses-proses yang mengurangi DO

1. Pencemar - ***Point sources,***

e.g., effluents from wastewater treatment plants and

industries

2. Pencemar - ***Non-point sources and local runoff,***

e.g., stormwater and agricultural runoff

3. Disturbance (scour) of bottom sediments with suspension of organic matter from the benthic layer into the water column (kenaikan BOD dan COD)

Ketersediaan makanan

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Food supply depends on seagrass meadows in the coral triangle

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Abstract

The tropical seascape provides food and livelihoods to hundreds of millions of people, but the support of key habitats to this supply remains ill appreciated. For fisheries and conservation management actions to help promote resilient ecosystems, sustainable livelihoods, and food supply, knowledge is required about the habitats that help support fisheries productivity and the consequences of this for food security. This paper provides an interdisciplinary case study from the coral triangle of how seagrass meadows provide support for fisheries and local food security. We apply a triangulated approach that utilizes ecological, fisheries and market data combined with over 250 household interviews. Our research demonstrates that seagrass associated fauna in a coral triangle marine protected area support local food supply contributing at least 50% of the fish based food. This formed between 54% and 99% of daily protein intake in the area. Fishery catch was found to significantly vary with respect to village ($p < 0.01$) with habitat configuration a probable driver. Juvenile fish comprised 26% of the fishery catch and gear type significantly influenced this proportion (<0.05). Limited sustainability of fishery practices (high juvenile catch and a 51% decline in CPUE for the biggest fishery) and poor habitat management mean the security of this food supply has the potential to be undermined in the long-term. Findings of this study have implications for the management and assessment of fisheries throughout the tropical

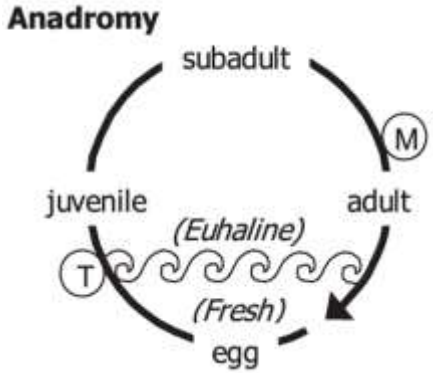
- Seagrass meadows can provide a major source of habitat for fish (subsistence and commercial value)
- Seagrass meadows are under sustained threat from a range of impacts worldwide, this study provides evidence of the need to conserve these not just to protect biodiversity but to protect food security
- conservation and local food security are interlinked processes that are not mutually exclusive.

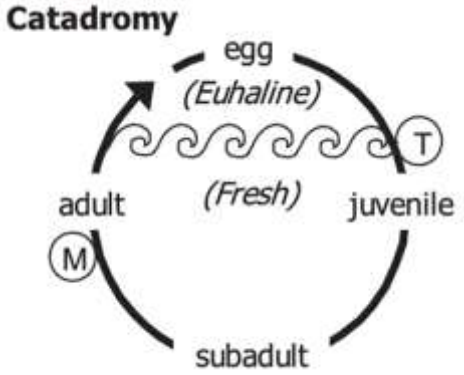
Migrasi ikan

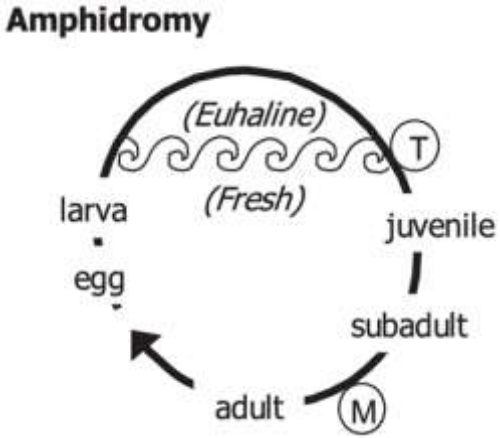
- It is sometimes the case in fishes that the life history needs of a population (e.g., foraging and reproduction) cannot be met by a single habitat
- This is due to variability in the habitat conditions (e.g., temperature), or to the changing needs of the population itself (e.g., foraging habitat vs. spawning habitat).
- Approximately 2.5% of all fish species undertake migrations
- The physical scale of migrations is highly variable and can range from hundreds of meters, to thousands of kilometers, as in eels (Anguilla spp)

Classifying Migrations

1. **Oceanadromous** migrations, such as those performed by tunas, white sharks (*Carcharodon carcharias*), and plaice (*Pleuronectes platessa*), occur entirely within seawater.
2. Migrations that occur entirely within freshwater are classified as **potamadromous**. Potamadromous migrations can occur solely in lakes (e.g., lake trout, Salvelinus namaycush), in rivers and streams (e.g., brook lampreys, Lampetra spp.), or can span both lake and fluvial habitats (e.g., white suckers, Catostomus commersoni).
3. Migrations that cross the seawater/freshwater boundary (e.g., Pacific salmonids, Oncorhynchus spp.) are classified as **diadromous**.







