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THE LIVE STORAGE OF LOBSTERS

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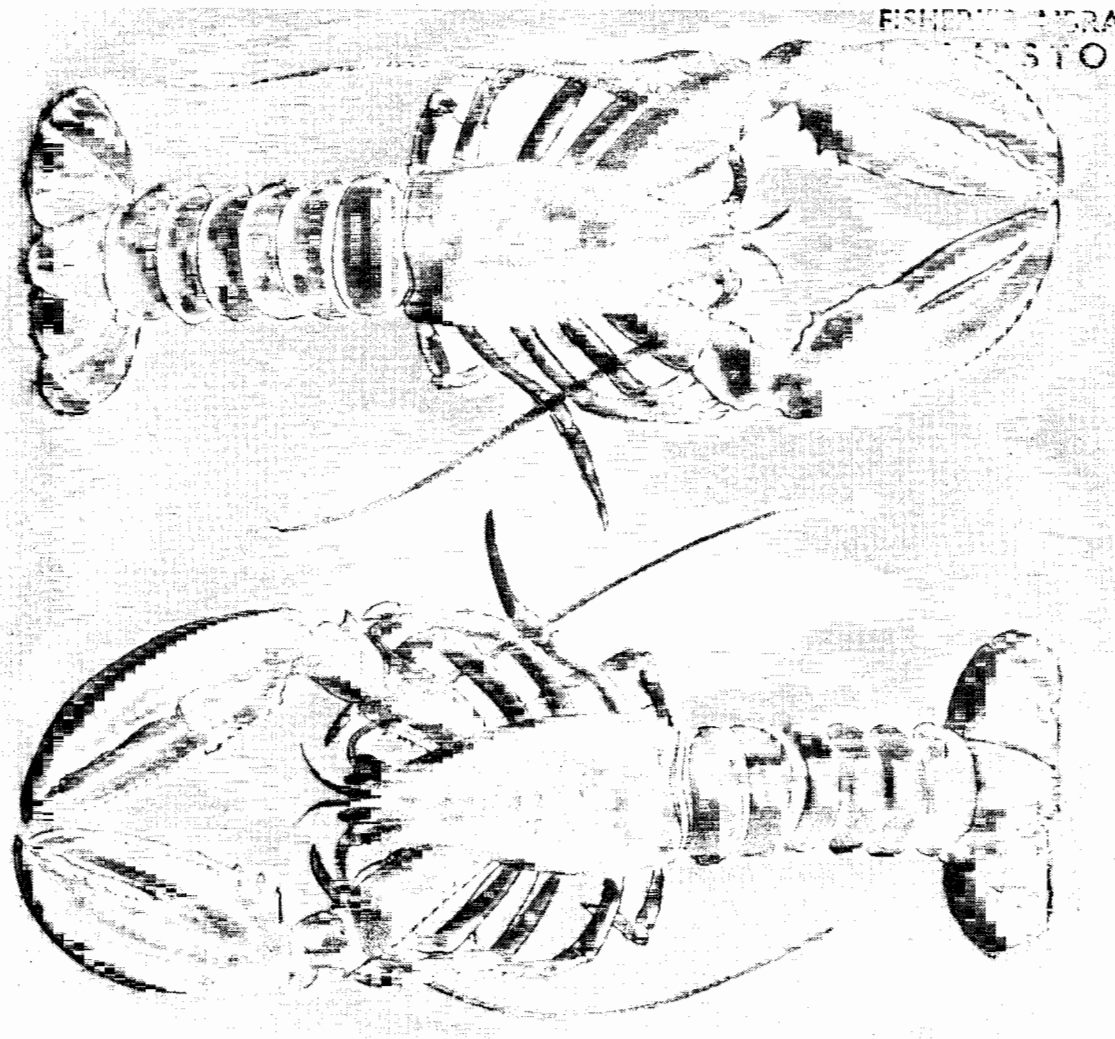

P. A. AYRES AND P. C. WOOD

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The authors:

P. A. Ayres, MI Biol, is a Senior Scientific Officer in the Marine Environment Protection Division of the Directorate of Fisheries Research. He is stationed at the Fisheries Laboratory, Burnham-on-Crouch, Essex. P. C. Wood, Dip Bact, is a Senior Principal Scientific Officer in the Marine Environment Protection Division of the Directorate of Fisheries Research. He is the Officer-in-Charge of the Fisheries Laboratory, Burnham-on-Crouch.

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THE LIVE STORAGE OF LOBSTERS

by P. A. Ayres and P. C. Wood

INTRODUCTION

With increasing consumer demand for live lobsters both at home and for the export market, many fish and shellfish merchants are perhaps considering the market potential of these crustaceans for the first time. In keeping with this demand for storage at market level, interest has also grown in the larger-scale storage of lobsters near sites of production. The object of this leaflet is to give a general introduction to the subject of lobster storage; suggested further reading and sources of further information are included for those wishing to pursue the matter in more depth.

