Open Learning Materials

SEAFISH

Handling, Transport and Storage of Live Crabs and Lobsters

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Handling, Transport and Storage of Live Crabs and Lobsters

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A Guide for Open Learners

This will help to explain what open learning is all about. It will help you to make the best use of your open learning module.

WHAT'S SO GOOD ABOUT OPEN LEARNING?

Open learning gives you freedom to choose. You study:

- what you like;
- where you like;
- when you like;
- at a pace to suit you.

You can pick the subjects you want. You don't have to be in a certain classroom at a certain time. You won't be bored because the teaching is too slow, or lost because it's too fast.

You seldom need any qualifications before you are allowed to study.

All this freedom lets you fit your studying into your daily routine.

The best thing about it for most people is that they can study without taking valuable time off work.

Modules are written in a way that allows you to study without help. However, it is expected that you will need assistance from time to time and this can normally be provided.

THINGS YOU SHOULD KNOW ABOUT YOUR MODULES

What is a module?

A module is the name we have given to a study package. It will have a printed text. In a few of them there will be audio or video tapes as well.

Each module will be divided into segments. You could think of each segment as a lesson.

Before you begin

Each module will have a short introduction. You will be given a list of things you will need. For some modules, special equipment will be needed. We can supply most of this. This section will also tell you if you need any knowledge or experience before you begin. Check that you have everything you need.

Objectives
Modules are based on objectives which tell you what you will be able to do when you have finished. These are clearly stated. You should check that the module objectives match your own reasons for studying. You will be told when you have achieved each one of the objectives. In this way you can easily keep track of your own progress.

SAQs
This is short for **self assessment questions**. These questions are carefully designed to help you. They let you know how you are getting on. They help you to find out any problems that you may be having with the material and help you to put them right.

Don't be tempted to skip these questions. Don't look at the answers before you try them! You will only be cheating yourself.

Where you are expected to write an answer, a space will be left in the text. Remember the module is your learning tool, not a textbook, so go ahead and write on it. **Don't** try to keep an answer in your head until you have checked it. **Always write down your answer first.** Writing the full answer down is very important, it makes you really think about what you are doing. The wide margins are also there for you to make notes in.

You will notice that the numbers given to the S.A.Q.s are out of sequence. We did this on purpose. This is to stop you from accidentally seeing the answer to the second S.A.Q. when you are looking at the response to the first. The responses to the S.A.Q.s are at the back printed on yellow paper. They are in the correct number order. We have called them responses because they are usually more than just answers. It is a good idea to read the whole response every time. It usually helps to know about common mistakes even though you got the right answer.

S.A.Q.s are shown by a box with a question mark and the number of the question.

? SAQ23

Important information
Other boxes are used to show different types of information. This box with the  in the top left corner contains important information.

Warnings
This box with the warning sign gives information about possible dangers, health hazards, etc.

Definitions
A box with smaller print is used for definitions and extracts from documents.

smaller print

Other emphasis

Shading like this is used to pick out important sentences and paragraphs.

Bold type is used to make **important words** or **numbers** stand out.

HELP IF YOU GET STUCK

At the time of obtaining your module you will be told of any support which can be arranged. This might be through one of the following:

- telephone;
- face to face meeting;
- letter;
- contact with your local Group Training Association for advice.

Questionnaire

Some modules will be accompanied by questionnaires. The questionnaire is your chance to help us. Your answers are our way of finding out if any changes are needed. If there is one, please remember to fill it in and return it.

HINTS ON STUDYING

When?

Try to get into a regular study routine. Set aside times for study but be ready to give and take a bit. Miss one of your planned sessions if you must, but try to make it up later.

Set yourself realistic targets such as 'I will finish segments one and two by this weekend' and **stick to them!**

Grab the chance to study at odd moments. You'll be amazed how much you can learn in fifteen minutes. It's difficult for the average person to really concentrate for more than 20 minutes at a time anyway. A word of warning - don't think you can learn anywhere. You need to be able to concentrate, there are often distractions which prevent this.

- Time spent just **reading** a module is not the same as time spent **learning.**

- You must become involved, the best learning happens when you're active, e.g. answering questions and making notes.

- Don't study for too long without a break.

