SHIPBOARD PROCEDURES FOR DECREASING LOBSTER MORTALITY

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The development of the offshore lobster fishery has created a need to decrease lobster mortality during long periods of storage onboard ship. This paper will discuss aspects of the shipboard storage problem and will present one successful shipboard storage method now in operation.

Any reduction in lobster mortality would be of economic value in two respects: (1) Individual fishermen increase their income by landing more live, healthy lobsters; and (2) The industry would benefit if more of the available resource was utilized. Though the value of the lobster fishery will be maximized given the live landings of the highest sustainable yield, losses in storage and transport will diminsh the potential profits.

The major causes of lobster mortality after capture are:

a) suffocation
b) thermal shock
c) rough handling
d) disease

A brief review of the cause and effect relationships will serve as an introduction to possible engineering solutions to the problem.

Suffocation seems to be the major cause of lobster deaths in storage. If water circulation and aeration are not provided or are not adequate, oxygen deficiency will result. The oxygen problem can be a localized one such as in tank corners where lobsters tend to congregate. Lobsters require a continuous supply of oxygen to live. Their oxygen demand increases at higher water temperatures and during feeding. For this reason, feeding lobsters in storage is not recommended. Feeding lobsters also results in increased waste products which make the environment unhealthy and consume the precious oxygen. Cold water not only lowers the lobsters' oxygen demand but increases the oxygen holding capacity of the tank water.

The most common method of replenishing the supply of oxygen to lobsters in holding tanks is to continually pump new sea water through the tanks. The disadvantages are the need for special equipment to move large amounts of water, and the lack of control over the water temperature.

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Water temperature should be held between 45° and 50° F. to minimize thermal shock. Thermal shock can result if lobsters are brought up from the colder bottom depths and stored at much higher water temperatures, or if a sea water circulation system is used, when passing through warm surface water. The key here is rate of acclimatization. Lobsters can survive in warm water provided it warms gradually. However, cold water is desirable because you can store more lobsters per gallon due to the increased oxygen holding capacity. Colder water also has the advantage of delaying moulting. Many vessels refrigerate and recirculate sea water in their tanks. Over longer storage periods, though, the oxygen must be replenished.

Massachusetts Marine Biologist, John Hughes, has developed a successful storage method in cooperation with lobstermen Jack Baker and Jack Marley. Mr. Baker is the owner of two stern trawlers, the Shanty Queen and the Shanty Girl, and two seafood restaurants, Baker's Lobster Shanty at Point Pleasant Beach, New Jersey, and Lobster Shanty North, P.E.I., Canada. Mr. Marley is the manager of the operations. Baker's vessels have refrigerated holds containing plywood tanks. The same seawater is used for the entire trip and is continuously aerated by means of an air pump system. What follows is a discussion of the components of this type of system.

The Hold

It is desirable to refrigerate the hold, which contains the lobster tanks, to maintain air temperatures between 40° and 45° F. Due to the wide variety of vessel and hold configurations, your local refrigeration people will have to provide the necessary assistance in choosing the right equipment. A standard freezer-evaporator system, using refrigerator plates or coils has been found to be adequate. The hold should be insulated and possibly a fan provided to improve air circulation. One refrigeration company familiar with lobster refrigeration systems, suggests foam implaced urethane as a good insulator. The lobsters should not be permitted to come in direct contact with the urethane as they will tear it.

In some installations, of a more permanent nature, it may be desirable to refrigerate the tank water directly. If this is the case, the cooling coils have to be made of or coated with a material that is not toxic to lobsters. The lobsters should not be allowed to come in direct contact with the coils. To avoid mass mortality due to a leak in a coil, a secondary coolant might be considered, such as brine, that can be detected by a salinometer before deaths occur. A common system is a separate cooling tank with a circulating water system to the lobster holding tanks.

If a vessel has a small hold it might possibly be cheaper to use ice outside the tanks. When using this method care should be taken that ice doesn't enter the tanks, since any decrease in the salinity of the tank water could be harmful to the lobsters.

The Tank

Ordinary Marine Grade plywood has been found to be good material for tank construction. However, the better exterior grade plywoods can be used with excellent results especially when coated. Rubber or plastic based paint should be used on the interior surfaces. The seams of the tanks can be bonded with brushable epoxy glue. Care should be taken to insure that no copper, lead, or zinc materials are used on the sea water side of the tanks. Stainless steel or plastic fittings are best since they are non-toxic to the lobsters and hold up well in the sea water environment.