Around the British coast there are basically two types of lobster storage. In a few coastal areas where large quantities of sea water are available long-term storage is practised, often in extensive tank systems. At other parts of the coast and at inland markets usually short-term storage is practised, generally at distribution centres or markets where lobsters are held before sale to the customer. The major advantages of live storage are (1) it permits flexibility of marketing and dispatch which can be carried out at convenient times or on demand (2) it reduces mortality by maintaining the lobsters in water (3) it ensures that the product arrives at its destination in good condition.

Long-term storage brings further benefits, particularly to those producers who are geographically isolated from major markets. Large consignments can be built up, customers can be supplied with equally graded shipments, advantage can be taken of bulk packing and transportation and, most important of all, lobsters may be purchased when cheaper and more abundant, and stored and sold when demand and prices are at a peak.

The conditions needed for lobster storage should be as good as those of the natural habitat of the lobster. While it is not always possible to recreate this environment in a tank there are four basic factors to be considered: the oxygen content of the water, its salt content, its temperature, the presence or absence of toxic substances, and the condition of the lobsters. Each of these factors will be dealt with in turn.

OXYGEN

Lobsters require oxygen to live and this they obtain direct from the water which surrounds them; as the water temperature rises so their oxygen uptake increases. However, the quantity of oxygen which may be held by sea water is reduced as the temperature rises, with the net effect that the amount of sea water lobsters require to satisfy their oxygen requirements during storage increases disproportionately as the temperature rises (Figure 1). This relationship is illustrated in practical terms in Figure 2, which shows that at 40°F (4.4°C) 100 lb (45 kg) of lobsters require 52 gallons (237 litres) of sea water each hour to supply their oxygen requirements; at 55°F (12.8°C), twice as much water is needed; at 63°F (17.2°C) three times as much and at 70°F (21.1°C) at least four times as much.

