

Cast Nets

Kaneaki Edo

Background and Objectives

Background

The cast-net method for sampling freshwater fish is a small-scale method of net fishing that can be conducted by one person. With a relatively long history, cast-net fishing is regarded as a traditional method of catching fish that has been used since antiquity. Historians have discovered evidence of net imprints on ancient pottery and the presence of ancient floats and sinkers, indicating that the cast-net method of catching fish has likely been in use since the Neolithic Age.

Cast net structure and use

A cast net is made up of three parts: the upper section (net band), the middle section (a conical-shaped net mesh), and the lower section, which is weighted. The practitioner casts using both hands and the shoulder, throwing the net onto the surface of water in an area likely to have the targeted fish. When hurled into the air, the net spreads out into a circular shape and expands; as the net hits the water surface, the weighted edges of the net descend into the water in a circular shape, spread out like a parachute, and trap the targeted fish within the circular section. Finally, when the weighted portions of the net reach the bottom of the stream, the top band of the net is pulled, cinching the net closed into a sacklike shape within the water. With the weights dragging along the stream bottom, the net is slowly drawn back to the caster's hands, collecting the captured fish within the net. In most cast nets, the internal part of the lower section of the net (the section with rounded margins) forms a pouchlike structure in which the fish are caught. In deeper waters, where fish swim in or above the middle layer of water, the weights on the cast net's characteristic conical shape (the cast net ring) and the purse line are pulled so that the net is quickly recovered by the caster in the water before the weights settle on the bottom of the stream. A light or bait is often used to attract the target fish into an area within the cast net's range (Hayes et al. 1996).

Types of cast nets

Cast nets can be broadly classified into the three types: rapid current, deep water, and standard. Standard nets are the most common; they spread out into a conical shape when cast. In rapid currents or shallow sections of rivers and larger streams, appropriate-sized cast nets have a net length that is short in relation to the size of the mesh (see below for a discussion of mesh size). The mesh spreads out into the form of a plate when cast. The weights that are used are relatively light. Cast nets used in deep water have a longer net length in relation to the size of the mesh. Deepwater nets are designed in a campanulate (bell-shaped) form and spread out into a buglelike shape when cast. This type of net is often cast into deep waters and from riverbanks and stream banks and bridges.

Cast net sizes

The diameter of expanded cast nets is generally between 3 and 7 m, and the total net length is between 2 and 3.5 m, but by no means is this a given. The proper cast

net must be selected after carefully weighing a host of factors, such as the size of the target fish, the fitness of the caster, and the physical characteristics of the sampling area.

Mesh sizes may range from 7 to 30 mm. Mesh size is measured by elongating the opposing corners of one square of mesh to collapse the mesh and then measuring the length of the extended mesh square from the knot on one side to the knot on the other. The chart below lists general mesh sizes and their relation to the size of fish caught.

Target fish size	Mesh size
6–10 cm	8–9 mm
8–13 cm	10–12 mm
13–16 cm	14–15 mm
16–25 cm	17–19 mm
23–25 cm	21–24 mm
30+ cm	30+ mm

If the mesh size is small, the sinking speed of the net is reduced; therefore, smaller mesh sizes are not suitable for fast moving bodies of water or for deep pools. However, if the mesh size used is larger than necessary, the target fish will escape through the mesh squares or may get caught in the mesh, weaken, and die.

The weight of a cast net can vary, but a typical cast net weighs between 3 and 5 kg. Heavier cast nets are appropriate for locations in which the net must sink more quickly (e.g., when the current is fast or the waters deep); however, if a cast net that is heavier than necessary is used, repetitive use of such a heavy net can become difficult for the person casting the net.

Rationale

Cast nets have been used to collect fish in shallow water canals surrounding marshes (Meador and Kelso 1990) and to collect nearshore lake species (Mizuno 1993). Taylor and Gerking (1978) used a cast net to collect the Ohrid riffle minnow *Alburnoides bipunctatus ohridanus* in depths from 0.5 to 1 m, where the net had a capture efficiency of approximately 10%. A combined cast net/electrofishing method has been used to better determine the presence/absence of adult masu salmon (also called cherry salmon) *Oncorhynchus masou* in deep pools where electrofishing alone is less effective (Edo and Suzuki 2003). Cast nets are widely used in freshwater fish sampling across the Russian Far East.

Training in the proper use of the cast net does require a substantial amount of time, but once a fieldworker habituates to using such a net, the area of the expanded net is pretty much fixed. Additionally, if the objective is a presence/absence sampling of a target fish species or a determination of the number of species, a cast net can be used in conjunction with electrofishing and other fishing equipment to increase the capture efficiency of the fish sampling. Analysis of cast net data is primarily catch-per-unit-effort.