The sizes of the tanks is dependent on the size and shape of the hold. Too large a tank can cause stability problems in rough weather. Surge effects in the tanks can harm lobsters. On Baker's boats the holds are 18' x 16' x 8' high and contain ten tanks 48" x 32" x 34" deep. Each tank holds 600 pounds of lobsters.

It may be desirable for fast turn-around operations to build smaller tanks that can be hoisted out of the hold. A variation on this concept might be permanent tanks containing a number of removable trays. This also has the benefit of decreasing the handling of the lobsters which will improve the quality of the landed product. Handling weakens and often injures the lobsters, which are already under stress. Handling also increases the possibility of death from such causes as loss of blood, infection, and the effects of overcrowding.

A drain should be located near the bottom of the tank so that the tank can be easily emptied in case of emergency or before docking. The drain, like all the sea water piping, should be either plastic or stainless steel.

The tank should have a removable splash cover. On Baker's vessels the covers can be hooked onto the overhead and out of the way while work is in progress.

The Air System

Baker's system uses a Conde air pump to supply the air to the tanks. This pump is a milking machine pump adapted for continuing commercial aquarium usage. It supplies a large volume of air at low pressure (18 cu. ft. /min. at 8 psi). The power supply for this pump can be either 110 or 32 volts.

The air pump discharges into an air main constructed of 1-1/2" plastic piping (PVC), running the length of the hold. At points along the air main, small brass air valves are screwed in, to which 1/4" flexible plastic tubing can be attached. The tubing is connected to an air gang valve for each tank.

The air gang valve is a small brass manifold that can contain any number of valves. It provides a means of controlling the air division to the air stones.

If the tanks are to remain in the hold, it does not matter where the air gang valve is located. However, if the tanks are to be removed often, (as for bulk offloading or removal for cleaning, drying, or repair), it is suggested the gang valve be mounted on the tank. This way only one air hose has to be disconnected to remove the tank.

Quarter-inch plastic tubing is run from the gang valve outlets to air stones located in three of the tank corners and in the center of each side, all on the bottom of the tank.

Air stones are devices (commonly found in home tropical aquariums) used to break the air flow into many tiny bubbles. The air stones for the tank corners can be the small round type and those for the sides can be the twelve-inch variety. The corner-located air stones should be enclosed in 1-1/2" PVC pipe mounted vertically. This pipe should be located about an inch off the bottom and extend up to within several inches of the water surface. The flow out of the air stone provides an air lift creating an upward flow of water thus circulating and enriching the water.

Filtration and additional circulation is provided by a small all plastic bilge pump located in the fourth corner of the tank. The pump discharges via a plastic hose to a quarter-bushel basket that contains filter material. The water is filtered and circulates back into the tank. Fibreglass should not be used as the filter material because it has been found that the strands of glass injure the lobsters. Instead, cotton waste or polyester wool can be used. If the tanks are made small, an air lift filtration system can be used instead of a bilge pump.

When the lobsters are taken aboard they should be banded as soon as possible. Wooden pegs should not be used because they invite diseases such as Gaffkemia which can cause high mortalities in storage areas.

Lobsters taken by otter trawls require several hours in a deck holding tank to clean themselves of sand. This is important because sand in their gill areas causes hardship in breathing, further weakening the lobsters. The deck tank also allows for the culling out of weakened lobsters that should be placed in special storage.

When installing pumps that supply sea water to lobster storage tanks, extreme care should be taken to see that there are no air leaks on the pump inlet side. This can supersaturate the tank water, and thus cause Gas Disease fatal to lobsters.

The tanks should be flushed regularly. Usually fresh tap water is sufficient but if there is any suspicion of disease-causing organisms present, a chlorine solution should be used. The tanks must be flushed well with fresh water after cleaning with chlorine solution.

The above system and handling procedures are effective. On Baker's vessels, losses have been cut from an average of 20 percent down to less than 2-1/2 percent. During one summer trip when surface water temperatures were in the 70's, they lost only 165 lbs. out of 7,300 lbs. landed; 90 percent of the fatalities were newly shed lobsters.

Conclusion

The practical application of scientific principles has contributed to the rapid growth of American technology. The development of effective but low cost systems for the shipboard storage of live lobsters is an example of a happy union of theory and practice. Many variations in similar systems are possible; however, the most successful will be those that adequately meet the basic biological requirements of the lobsters. The success of the system described above reflects its capacity to either compensate for the lobster's needs or to adjust the needs of the lobster to fall within the capabilities of the system. Either way, the result has been one of success.

References

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