IX

TRANSPORTATION OF FINGERLINGS AND JUVENILES OF MARINE FINFISH

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Open seacage farming has become a viable marine system to grow the marine finfishes in large scale from fingerling stage to marketable size in a commercial way. Major advantage of marine cage culture systems is, unlimited supply of high quality seawater and large carrying capacity for a substantial aquaculture production. In order to stock large scale fingerlings or juveniles collected either from natural waters or hatcheries it is essential to transport them to cage site in live and healthy condition.

There are two basic transport systems for live fish - the closed system and the open system. The closed system is a sealed container in which all the requirements for survival are self-contained. The simplest of these is a sealed plastic bag partly filled with water and oxygen. The open system consists of water-filled containers in which the requirements for survival are supplied continuously from outside sources. The simplest of these is a small tank with an aerator stone.

The basic factors and principles associated with any live fish transport systems are evaluated before the actual ways of fish transport are commented on. The transportation of live fish involves the transfer of large numbers (or biomass) of fish in a small volume of water. During transportation, fish are subjected to handling stress and may die, if survive, growth of fish may be affected. The principles governing packaging, handling and transportation of live fish are essential to minimise stress.

Major stress factors influence transportation

Quality of fish: The quality of fish transported is a decisive criterion. The fish to be transported must be healthy and in good condition. Weakened individuals should be eliminated from the consignment, particularly when the temperature during shipment is high. When the fish are of poor quality, even a great reduction of fish density in the transport container fails to prevent fish losses. If the transport time is much longer, weak fish are killed at a much higher rate than fish in good condition. The fishes should be acclimatized to a lower water temperature before transport to avoid stress factors. To reduce the temperature for cooling the water natural ice should be used and usage of ice of carbonic acid should be avoided. As a guide ratio, 25 kg of ice will cool 1 000 litres of water by 2°C. If the water contains fish during the cooling process, the temperature drop should not be faster than 5°C per hour. Direct contact of fish with ice should be prevented at the same time. The total temperature difference should not be greater than 12–15°C, with respect to the species and age of the fish.

The fish to be transported, except for the larval stages should be left to starve for at least a day. The fish with full digestive tracts need more oxygen, are more susceptible to stress, and produce excrements which take up much of the oxygen of the water. The transport time of the larvae of herbivorous fishes should not last longer than 20 hours and that of many aquarium species should be shorter than 12 hours.

Dissolved oxygen (DO): The presence of dissolved oxygen does not presuppose an absence of stress as other adverse factors can still exist with high DO, eg. high water temperature, pH changes. Fish demand for dissolved oxygen as fish depends on water temperature, fish density (numbers and size), time of last feeding (level of starvation) and transportation time. It is therefore important to keep the transport water cool and fish biomass at an optimum, with due consideration for possible delays in transportation and the need for additional oxygen by the fish. Starving the fish prior to packing would also slow down ammonia accumulation and minimise unnecessary uptake of dissolved oxygen.

Ammonia (NH_3): Ammonia is excreted by fish and is reported to be toxic at low concentrations of 0.6 ppm. Ammonia excretion by fish decreases as its concentration in water increases, resulting in high blood ammonia. High blood ammonia elevates blood pH which affects enzyme-catalysed reactions affecting metabolism. Starvation and lowered temperatures reduce ammonia excretion.

Carbon dioxide: Fish become distressed when carbon dioxide (from respiration) accumulates rapidly in water since the blood is unable to carry oxygen under these conditions. Low levels of carbon dioxide (3–6 ppm) may be beneficial since it prevents the buildup of unionised ammonia. Carbon dioxide is also a mild anaesthetic and may be considered in alleviating stress during transportation.

Handling: Stress during handling and packing may be so severe as to cause chronic and acute mortalities. Poor handling and packing procedure may also cause osmoregulatory and metabolic disfunctions. Therefore it is important to proceed gently and quickly.

Water temperature (heat and cold): Water temperatures greater than 28°C accompanied by declining dissolved oxygen and increasing ammonia, create a hostile environment. This is the likely situation if fish are over-packed or transportation is delayed under tropical conditions. Temperatures that are too low (<18°C) can cause thermal shock, especially in young fish. Stressed fish usually succumb to diseases after 1–2 weeks, if not already dead on arrival.

