



The Great Lakes Fisheries Leadership Institute

Great Lakes Fisheries Habitat

Presented by Dan Hayes

based on material from

C.R. Dolan and J.M. Epifanio



Photo Credit: NOAA



Definitions of Fish Habitat

“Habitat for fish is a place--or for migratory fishes, a set of places--in which a fish, a fish population or a fish assemblage can find the physical and chemical features needed for life, such as suitable water quality, migration routes, spawning grounds, ...

Although food, predators, and competitors are not habitat, proper places in which to seek food, escape predators, and contend with competitors are part of habitat, and a suitable ecosystem for fish includes habitat for these other organisms, as well.” (Orth and White 1993)

Definitions of Fish Habitat

“Habitat is simply the place where an organism lives... Physical, chemical, and biological variables (the environment) define the place where an organism lives. Niche, a closely related term, defines the way a species adjusts to other related species in this space.” (Hudson et al. 1992)

Water is basically what fish require



Photo Credit: GLFC

Fish need:

- Water to live
- Good water quality

• Tolerances

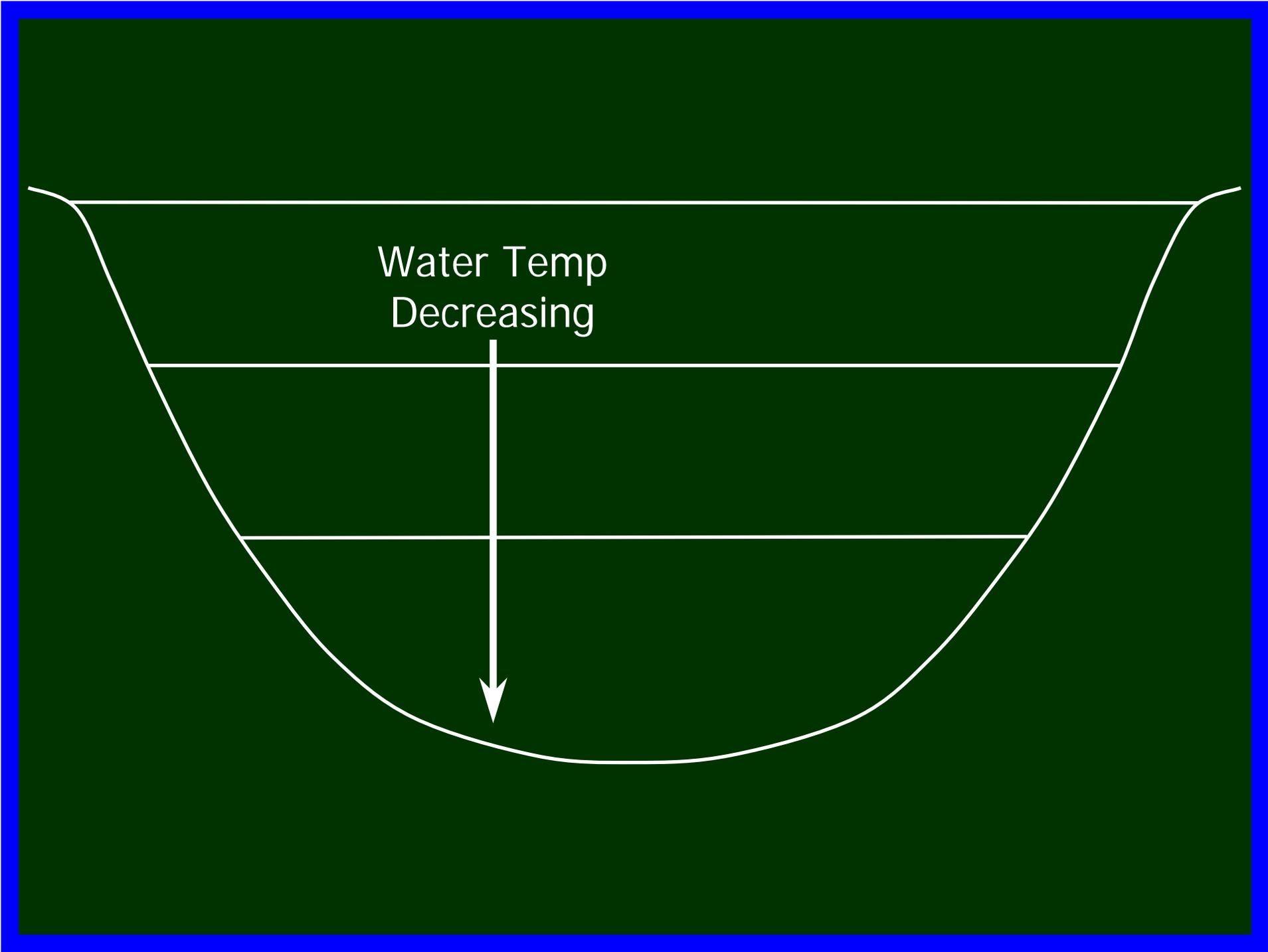
Temp

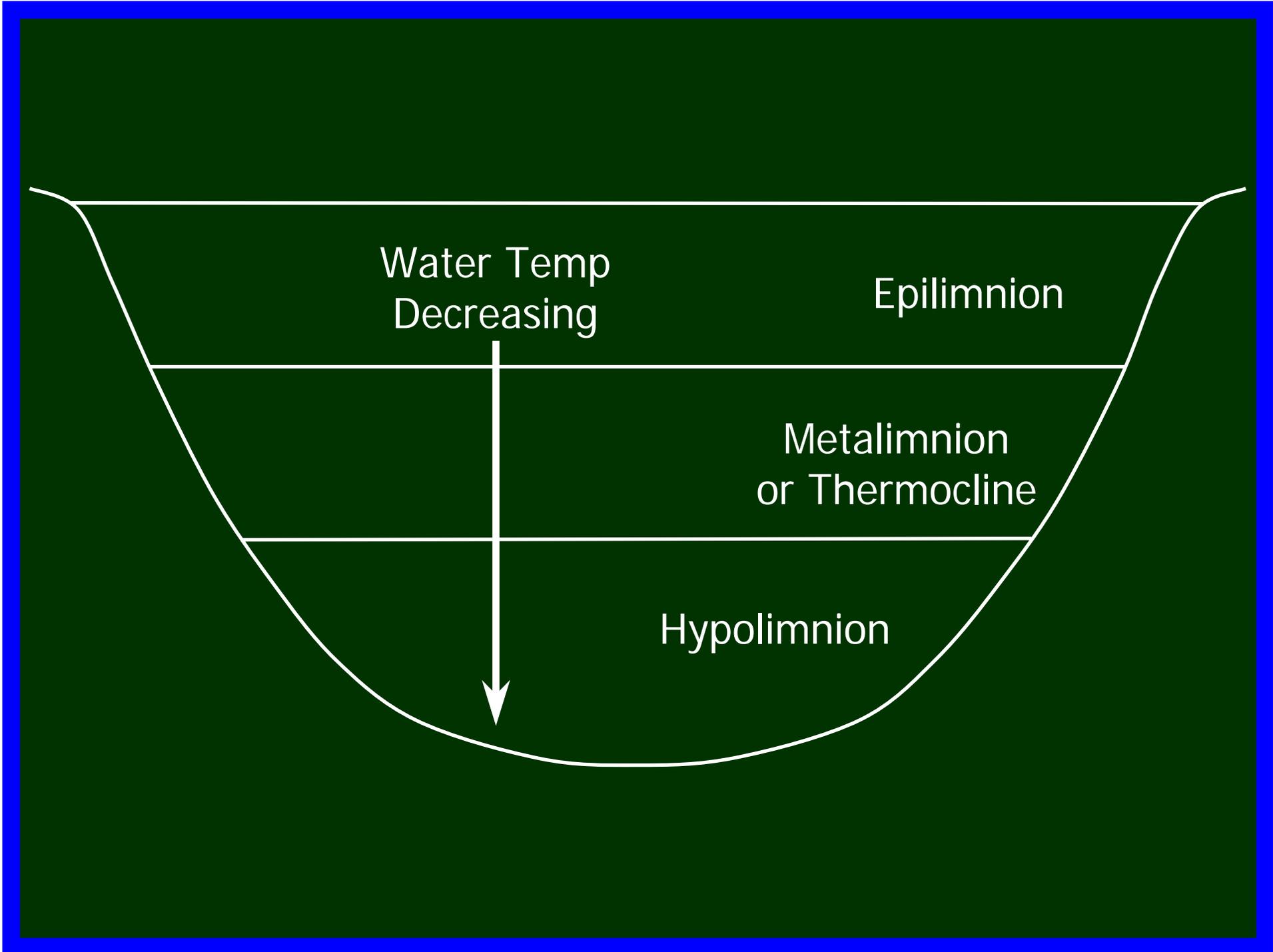
Dissolved O₂

Pollutants



Water Temp
Decreasing



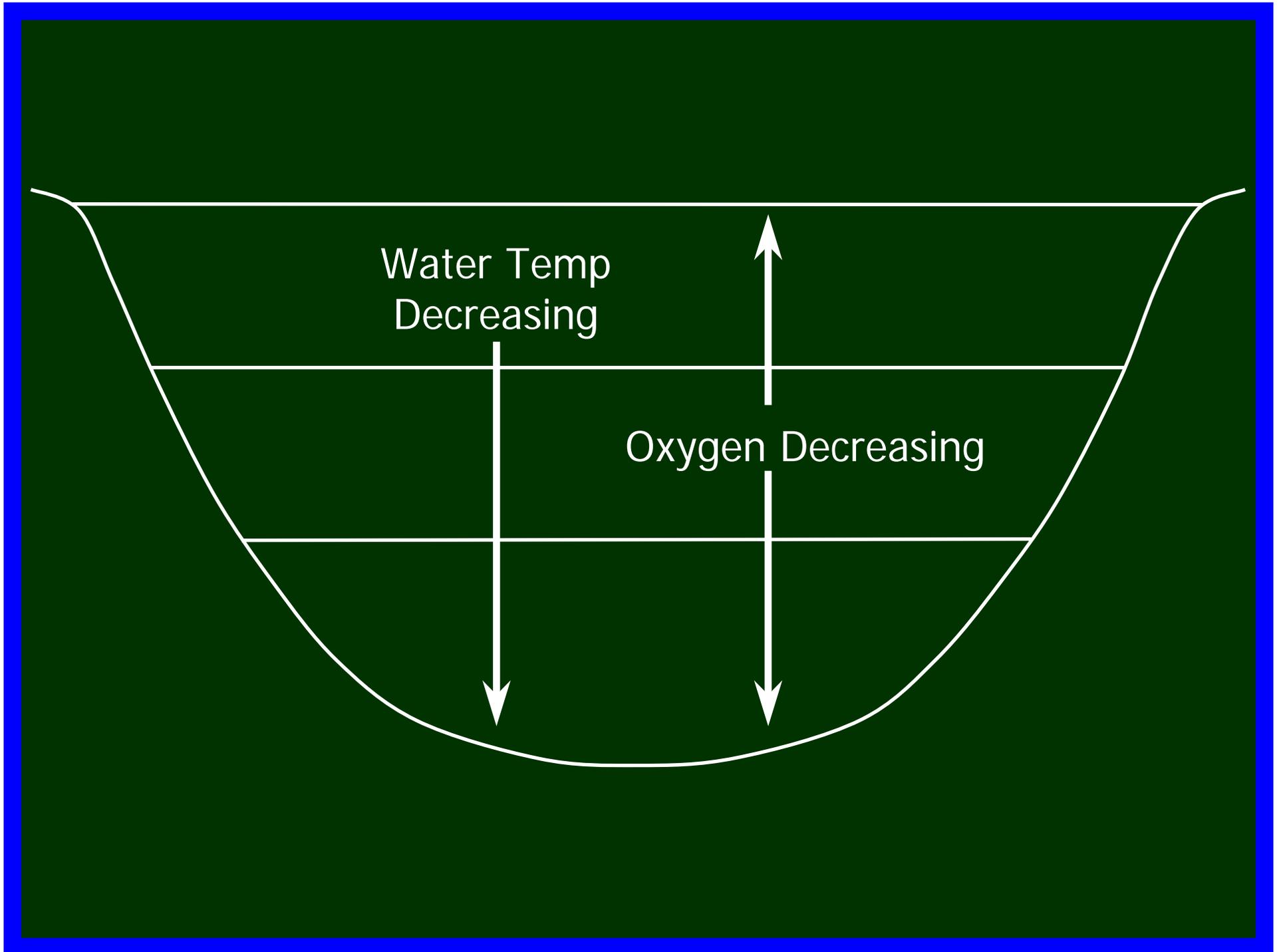


Water Temp
Decreasing

Epilimnion

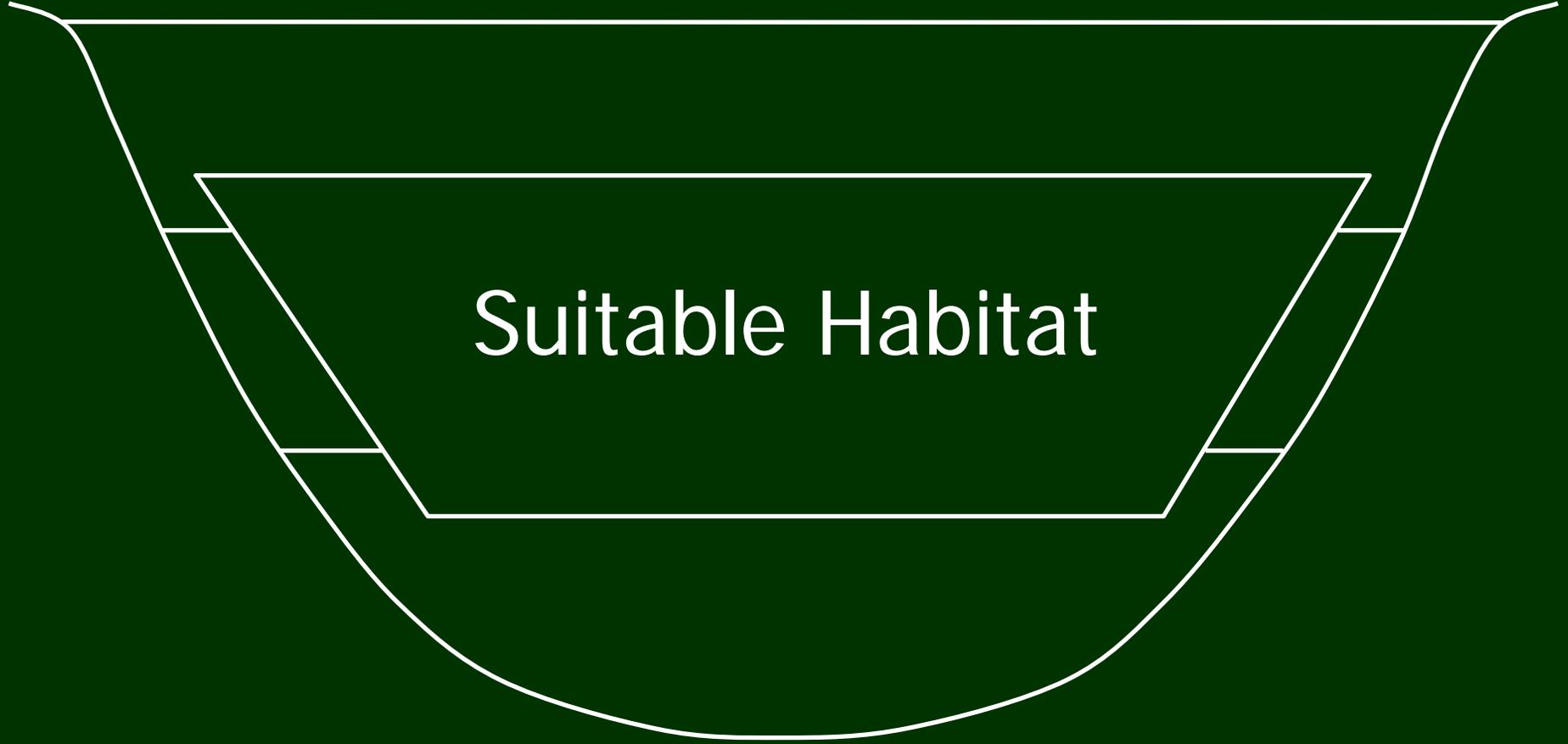
Metalimnion
or Thermocline

Hypolimnion



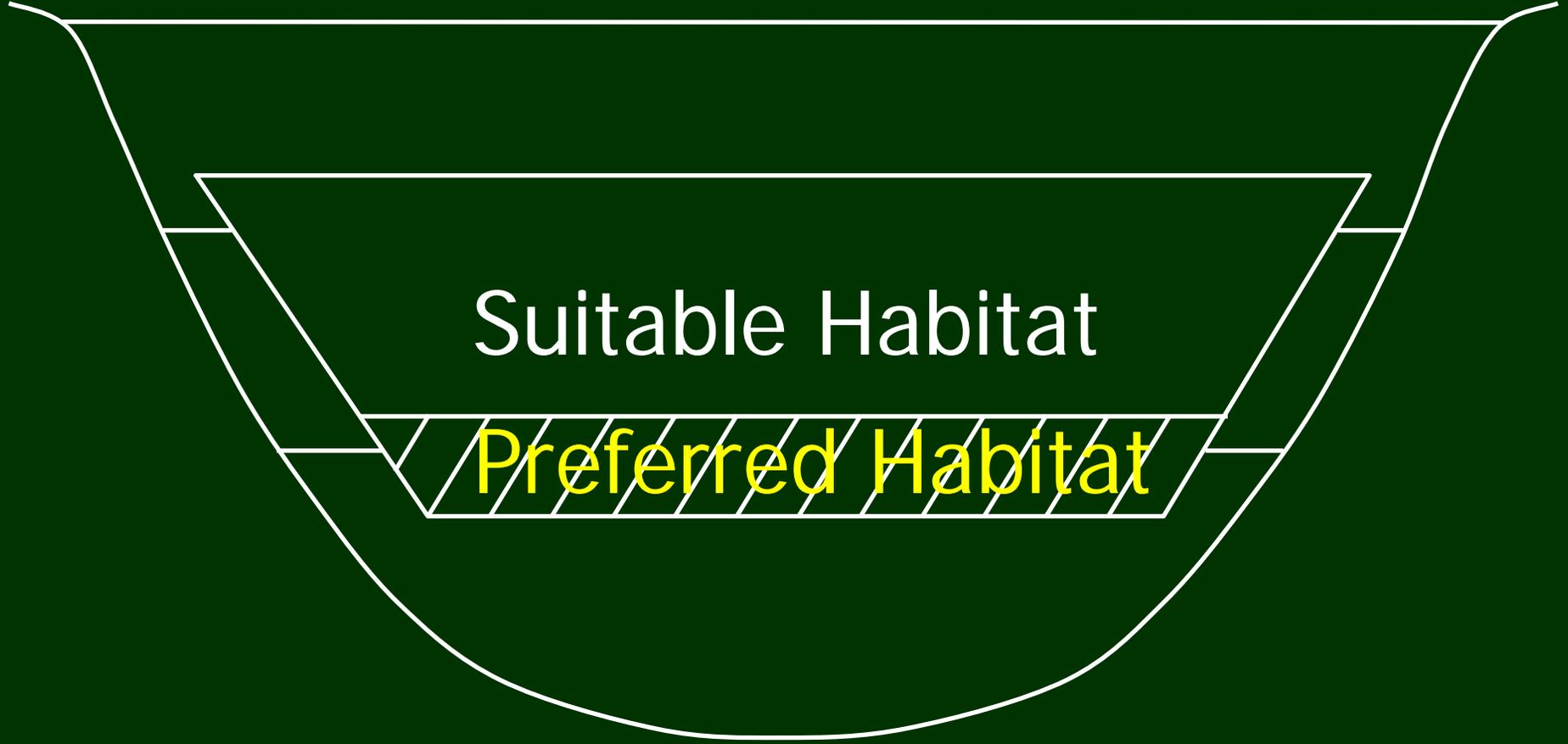
Water Temp
Decreasing

Oxygen Decreasing



The diagram illustrates a cross-section of a riverbed. A thick blue border surrounds the entire image. Inside, a white line depicts the river's surface, which is relatively flat. Below the surface, a white line shows the riverbed's profile, which is U-shaped. Within this U-shape, a trapezoidal area is outlined in white, representing the 'Suitable Habitat'. This habitat is wider at the top and narrower at the bottom. The text 'Suitable Habitat' is written in white, centered within this trapezoidal area. The background of the diagram is a solid dark green color.

Suitable Habitat