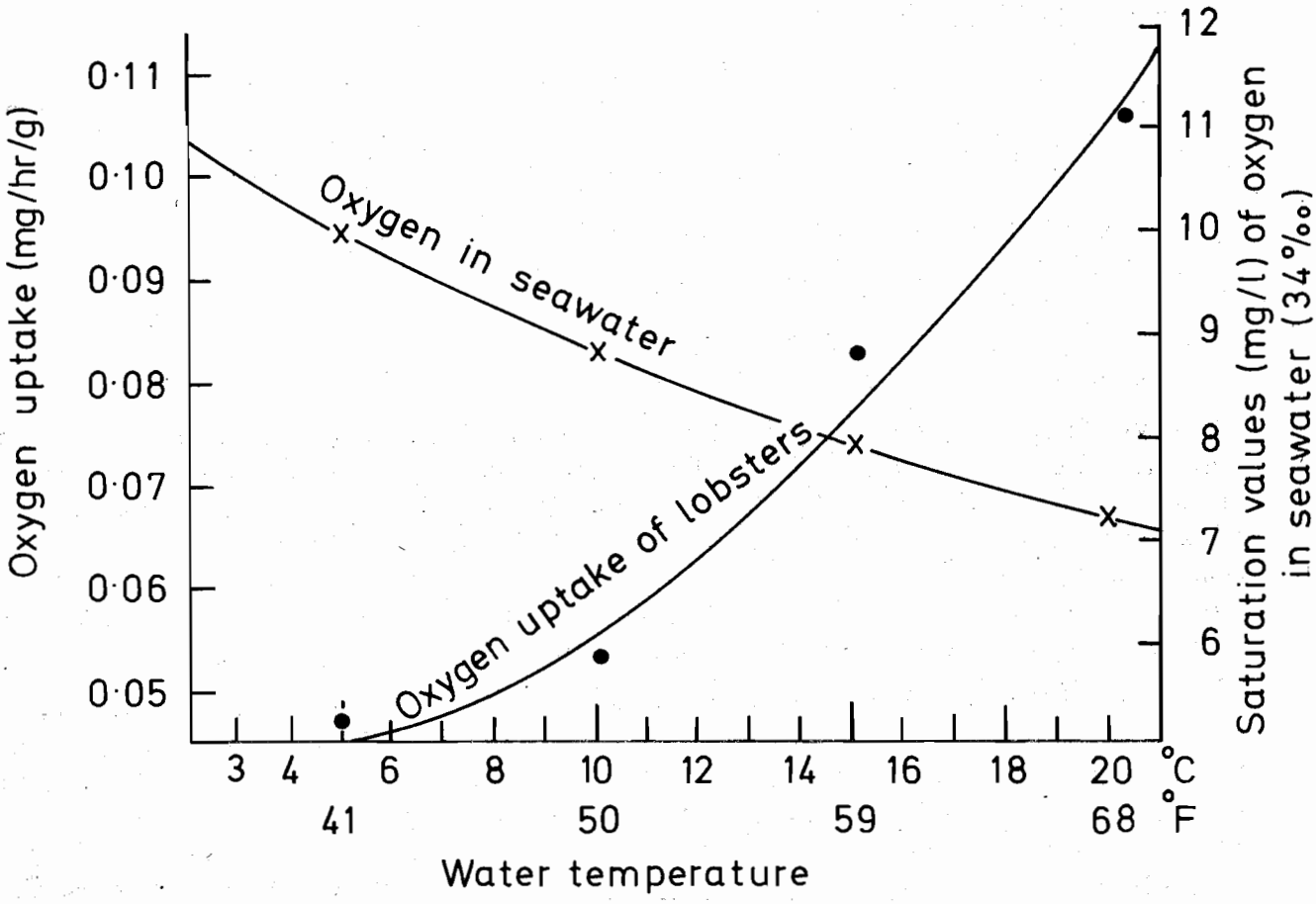

Figure 1 The effect of water temperature on the oxygen content of sea water and the oxygen uptake of lobsters.

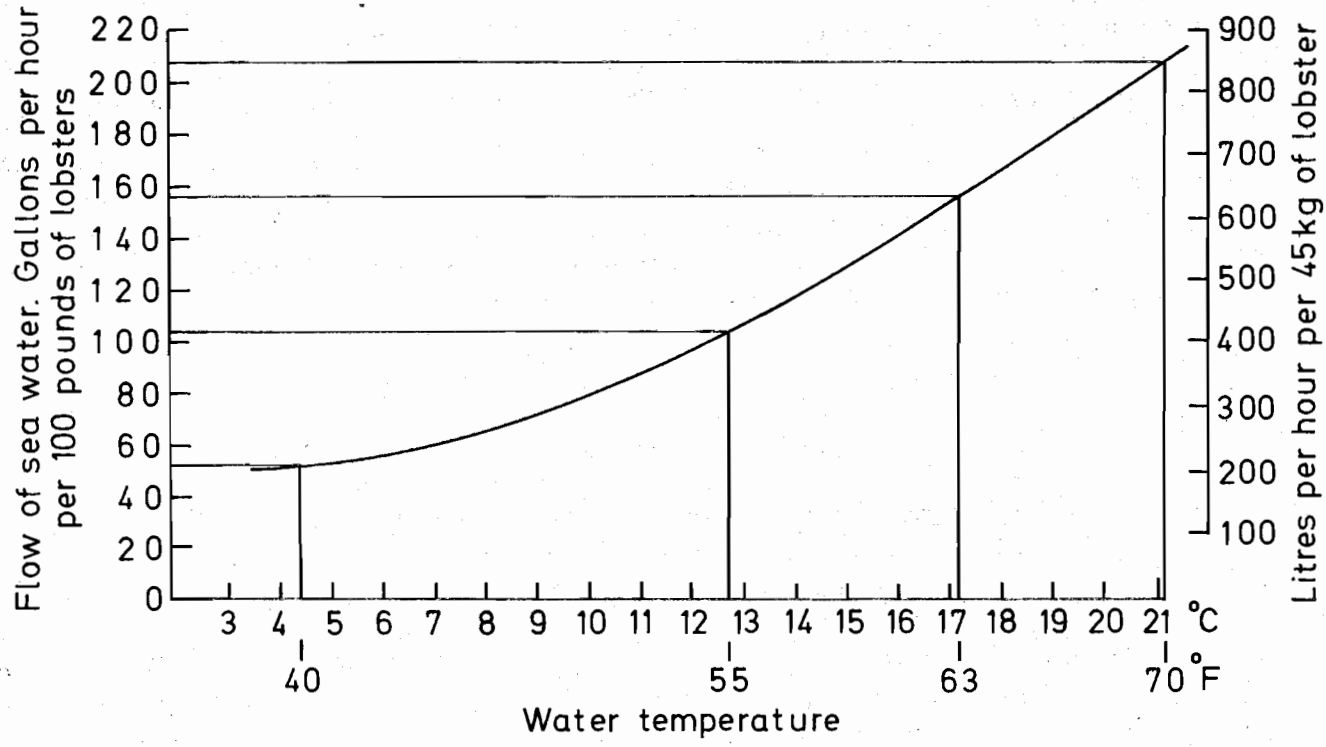

Figure 2 Flow of sea water needed each hour by 100 lb of lobsters over a range of temperatures.

SALINITY

The open sea contains between 3.4 and 3.6% salt and for lobster storage a minimum of 3% is required. At most open coastal sites salinity is not generally a problem, although estuaries or other areas receiving fresh water run-off should be used with discretion. Where salinity conditions are marginal, sea water can often be taken in for storage purposes at high water when salinities are likely to be less affected by the influence of fresh water. Away from the sea and where storage units are small, artificial sea water can be prepared from a mixture of five simple salts and tap water, but cost may be prohibitive where large water volumes are required.

