

Biol 596 – Ecology of Fishes and Fisheries Biology

Population dynamics and estimating abundance

Sources of population dynamics:

Hypotheses to explain variability in survival (strength) of cohorts (year class) of larvae

Recent emphasis: survival of early benthic stages

Hypotheses involving post-settlement processes to explain variability in size and distribution of benthic populations

A) Equilibrium models

Competition Hypotheses (inter- and intra-specific)

Examples of intraspecific competition:

Examples of intra- and interspecific competition:

Summary of competition effects:

Predation Hypothesis (Hixon 1991)

predators as source of density-dependent mortality

Example:

B) Non-Equilibrium Models:

“Recruitment Limitation” Hypothesis (Doherty 1983, Victor ‘86, Doherty and Fowler ‘94)

Predation Ho (Hixon 1991)

predation reduces numbers below levels that saturate resources

“Pluralistic” Approach (Jones 1991)

probably a combination of all of the above

Methods for estimating fish population size

The types of sampling methods and devices used to sample fishes are highly specific for species, size of individuals, and type of habitat.

Each method or gear has its advantages and disadvantages.

General objectives of sampling populations of fishes

To determine:

Problems in assessment of fish populations

(1) **Patchiness**

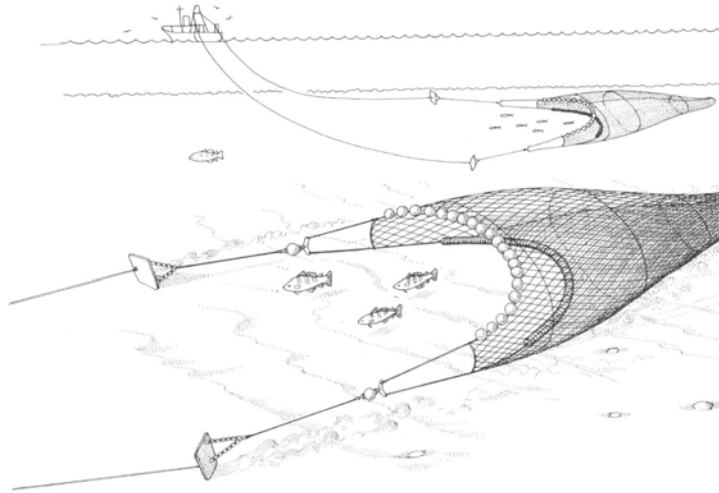
(2) **Depletion of stocks by sampling without replacement**

(3) **Determining the area or volume sampled**

(4) **Differential behavior of fish species** -- introduces potential bias depending on what sampling method is used.

Standard sampling gear/techniques

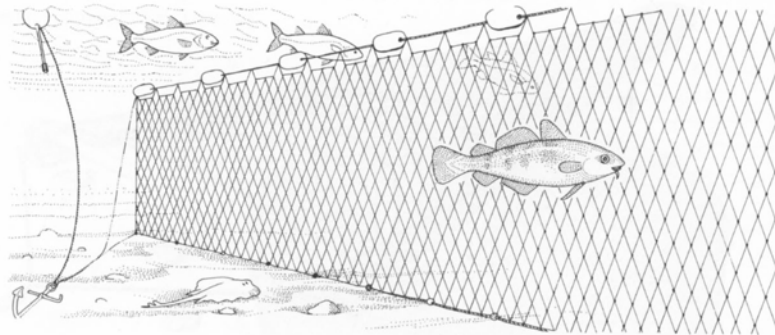
- (1) **Otter trawls** -- bag-like nets used on sand or mud bottoms. Some trawls fitted with large rollers or wheels, have made rocky-bottom trawling feasible.



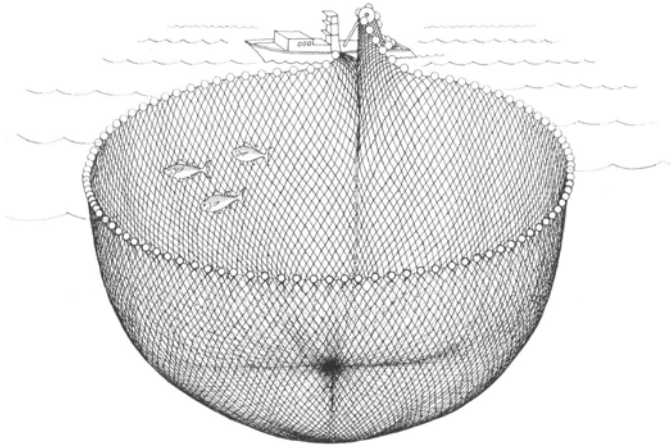
- (2) **Gill nets** -- (**entanglement nets**) nets with uniform mesh size or a multi-panel net, with each panel having a different mesh size. Gill nets capture fish as the name implies -- fish swim into the net and their opercula get caught in the mesh and they can't go forward or back out of the net. Nets are constructed of nylon or monofilament and designed to fish while floating on the surface.

