Pond Fertilization: Art, Science or Luck?

Art

Purpose is to promote the growth and development of correct size and species of zooplankton prey for fish fry.

Importance

- Provide food source for larval fish.
- Supplements formulated feed.

Fry Size

Common Name	Fry Size inches (mm)
Sunshine bass	1/16-1/4” (2-6 mm)
Fathead minnow	5/32-1/4” (4-6 mm)
Yellow perch	3/16-9/32” (5-7 mm)
Walleye	1/4-9/32” (6-9 mm)
Channel Catfish	13/32-15/32” (10-12 mm)

Quality Zooplankton

- Group
  - Rotifers/Copepods/Cladocerans
- Species
  - *Daphnia magna* vs *Daphnia pulex*
- Size
  - different fish species need different sizes of zooplankton as first prey.

Goal of hatchery managers

- Recipes for all situations

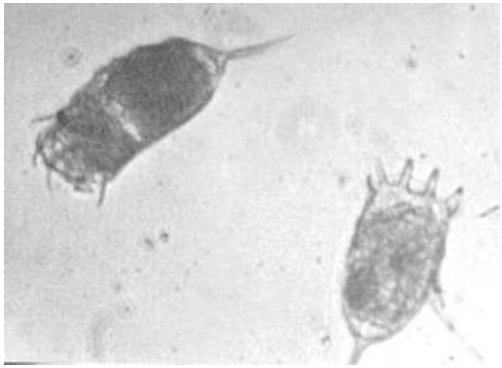
Reality

- Ponds are complex ecosystems shaped by predator/prey relationships.
- Actual rates determined by individual pond fertility.

Science

- Types of zooplankton
  - Rotifers
  - Cladocera
  - Copepods

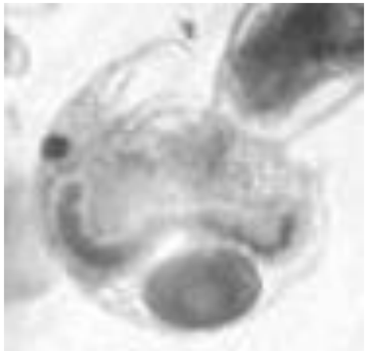
Types of Rotifers

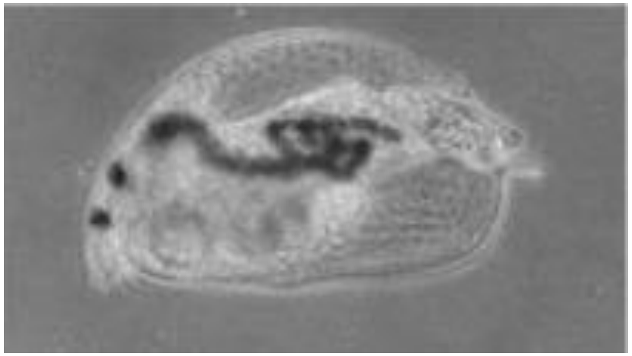


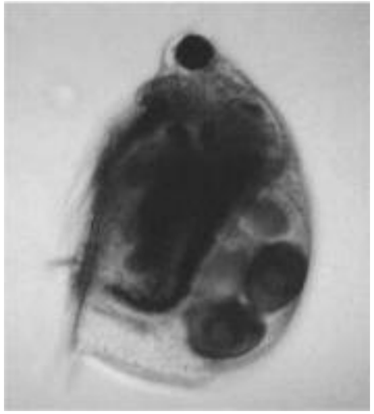
Rotifer Life History

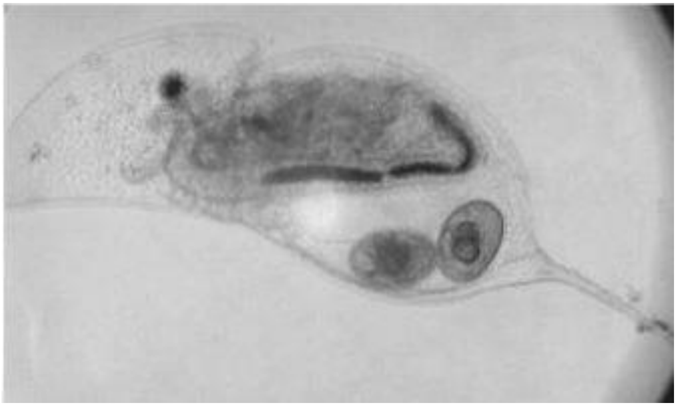
- Females parthenogenetic – produce diploid (amictic) eggs which, without fertilization, develop into adults.
  - Allows fast multiplication.