Objectives

When used in appropriate circumstances, cast nets are effective in determining the presence/absence of a target fish species and the number of fish species within a target habitat. In addition, when the cast net can be expanded or cast to a set size

on a consistent basis, a researcher can investigate the relative differences between populations and number of species between specific habitats. Finally, by using information such as the area of the expanded cast net, the number of times the net is cast, and the number of fish caught in each cast, it is possible to estimate abundance of a target fish species within a fixed habitat.

Sampling Design

Site selection

A cast net can be used to effectively sample various populations using a small number of field workers if it is used in areas with little cover (e.g., areas not covered by submerged logs), or smooth bottom sediment, and in streams and bodies of water that are not particularly fast-moving or deep. For example, if the area sampled with the cast net is a pool within a relatively slow-moving stream or river that is from 1 to 1.5 m deep (approximately) with little bottom cover, cast net sampling will be more effective than electrofishing in collecting fish species (again, depending upon the target fish); however, the efficacy of gathering samples will diminish and this method will not be suitable as a quantitative sampling method when used in areas with diverse topography or dense cover (e.g., submerged logs, grass), high vegetation, or rough bottom sediment, nor will it work in streams or rivers that are deep or swiftly flowing.

Field/Office Methods

Setup

Select the cast net length and mesh size after carefully considering the size of the fish to be sampled, the environmental conditions of the sample area, and the strength of the individuals doing the sampling. The cast net will often tear during use when it snags on obstacles in the water, so it is recommended that several nets be prepared in advance or, if possible, that a repair kit (a needle and thread) be available. Waders should be used in locations where the person using the cast net will need to stand in a stream or pond. The cast net will often get caught on a person's elbow or shoulder as it is cast, which can often cause the upper body to become quite wet. It is best to wear either raingear on the upper body or clothes that will not be damaged if they become wet. Also, prepare a container to hold the captured fish samples. It is often helpful to wear polarized glasses to check the target area for fish and hidden obstacles.

Events Sequence

Preparation prior to casting the cast net

There are a variety of ways to throw a cast net. The most common way is described here. First, remove all kinks from the net mesh and the net band. If the person casting the net is right-handed, grasp and hold the net band with the left hand. Next, gather together collapsed folds of the upper net band into the left hand. At this point, make sure that the bottom and weighted part of the net rests on the ground. With the left wrist coming up to approximately hip level each time more of the upper net band is collected, continue to collect the upper band of the net and

mesh with the left hand. Grasp approximately one-tenth of the mesh area with the right hand, and after placing this mesh on the left elbow, gather about half of the remaining net mesh into the right hand. Next, grab some of the mesh with the left hand as well. At this point, the cast net will be in contact with the caster in three places: the right hand, the left hand, and the left elbow (or shoulder).

Casting method

When prepared to cast the net, quietly and without disturbing the target fish approach the area towards which the net will be cast. At this point, the caster should make sure that no shadow falls on the surface of the water. If the net is being cast into a stream with a current, cast the net downstream or sideways into the current. Once the target area has been approached, determine to the extent possible whether any obstacles or debris are present and if any fish are present. Once the sampling area has been determined, turn towards the area to be sampled and establish a line of sight. At this point, the body of the caster should be leaning somewhat forward towards that direction. Then, extend both hands forward and grasp the net as described above. After confirming that the bulk of the net is away from the caster's body, lightly swing the net in a backswing to the left and rear. Use the momentum generated from this light backswing to reverse directions and throw the net forward towards the sampling spot. Once the net is traveling in a forward direction, release both hands. The net mesh will expand depending upon the shape of the fingers of the caster's right hand, which is gripping the mesh. It is very important to release the net from the index finger side to the little finger side. If thrown successfully, the net will open up to form a nice round shape before hitting the water surface. The caster can also twist the feet and body when throwing the net to facilitate a smooth cast.



FIGURE 1. — Throwing a cast net takes experience and strength. Above, a fisheries biologist demonstrates his practiced cast net throwing technique.

Fish capture

After the net has been cast, wait until the weights have settled to the bottom of the sampling area. Then slowly pull the net band and collapse the net, drag the

weights over the bottom, and pull the net back towards the caster with both hands. The fish will be caught in the sacklike shape formed by the bottom part of the cast net, and the fish will be collected by drawing the net back to the shore. Be sure to use the purse line and cast-net ring before the weights hit the bottom of the sampling area. The purse line will collapse the net within the water as long as it is pulled before the weights settle to the bottom. The cast-net ring should be left in the left hand so that once the net has been cast, it may be collapsed from the center of the net via the net band before the cast net weights have settled to the bottom. Again, a light or bait can be used to help congregate the target fish into the sampling area.

Cast net care

Vegetation and other aquatic objects often collect within the cast net during use. As a result, it is recommended that the cast net be cast once before use in order to clean such remnants from the net. After the cast net has been used, clean with water, dry in the shade, and store. Most cast net meshes are made of nylon, which is particularly sensitive and easily degraded by ultraviolet rays; therefore, try to keep nets out of direct sunlight.

