GEAR REVIEWS

1. GILL NETS

- ***Quantification of Effort***

Gill net effort is usually calculated by multiplying the length of net by the length of time it was set. Catches are then standardized to units such as number of fish captured per metre-hour, or per 100 metre-days. There are some complicating factors with respect to length of time set. Catches can be expected to decline due to localized depletion of fish unless fish are very abundant or mobile, or both. Also, the efficiency of gill nets can decrease as fish accumulate in the net, a phenomenon known as gear saturation. The rate of saturation depends on the rate at which fish are caught, which in turn is typically related to fish abundance, so that catchability can be inversely related to density (Hansen et al. 1998; Borgstrøm, 1992; Henderson and Nepsy, 1992). Obviously, damage to (holes in) nets decreases their efficiency.

The part of the day during which nets are set can also influence catches. Minns and Hurley (1988) observed both increasing and decreasing catch-per-unit-effort with increasing set time in gill nets set in the late afternoon and lifted 1.5 to 12 hours later. Species richness increased with length of time set. They hypothesized that time-of-day influences on activity contributed to differences in catch rates and species richness, as the sets variously included daylight, dusk, overnight and dawn periods. Often gill nets are set in the late afternoon and lifted in the morning. This is referred to as an overnight set, and because an overnight set fishes during dawn and dusk and overnight, as well as during a portion of daylight hours, it should sample fishes that are active during any of these periods. Dawn and dusk are probably important periods as many species demonstrate crepuscular activity. Minns and Hurley (1988) also examined the influence of the length of net on catch-per- unit-effort.

Clearly, it is important to standardize gear and methods as much as possible if gill net catches are to be used as an index of abundance. Even with standardization, gill net catches are notoriously variable and large numbers of sets are likely to be required if the goal is to demonstrate statistically significant differences between locations or years.

- ***Fish Injury/survival***

Gill nets are not usually thought of as a gear to be used when investigators wish to keep fish alive, except when fine mesh gill net sets are set for short periods on spawning shoals to catch lake trout (*Salvelinus namaycush*) by their teeth. However, mortality appears to vary widely depending on the species and ambient conditions (C. Portt, personal observation). Fish that become wedged or tangled in a manner that obstructs the opercula or the mouth so that they are prevented from ventilating usually die. However, fish that are able to ventilate after they are caught often survive capture. The likelihood that fish will survive capture also appears to increase as water temperature decreases, which may be related to dissolved oxygen concentrations. Physical injury during retention and removal can also occur, including injury to the gills and the integument. We are aware of no post-capture survival studies.

Beach Seines

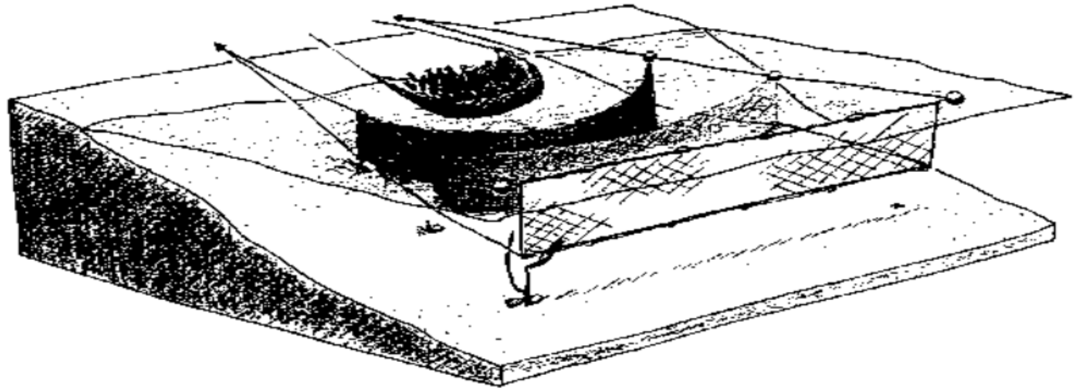

Fig – 4.5

- ***Description and method of use***

Beach seines consist of a length of fine mesh strung between a positively buoyant line (the float line) and a negatively buoyant line (the lead line) that is pulled through the water to encircle fish. Often a *bag* of the same mesh that extends behind the plane of the net is built into the midpoint, so that fish move into the bag as the net is pulled forward. Seines with a bag are referred to as *bag seines*. Seines can be built using a variety of mesh types and sizes, but the typical beach seines used in research are made of a woven (also called knotless) nylon mesh with 6 mm (1/4 inch) openings. The weight or strength of meshes varies and can have a significant effect on durability. A description of a seine normally includes its length, depth, the dimensions of the bag (if present), and the mesh size and material. Sometimes the amount of floatation and weight on the lead and float lines is also provided.

Beach seines can be used by wading or deployed from a boat. A single deployment and retrieval of a beach seine is usually referred to as a *haul*. In the simplest technique two people, one on each end of the seine, walk in parallel through the water with the seine forming a U-shape behind them. Seines are also often deployed by keeping one end fixed and deploying the net in a semi-circle, either by wading or from a boat. To prevent fish from escaping, it is critical that the lead line remain on the bottom. Sometimes a pole is attached to each end of the seine and used as a handle. The lead line is attached to the bottom of the pole, which is kept on or at the substrate. An alternate method is to tie a loop in each end of the lead line and place it over the operators' feet that are closest to the net, and to hold the float line in the hand closest to the net. The bottom line is pulled forward by the operators leg (Fig. 4.3).

The beach seine haul is culminated by bringing the two ends of the seine together and pulling the net forward so that the encircled fish end up either in the bag or, if no bag is present, in the mesh that is between the lead and float lines. This is achieved by bringing the two ends of the lead line together and retrieving the lead line, slightly in advance of the float line, forcing fish back into the bag or back of the net. This is normally done at the shore (hence beach seine). It is possible to retrieve a seine into a boat, but the efficiency is lower (Bayley and Herndeen, 2000).