WATER TEMPERATURE

Generally the lobster can withstand a wide range of water temperatures, provided that fluctuations are gradual and not abrupt. During storage the aim should be to reduce the water temperature and keep it between 40°F and 50°F (4.5-10°C). This can be achieved in small storage units by the use of refrigeration equipment, but for the larger flow-through systems this would be prohibitively expensive and not practical; in such situations lobsters can be stored at the incoming seawater temperature providing the rate of flow is adequate to maintain temperature and oxygen requirements. In any event, in enclosed systems, as water temperatures rise water must be recirculated at increasing rates to ensure that adequate supplies of oxygen are introduced.

TOXIC SUBSTANCES

When lobsters are stored at high density or at high temperature, or when water is held for a long time, the waste substances produced by the lobsters can prove toxic. These wastes are not of significance where water runs to waste continually, but in smaller units, involving a high concentration of lobsters, large quantities of toxic waste may accumulate and result in increasing mortality. In addition to toxic wastes produced by the animals, there are a number of potentially toxic materials which may be inadvertently introduced during the construction and operation of a lobster storage system. Copper and its alloys, brass, bronze, etc., are toxic, as are lead, zinc and some formulations of stainless steel. The main materials of construction should therefore be plastic, wood, stone, brick, concrete or reinforced glass fibre. Certain insecticides (e.g. DDT) found in fly sprays etc. are highly toxic for lobsters even if applied at some distance from the tank, i.e. in packing areas.

LOBSTER CONDITION

The condition of the lobster itself is most important, since under no circumstances can a storage system be expected to cope successfully with moribund or badly damaged animals. If weak ones must be stored, they should be maintained separately under close observation. In intensive storage units the presence of dead lobsters may seriously affect the efficiency of the unit and may rapidly lead to more deaths. Recently moulted (soft) lobsters should not be stored, nor should those which are damaged or which have cut or plugged claws. Infection may enter the lobster through damaged areas with potentially severe consequences.

A blood disease of lobsters, known as Gaffkaemia, has been found in lobsters imported from Canada and also in a few from this country. The infection may be maintained in large-scale and intensive lobster storage units and may easily be passed on by diseased to new stock. Risks of mortality from the disease, which is generally rare in the United