Types of Cladocerans



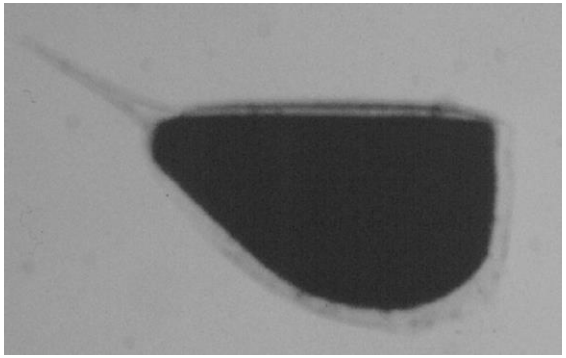






Cladoceran Life History

- Similar to Rotifers.
  - Females parthenogenetic
  - Produce amictic eggs (diapause eggs)
- Produces resting egg (ephippium).



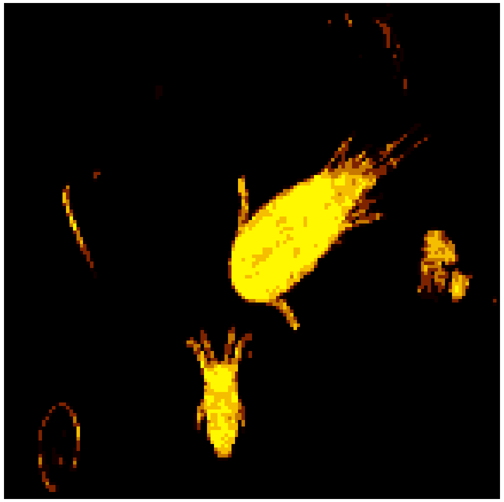
Types of Copepods

- Subclass Calanoida
- Subclass Cyclopoida

Types of Copepods

Copepod Life History

- Only sexual reproduction.
- Eggs hatch to *nauplii.*
  - ~ 5 or 6 naupliar stages.
  - no resemblance to adult.



Population Trends

Sampling

- Most common using a Wisconsin plankton net.
- Other methods include plankton pump and tube sampler.

Fertilization

- Organic
  - Animal manures – horse, pig, cow
  - Hays – alfalfa, bermuda, clover
  - Meals – cottonseed, corn, soybean
- Inorganic
  - Nitrogen – calcium nitrate, potassium nitrate
  - Phosphorus – superphosphate, rock phosphate