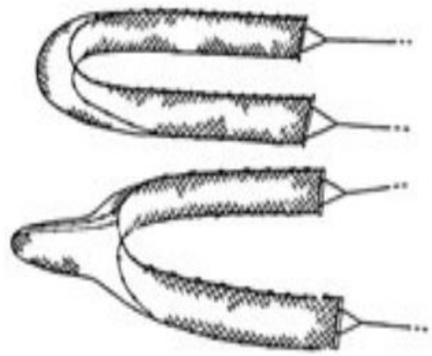

Fig.4.6

- ***Habitat considerations***

Beach seines are normally only used in water depths that are less than one half or two thirds the depth of the seine, so that the lead line remains on the bottom and the float line remains at the surface as the net is pulled forward. Deployment and retrieval is easiest over smooth bottoms with no debris or obstructions. Seine nets can become snagged on rocks, logs, etc., and often can only be freed by pulling the net backward, off the object. Where debris is present it is useful to have a third person follow the net who can free it when it becomes snagged. Often the lead line is raised off the bottom when the net is snagged, and this, in combination with the unsnagging process, can allow fish to escape. Pierce et al. (1990) found that capture efficiency decreased with the number of snags that were encountered. Rough bottoms will also increase the likelihood that fish can escape beneath the lead line. Parsley et al. (1989) found that, generally, efficiency was higher over smooth substrates than rough substrates, although the difference was often not statistically significant.

Dense macrophytes prevent the lead line from reaching the bottom. Macrophytes or other debris caught in a seine can cause the seine to roll up upon itself, so that the lead line is raised from the bottom and the outside of the net becomes the leading edge, which reduces capture efficiency (Pierce et al. 1990). In some circumstances, debris can prevent water from flowing through the mesh, creating a current away from the front of the net and making it difficult or impossible to pull the net forward. Accumulations of macrophytes or other objects can become so heavy that weight alone makes it impossible to pull the net forward. However, Pierce et al. (1990) found that when corrected for rolling, catchability increased with increasing macrophyte density. They attributed this to fish being less agitated and less likely to flee during capture where macrophytes were present. High turbidity may have a similar effect.

Fine mesh seine nets cannot be used in strong currents because the resistance that they create makes it impossible to pull them. Even if the net can be pulled forward, the force of the current can raise the lead line from the bottom, much like accumulated debris can in still water. Larger mesh seines built for use in strong current are often equipped with very heavy lead lines or weighted with chain along the bottom to prevent this from occurring. Seasonal differences in efficiency were reported by Allen et al. (1992). They suggested that these may be due to seasonal differences in fish size, temperature influences on swimming ability, or seasonal differences in turbidity.

- ***Selectivity/Efficiency***

Like all mesh-based equipment, the minimum size of fish retained is determined by the size of the openings in the mesh. Some fish that could pass through the openings are often retained in small mesh seines, apparently because they are not aligned perpendicular to the openings. Tangling is not prevalent, but can occur.

Avoidance is a major factor affecting selectivity of seines and it is influenced by swimming ability and behaviour. The efficiency of seining can be broken down into encircling efficiency and retention efficiency. For individuals that attempt to avoid being encircled by fleeing, catchability generally decreases as swimming speed increases (Bayley and Herendeen, 2000). This results in catchability decreasing with fish size.

Several researchers have documented that benthic fishes are less likely to be captured than mid-water species (Pierce et al. 1990; Lyons, 1986; Parsley, 1989), presumably because they escape beneath the lead line. Bailey and Herendeen (2000) found that the catchability was highest for surface and mid-water schooling species, intermediate for territorial and cover-seeking species and lowest for demersal and eel-like species. Pierce et al. (1990) found that catchability increased with size for benthic species but not for midwater species. They attributed this to smaller benthic individuals being more likely to pass beneath the net than larger individuals.

Pierce et al. (2001) reported that seining at night resulted in significantly higher species richness estimates than seining during the day, but total density did not differ significantly between day and night samples. It has been the experience of the senior author that in relatively clear water with adjacent deep habitats, species composition can differ markedly between night and day seine catches. Allen et al. (1992) found that maximum species richness in estuarine habitats was reached after between 6 and 12 seine hauls depending on year and season. Dewey et al. (1989) noted that species richness in seine catches was much higher than in pop net catches. This can be attributed in part to the larger area sampled by seining, and possibly also to the finer mesh of the seine.

- ***Quantification of Effort***

Effort is usually expressed in terms of catch per haul if all hauls are similar, catch per distance hauled (e.g. catch per m) or catch per unit area seined (e,g, catch per m2). Usually in any given study the same seine or identical seines are used for all hauls so that gear characteristics, such as the presence of a bag or the length of the seine, do not contribute to variability. There is rarely an attempt to correct for snags, debris or other factors that can affect the efficiency of individual seine hauls. Such corrections would be difficult since the affect of such events on the probability of fish escaping would vary widely. In practice, investigators will often abort hauls when catchability is compromised, or will complete them but exclude them from analyses that assume constant catchability among hauls.

- ***Fish Injury/survival***

Seined fish are subject to the stress of capture but are usually not injured. Exceptions are small individuals that are wedged in the mesh and fragile species, including those that lose scales easily (e.g. some *Notropis* spp). Additional stress and mortality can occur while the catch is being processed. Processing time increases markedly when fish must be sorted from algae, macrophytes or organic debris. Leaving the bag of the seine in the water or placing the catch in a water-filled container during processing reduces stress.