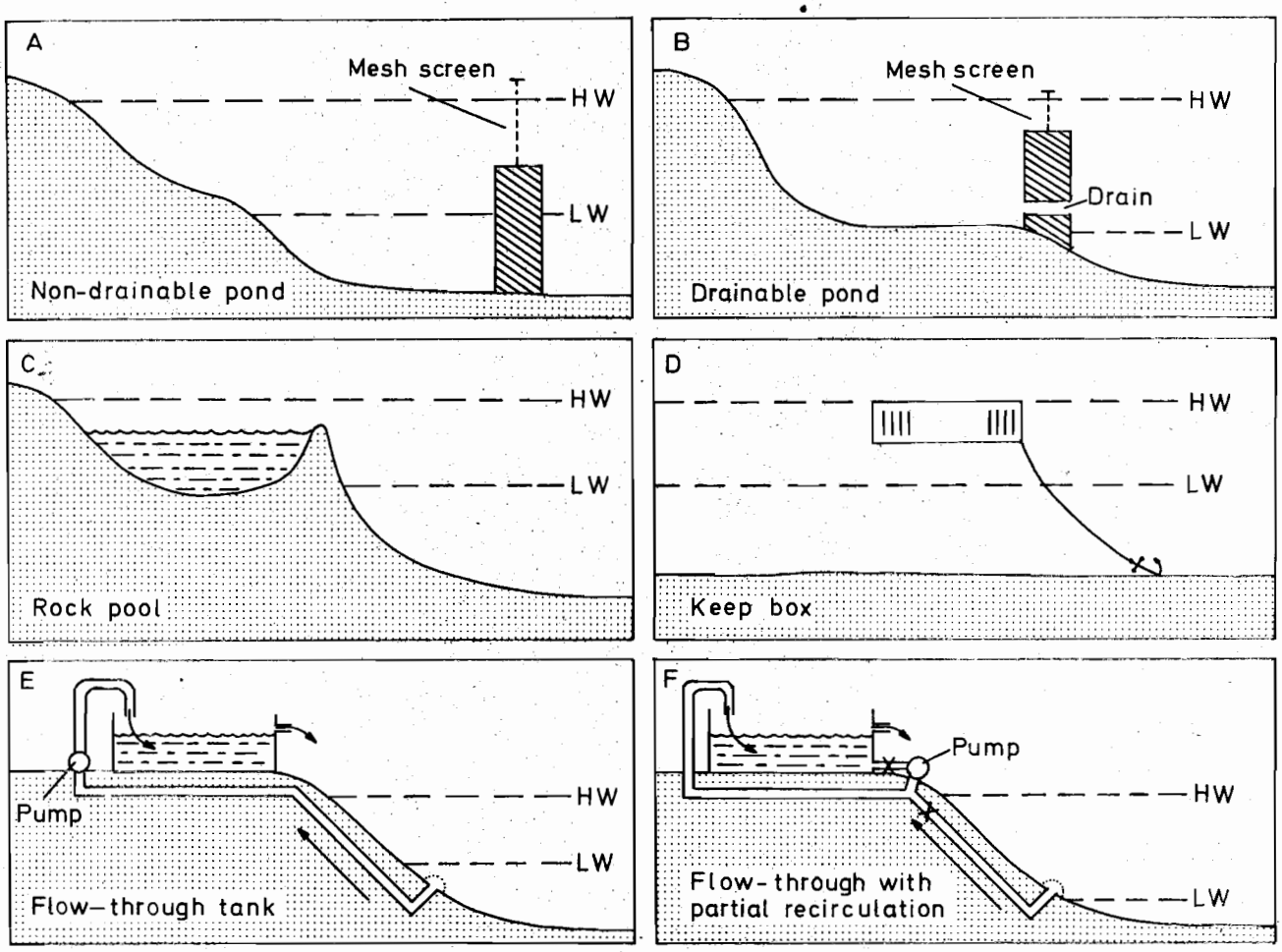

Figure 3 Types of coastal lobster storage unit.
A-D Tidal systems; E-F Pumped systems.

Kingdom, can be reduced by (a) maintaining water temperatures between 40°F and 50°F (4.5-10°C) (b) improving handling by removing dead or damaged animals (c) reducing storage density (d) increasing the frequency of water changes.

TYPES OF STORAGE UNIT

The type of storage unit to be used will depend on the local conditions of the area where it is established.

Near to the coast where large quantities of sea water are available, relatively simple forms of storage of the types illustrated in Figure 3 may be used. Systems which require tidal exchange to function properly are the drainable and non-drainable ponds, the intertidal pool and the keep box.

Keep boxes provide a cheap and useful method for short-term lobster storage (Figure 3D), but there may be problems in finding a suitable, sheltered and accessible site. The method has two major disadvantages (i) floating keep boxes just below the surface may, in estuarine areas, suffer from the effects of reduced salinity since fresh water will normally be near the surface and (ii) damage may occur during storage as keep boxes normally hold lobsters in a layer up to 2 ft deep. Examination of the boxes used in several areas shows that about 20 cubic feet of storage space is required for every 100 lb of lobsters. The aim should be to keep the boxes as shallow as possible to avoid lobsters being piled up too deeply.