This module will remind you of suitable places to stop for a while, but if you need a break earlier, take one. It's entirely up to you.

Where?
Try to find somewhere where you will not be distracted. Almost anywhere will do. It all depends on how you are placed at home and at work. Don't forget your local library. Fishermen might find their local mission is able to help, especially with video equipment.

The secret is, **be flexible.** If the kids are having a party, go to Auntie's. If she's not in, go to the library. All you need is somewhere where you can get on with it and not be disturbed.

Carry your module with you when you can. Try to find gaps in your normal routine when you could do some useful studying.

Now that you've decided to have a go, **stick with it!** Don't give up. Most people find studying hard at times, this is quite natural. It is also quite natural to need help with parts that you find especially difficult. However, we're sure you'll find it worthwhile.

Introduction

This module is intended to assist anyone involved in the handling, storage and transportation of **live** shellfish after **catching and landing has taken place.**

The aim is to help you to maintain the animals in good condition throughout. To achieve this the module describes recommended methods for handling, storing in natural and artificial sea water and transporting in water and in air.

The term shellfish covers a wide range of marine animals. This module deals only with those shellfish which are called **crustaceans.**

The particular species of shellfish covered by this module are as follows:

- Brown Crab;
- Green Crab;
- Velvet Swimming Crab;
- Spider Crab;
- Lobster;
- Crawfish;
- Nephrops.

NOTE: The module **does not cover** the handling, storage and transportation of the species of shellfish known as **molluscs** such as mussels, scallops and oysters.

The module includes an appendix containing references to technical reports and statutory regulations. You should become familiar with these regulations and reports and read through them after completing the five segments of the module.

A second appendix gives the addresses of the appropriate Government Offices in England, Scotland and Northern Ireland.

Pre-Entry Requirements
No previous knowledge is assumed although you would probably find it helpful if you have some experience of handling and can identify some of these animals. You may also find the module 'Fish and Shellfish Identification' useful although the species mentioned above are only a small minority of the total covered by the module.

Equipment Required

No special equipment is required. You will only require a pen or pencil to answer the SAQs in the spaces provided.

Objectives

When you have completed this module you should be able to:

1. Identify some common species of crustaceans and explain how they function.

2. Describe ideal conditions for holding live shellfish in water.

3. State the advantages to be gained from the storage of live shellfish and describe suitable storage facilities.

4. Describe methods of transporting live shellfish in air and state some of the problems encountered.

5. Describe methods of transporting live shellfish in water and state some of the problems encountered.

Segment One

Shellfish are Living Creatures

Segment One - Shellfish are Living Creatures

INTRODUCTION

This first segment includes a brief description of the crustaceans dealt with in the module. It gives a background to the biology of these animals so that you will have a basic understanding of how they function and why they cannot live for long periods out of water.

AIMS OF THE SEGMENT

The main aim of the segment is to help you to achieve Objective One given on page xiii.

When you have completed the segment you should be able to:

- Identify species of crustaceans from drawings and descriptions given in this segment;
- Describe what is meant by the terms combustion, breathing and respiration;
- Describe one function of the gills;
- State where the gills are found on a crab or lobster;
- Explain why shellfish die in air;
- List factors that can lead to heavy losses when shellfish are taken into air.

MAIN FEATURES OF THE SHELLFISH

Let us start by looking at each species in turn and find out some background information on their biology.

REMEMBER: In this module we're only interested in this module with those shellfish that are:

- known as crustaceans;
- supplied to the market live.

Here's the list of shellfish again, together with alternative common names and their Latin names.

- Brown crab or common edible crab; Cancer Pagurus;
- Green crab or shore crab; Carcinus Maenas;
- Velvet swimming crab, Wooley or Fiddler crab; Liocarcumus Puber;
- Spider crab; Maia Squinado;
- Lobster; Homarus Gammarus;
- Spiny or Rock Lobster; Palinurus Vulgaris;
- Nephrops, Scampi, Dublin Bay Prawn, Norway Lobster, Langostine, Prawn; Nephrops Norvegicus.