Organic Fertilizers

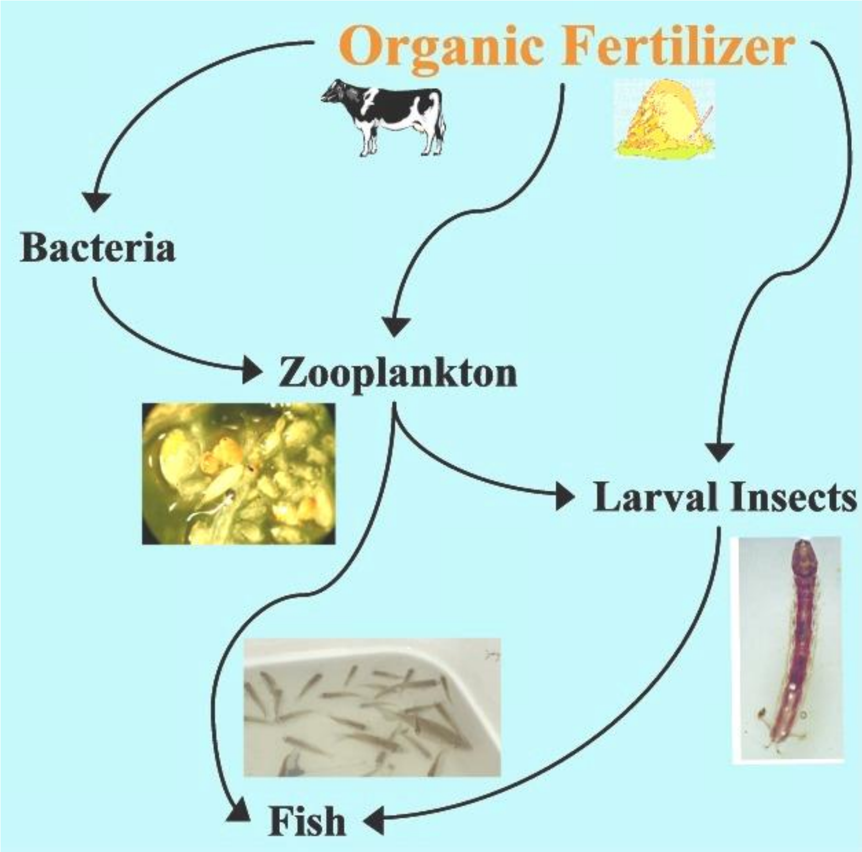
- Direct food source for zooplankton.
- May clear turbid water.
    - positively charged ions released bind with clay particles
- Direct food source for tilapia and carp.

Organic Fertilizers

- Energy source for nitrifying bacteria.
- **Selection criteria**
  - **low carbon:nitrogen ratio**
  - **fine particle size**
  - **readily available and economical**

Organic fertilizer

- Heterotrophic food web



Organic Fertilizers

Type	N:P:K
Cottonseed meal	6.9:2.4:1.7
Soybean meal	7.1:1.4:2.0
Alfalfa hay	2.4:0.6:2.4
Sheep manure	1.4:0.5:1.2

Inorganic Fertilizers

- Autotrophic food chain.
- Limiting factor in freshwater systems is often phosphorus.
  - in late summer, nitrogen may be limiting
- Fast acting.
- Selection criteria.
  - adequate phosphorus and nitrogen
  - economical and ease of application
- Chemical designation N:P:K.

Inorganic Fertilizers

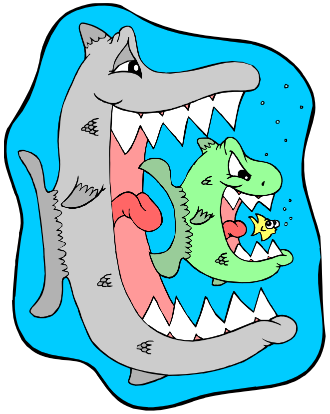
Fertilizer	N:P:K
Urea	45:0:0
Sodium nitrate	16:0:0
Phosphoric acid	0:54:0
Superphosphate	0:18-20:0
Triple superphosphate	0:44-54:0
Potassium nitrate	13:0:44

Nutrient Ratios

- Maintaining high N:P ratios, i.e. > 7:1, may inhibit blue-green algae.
- Blue-greens are undesirable.
  - May release toxins.
  - May form unsightly filamentous mats.
  - Not a good food source for zooplankton.

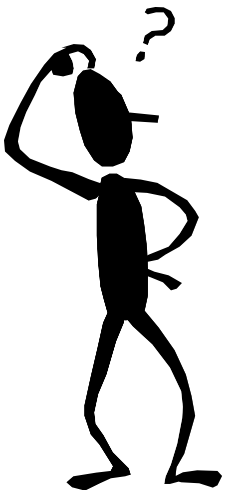
Fertilization

- Need source of nutrients for food webs.
- Organic fertilization provides C.
- Inorganic provides N and P.
- But which is needed more, and how much is needed?