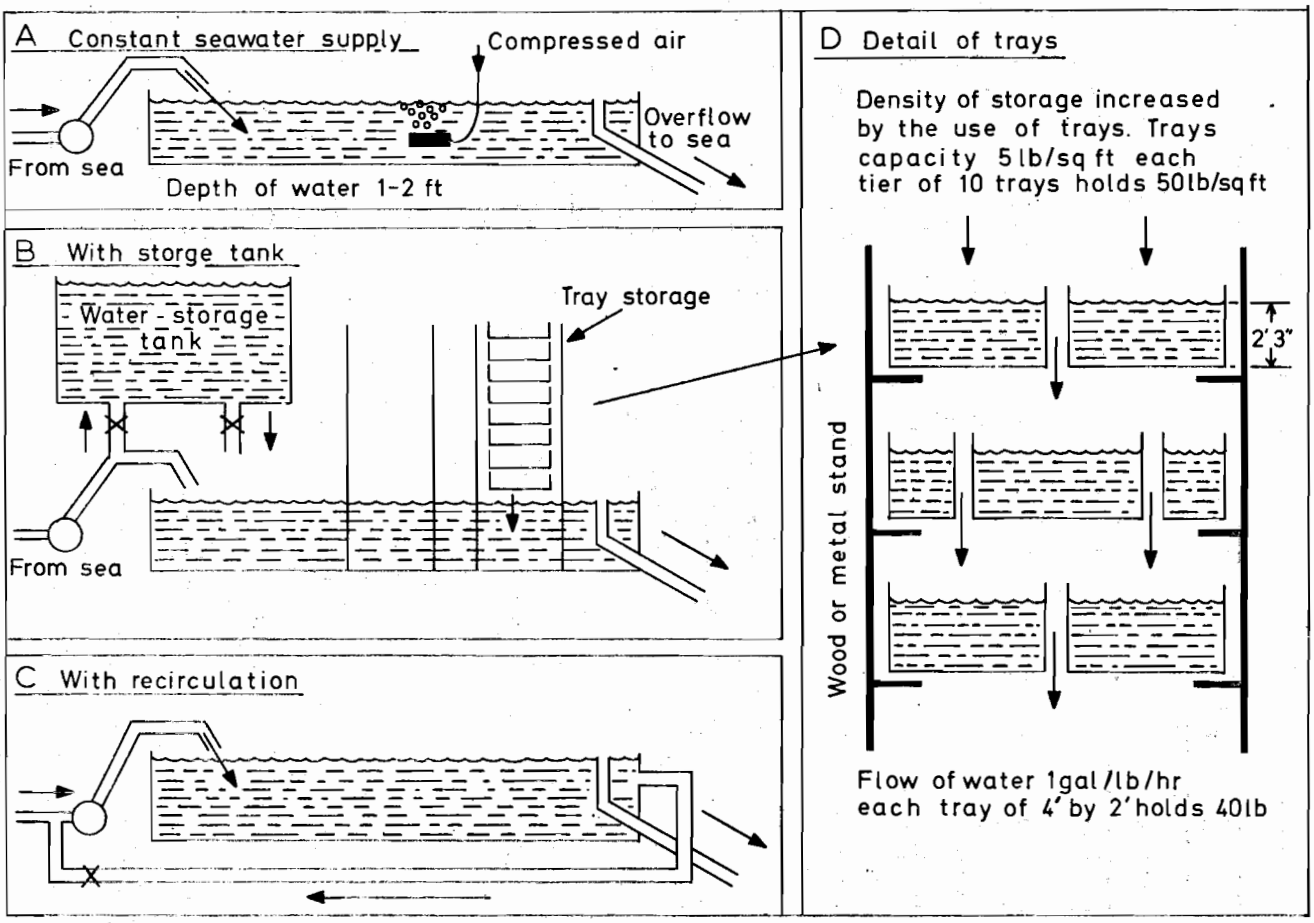

Figure 4 Methods of lobster storage using a flow-through system.

A large embayment of the sea can often be converted into a non-drainable pond for long-term storage; lobster densities of up to one pound weight per square foot of sea bed are common (Figure 3A). Water is held in the pond by a perforated dry stone wall and flows in and out with the tide, although there is some delaying action caused by the wall. The pond never drains completely and lobsters can be collected only by fishing them with a net. This type of unit is usually near to the fishing area and useful in that by intelligent use it is possible to stabilize the price of lobsters. A good example of the intertidal type of storage pond is that at Roscoff, France: the tide is allowed to move in and out, and at low water the minimum depth is 7 ft. When it is necessary to fish the doors are opened at low tide and the water depth reduced to 2 ft thus enabling fishermen to wade in and collect the lobsters.

The simplest and probably the safest shore-based unit is the type where water is pumped from the sea continuously and allowed to run through the tank to waste (Figures 3E and 4A). At some sites it may be necessary to recirculate at low tide, such as where the intake is set intertidally or where water is of insufficient salinity at certain times (Figures 3E and 4C). As an alternative, a water storage tank may be used to provide water when it is not available from the sea (Figure 4B). The density of storage may be increased by the use of a series of trays, one on top of the other. Each tray holds only 2 or 3 inches of water which is delivered to the top tray and cascades through those underneath (Figure 4D).

In recirculating units, it is essential to promote oxygenation of the sea water. Oxygenation can be assisted by cascading the water, by using a compressed air supply or by insertion of an air bleed on the pump inlet (Figure 5). In addition, a filter can be usefully

