M. Sc. - II Sem.

Interdisciplinary Course

ZOO206: Ornamental Fishery & Aquarium

Live Fish Transport- Fish handling, Methods of fish packing forwarding techniques

Ornamental fishes aimed for stocking and sale need to be transported from one place to another in the live condition for lesser or larger duration. If the fish or their seed (spawn, fry, fingerlings) are anaesthetized and packed in oxygen pressure, they would be able to withstand the transportation stress considerably well for an extended duration. The transportation of ornamental fish involved the use of oxygen, transparent polythene bags, an insulating box, cello tapes, rubber bands, antibiotics, Styrofoam and water. Transportation of ornamental fishes is done in cold climate (early morning). Warm water holds less oxygen than the cold water. When the temperature of the water rises, the lower oxygen levels increase stress on fish (optimum temperature for many trout species is 15 ^{0}C). Fish that are experiencing elevated stress often do not survive the additional stress of being caught, handled and released. Fish should be moved quickly and efficiently to minimize stress, the risk of disease outbreaks, and mortality. Important considerations for transporting fish include- 1) type of container, 2) transport vehicle, 3) aeration, 4) type of water, and 5) additives for sedating the fish.

Why ornamental fishes are transported in oxygen container

During transport, toxic gases like CO_2, and NH_3, tend to accumulated in the water (transporting medium) due to metabolic activities of fishes. These toxic gases reduce oxygen content of water and tend to stimulate stress. This will in turn increase the concentration of toxic gases reduce, which results in mortality of ornamental fishes. Hence, oxygen should be filled in carries transported.

Conditioning of Ornamental Fishes Prior to Packing

Before transporting seeds to the long distances in open or closed system of transport, ornamental fishes should be conditioned in order to get rid them off excreta and to ensure them to subsist in a restricted area in which they are liable to be subjected during transport.

The most common method of conditioning is to store ornamental fishes in a cloth hapa in the ponds or in still part of the river or in tanks. The depth of water for a conditioning enclosure is to be maintained to a minimum of 30 to 35 cm. The period of conditioning depends on the size and health of the spawn, fry and fingerlings. Clean and natural water at a temperature of 20-23 ^{0}C is suitable for conditioning of ornamental fishes. During conditioning and transportations, ornamental fishes should not be handled with bare hands because the slime and scales covering the body will be removed and thereby render them vulnerable to fungal and bacterial infections. Ornamental fishes collected from the nurseries and kept in nets fixed in ponds on which water is splashed from all directions and the frightened fry pass excreta. After the ornamental fishes have been properly conditioned, they are ready for transport.

Packaging system

There are basically two major types of live fish transport systems: the open system which uses live fish tanks, and the closed system which involves fish packed in polyethylene bags. The system used for packaging live ornamental fish for air transport is a closed system, in which all factors necessary to meet fishes' requirements for survival are self-sustained. The system involves packing the fish in sealed polyethylene bags filled with water and over-saturated with oxygen. The bottom of the bag either has a seam or a rectangular base. For the seam type bags, the 2 bottom corners are tied together with rubber bands or heat-sealed to round off the corners so that the fish are not trapped and squashed in the corners.

Methods of packing in closed systems

Fishes should be starved for about 2 to 3 days before being transported. The packing starts just prior to transportation. Polythene bags are packed in cardboard boxes for short journeys and for long journeys they are packed in Styrofoam boxes with some ice. In closed system, polythene bags of various sizes are used (40 x 25cm, 40 x 18 cm, 60 x 30 cm). Polythene bags of 33 litre capacity measuring 74 x 46 cm and made of 0.0625 cm gauge material are widely used for transportation of ornamental fishes. In this method, the bag is first filled with 1/3 of its capacity (volume of water and oxygen would be 1:3 ratio) with water (6-7 litre). Then, the bag is inflated with oxygen up to about 2/3 from an oxygen cylinder. The upper 10-15 cm of the bag is twisted bend and tied securely with string with leak proof knot, which will not open by itself during transport. It is generally advisable to keep each plastic bag individually in containers of cardboard or metal or wooden boxes to prevent leakage by inadvertent damage to the bag during transport. The layers of paper may be inserted between plastic bags in the box to avoid sight of aggressive species. The mortality is found to maximum of 5%. Regulation of standards of holding facilities and of packing is important to ensure minimum mortality of fishes at holding facilities and in transport. Packaging methods have improved considerably over years mainly owing to feed back from customers and many exporters. Now guaranteed almost 100% survivals for most destinations, provided good connecting flights are available.