Brown Crab (Edible Crab)

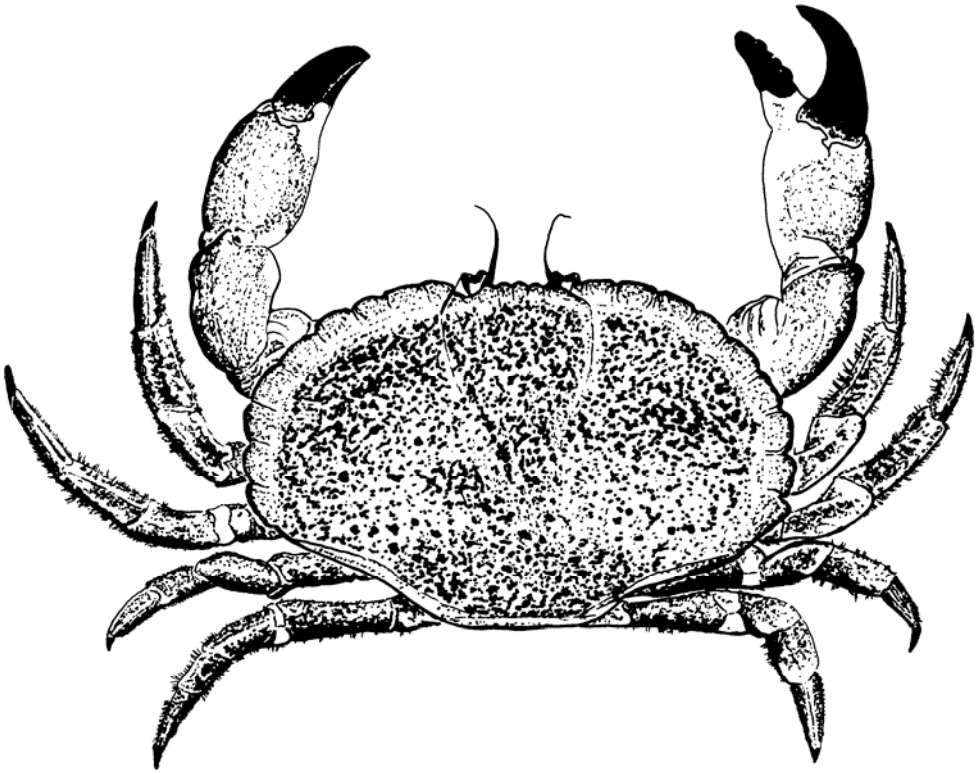


Figure 1 Brown Crab

Average carapace breadth of 150mm with a maximum breadth of 250mm. Edible crabs live on sandy or rocky ground in depths of 1-30m in summer, 30-50m in winter, around the entire British coastline. The edible crabs have a slow growth rate, reaching sexual maturity at between five and six years old. Caught in baited traps, its natural colour is brownish/purple but it becomes brownish/red after cooking.

Green Crab (Common Shore Crab)