A diagram illustrating a habitat cross-section. The background is dark green, and the entire image is framed by a thick blue border. A white line outlines a wide, shallow basin at the top, which narrows and deepens towards the bottom. Within this basin, a white trapezoidal shape represents the 'Suitable Habitat'. Inside this trapezoid, a smaller, narrower trapezoidal area at the bottom is filled with diagonal hatching and labeled 'Preferred Habitat' in yellow text.

Suitable Habitat

Preferred Habitat

Factors Frequently Limiting Fish Populations

- Temperature
- Oxygen
- Substrate
- Water velocity
- Turbidity (clarity)
- pH
- Water depth
- Food resources
- Predators

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Limits

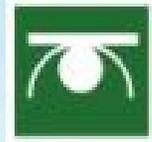
- Distribution

- Abundance

Births

Deaths

Growth



Classification of Habitats



Photo Credit: Unknown



Classifying Fish Habitat by Habitat Characteristics

1. Temperature

- a) Does lake stratify, and how often
- b) Zones within a lake
- c) Streams classified as warm-water, for example

Classifying Fish Habitat by Habitat Characteristics (cont.)

2. Productivity or trophic status
 - a) Oligotrophic - low productivity
 - high oxygen content
 - clear water
 - often cold water
 - b) Mesotrophic - moderate productivity
 - moderate oxygen
 - moderate water clarity
 - “cool” water
 - c) Eutrophic - high productivity
 - little or no oxygen near bottom
 - water very green
 - often warm water

Water Zones

Nearshore waters



- Shallower, warmer waters
- Fish diversity and production is greater than in offshore waters
- Most Great Lakes fishes use for one or more critical life stages

Offshore waters



- Deeper, cooler waters
- Often vertical stratification of temp
- Inhabitants include salmon, whitefish, deepwater sculpin



Wetlands

Coastal

- Protect shoreline
- Remove excess nutrients
- Support aquatic food web

Inland

- Reservoirs for Great Lakes basin water
- Regulate sediment and pollutant loads
- Vehicle for nutrient exchange



Streams & Tributaries



- Great Lakes fish use these areas at different times in their life cycle
- Impacts to tributaries affect main lakes



Inland Terrestrial Systems



- Forests, barrens, and prairies
- Support rare ecological communities
- Terrestrial animals depend on aquatic animals for food
- Terrestrial systems provide nutrients to aquatic systems



