Fish Conservation and Management
CONS 486

Habitat management and manipulation
Chapter 10 Ross

Read Chapter 9 Ross (Habitat Deterioration)—will not cover in lecture
Major theme: Linking science to conservation & management

Basic science
- Physiology
- Behaviour
- Population ecology
- Ecosystem ecology
- Habitat data (limnology, oceanography)
- Life history

Applied science
- Fisheries exploitation data
- Applied life history data
- Human dimensions: socio-economic data

Conservation
- Protecting populations & habitats
- Restoring populations & habitats

Management
- Harvest regulations
- Managing fisheries & habitats
Habitat management & manipulation

1. Stream channels
2. Natural lakes
3. Reservoirs
Manipulations within existing stream channels
Manipulations within existing stream channels

Goals:

• Increase habitat complexity
  – Protection from predators & competitors
• Increase shelter from high velocity water
Manipulations within existing stream channels

Approaches:

• All can be addressed by creating pools and shelter
  – E.g., log and boulder placements
Addition of boulders and wood
V-shaped log clusters help to create pools!
Large wood additions to create rearing pools
Manipulations within existing stream channels

Effectiveness:

• Short-term studies show that biomass and catch of desired fishes can increase.

![Graph showing total salmonid biomass as a function of pool volume.](image)

Fig. 5. Total biomass of age 1+ and older salmonids as a function of pool volume for seven sections of Musqueam (sections 1–6) and Cutthroat (section 11) creeks sampled in April 1990 (see Fig. 1). Ninety-five percent confidence intervals for biomass are smaller than the points in each case and are given in Table 4.

Fausch and Northcotte (1992) research at Musqueam Creek (remember FRST 386!)
Manipulations within existing stream channels

**Effectiveness:**

- Few long-term studies

- Is production higher or are fish just being attracted from nearby locations?
Manipulations within existing stream channels

**Costs:** Can be intensive/expensive to implement and maintain
- Can be accomplished with help of volunteers/community
- But monitoring and assessment usually is lacking
- May be cost-effective relative to large infrastructure like hatcheries
Stream creation (rather than enhancement) is much more costly but can have significant benefits—e.g. Weaver Creek spawning channel—needs daily attention, but involves monitoring and has strong outreach and education.
Manipulations within natural lakes
Manipulations within natural lakes: enhance habitat

Goals:

• Increase available cover
  – For protection from potential predators or competitors
  – Create locations where fishers can be more successful

• Enhance shoreline habitat
  – Prevent erosion
Manipulations within natural lakes: enhance habitat

Approaches:

• Creation of artificial reefs
  – e.g. waste concrete, boulders, tires

• Stabilize shorelines
  – e.g., use construction materials or plant life
Construction of an artificial reef, Lake Erie (offshore near Lorain, Ohio)
Cobblestones for shore protection, Port Wing, Wisconsin
Shoreline protection using tires, Port Wing, Wisconsin
Marram grass dune stabilization, Warren Dunes State Park Lake Michigan
Rip rap (large boulder placement) for shoreline protection from erosion and scouring, Indiana
Manipulations within natural lakes: enhance habitat

Effectiveness:

• Questionable effectiveness!
  – Are fish populations enhanced or concentrated?
  – If they are merely concentrated, they could suffer higher fishing pressure

• Shoreline stabilization can be effective at reducing erosion, sediment input, littoral habitat protection
  – Can be unsightly if built with construction materials
    • Viable substitute for natural shoreline stabilization?
  – Grass/shrubs/trees can look nice!
    • Ecosystem function?
Do Artificial Reefs Increase Regional Fish Production? A Review of Existing Data


ABSTRACT
We reviewed the scientific literature to determine whether the construction of artificial reefs increases the regional production of marine fishes. An evaluation of this technique is warranted by its high cost and logistical difficulty. Our review indicated that reef construction may have potentially deleterious effects on reef fish populations, including (1) increasing fishing effort and catch rates, (2) boosting the potential for overexploitation of stocks by increasing access to previously unexploited stock segments, and (3) increasing the probability of overexploitation by concentrating previously exploited segments of the stock. In contrast, the literature contained few studies that unambiguously demonstrated that artificial reefs increased regional fish production rather than merely concentrated available biomass. In addition, the literature on population regulation in reef fishes did not provide convincing evidence that reef fishes were limited by insufficient quantities of hard-bottom habitat. Consequently, potential positive and negative aspects of reef construction should be carefully evaluated prior to the addition of new reefs to marine environments.

