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A BARGE FOR THE TRANSPORT AND STORAGE OF LIVE FISH

by

J I Edwards
DAFS Marine Laboratory, Aberdeen, Scotland, U.K.

Abstract

A method of transporting delicate species of fish from the place of capture to the site of experiments using a 'fish barge' is described. The paper includes a summary of the first year's operating experience.

Résumé

On décrit une méthode pour transporter des poissons des espèces délicates du point de prise au lieu même des expériences en employant un 'chaland aux poissons'. Ce mémoire comprend un sommaire de l'expérience acquise pendant le première année des activités.

Introduction

Acoustic surveys designed to estimate the biomass of fish (Edwards and Bailey, 1978; Edwards, Bailey and Wilson, 1979; Thorne, 1973; Nakken and Dommasnes, 1975; Johannesson and Losse, 1973), require a detailed and accurate knowledge of the target strength of the species of fish under investigation. The target strength of fish can be measured in several ways, one method used in the Marine Laboratory, being to measure the properties of fish confined within an experimental cage (Edwards, 1975; Dunn, 1979; Forbes, Simmond and Edwards, 1980).

This technique requires a supply of live fish in good condition at the experimental site. Gadoids (cod, haddock, saithe) present little problem in this respect. They can be captured in relatively shallow water using hook and line and they can be transported in tanks over long distances by road without suffering ill effects. In contrast, shoaling pelagic species (sprats, herring, mackerel) are difficult to capture and maintain in good condition. They are very susceptible to physical damage, in particular, to the loss of scales which occurs as a result of abrasion. This generally leads to the death of the fish within a relatively short period of time. Shoaling pelagic fish can only be captured in a condition suitable for target strength experiments by fishing methods which depend on encircling, such as ring netting, purse seining or beach seining. Further the fish may only be available in locations remote from a site suitable for target strength experiments. In an attempt to overcome the problems associated with the capture and transport of shoaling pelagic species a 'fish barge' has been developed.

Design Criteria

A vessel or 'fish barge' capable of moving the fish in good condition from the place of capture to the experimental site was designed to meet the following requirements:

(a) The vessel should be sufficiently large to carry at least 1 000 25cm herring.
(b) The fish should be supplied with an adequate flow of water of the correct salinity, temperature and oxygen content.
(c) The inside of the tank should be smooth and resilient to minimise damage to the fish caused by abrasion and collision with the tank walls. (It has been found that when shoaling pelagic fish are introduced to a tank they tend to swim at the sides of the tank and collide with them at high speed.)
(d) The vessel should be capable of operating in moderate sea states ie 5 or 6.
(e) The vessel should be capable of being towed by commercial fishing vessels at their normal cruising speed of nine knots.
(f) The vessel should preferably be cheap to construct and maintain.
(g) The fish barge should be capable of operating in polluted waters, thus prohibiting the use of permanent openings in the hull to provide water circulation.

Description

Figure 1 illustrates the more important features of the fish barge and these are described in more detail below.

The barge is constructed from glass reinforced plastic. The hull is an adaptation of a 8m life-boat hull commonly used by the North Sea Oil Industry. The hull has been modified to contain a tank of approximately $10m^3$, the space between the hull and the tank being filled with rigid plastic foam. The tank and decking are constructed of plywood sheathed with reinforced plastic and the deck is finished with a non-slip surface. The barge is fitted with bilge keels to improve stability at high towing speeds and to allow it to sit on a flat surface without the need for supports. In compliance with normal safety requirements the barge is fitted with hand-rails, navigation lights, anchor warps and fenders.

The tank is equipped with three removable covers which are constructed from a sandwich of 5cm plastic foam covered with glass reinforced plastic to ensure a light but rigid construction. The covers are held in place with clamps and a seal is maintained by compressing a closed cell neoprene foam strip. When not in use the covers can be stacked within the limited deck area available.

The tank is lined with a nylon reinforced PVC bag which is slightly smaller than the tank and is suspended within the tank by elastic cord. This form of construction allows a buffer zone between the hard wall of the tank and the volume which contains the fish. The bag is punctured at intervals of 300m by 15mm holes which allow a restricted flow of water between the bag and the buffer zone. The bag thus forms a resilient and smooth boundary to the tank which minimises the damage to fish caused by abrasion and collision.

Sea water is circulated through the tank by two completely independent but identical pumping systems. The pumps are powered by 24V lead acid accummulators and are controlled by timing circuits which allow the duty cycle of the pumps to be varied between 10% and 90%. A fully charged set of batteries provides approximately five hours of continuous running for each pump and this can be extended by using a lower duty cycle. Water is pumped through two independent inlets fitted with cowls to increase reliability. When both pumping systems are operating at maximum rate a complete water change is effected in approximately one and a half hours.