Photo Credit: INHS, KNR



Habitat Use by Great Lakes Fish

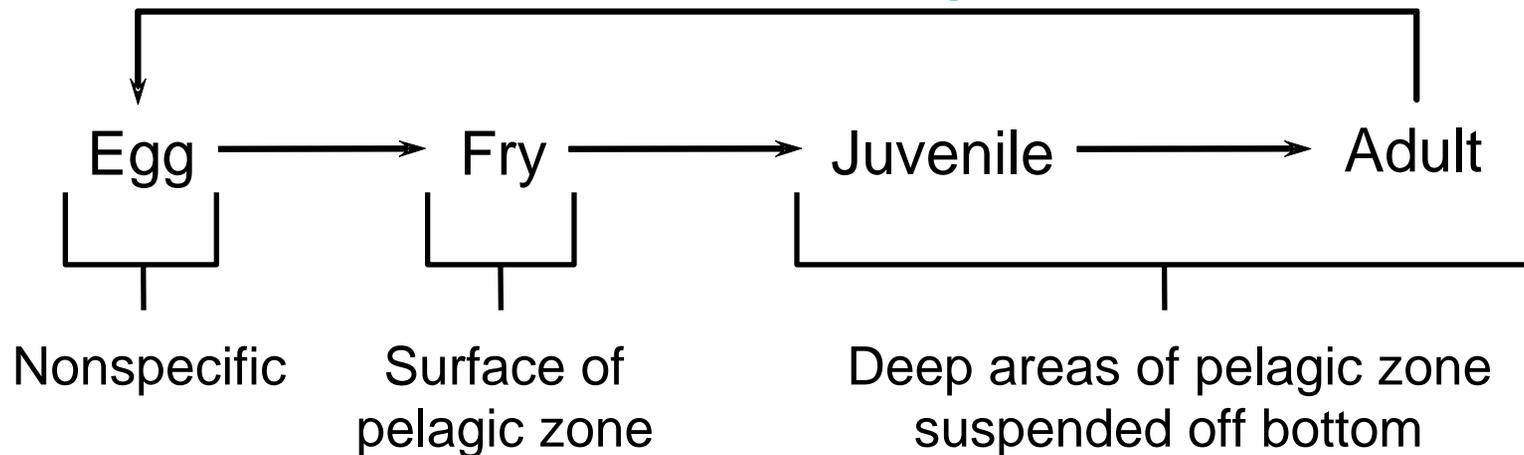


Photo Credit: Unknown



Great Lakes Fishes and Their Habitat Needs

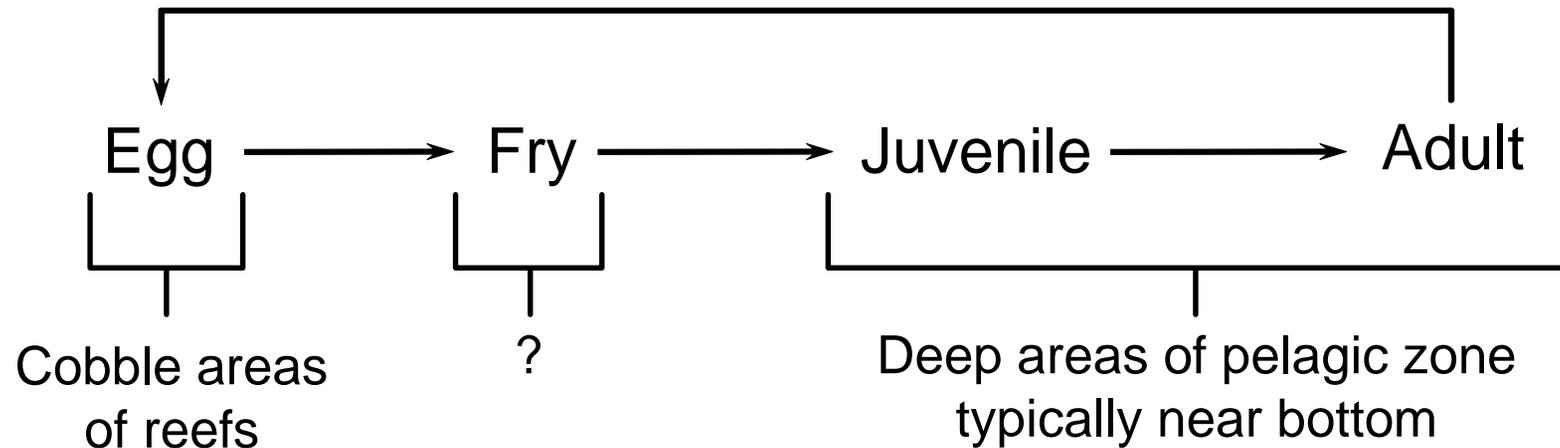
Lake Herring



ontogeny = development of an organism from embryo to adult

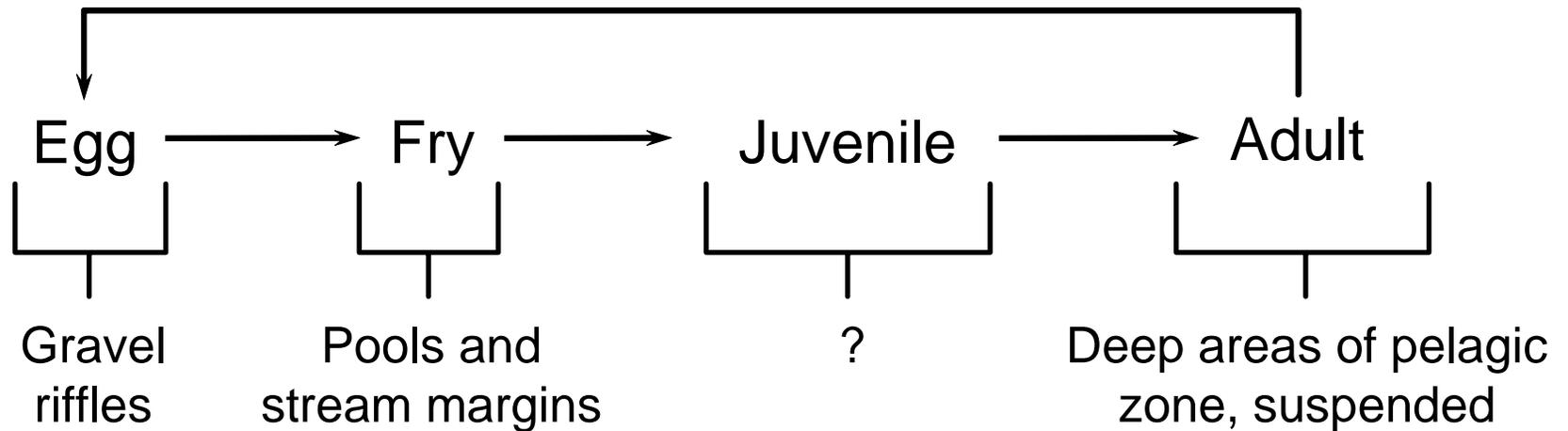
Great Lakes Fishes and Their Habitat Needs