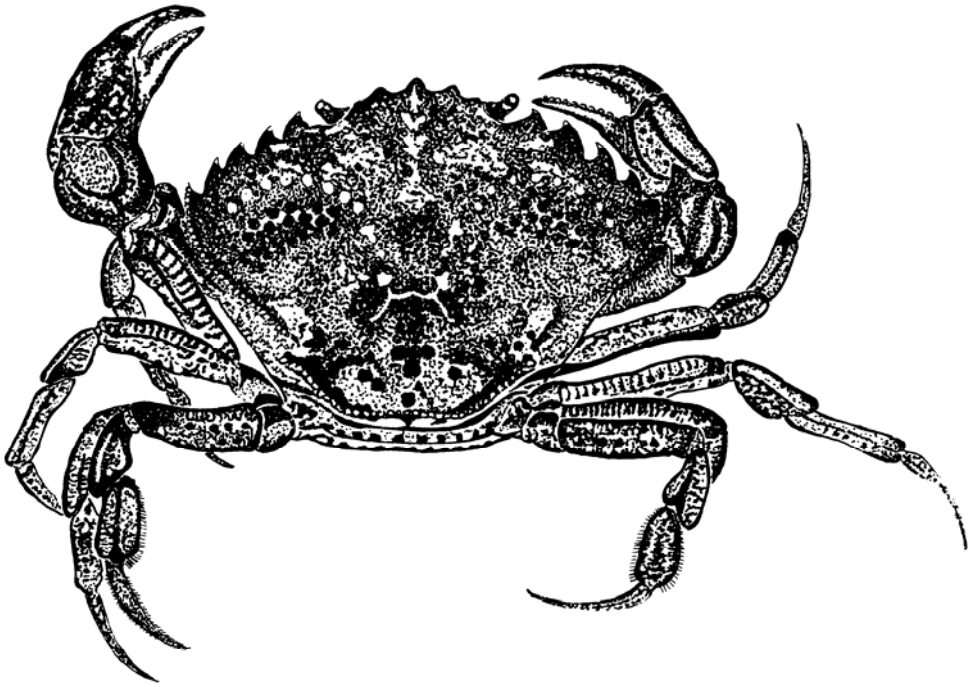


Figure 2 Green Crab

Average carapace breadth of 50mm with a maximum carapace breadth of 90mm. This crab can be intertidal. In the summer months it is found between the high and low water tide marks where it comes into air at night to feed. Its colour is variable dark green/grey with white, yellow and orange marks. Caught in baited traps.

Velvet Swimming Crab

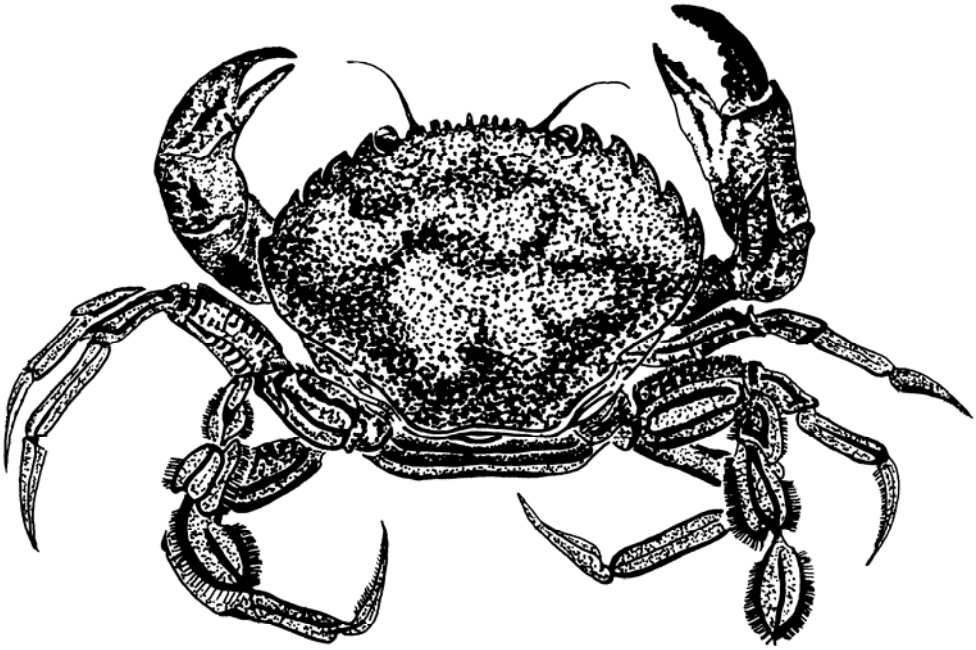


Figure 3 Velvet Swimming Crab

Average carapace breadth of 70mm with a maximum carapace breadth of 100mm. This crab is found mainly on the Atlantic coastline of the UK and in smaller numbers on the east coast of England and Scotland. It is widespread in rocky areas where there is a lot of water movement. It is a dirty brown colour, has a blueish tinge to its limbs and red eyes. It gains its name from the top shell being covered with fine hair. It is caught in baited traps.

