# INTRODUCTION TO AQUATIC SCIENCES

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|---|---|
| 10. Week | Fish Transport |

Introduction to Aquatic Sciences

## WEEKLY TOPICS (CONTENT)

| Week | Topics |
|---|---|
| 1. Week | Aquaculture in Turkey and world |
| 2. Week | The role of fish in human consumption |
| 3. Week | What is fish? Taxonomy of fish |
| 4. Week | Aquatic Crustacean |
| 5. Week | Water quality for aquaculture |
| 6. Week | Introduction to marine fish |
| 7. Week | Introduction to freshwater fish |
| 8. Week | Live foods (microalgae, zooplankton and *Artemia*) |
| 9. Week | Introduction to fishing techniques |
| 10. Week | Fish transport |
| 11. Week | Introduction to fish disease |
| 12. Week | Introduction to fisheries economy |
| 13. Week | Processing and marketing of fish |
| 14. Week | Introduction to fisheries and aquaculture management |

**Photograph web page:**
https://www.clearbags.com/bags/fish

Lim, L. C., Dhert, P., & Sorgeloos, P. (2003). Recent developments and improvements in ornamental fish packaging systems for air transport. Aquaculture Research, 34(11), 923-935.


**Abstract**

Current ornamental fish packaging systems are characterized by very high fish loading densities and high metabolic wastes in the transport water after shipment. They focus mainly on management of the quality of transport water. Recent studies using the guppy as a model fish showed that post-shipment mortality could be reduced through enhancement of the stress resistance of the fish, and hence emphases should also be placed on the preparation of the fish for transport and recovery of the fish after shipment. Farmers can contribute significantly by applying nutritional prophylaxis before harvesting. Exporters may use the salinity stress test to identify fish lots of good quality for transport, apply health prophylaxis to eradicate parasites and optimize other techniques such as starvation of the fish or addition of salt to the transport water to enhance the stress resistance of the fish. Importers may adopt proper acclimation procedure and allow fish to recover in low salinity water to reduce post-shipment mortality. As the main bulk of post-shipment mortality is stress-mediated and occurs during the 1-week recovery period, the industry should consider revising the basis of the current warranty system for their customers, from death on arrival to cumulative mortality at 7 days post shipment (or death after 7 days, DA7), in order to cut down fish losses after shipment.



**Keywords:** air transport, fish packaging, nutritional prophylaxis, ornamental fish, post-shipment mortality, stress resistance

The transport
of live fish
A review

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ADVISORY COMMISSION
(EIFAC)

EIFAC
TECHNICAL
PAPER

48

FOOD
AND
AGRICULTURE
ORGANIZATION
OF THE
UNITED NATIONS
Rome, 1986

**Photograph web page:**
http://www.aqua-pac.de/en/fishtransportbags/

PREPARATION OF THIS DOCUMENT

The present document is based on a general review of the existing literature concerned with live fish transport. It has been prepared by the author in 1983–84 as a voluntary contribution, for which EIFAC is most grateful.

The cover photo graph is by A.G. Coche. It represents the transport of carp fry in plastic bags with addition of oxygen.

Berka, R. (1986). The transport of live fish: a review (Vol. 48). Rome: Food and Agriculture Organization of the United Nations.


ABSTRACT

The basic principles of fish transport and the main factors affecting it (fish species, fish developmental stages and quality, transport time, temperature, oxygen content, fish metabolism products, etc.) are evaluated on the basis of an analysis of the pertinent literature. For the two basic fish transport systems, the closed and the open ones, the transport units are described and the densities of transported fish per unit volume under actual conditions are tabulated for guidance. The survey is complemented by the description of the existing methods for the chemical treatment of the environment inside the transport systems and for the treatment of the fish transported, such as fish anaesthetics, chemical water conditioning and antibacterial treatment.



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


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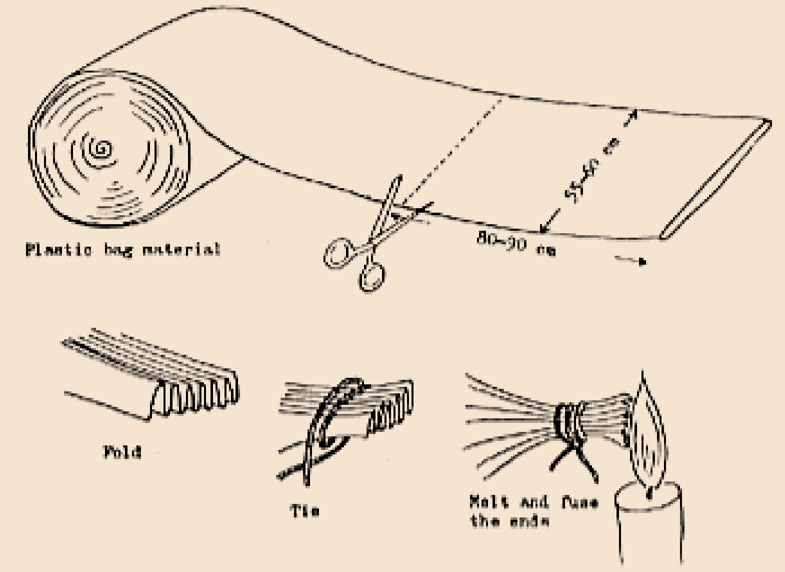