Table 1 Recommended packing density of ornamental fishes for transportation

Serial No.	Size of fish or fingerlings (cm)	Density (numbers)
1	0.5-1.0	1000
2	1.1-2.0	500
3	2.1-3.0	200
4	3.1-4.0	100
5	4.1-5.0	75
6	5.1-6.0	50
7	6.1-7.0	20
8	7.1-8.0	15

Factors to be taken into consideration while packing

Density

As an appropriate guide 2 kg of fish can be placed in 20 litters of water inside a polythene bag, with large oxygen filled space above it, and at 10 degree Celsius, can be carried for 5 hour without the need for further oxygenation. However the density chosen will in practice depend upon the species, the type of the tank, the temperature and many other factors, and must really be determined by trial and error for each specific situation. At high densities fish become agitated which increases oxygen consumption and risk of damage. Loss of mucous may also occur which can cause discomfort or choking of the gills. Foaming of mucus laden water may occur with aeration, and may be suppressed by the non-toxic antifoaming agent.

Temperature

The temperature influences the activity and the oxygen consumption of the fish, and also the oxygen carrying capacity of the water. High temperature especially may also be directly lethal to fish. From all these aspects a low water temperature at least as cool as the water from which the fish were taken is preferred. Cooling the fish has often been used successfully to calm fish for transport. Chipped or crushed ice is satisfactory for most of the journeys but not for long distance air freighting of fish, dry ice has a greater cooling capacity for its weight. However caution must be exercised to prevent from the evaporating CO_2 from dry ice coming into contact with the water. Deep frozen blocks of ice or special cooling bags are safer and last a very long time.

When fish from warm tropical waters, water-cooling can be a handicap. Heavy insulation reduces cooling to a minimum and chemical-heating packs can be helpful. The problem is most pronounced when tropical species are being transported to temperate climates, especially if fish are transhipped from one aircraft to the other and the container is left exposed to ambient conditions at the airport. Perhaps the best solution in this event is to arrange someone on the spot to properly look after fish being transhipped.

In most cases extreme temperature changes can be avoided by adequately insulating the fish container with plastic foam or expanded polystyrene and by travelling only at the appropriate time of the day. Temperature changes should be effected gradually. For example by the switching on to cool gear or adding ice bags or dry ice containers after the fish have been placed in the transporting tank. On arrival at more permanent holding facilities, the temperature should be raised or lowered slowly over several hours if the difference is more than few degrees.

Dissolved gases

To maintain fish in healthy state there must be sufficient oxygen in the water. In addition the build up of carbon dioxide and ammonia must be prevented. Gas concentration can become critical under transport conditions where the fish are stressed and their oxygen requirement is greatly elevated. Oxygen concentration can be maintained by bubbling compressed or pumped oxygen or air, or by surface agitation. For small quantities of transport for a short period, continuous aeration is necessary. The fish are provided with well aerated water with an air space above it. The vehicle movement will provide an agitation effect. The effectiveness is increased by maximizing the surface area, or by providing an atmosphere of oxygen above water. For this purpose a large space of about 4 times water volume must be left in the container to contain the air or oxygen. Where larger fish are being transported on especially long journeys or when animals have a large oxygen demand, it is necessary to bubble air or oxygen continually through the tank. Pure oxygen is not harmful to freshwater fish but the cost of gas and associated equipment may render compressed or pumped air a more attractive alternative. If a gas cylinder is used it is important to use a pressure regulator to meter the gas flow and to ensure that gas continues to flow at a constant rate regardless of the cylinder pressure.

Carbon dioxide is toxic to fish, both directly and by decreasing their ability to extract oxygen from the water with low densities and high aeration rates it is unlikely to attain toxic levels. Where fish are transported without continual aeration, CO_2 does build up. With high densities of fish and low densities of oxygen CO_2 concentration may become a problem though the level of oxygen remained high. Loss of balance of fish can occur at CO_2 level below lethal, so advance warning of a critical situation is given.

Ammonia is produced as the major nitrogenous excretory produce by most teleosts and is very toxic. Oxygen concentrations and ph both affect ammonia toxicity. It is un - ionized ammonia which is particularly toxic. Oxygen concentrations and ph both affect ammonia toxicity. It is the un- ionized ammonia which is particularly toxic and the equilibrium is markedly influenced by pH. A shift from ph 8 to 7 produces tenfold decrease in the quantity of unionized ammonia. Decrease in dissolved oxygen increases the toxicity of un ionized ammonia. A change in pH ratio across a tissue (eg gills) can also greatly influence the concentration of the un-ionized gas on each side of barrier. At low fish densities the build up of ammonia is unlikely to create problems during transport. The risk can be reduced further by holding fish without feeding for two days before transporting as ammonia excretions rate drops rapidly in the case unfed stage.