Lake Trout



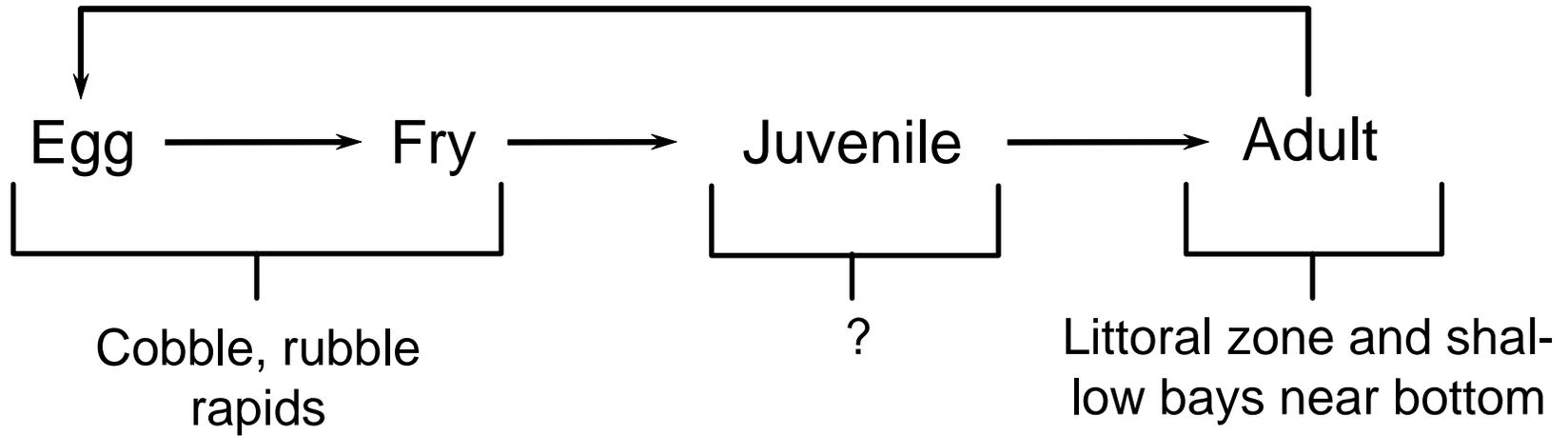
Great Lakes Fishes and Their Habitat Needs

Chinook Salmon



Great Lakes Fishes and Their Habitat Needs

Lake Sturgeon



Cover



Photo Credit: Unknown,
Michael Eversmier, GLFC



▪ Fish orient to physical structure

- Rocks, gravel, sand
aquatic plants, reefs,
logs

▪ Uses of cover

- Predator avoidance
- Shelter from storms
- Temp regulation
- Escaping high flow
- Ambush of prey
- Egg deposition



Feeding



Photo Credit: Unknown, INHS

- Fish have preferred feeding habitats
 - Benthic fishes may feed over sandy, silty, muddy areas
 - Planktivorous fishes may feed in open water
 - Ambush predators may be found in areas of high structural complexity
 - Open water predators may feed on schooling prey species



Spawning

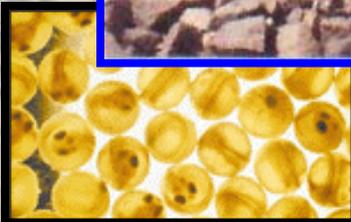
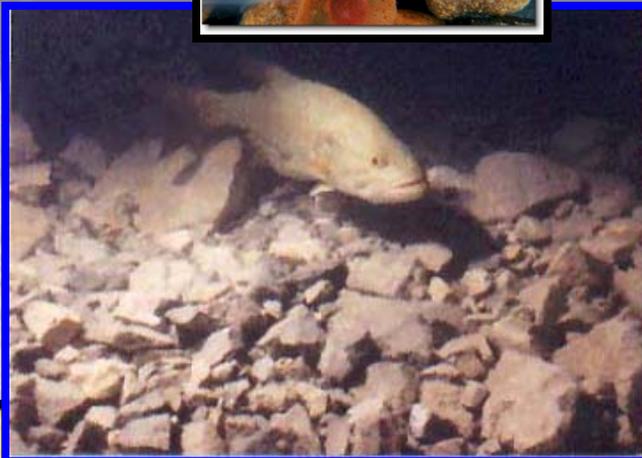


Photo Credit: Nick Giles,
Michael Eversmier, AFS

▪ Fish spawn:

- In different habitats
- Over different substrate types
- In different flow conditions
- In different temp conditions
- Near aquatic plants or woody structure



Spawning Habitat Use

	Pelagic	Sand	Gravel	Plants	Holes
Lake	6	2	10	9	3
River	0	0	24	7	1
Both	0	2	22	16	9