Methods of alleviating stress

Reducing transport water temperature : This prevents thermal stress and improves oxygen stability. Ice should be used in the correct quantities and this depends on fish species and size and also the transportation period. Alternatively, cooled water (18°C) can also be used by lightly sedating the fish in 18°C water prior to packing, and then using water at the same temperature for transport. Under air freighting conditions, this temperature increases by about 1–4°C after 12–14 hours, and fish are usually alive.

Insulation: The use of insulated containers like styrofoam boxes, newspaper lagging helps to maintain the temperature of transport water, being poor heat conductors. They also reduce vibration.

Anaesthesia: Anaesthesia prevents fish hyperactivity. The oxygen consumption of newly-packed fish elevates for 30–60 minutes and declines as fish acclimate to the new environment. The first 30–60 minutes after packing is therefore important. Some anaesthetics used are MS-222, carbonic acid, benzocaine and phenoxyethanol. However the use of certain chemicals for anaesthetising food fish is not to be recommended.

Transportation of live fish : Fish are transported live as live fish are transported by air, road or overseas source to the local farm site for culture. Transportation can be made by using cheap materials and equipment like plastic bags, rubber bands, compressed oxygen, cardboard or styrofoam boxes. Food fish fingerlings are packed at about 500 per bag at two bags per carton. It can be generally observed that as fish size increases, the numbers packed per bag decreases (Table 1). However, a higher biomass is tolerated by larger fish.

Table 1: Food fish fingerling packing conditions by the 'plastic bag' method and transportation time ranging from 8–12 hours

Packing conditions	Fish mean wt (g)	No./beg	Biomass g/L		Transport water temp. (°C)
Fish species					
Grouper	8–11	100	89–100	7–9	28–29
	11–14	50	102–128	4–5	28–29
	11–17	50	147	4–5	28–29
Seabass	4.5–5	70–100	50–100	11–20	27–28
	>5–10	60–100	93–148	14–35	25–28
	>10–15	50–100	94–180	8–16	27–28
	>15–20	50	133	8	27–28
	>20–30	35–60	200–300	7–10	27–28
	>30–40	35–40	222–267	6–7	27–28
	>40–50	35	292	6	27–28
	>50–70	25	267	4	27–28
	105	20–25	525	5	27–28

Transportation of larger-sized fish (Regional / Local) Transfer of live market size fish from farm to landing point (by boat in tanks).

a. Transportation of live market - size fish from landing point to Landing Centre (in tanks on lorries).
b. Transfer of live fish from farm to farm (by boat, in tanks).

Seabass Fingerling Packing :
Packing in oxygenated plastic bags

Method I

- Measure about 3 times the fish weight of filtered seawater (eg. if fish is 600g, measure about 1.8 litres of seawater) and pour into a plastic bag.
- Transfer the fish gently into the bag.
- Measure the height of water in the bag.
- Insert the delivery tube from the oxygen cylinder well into the water and oxygenate slowly, twisting the plastic bag round the tube to prevent oxygen loss.
- Gradually inflate the bag so that oxygen occupies about 4 times the water volume.
- Secure the bag with rubber bands, leaving the outer bag free. Make sure the bag is firmly inflated and not flaccid.
- Secure the outer bag with more rubber bands.
- Place the packed bag of fish into a styrofoam box lined with newspaper (lagging to prevent rapid temperature change).
- Store the box in an air-conditioned room (19–22°C) for 12 hours to simulate our cargo temperatures and transport.

Method II

- Measure about 3 times the fish weight of filtered seawater (eg. if fish is 600 g, measure about 1.8 litres of seawater) and pour into a plastic bag.
- Transfer the fish gently into the bag.
- Calculate the volume of cooled (18°C) filtered seawater required to cover the fish (weight of seawater = 3 × wt. of fish).
- Pour the water into the plastic bag.

- Calculate the weight of ice required (25g ice/l seawater) and weigh the ice out in a small plastic bag. Secure the bag of ice and place it in the plastic bag of water.
- Transfer the fish gently into the bag.
- Measure the height of water in the bag.
- Insert the delivery tube from the oxygen cylinder well into the water and oxygenate slowly, twisting the plastic bag round the tube to prevent oxygen loss.
- Gradually inflate the bag so that oxygen occupies about 4 times the water volume.
- Secure the bag with rubber bands, leaving the outer bag free. Make sure the bag is firmly inflated and not flaccid.
- Secure the outer bag with more rubber bands. ■

Source:

Berka, R., 1986.The transport of live fish.A review. EIFAC Tech.Pap., (48):52 p.

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