Fig. 5.3 (Continued)

(g)



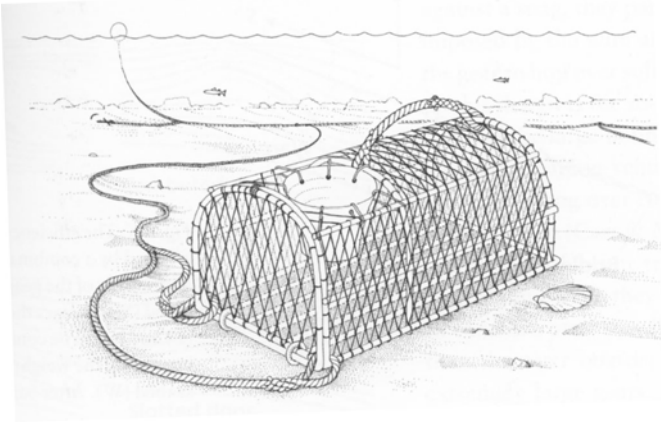
- (3) **Roundhaul nets** -- encircle nets fish aggregations. Nets are continuous and wall-like, with corks on the top and leads on the bottom. When a school or aggregation of fish is sighted, A buoy or skiff is released into the water and the net is set across the path of the fish. The net is set in a circle. A purse seine has a drawstring running the length of the lead line, which is pulled tight after the set, thus enclosing the fish. Roundhaul nets are best for schooling or aggregating fishes over deeper water.



- (4) **Impounding nets** -- Beach seines, usually about 60-100 ft. in length, set by people or by skiff parallel to shoreline. The net is then pulled in from both ends while keeping the lead line on the bottom, which traps fishes and forces them onshore.

(5) **Fyke nets** -- example of nets that trap fish by deflecting them into an enclosure. Escape of fish is difficult by funnels or V-shaped cones that extend inward. These nets are most effective when placed along narrow water passages (estuaries, or channels near jetties, etc.

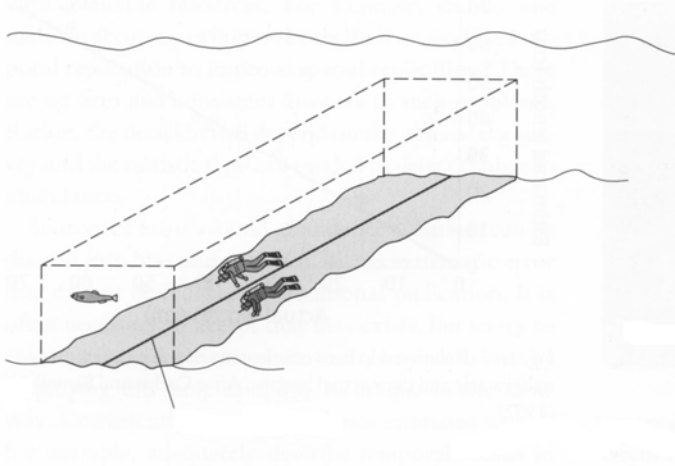
(6) **Fish traps (pots)** - rectangular or circular cages that are set on bottom or in midwater. The traps have openings that become smaller toward the inside. Traps are attached by a line and buoy for recovery from the surface. Traps can be baited or not. Fish traps are useful in habitats that are difficult to sample by other means, such as deep-water rocky areas.



(7) **Electrofishing** -- Use of electricity for capture -- popular in freshwater streams. Alternating current stuns but rarely kills fish, whereas direct current causes fish to move toward the positive electrode.

(8) **Chemicals /gases** -- use of chemicals to kill or anaesthetize fishes -- most effective in closed bodies of water, tidepools. May be more effective in habitats such as crevices and algal mats that are difficult to sample using other techniques.

(9) **Direct observation -- underwater surveys** -- where water visibility is good or reasonable, underwater diver surveys can be an effective and relatively non-disruptive way to count different species.



For cryptic and small sedentary fishes, quadrats (square sampling units, made of PVC, rebar, etc.) can be used to better estimate the abundance of these species.

(10) **Mark-recapture methods** -- unlike previous methods, you are trying to get an estimate of the population in an area. The idea is to collect a sample of the population, tag or mark those fish, release them, and then resample the population again from once to several times. Population size can be calculated from the number of marked vs. unmarked fish caught in subsequent samples.