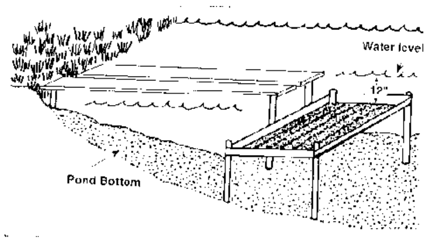
What fertilizer to use?

- Inorganic fertilizers for immediate results.
- Organic fertilizers for long-term application.
- Combination of both .



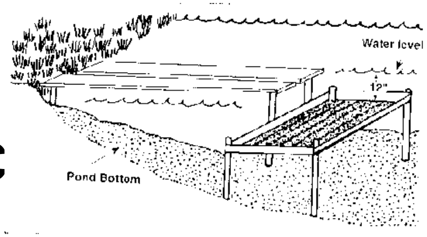
Fertilizers Applications

- Organic Fertilizers
  - Apply fertilizers completely around pond edge.
  - Frequent application



Fertilizers Applications

- Inorganic Fertilizers
  - liquid
    - mixed into prop wash or mixed 10:1 (sprayed)
  - powder
    - soluble, blown onto pond surfac
  - granular
    - fairly insoluble, placed onto shallow wooden platform 1 ft below pond surface



Concerns Related to Fertilization

- Low oxygen levels (organic)
- Costs of either the product (inorganic) or transportation (organic)
- Greater fluctuations in daily oxygen and pH levels
  - pH elevations especially a problem with inorganic fertilizers
- Increased aquatic vegetation levels

Suggested Organic Fertilization Regimes

- Initial application of 250 lbs/acre followed by weekly applications of 50 lbs/acre.

Suggested Inorganic Fertilization Regimes

- Liquid
  - 11-37-0
    - ½-4 gal/acre depending on alkalinity
- Power
  - 12-52-4
    - 4-32 lbs/acre
- Adjustments as necessary to allow for plankton bloom
- Need for pond liming in ponds with <20 mg/L alkalinity

Midwestern Fertilization Regimes

- Water naturally high in phosphorus
- Following ‘Southern’ recipes can cause problems with blue-green algas
- Need to measure prior nutrient levels

Walleye Culture Recommendations

- Organic fertilizers
  - 100 lbs/acre/week
  - Use of meal last 2 weeks of culture
  - Consideration of soybean meal due to increase level of nitrogen
    - 7.07% for soybean meal vs. 2.9% for alfalfa pellets
  - Application
    - Pond parameter limited to 2-3 feet water depth
- Inorganic fertilizers
  - Adjust NO3-N:P to 7:1 3 weeks post stocking

Culture Recommendations

- Water Chemistry
  - 2X weekly
  - Morning dissolved oxygen
  - Afternoon pH
  - Ammonia
- Zooplankton
  - Measure bi-weekly
  - Fish harvests
  - Watch zooplankton dynamics and initiate harvests in accordance