Figure 5 Procedure of closing the bottom end of a polyethylene sleeve (Woynarowich and Horváth, 1980)

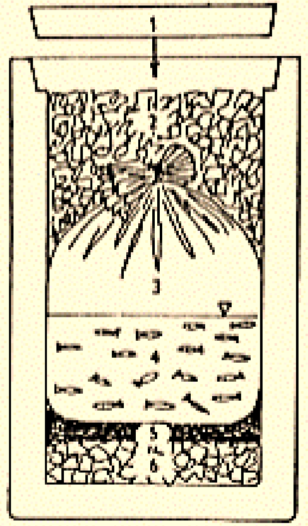

Figure 6 Transport of a bag in styrofoam case (Vollmann-Schipper, 1975)
1 - lid, 2 - insulation filling, 3 - oxygen atmosphere, 4 - water with fish, 5 - insulation lining, e.g., foam rubber, 6 - ice

Berka, R. (1986). The transport of live fish: a review (Vol. 48). Rome: Food and Agriculture Organization of the United Nations.

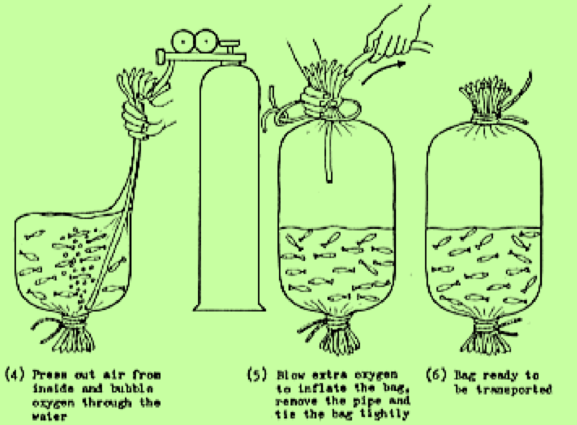


Figure 7 Procedure of filling the bag with water, stocking with the fish, displacing the air, introducing oxygen and closing the upper end (Woynarowich and Horváth, 1980)

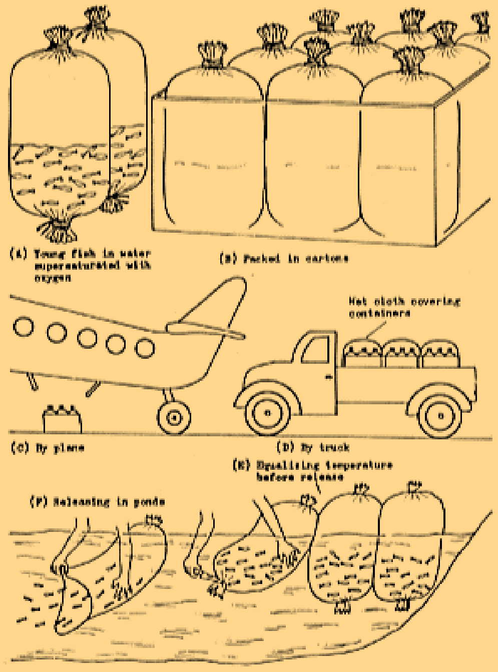


Figure 9 Transport of young fish packed in plastic bags (Woynarowich and Horváth, 1980)

Table 5

Numbers of young fish to be transported in a polyethylene bag with a volume of 50 litres, i.e., 20 litres of water and 30 litres of oxygen

| Fish Species | Size of fish (cm) | Water temperature (°C) | Fish density in bag (ind.) | Total weight of fish in bag (g) | Losses (%) | Maximal time of transport (h) |
|---|---|---|---|---|---|---|
| Brown trout | 4–6 | 10 | 500 | 800–1 200 | - | 12 |
| Rainbow trout | 9–12 | 10 | 200 | 2 000–2 500 | - | 12 |
| | 12–15 | 10 | 100 | 2 000–2 500 | - | 12 |
| Pike | 4–6 | 10 | 1 000 | 800–1 200 | <3 | 24 |
| | 6–9 | 12 | 500 | 800–1 200 | <3 | 12 |
| Pike-perch | 4–6 | 12 | 1 000 | 1 000 | <1 | 12 |
| | 6–9 | 10 | 1 000 | 1 300–1 600 | <1 | 12 |
| | 9–12 | 10 | 500 | 2 000–3 000 | <1 | 8 |
| Carp | 4–6 | 15 | 1 000 | 2 000–3 000 | <2 | 8 |

Note: Transport should not be interrupted for longer than 15 minutes

Berka, R. (1986). The transport of live fish: a review (Vol. 48). Rome: Food and Agriculture Organization of the United Nations.