Fish are vulnerable to increases in water temperature in excess of approximately 5°C above their normal ambient temperature. Fish tanks refreshed with a limited supply of water may become overheated as they absorb heat from the atmosphere. However the fish barge is effectively isolated from the atmosphere by the insulation inherent in the foam-filled tank covers and buoyancy compartments, combined with the high thermal capacity of the 10 cubic metres of water which the tank contains.

Recovering fast moving pelagic fish from the large tank proved to be very difficult using conventional 500mm dip nets. The dip nets were difficult to manoeuvre and tended to damage the fish by abrasion when they were lifted out of the water. A more suitable method of capturing the fish was devised consisting of a curtain of netting attached at the top of a beam which is placed across the tank. The bottom of the curtain is weighted with a length of chain. The curtain forms a mobile barrier which can be used to restrict the volume of water in which the fish can swim. The fish are then recovered by scooping them out with large plastic buckets. Using this method the fish never leave the water and mechanical abrasion is greatly reduced.

Operating Experience

The fish barge has been used to transport mackerel and herring over distances of up to one hundred miles at packing densities in the region of 10-100 fish per m^3 (approximately 25cm herring). Experience has shown that packing densities in the region of 50 fish per m^3 are the best compromise between transporting large numbers of fish and providing a safety margin should either or both of the water circulation systems fail. High packing densities rely on maximum water circulation rates to maintain adequate supplies of dissolved oxygen. Should these not be maintained, a large number of mortalities occurs within one or two hours.

The barge has also been used to hold fish for periods in excess of one week without significant mortality prior to target strength experiments. Tagged herring and mackerel have been stored in the large for three weeks to obtain data on tagging mortality.

Towing speeds of nine knots have been achieved in good weather conditions and the barge has proved manoeuvrable enough to be positioned alongside ring nets so that herring can be transferred directly into the barge using large plastic buckets. It can also be positioned alongside the experimental rig so that fish can be transferred directly into the experimental cage. In this way the fish only undergo two transfers and the chances of physical damage are minimised.

The vessels used to tow the barge have ranged in size from a 5.5m 60HP open launch through commercial ring net boats to FRV 'Mara', a 22.25m research vessel. When the barge is towed behind a small vessel in a fully loaded condition (displacement approximately 12 tonnes) it is essential to steer the barge actively. However, as might be expected, as the mass of the towing vessel increases the barge has less effect on the towing vessel and the rudder can be fastened amidships and left unattended.

Conclusions

The fish barge has proved to be a very effective means of transporting large numbers of delicate pelagic fish from the site of capture to the site of target strength experiments. It has also been used successfully to store fish until required for experiments. It has found application as a portable fish tank in herring and mackerel tagging experiments.

Acknowledgements

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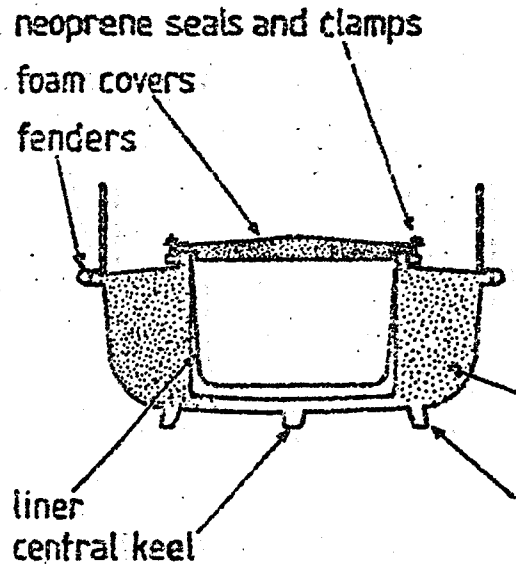