Diadromous

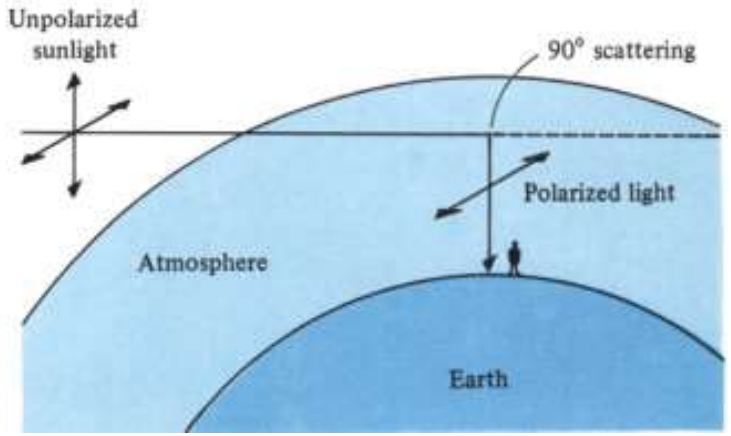
a) **Anadromy** occurs when most feeding and growth occurs in saltwater and fully grown adults move back into freshwater to spawn (e.g., Pacific salmon).

b) Conversely, **catadromy** occurs when most feeding and growth occur in freshwater and the fully grown adults move into saltwater to spawn (e.g., eels).

c) The last subcategory, **amphidromy**, occurs when there is a brief excursion from freshwater to sea water during the juvenile stage, but the majority of feeding and growth and spawning occurs in fresh water. This last subcategory is most common in fishes inhabiting islands in the tropics and subtropics (e.g., *sicydiine gobies, Sicydium spp.)*

Orientasi di perairan terbuka

- Matahari
- Cahaya terpolarisasi
- Geomagnetik



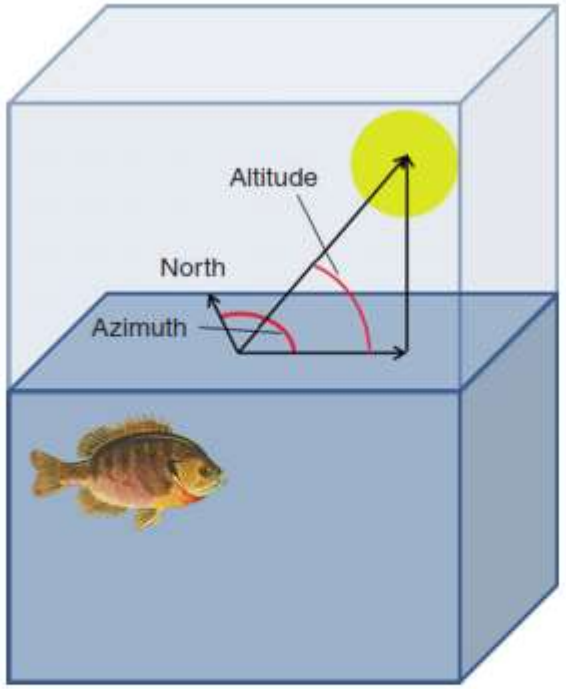
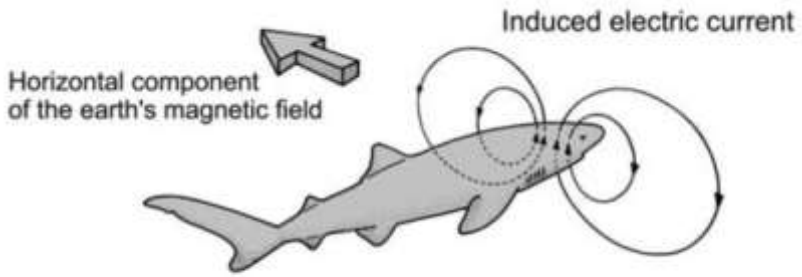


Figure 2 Solar information used by fishes for orientation in open water. Directional information is derived from changes in the angle of the sun in both the vertical (altitude) and horizontal (azimuth) planes. Fish possess a biological clock and calendar that allows them to compensate for diel and seasonal changes in these parameters.



Shark heading east in the open ocean

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