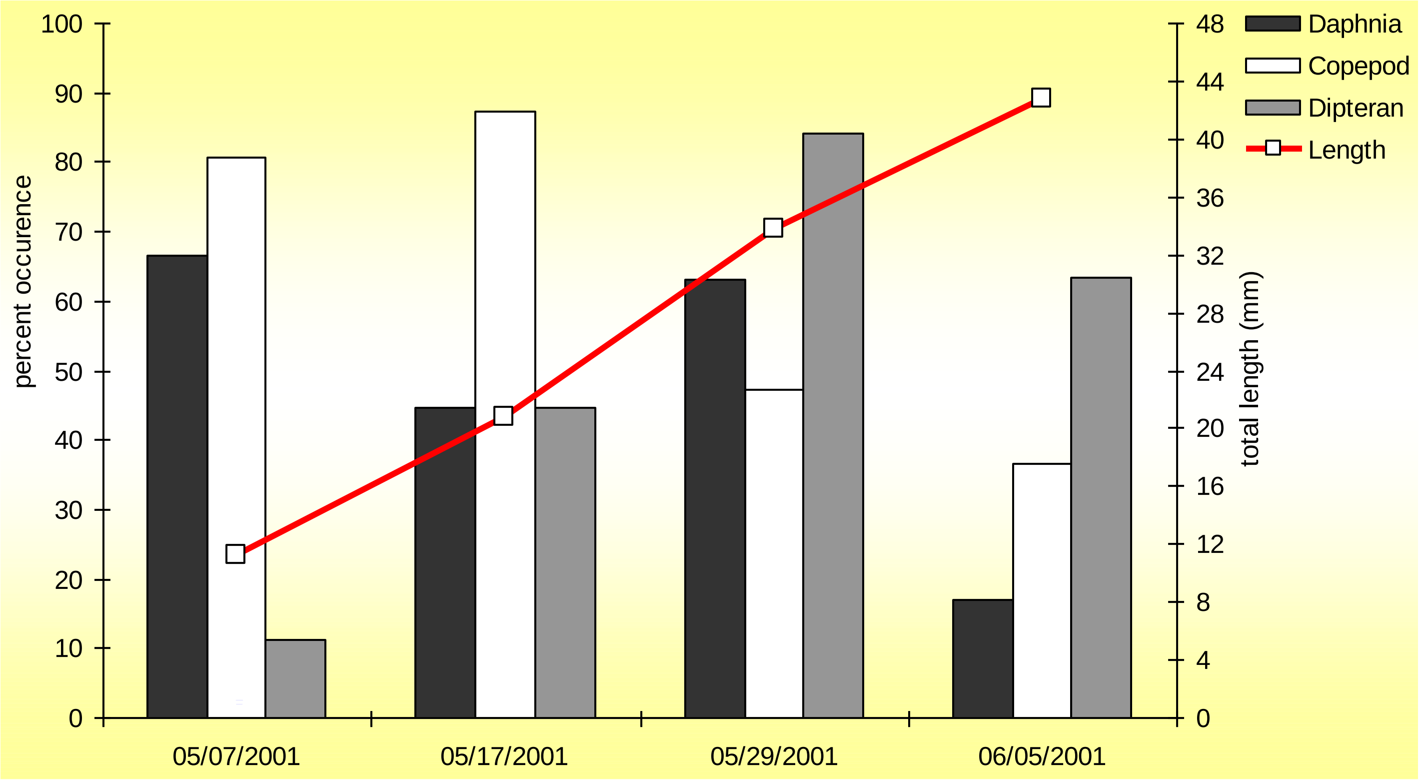
Application

- Pond Water Analysis
  - Total phosphorus = 0.43 mg/L P
  - Nitrate (NO_3) = 0.7 N
- Fertilizer analysis
  - 10-0-0
- Ratio of NO_3:P
  - 0.7/0.43 = 1.6:1
  - Target ratio is 7:1

Take Home Message

- Need to know actual chemical levels of fertilizers and culture water.
  - What form is the N and P (fertilizer)?
  - Adjust molecular weights to account for different chemical compounds.
  - Realize that sometime it is the ratio that is important as opposed to actual nutrient level of the water.
- A pond's nutrient levels influenced by culture history as well as nutrient inputs.
- Water sources influence
  - Use of wild water may have both additional nutrients as well as invertebrates

