Low Horsepower Trawling

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Historically, small vessels in the 10 to 15 meter length class equipped with low horsepower engines were considered unsuitable for trawling. Recently, however, Ocean Arks International (OAI) developed a self-contained commercial scale trawling system which is easily fitted aboard small vessels. The AQUARIA I, a 12 meter, sail-assisted research vessel, equipped with this system, has been fished successfully in the waters of New England over a 5 month period. In comparison to modern commercial trawlers in the area, the catch ratios of AQUARIA I are highly competitive and show real potential for profit

Although the AQUARIA I trawler has only been tested in New England waters to date, the system was designed to aid fishermen in developing third world countries. The system can be constructed using materials available in any environment and is easily operated and maintained. It is hoped that with adaptation, this type of trawler can be introduced successfully into developing fisheries.

A basic trawling rig is made up of the net, the trawl doors or otter boards, and steel wire towing warps. The net is towed along the sea floor at a speed between 2 and 4 knots. The trawl doors (otter boards) function to spread open the net during the towing operation. Water pressure on the leading face of the doors causes an outward shearing effect that maintains the correct net opening. Until very recently the role of the trawl door was seen as purely mechanical (to open the net), but with the advent of low-light television technology, it was observed that the doors were an important and dynamic part of the fishing action. As the heavy doors are towed along the bottom, vibrations are sent out ahead that cause fish to herd into the path of the oncoming net. Also, the doors set up a trailing mud or sand screen which fish are very reluctant to cross, further heightening the herding effect. For these reasons, it is not necessary to fasten the net directly to the doors but it may be attached by warps and follow a considerable distance behind (in some cases over 100 meters).

Net designs vary: some are built to fish hard on the bottom with very little vertical rise and are suitable for bottom hugging species such as flounder, shrimp and shellfish. High-rise nets, designed to fish higher in the water column with only the lightest contact with the bottom, are more often used in pursuit of pelagic species. Combination nets are commonly used. They are not as efficient as dedicated nets but catch a wider sample of commercial fish. The combination net can be easily adjusted by the fisherman to target species.

A modern, near shore trawler, typically 20 to 30 meters in length, is powered by a heavy diesel engine with a minimum of 500 horsepower which consumes large quantities of fuel. The fishing operations are complex and demand a skilled, experienced crew of at least three men. The fishing gear is heavy and cumbersome, cluttering most of the working deck space. The boat will usually have a fish hold of approximately 30 tons.

In comparison, the AQUARIA I is built of balsa-cored fiberglass and measures 12 meters long, 4 meters wide and draws 1.5 meters. Underneath the waterline she has the appearance of a typical cruising sailboat with a full keep, exposed propeller and a separate skeg hung rudder. The boat is equipped with a small General Motors Detroit Diesel 453 engine of about 80 horsepower mated to a 24" propeller which is quite fuel efficient. The boat has, for its class, a spacious deck and a large capacity fish hold of about three tons.

Aboard most modern trawlers the winches are located directly behind the wheelhouse and above the engine. This location limits work space and is very dangerous due to the fact that trawl wires run along the deck at both calf and head height.

The trawling system aboard the AQUARIA I is wholly contained in a steel A-frame mounted on deck over the stern of the boat. Two separate towing winches, controlled independently, are located directly beneath the port and starboard towing blocks hanging on the outboard ends of the frame. Power to the winches is provided by a hydraulic pump driven by the main engine. Only two hoses connect the pump and A-frame, a supply and return.

In locating the winches aft, OAI departed from normal trawling design but this location serves several important advantages. Without wires or turning bollard running along the deck, the fisherman is allowed to work in a safer environment. This system is also far more cost effective than the normal location of the winches behind the wheelhouse since the tow wire passes over only one block sheave, extending wire life. Finally, the winches do not intrude on the deck space.

A large net reel was built into the A-frame with its axis some 2 meters above deck level. The hydraulic motor capacity and sprocket ratios of the net reel drive were carefully engineered so the net reel would take over all of the complex operations of handling a net. The reel was positioned over the stern so that when the net was being hauled in and the reel was filled with most of the net, the bag or codend could be hoisted out of the water by the reel's own power, swung inboard sufficiently for the codend to be tripped, and the catch dumped on the stern. In setting out the gear, the codend is simply pushed overboard and the rest of the net unreeled. Connecting and disconnecting the net from the reel to the trawl doors is done by using G-hook connections. All trawling operations can be controlled by a total of three hydraulic valves and are easily operated by one person.

Sea trials with the AQUARIA I and the equipment were conducted over known trawling grounds in order to directly compare catch rate and efficiency to commercial vessels operating in the area. Results so far have shown that with much less horsepower and fuel consumption, catch rates have been at least equal to, and never less than, those of vessels specifically designed as trawlers and with three times the horsepower of the AQUARIA I.

OAI has attributed the high catch rates to the fact that, although the horsepower is low and the gear light, the engine thrust, door size, and net drag and design are all well balanced, lending themselves to high efficiency. A major competitive advantage for light gear is that when the net makes fast on a bottom obstruction, the boat does not have sufficient weight and momentum to cause serious damage to the trawl. The boat stops and the trawl can be retrieved. In contrast to larger and heavier boats where bottom obstructions can cause serious and expensive damage, the fisherman on the small boat is not confined to only smooth bottom but has the confidence to fish rockier waters to take advantage of greater concentrations of fish.

Experiments were carried out using the AQUARIA I's sails as an auxiliary source of power while trawling. The system is independent and does not need sail-assist to fish successfully but substantial benefits may be drawn from a sailing rig. Under working conditions, and without sail-assist, it was found that it was not necessary to use all the power available from the engine; the throttle was usually reduced by 10 to 20% to maintain an efficient towing speed. With the sails up, and in a moderate breeze, it was found that the throttle had to be cut back to almost idle to keep the same speed - a substantial saving in fuel. To answer the question whether the sails could be used alone to power trawling operations, the answer is yes but with a very limiting restriction. In moderate or fresh breezes a towing speed of 2 to 3 knots can be achieved by sail alone; However, at this speed there is insufficient water pressure on the rudder for it to have any effect while towing, and the boat is essentially rudderless - it needs direct propeller thrust to be effective.

Historically, trawling has been the surest way of making a return on an investment in a fishery. With a trawl by stern vessel such as AQUARIA I, the artisanal fisherman now has the opportunity to capitalize on an industry that is most often controlled by the wealthy.

In summary, the trawling system aboard AQUARIA I can be adapted to almost any existing vessel and creates a safe work environment. With the exception of the winches, the materials used to build the system are readily available in any environment and can be manufactured on site. The hydraulic system, although sophisticated in design, is simple to build and use and can be easily repaired at sea. A fisherman will not break a fishing trip because of gear failure. Although the gear aboard the AQUARIA I is light we are not talking

about light duty. The system is engineered to stand up to the regular abuses of everyday fishing.

Also, this system makes the boat a multipurpose tool: the net reel can be used for gill netting or longlining; the winch head, combined with the clear deck can be used for setting traps or pots. Due to the size and weight of the gear in this system the crew is not restricted to fishing only well known waters. The gear is less likely to be damaged on an obstruction giving the crew more confidence. With this light approach to trawling, environmental impact is minimal and fishing grounds will not be destroyed.

The system also lends itself to management. Fishing efforts can be regulated by horsepower or by door size. And finally, the system was designed to be affordable and will be workable under the kinds of conditions expected to be met in a developing fishery. Up until now because of the complexity of existing trawling systems special skills were needed to operate a trawler. A minimum familiarity will let anybody fish it, anybody fix it and hopefully anybody finance it.