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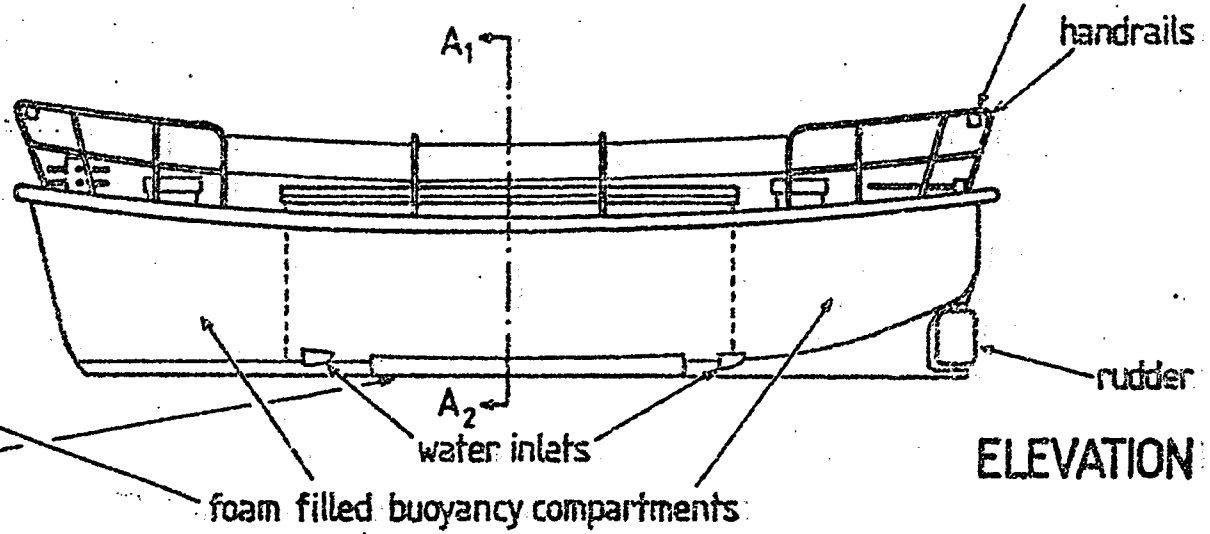

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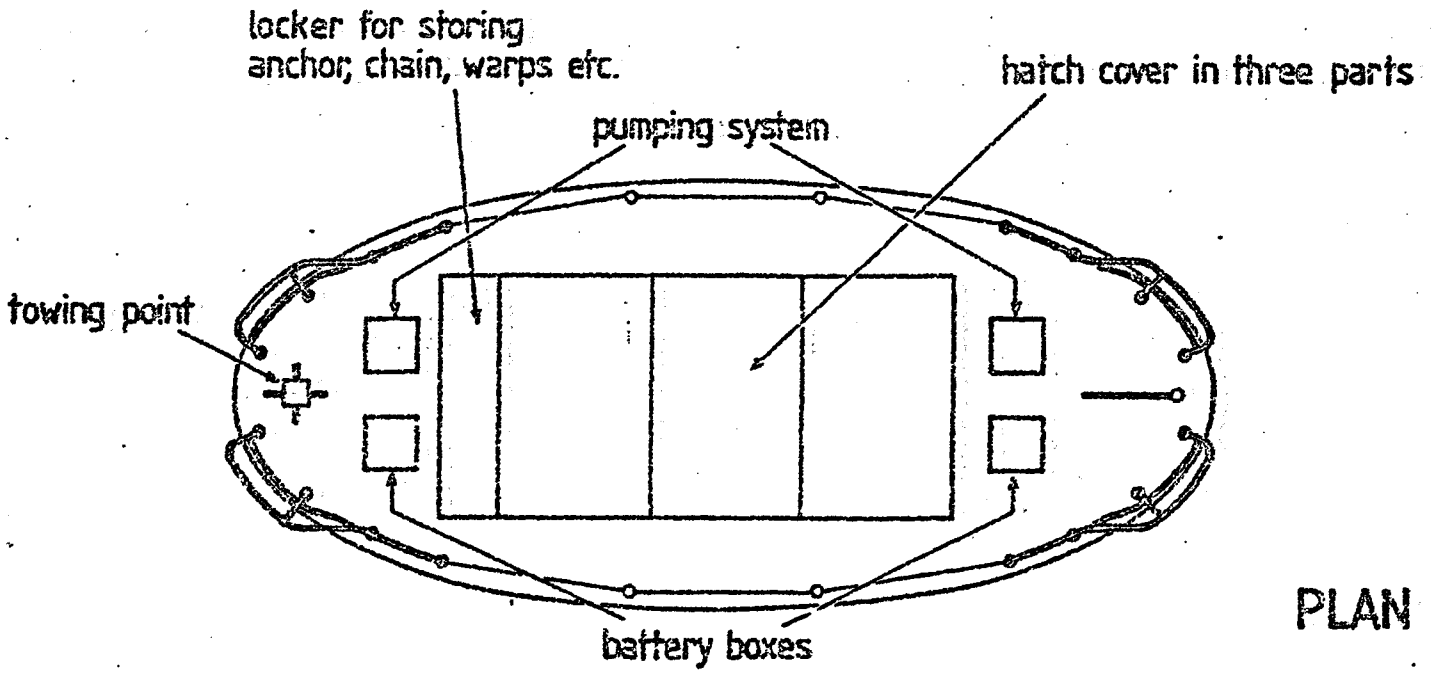

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