Salinity

The body fluids of salt water fishes and freshwater fishes have salt concentration between those of freshwater and seawater. Thus both are under osmotic stress, and having to work to maintain their internal ionic equilibrium. When fish is physically damaged the rate of exchange can increase and represent a greater stress. Alteration of the external medium has been used in the transport of both freshwater and sea fish to reduce this stress.

Anaesthetics

Increased physical activity during transport can adversely affect the health of the fish in two ways. First is physical damage by the abrasion with the packing container second is by a physiological reaction to a physical activity and other environmental factors such as low dissolved oxygen. Such reaction is manifested in high blood lactate levels, which can cause serious debilitation or death. The level of physical activity of the transported fish must be kept to the minimum. Lower temperature can help, as can cover carrying tanks with lightproof material. A third possibility is the use of tranquilizers. A considerable range of chemicals are potentially useful as tranquilizers, some being employed at higher concentrations as anesthetics.

Preparing of fishes

1. Acclimated for 48 hours. Fishes are starved during transport.
2. Well aerated water dissolved with the following chemicals-
   a) 5% Methylene blue (10 drops in 50 litre of water)
   b) 0.01% of common salt solution (10 mg of sodium chloride dissolved in 100 ml of water).
   c) Epson salt (2 teaspoonful of this salt dissolved in 50 litre of water).
   d) Tetracycline (500 mg dissolved in 50 litre of water).

Previously well-fed and 4 hour starved fish could withstand rigorous packing and air transport. Tranquilizers like quinaldine or paraldehyde can be used in mild concentration to reduce the activity of the fishes.

Methods of sedation

Earlier to anaesthetization and transport, healthy ornamental fishes are collected from the rearing tank and are kept under starvation for 24 hours in aerated waters. The desired concentrations of anaesthesia are prepared well in advance for use for sedating the fish under transport

Sedation

The exact time (in seconds) taken by the fish for loosing balance partially or completely is known as induction time. The subsequent behavioural changes especially to time (in seconds) in which the respiratory movement became irregular are considered as reflex activity. The period prevailing between the induction time and reflex activity is considered as anaesthetic period. When the fishes show imbalance in a particular anaesthetic concentration, they are carefully removed and are transferred to glass tank (30 x 15 x 30 cm) containing aerated water for the test purposes.

The fishes are acclimated for stocking in the aquarium tank as indicated below-

1. When the fish are transported in the transportation bag for longer periods, it is made sure that there is more air than water in the bag.
2. Before introducing the fish to their new home, it is required to place the fish transport bag into the tank with opening facing upwards.
3. The mouth of the bag has to be opened and the edge folded down. The open bag will float in the water.
4. Over a period of 15 minutes, small quantities of water are poured slowly from the ornamental fish tank into the bag, two to three times till the original contents of the bag is replaced.
5. After about 30 minutes, the fishes are taken out gently and put into the tank water. The transport water should not be poured in to the fish aquarium.

Table 2 Common anaesthetics used in fish transport

Name of Anaesthetics	Dosage	Use	Remarks	Recovery times (Hours)
Tricaine methane sulphonate (MS 222)	0.003-0.005 g/l or 0.003-0.005 ml/100 ml water	To transport brood fishes	Ideal for young and adult fishes	20-24
Quinaldine (2 Methyl quinaldine)	0.009 ml of quinaldine is dissolved in equal volume a acetone and made to 1 litre in water	To transport brood fishes	pH of the water should be adjusted to 6	12-24
Carbonic acid (500 ppm)	8 ml of 7% sodium bicarbonate added to 8 ml of 4% sulphuric acid to prepare 500 ppm solution	To transport moderately sized fish and fingerlings	Cheap, safe and economical; immediate oxygen packing is needed	12-26
Chloral hydrate	0.025 ml/100 ml of water	To transport adult and small fishes	Prolonged induction time; fast recovery; readily soluble in water	12-24

Chlorobutanol	0.002-0.003 ml/100 ml of water	To transport adult and small fishes	Slow induction and recovery time	12-24
Paraldehyde	0.01-0.05 ml/100 ml of water	To transport adult and small fishes	Slow induction and recovery time	12-24
Tertiary butyl alcohol	0.30-0.35 ml/ 100 ml of water	To transport adult and small fishes	Excess dose will kill the fish	24-28

Note: The period between induction time and reflex activity is called holding time or sedation time

Transport of export consignment

The ornamental fish farms which export fish to foreign countries should keep the following materials ready for transport-

1. Glass tanks and circular or rectangular cisterns for acclimatizing the fishes.
2. Mechanical or chemical filters.
3. Air compressors and oxygen cylinders with accessories.
4. Hand nets made of bolting silk cloth.
5. Thermocol or Styrofoam carton boxes.
6. Polythene bags (300-350 kg) and rubber bands
7. Marking pens, printed labels, adhesive tapes etc.

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