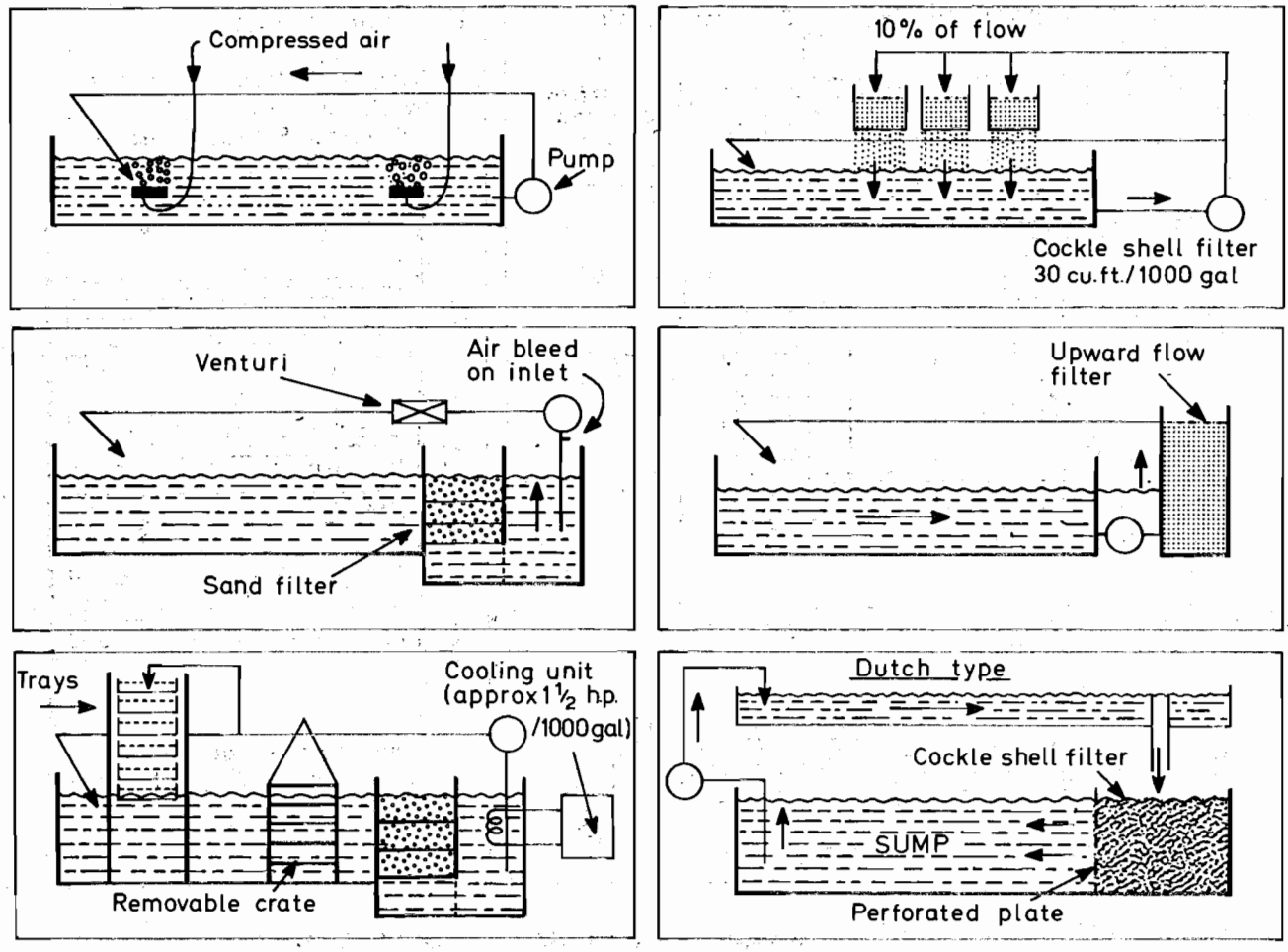

Figure 5 Methods of lobster storage using recirculated sea water, showing methods of aeration and filtration.

incorporated to extend the time the water can be held; this may consist of a gravity or upward-flow bed of filtering material, e.g. stones, coarse sand, or cockle shell. Storage densities can be increased, up to four-fold, by reducing the water temperature with refrigeration equipment. As a general rule each 1000 gallons of water needs a refrigeration unit having a compressor motor of about $1\frac{1}{2}$ hp.

Where tanks are situated inland, away from a ready supply of sea water, artificial sea water can be made up from a mixture of simple salts, details of which are shown in Table 1.

Many of the features described above have been combined in commercially-available storage units, suitable for short-term storage. These are free-standing units which use a series of trays over a built-in sump (Figure 6). Such units include a circulating pump, a cooling and aeration unit and a filter; they operate entirely on artificial sea water. A unit measuring about 5 ft long and 4 ft high can hold up to 250 lb of lobsters in six trays, all of which are enclosed in a wooden cabinet. Other units are available to store proportionately larger quantities, and with deeper trays may also be used for the storage of crawfish.

Table 1 Composition of artificial sea water for lobster storage

Common name of salt	Chemical composition	Weight of salts for				
		100 gallons (450 litres)			1000 gallons (4500 litres)	
		lb	oz	(kg)	lb	(kg)
Sodium chloride (common salt)	NaCl	23	8	(10.66)	235	(106.6)
Magnesium sulphate (Epsom salt)	$MgSO_4.7H_2O$	5	12	(2.61)	57	(25.9)
Magnesium chloride	$MgCl_2.6H_2O$	4	9	(2.07)	46	(20.9)
Flake calcium chloride	$Ca\ Cl_2.2H_2O$	1	3	(0.54)	12	(5.5)
Potassium chloride	KCl		9	(0.26)	6	(2.7)
	Total	35	9	(16.14)	356	(161.6)

This will give a sea water of approximately 3% salinity. Salts of common industrial or agricultural grade are adequate