Nursery

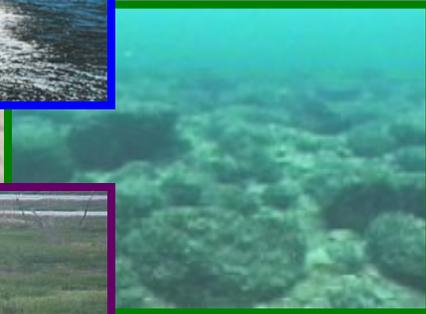


Photo Credit: NOAA,
Unknown, USFWS



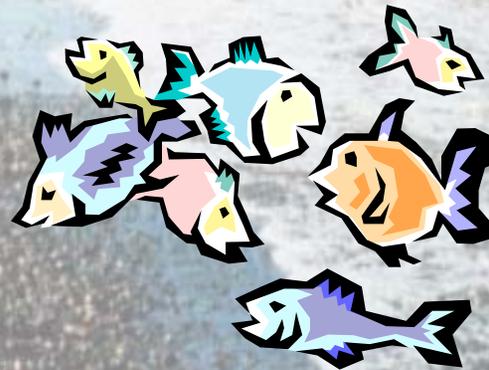
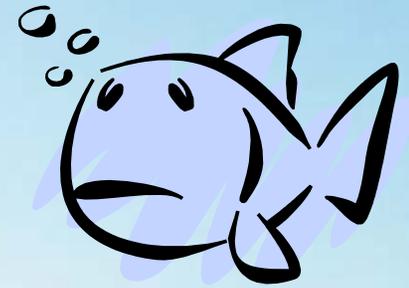
- Fish deposit eggs in areas that increase survival
 - Nearshore/littoral areas
 - Coastal wetlands
 - Inland wetlands
 - Rocks, gravel, sand, logs, limbs
 - Interstitial spaces
- Such areas often provide abundant food resources and cover



Migration

- Fish use many different habitats for migratory purposes

- Fish spawn in different places than where they reside
- Overwinter in areas far removed from summer residence
- Use open water, channels, littoral areas as a highway to move from one habitat to another



Seasonal Uses/Overwintering

- Fish utilize different habitats seasonally

- Migration
- Spawning
- Feeding
- Over-wintering
 - Deep water
 - Windbreaks
 - Areas with temps just above freezing

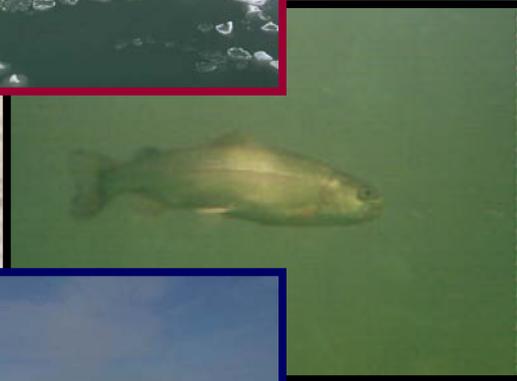


Photo Credit: NOAA, Unknown



Great Lakes Habitat Degradation



Photo Credit: INHS, Unknown, NOAA



Threats to Fish Habitat

- **Direct, in-lake habitat**
 - ◆ **Water quality and eutrophication**
 - ↗ Oxygen
 - ↗ Water clarity
 - ↗ Productivity
 - ↗ Toxic substances
 - ◆ **Shoreline development**
 - ↗ Dredging
 - ↗ Shoreline armoring
 - ↗ Wetland loss
- **Inland and upland influences**
 - ◆ **Dams**
 - ◆ **Channelization**
 - ◆ **Watershed influences**
 - ↗ Sediments
 - ↗ Nutrients



Logging



Photo Credit: WK&P

- Forests were clear cut
- Protective shade was removed from streams and river
- Sawmills left streams and embayments clogged with sawdust



Urbanization



- **Cities developed**
- **Untreated human wastes became a problem**
 - **Bacterial contamination**
 - **Floating debris in rivers and nearshore areas**
 - **Waterborne diseases developed**
 - **Nutrient levels exceeded what water bodies could handle**



Photo Credit: NOAA, Unknown

Industry

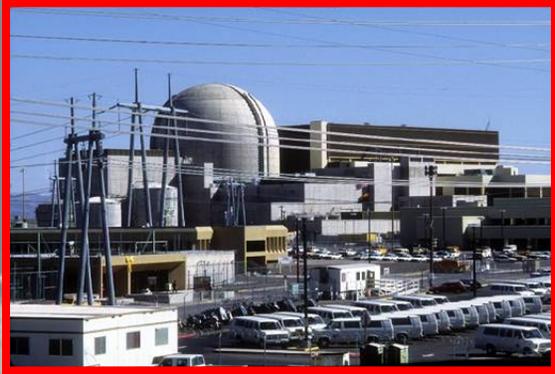


Photo Credit: NOAA, Unknown

- Untreated industrial wastes lead to degradation of one water body after another
- New chemical substances came into use
 - PCBs, DDTs



Agriculture



Photo Credit: YMDLD, Unknown

- Prairies were plowed
- Exposed soils washed away more readily
- Valuable stream and river habitat were buried under sediment
- Non-organic fertilizer run-off from agriculture fields led to over-fertilization of water bodies



Impacts to Wetlands

- **Non-native species**
 - Purple loosestrife
- **Fragmentation & Loss**
 - Agriculture
 - Industry
 - Urban development
- **Shoreline Modification**



Photo Credit: USGS



Impacts to Coastal Shores

- Residential development
- Non-native species
- Blowouts
- Hardening of shoreline



Photo Credit: NOAA, USGS



Impacts to Terrestrial Systems



- Tourism
- Development
- Deforestation



Photo Credit: ISM, WK&P

Impacts to Tributaries

- Channelization
- Dredging
- Dams
- Sedimentation
- Bankside vegetation loss
- Flooding
- Toxic contamination

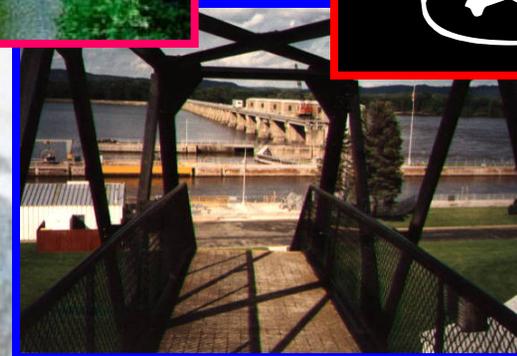


Photo Credit: LFC, Unknown



Impacts of Pollution on Habitat



Photo Credit: Unknown, NOAA



Pollution

Any chemical, biological, or physical change to air and water quality that has harmful effects on living organisms or makes water unsuitable for desired uses.