**Methods for reducing stressors and maintaining water quality associated with live fish transport in tanks: a review of the basics**

Harmon, T. S. (2009). Methods for reducing stressors and maintaining water quality associated with live fish transport in tanks: a review of the basics. *Reviews in Aquaculture*, *1*(1), 58-66.

**Relationship between body weight and loading densities in fish transport using the plastic bag method**

Froese, R. (1988). Relationship between body weight and loading densities in fish transport using the plastic bag method. Aquaculture Research, 19(3), 275-281.

https://patentimages.storage.googleapis.com/72/00/4a/fe68681a919a91/US6306352.pdf
https://patents.google.com/patent/US6306352B1/en

**OXYGEN GENERATING MATERIALS, CARBON DIOXIDE ABSORBING MATERIALS, AND TRANSPORT SYSTEM AND TRANSPORT METHOD OF LIVE FISHERY PRODUCTS**

The present invention provides an effective oxygen generating materials, carbon dioxide absorbing materials, and transport system and transport method of live fishery products for use upon transporting live fishery products. An oxygen generating materials of the present invention is prepared by packaging solid peroxide and peroxide decomposition catalyst with a moisture-permeable material having a cup method moisture permeability (40° C., 90% RH) of more than 20 $g/m^2/24$ hr and being impervious to water at normal pressure. Furthermore, a carbon dioxide absorbing materials are prepared by packaging alkaline earth metal hydroxide and/or oxide with a gas-permeable material having a Gurley method gas permeability (JIS P8117) of 0.1~3000 sec./100 ml of gas and being impervious to water at normal pressure. Moreover, the transport system of live

# Summary

This report addresses issues that are assessed to be relevant for animal welfare in live fish transport. The authors suggest to divide the transport process into seven phases; (1) the planning phase, (2) preparing fish, (3) preparing vessel, (4) the loading phase, (5) the transport phase, (6) the unloading phase, (7) wash and disinfection. Under each of these phases best best practise routines or topics are addressed. Relevant literature is also quoted, both litterture that is published in peer review journals and other reports that are found to be relevant to the topic are used. The following bulletpointed list sums up the suggested best practises under each phase:

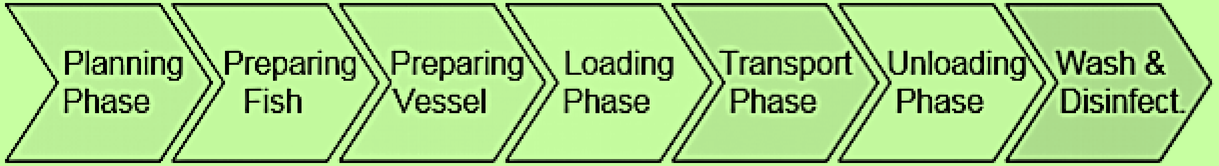


**Figure 1.** Value chain transport of live fish

Rosten, T. W., & Kristensen, T. (2010). Best practice in live fish transport.

**Abstract** Although species-specific aquaculture production systems typically operate over reduced geographical ranges relative to many other terrestrial animal production systems, it is nonetheless often necessary to transport live fish between facilities by road to permit on-growing or finishing. Road transport is therefore common in Australian salmonid (trout and salmon) production and is a particularly significant feature of Atlantic salmon (*Salmo salar*) culture in Tasmania, where it is necessary to transport juvenile fish (smolts) from inland freshwater hatchery facilities to coastal marine farms for grow-out to slaughter.

The most obvious respect in which road transport of live fish differs from that of terrestrial livestock is the requirement to provide a life-support system for the duration of the process. Aside from an inherent requirement for water, it is essential to provide oxygenation to support basic respiration. Thereafter, water quality must be managed to limit the accumulation of potentially toxic metabolites. Among these, carbon dioxide ($CO_2$) is of particular concern. Without appropriate management, $CO_2$ can rapidly accumulate to levels as high as 80 $mg/L^{-1}$ and result in hypercapnia, respiratory dysfunction, narcosis, and ultimately death. Current life-support systems typically function to maintain $CO_2$ at acceptable levels of 20-30 $mg/L^{-1}$. Water temperature changes during and at the end of the transport process may also be an issue but are typically only a relatively minor consideration.

In common with other livestock transport systems, the loading process and associated handling can evoke a physiological stress response which, though intended to be adaptive, may interact synergistically with aspects of the life-support system. Increased rates of oxygen consumption and $CO_2$ excretion place additional demands on the life-support system while, from the fish's perspective, the changes in gill perfusion and circulation that facilitate such alterations in gas exchange can also operate to increase solute loss and result in diuresis and ionoregulatory dysfunction. As a consequence, once a suitable life-support system has been provided, the efforts of salmon farmers are focused on the need to minimize handling stress. The majority operate sophisticated pumping and counting systems that are intended to minimize aerial exposure of fish and, in a manner consistent with the natural behavior of the animal, mimic as far as is practicable the process of being washed downstream.

King, H. R. (2009). Fish transport in the aquaculture sector: An overview of the road transport of Atlantic salmon in Tasmania. Journal of Veterinary Behavior: Clinical Applications and Research, 4(4), 163-168.

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