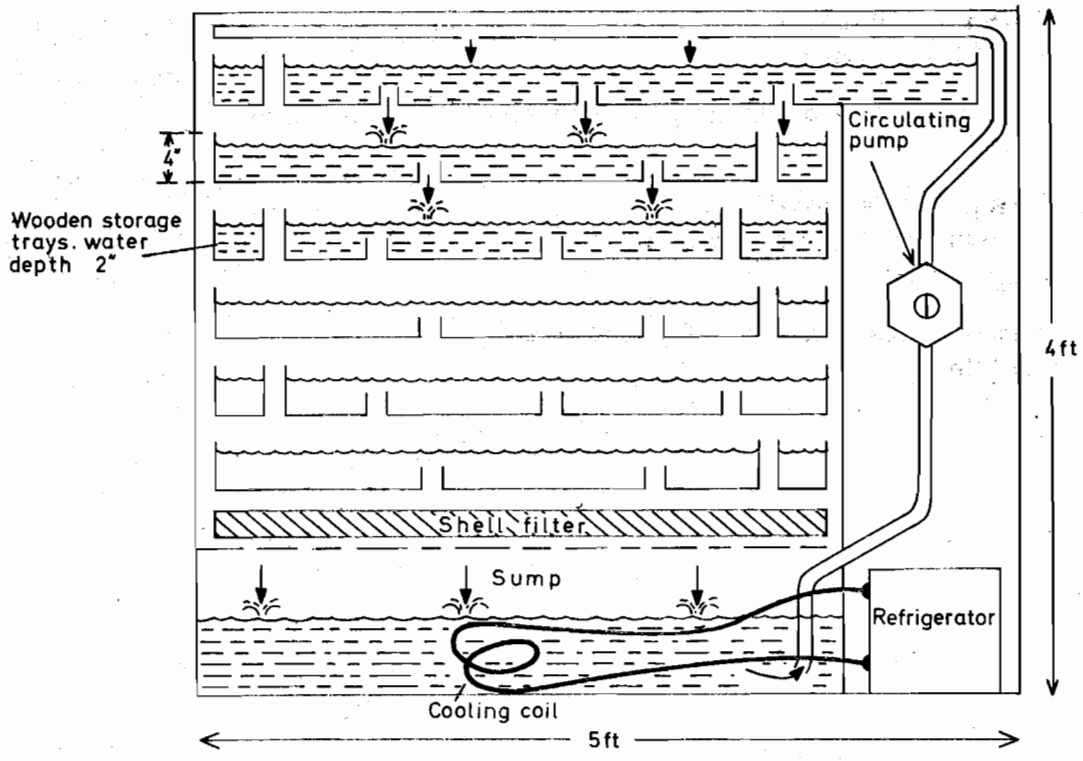

Figure 6 Section of self-contained storage unit to hold 250 lb of lobsters. The unit consists of 6 trays, each holding 5 lb/ sq ft; volume of water 65 gallons, rate of flow 250 gallons per hour, water temperature 50°F.

SOME DO'S AND DONT'S

Table 2 summarizes some of the major factors to be considered in lobster storage. It should always be borne in mind that although successful lobster storage is not difficult, breakdown of equipment in the system can result in very expensive losses of stock. It is therefore advantageous to make provision for such occasions by having stand-by equipment available and by the installation of alarm systems and fail-safe devices.

Table 2 A check list for successful lobster storage

DO'S	DONT'S
1. Check animals daily - remove weak or damaged lobsters	1. Attempt to store soft, weak or damaged lobsters
2. Turn over stock frequently on a rota system	2. Handle lobsters roughly
3. Avoid toxic materials in construction and operation	3. Feed lobsters in tanks; this creates more problems than it solves!
4. Band or tie claws securely	4. Cut or peg claws to prevent fighting
5. Check salinity and temperature regularly	5. Cause sudden changes in temperature or salinity
6. Keep water temperature between 40°F and 50°F (4.5-10°C)	6. Expose lobsters to extremes of temperature, i.e. near freezing or excessive warmth (and dryness)
7. Change water frequently or fit an efficient filter system	7. Overload storage systems
8. Keep tanks shaded and away from bright lights	8. Overfill tanks with water - shallow water is adequate
9. When preparing artificial sea water use correct weight and chemical composition	
10. Keep lobsters in a single layer where possible	

SUGGESTIONS FOR FURTHER READING

General reference books

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WOOD, P. C., 1966. Lobster storage and shellfish purification. Lab. Leafl., Fish. Lab. Burnham, No. 13. 15 pp. (Out of print).

For further information on lobsters/lobster storage contact:

Scotland	Department of Agriculture and Fisheries for Scotland, Marine Laboratory, Victoria Road, Aberdeen, Scotland AB9 8DB Telephone: Aberdeen (0224) 876544
England and Wales	Ministry of Agriculture, Fisheries and Food, Fisheries Laboratory, Remembrance Avenue Burnham-on-Crouch, Essex CM0 8HA Telephone: Maldon (0621) 782658