Photo Credit: Unknown



Point Source Pollution

- Origin can be traced back to a specific entry point such as a drainpipe



Photo Credit: LFC, Unknown



Non-point Source Pollution

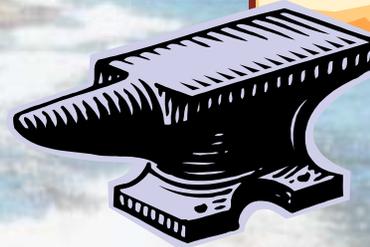
- Origins are many different sources that are difficult to regulate and control

Photo Credit: YMDLD, Unknown, NOAA



Classes of Pollution

- Inorganic plant nutrients
 - Nitrogen & Phosphorous
- Inorganic Chemicals
 - Heavy metals
- Organic chemicals
 - Oil, gas, solvents
- Oxygen demanding wastes
 - Decomposition



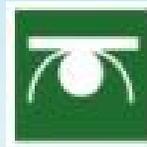
Classes of Pollution

- **Sediments**
 - **Turbidity**
- **Thermal pollution**
 - **Heated water**
- **Pathogens**
 - **Fecal coliform bacteria**
- **Genetic Pollution**
 - **Disruption of an aquatic system by the deliberate or accidental introduction of nonnative species**



Photo Credit: Unknown





Exotic Species and Habitat



Ohio Sea Grant



Photo Credit: IISG, OSG, NSGN



Exotics Often Provide Signals



Photo Credit: NSGN, Shedd Aquarium

- Presence suggests habitat alteration or degradation



Trends That Promote Invasions



Land-use changes

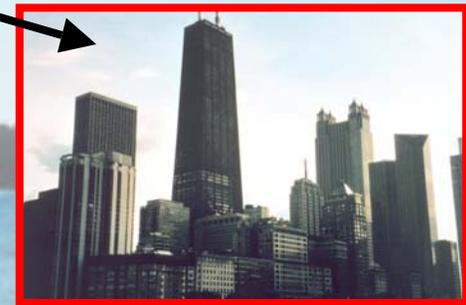


Photo Credit: INHS, NOAA



Increase in number of vectors that promote species movement



Round Goby

- Ballast water introduction
- Displaces native sculpin from interstitial habitat
- Consumes lake trout eggs



Photo Credit: David Jude, NSGN, Shedd Aquarium



Sea Lamprey

- Gained entry through the Welland Canal
- Used native fish such as lake trout as prey



Photo Credit: USFWS, NOAA, NSGN



Alewife

- Gained entry through the Welland Canal
- Predation on yellow perch larvae
- Massive die-offs created aesthetic problems



Photo Credit: NSGN, Shedd Aquarium

- Competition for habitat with native prey species



Pacific Salmon

- Intentional introduction
- Solution for controlling alewife population
- Compete for native fishes for food
- Support major element of recreational fishery



Photo Credit: NSGN, Shedd Aquarium



Zebra Mussels

- Ballast water introduction
- Restructuring of phytoplankton & zooplankton communities
- Fouling of native mussels
- Competition for food with native fishes



Photo Credit: NSGN, USGS, NOAA



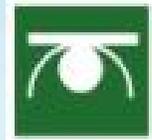
Purple Loosestrife

- Introduced by horticulture industry
- Replacing cattails in wetlands



Photo Credit: NSGN, NOAA





Impacts of Climate Change on Habitat



Photo Credit: NOAA, Unknown



Effects of Climate Change

These potentials exist:

- Temps may warm
- Less lake-effect snow
- Decreases in annual snowfall
- More summer precipitation
- Stream flows will be affected
- Patterns and intensity of weather may change



Impacts of Water Level Fluctuations on Habitat

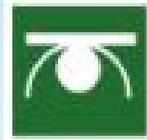


Photo Credit: NOAA



Water Level Fluctuations

- Normal Occurrence
- Due to natural factors and human activities

Natural Factors

Precipitation
Run-off from drainage basin
Evaporation
Inflow/Outflow from tributaries

Photo Credit: Unknown



Man-made factors

Diversions into or out of the basin
Consumption of the water
Dredging of outlet channels
Regulation of outflows



Impacts to Fish Habitat

▪ Low water

- Nearshore areas may dry out
- Fish cannot spawn
- Nearshore areas may retain too little water
- Fish may spawn unsuccessfully
- May not be suitable for nursery

▪ High water

- Nearshore areas are eroded
- Rock & sand provide sediment to beaches
- Coastal wetlands buffer high water
- Armored shorelines prevent erosion and starve depositional areas



Photo Credit: NOAA





Managing Great Lakes Habitat



Photo Credit: NOAA



What can we do?

- Protect
- Restore
- Mitigate
- Enhance



Photo Credit: NOAA



How do we restore or protect?

Ultimate Factors

Proximate Factors



Watershed
Management

Temperature - riparian vegetation

Sediment - erosion control

riparian vegetation

sediment traps

Cover - structures

Water depth- structures



Photo Credit: NOAA



Stocking as Mitigation

- Stocking may only treat symptoms of a larger problem (degraded habitat)
- Stocking may be only a temporary fix
- Degraded habitat may need to be restored
- Restoring habitat may help a species achieve higher levels of production & success naturally



Photo Credit: USFWS, IDNR





Great Lakes Sea Grant Fisheries Leadership Institute



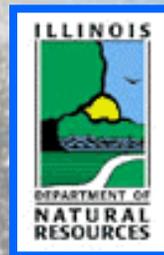
Acknowledgments



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The End