Manipulations within natural lakes: control unwanted vegetation

Goals:

• Decrease unwanted littoral vegetation, especially from non-native invaders
• E.g., Eurasian water-milfoil

Eurasian water-milfoil
Myriophyllum spicatum
(Non-native)

Northern water-milfoil
Myriophyllum sibiricum
(Native)

Leaves in whorls of 3-5 and may be widely spaced along the stem

Note: More than 12 pairs of leaflets

Note: Usually 12 or fewer pairs of leaflets
Eurasian milfoil: high densities can interfere with swimming, boating and fishing
Eurasian milfoil: high densities can interfere with swimming, boating and fishing
Manipulations within natural lakes: control unwanted vegetation

Approaches:

- **Herbicides**: costly, dangerous to water quality, only effective seasonally
- **Mechanical harvesting**: akin to lawn mowing, cheap, safe, only effective for a few weeks/months
  - Cultus Lake milfoil control
- **Introductions of biological control agents**: 
  - eg. sterile grass carp, milfoil weevils: always risky when adding a new species, unknown competitive interactions
- **Waterscaping**: tree plantings to slow macrophyte growth nearshore, cruising lanes, manipulating density and species composition to achieve maximum invert biomass with overhead cover from floating macrophytes
Figure 10.3  (1) A row of trees planted on a south shoreline will shade the water and retard rooted aquatic plants growing near shore; (2) in small, shallow lakes with heavy fishing pressure, cruising lanes through heavy vegetation can be provided by covering the bottom with fiberglass screens topped with rock; (3) waterscaping may be done with broad-leaved ponds weeds and water lilies to provide invertebrate food for fish and waterfowl, shelter for prey species, and spawning habitat. (Redrawn from Engle 1989.)
Milfoil weevils have been introduced in recent years! North American native aquatic beetle species that eats primarily milfoil. Cost about $1 each; introduced over multiple years. Example in Ontario at Lake Scugog (part of Kawartha Lakes) – 136000 acre lake and about 75,000 individuals introduced over 3 years. Now being tested in Rondeau Bay Lake Erie.
Manipulations within natural lakes: control unwanted vegetation

**Effectiveness/cost:**

- All may be effective at increasing abundance of some fishes
- Some have less inherent risks but may be economically more costly
  - e.g., mechanical harvest, waterscaping
- Some have more risks with uncertain long term costs
  - e.g. biological control

Beware: “there was an old lady who swallowed a fly...”
Manipulations within reservoirs
Manipulations within reservoirs

- Reservoirs: artificially created and maintained environments
  - have control over water levels and outflow temperatures

- Fish community may be largely artificial/non-native
  - so usually less political or ethical concern with manipulations

- These systems can have some of the largest management actions

- Good areas for site-specific adaptive management to assess effectiveness
  - An experimental framework for management
  - Involves monitoring and comparing outcomes of different management actions
Manipulations within reservoirs

Goals:

• Reduce impacts of “trophic depression” on primary production that is available to fish
• Attempting to enhance the ‘pelagic’ community
Manipulations within reservoirs

Approaches:
Water level fluctuations (very local/issue specific)

• Prolonged winter drawdown can kill some rooted aquatic vegetation

• Spring **flooding** draws nutrients from decomposing herbaceous vegetation which is then available to phytoplankton
  – spring nutrients then go to phytoplankton instead of rooted vegetation
Manipulations within reservoirs

Goals:
• Direct manipulation of fish community towards more desirable species
Manipulations within reservoirs

Approaches:

Water level fluctuations

- drawdown water levels to expose eggs of undesirable shoreline spawners (e.g. carp)

- flood shorelines during spawning periods of desired fishes thus providing more littoral cover (e.g. for perch and pike)

- spring and summer drawdowns can concentrate forage fishes (that were in littoral) into areas where predation is more efficient thus accelerating growth of predators

- could flood nearshore in the fall to enhance waterfall breeding
Manipulations within reservoirs

Goals:
• reduce fish kills in small eutrophic artificial lakes caused by hypolimnnetic oxygen reduction, and increase lake volume available to desired fishes
Manipulations within reservoirs

Approaches:

• destratify the lake in the summer using compressed air blowers that blow bubbles from bottom of lake entraining cold, oxygen poor water into warm oxygen rich epillimnion (maintain lake in fall turnover mode)
Reservoirs: Other manipulation issues

- Must consider down-stream thermal habitats when releasing water

Figure 8.8 The quality of water withdrawn from a reservoir determined by the depth and location of water withdrawal points (A, B, C) in relation to the thermocline: A Oxygenated epilimnetic water; B Anoxic hypolimnetic water; C Anoxic, sediment-laden water (After Cole and Hannan, 1990)
Dam it, were done.
Au ‘re ser voir’!