Relative Importance of Prey



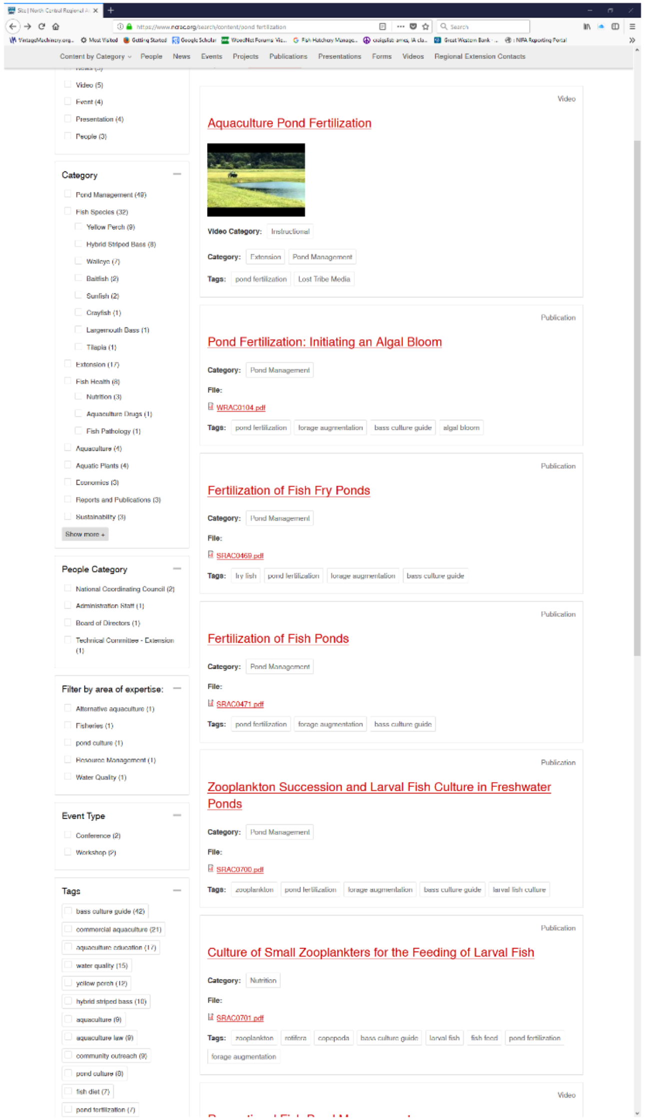
Benthics

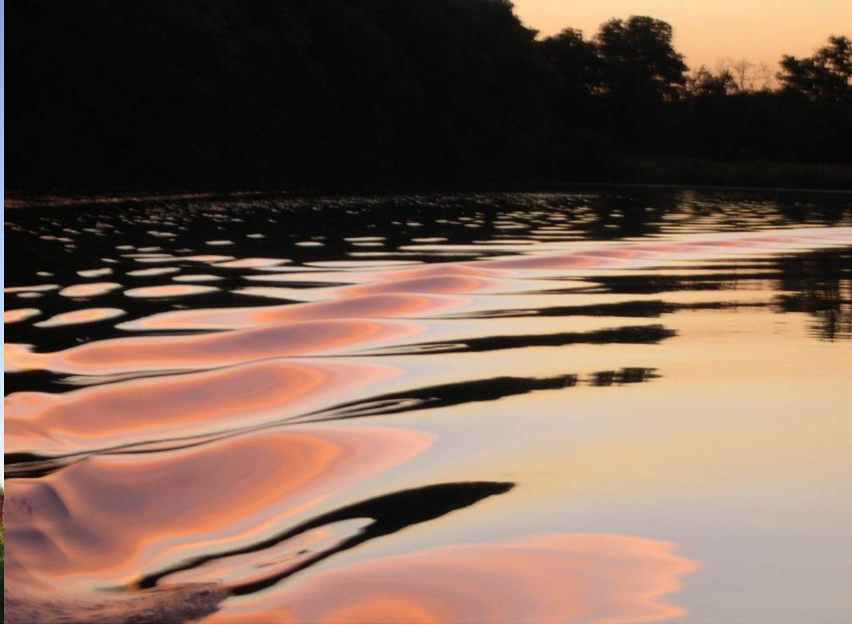
- Often used as primary prey for advanced fingerlings of predacious fish.
  - Walleye
  - Hybrid striped bass
  - Largemouth bass
- 2-3 week lag time after stocking.
- Need organic substrate.

Overall Summary

- Measure water fertility prior to initiation of any fertilization program.
- Establish large populations of desirable zooplankton prior to stocking larval fish.
- Maintain fertilization rates as long as water quality allows.
- Difficult to manage both large populations of zooplankton and fish fry.
- One recipe for all ponds is difficult.
- No need to fertilize ponds where fish are being fed.

Information Sources



Thank you **Questions?**