Data Handling, Analysis, and Reporting

Measurement Details

Quantitative sampling with cast net

In order to take an effective quantitative sample, the cast net must have a fixed area when expanded or spread out; therefore, prior to sampling, it is important to cast the net out while on land and calculate the average area of the net when it is expanded (factoring in error). In the field, maintain as constant the area of the expanded net and the number of times the net is cast. Measure the species, number, size, and so forth of the fish captured with each cast. For presence/absence sampling for specific species and for determining the number of species, data can become increasingly precise as the number of casts and the sampling area are increased. To study the relative differences in the number of fish and species among various habitats, the number of times the net is cast and the area sampled are unified to make it possible to compare the number of fish and fish species.

Estimating the number of fish sampled by cast net

If the capture efficiency of the cast net sampling can be maintained, the exclusion, mark-recapture, or quadrant methods can be used to estimate the number of a target fish within a specified habitat.

Exclusion or mark-recapture methods assume no movement of the sampled population into or out of the sampling area during the sampling period. In these situations, it is best to enclose the habitat to be sampled to the extent possible with a net during the sample period to prevent fish from escaping. For example, if the objective of the sampling is to estimate the number of cherry salmon in the deep part of a river, a net would be placed upstream and downstream of the sample area to prevent the fish population from escaping. Once the containment

nets have been put in place and while sustaining a stable capture efficiency and a fixed area of the expanded cast net upon casting, the cast net can be used to collect samples repeatedly. Collections by cast net should be separated by a set amount of time (normally several hours). If the exclusion method is used, place the captured target fish into containers and do not release them back into the habitat being sampled until the sampling has been completed. The collection is normally repeated two to three times, and each time the collection is done, the entire population is estimated from the rate of decrease in the fish number. If the mark-recapture method is used, each fish captured during collection is marked and released back into the habitat from which it was captured. After a specified period of time, fish are again captured using the cast net, and the total fish population can be calculated from the percentage of tagged fish within the population of fish captured during the second sample.

In the quadrant method, the concentration of the target fish within a specified area is calculated, and the number of fish existing within an entire target habitat is estimated by extrapolating this number throughout the total habitat. If the population is being estimated based upon a quadrant method using a cast net, measure the capture efficiency of one cast of the net prior to sampling and make sure to sustain that capture efficiency throughout the sampling. However, when actually in the field, the conditions of the target habitat are liable to change, and it is normally very difficult to maintain a stable capture efficiency. If this occurs, divide the target habitat by distinct topography types and calculate the capture efficiency for each type of habitat in order to minimize the variability of capture efficiency.

For specific details on estimating fish numbers using methods other than those described above, please refer to the protocol's fish population estimation methods.

Personnel Requirements and Training

Responsibilities

Cast nets can be used by a single individual; however, when more than one individual is present, duties can be divided so that one person captures the target fish using the cast net and another person measures the captured target fish. This increases the efficiency of the cast net method.

Because cast-net fishing is an extremely effective tool for catching fish, there are many areas in which its use is prohibited or permission must first be obtained and authorities notified.

There are also many heavy weights attached to the cast net. It can therefore be dangerous and should never be cast towards another person.

Qualifications

The average cast net weighs between 3 and 5 kg, and the net is cast using centrifugal force after being placed on the shoulder and/or arm. As a result, if the person using the cast net is not sufficiently strong, he/she will not be able to cast or walk with the net for a sustained amount of time.

Training

Skilled use of a cast net requires substantial training and experience. Without adequate preparation, it would be difficult for the caster to ensure that the area of the expanded cast net is relatively uniform or avoid catching the net on obstacles, which would damage the net. Training to learn the proper casting technique should first be done on dry land. Casting the net onto concrete can damage the net, so practice casting either on grass or a relatively soft surface. Once the cast net can be thrown so as to open up into a nicely formed circular shape, go out into the field and practice throwing the net into a river or pond. Select a suitable environment and cast the net so that it expands out onto the surface of the water while avoiding any obstacles. Once these techniques have been mastered, the caster may collect fish. In any event, it is extremely important to practice throwing the net many times until casting becomes second nature. It is best to practice and improve until the shape of the net can be controlled as it is cast.

Operational Requirements

Workload and Field Schedule

A cast net is relatively heavy, and its use can quickly expend energy. A field schedule should accommodate the strength of the person sampling.

Equipment Needs

- Cast nets (including spares)
- Waders
- Raingear for the upper body
- Polarized glasses
- Container or creel (wicker basket for holding fish) or net to hold the captured fish
- Cast net repair kit (a needle and thread)
- Cast net ring
- Optional equipment: light or bait to gather the target fish

Budget

Prices for cast nets vary depending upon size and material, but they are not particularly expensive fishing gear. The most economical nets start at less than \$100, while the more expensive ones may cost several hundred dollars.

Literature Cited

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