Spider Crab

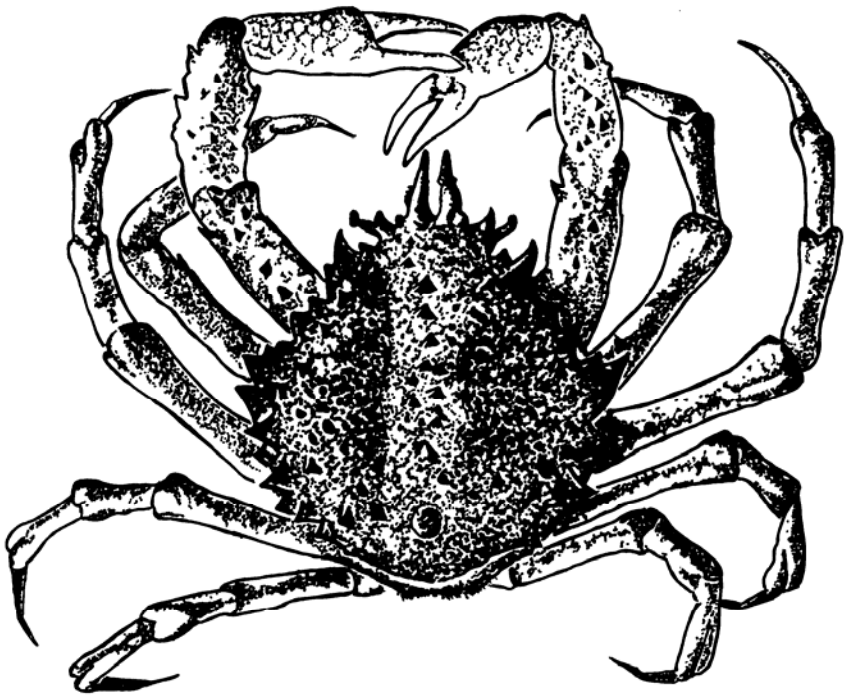


Figure 4 Spider Crab

Average carapace breadth of 80-110mm with a maximum breadth of 180mm. This crab is mainly restricted to the South West coast of England, where it moves around slowly, over rocks and seaweed from depths of 0-50m. These crabs are caught in baited traps/pots, mainly in the summer months. This shellfish is white with pink/red coloured spots.

Lobster

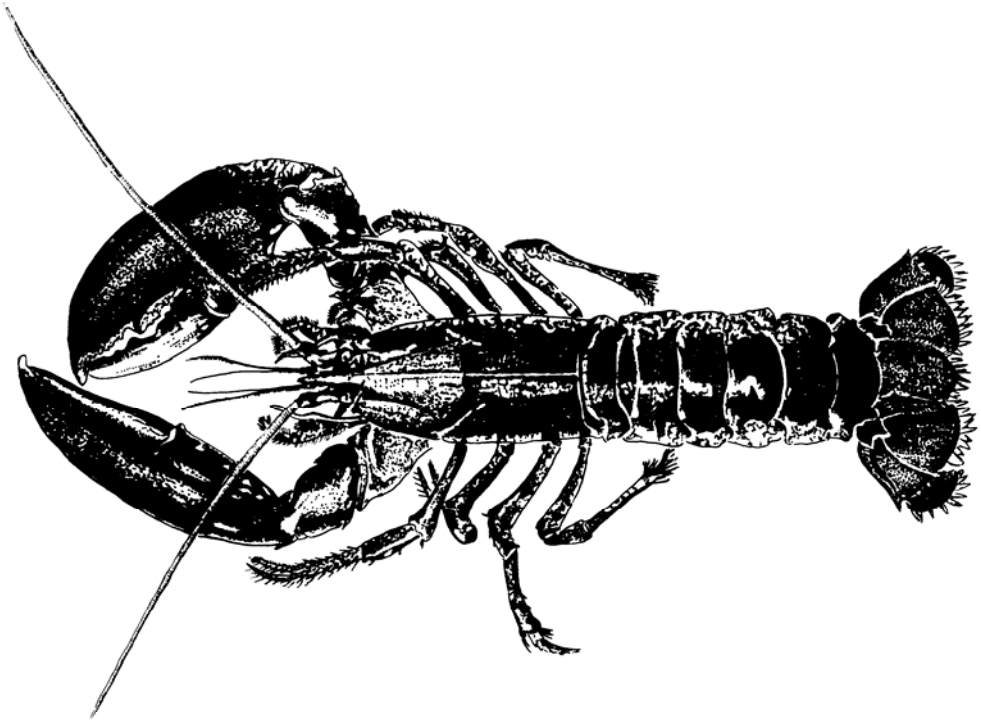


Figure 5 Lobster

Average length of 280mm with a maximum length of 500mm. The European Lobster is found all around the coast of Britain living on rocky bottoms in depths of 2-40m, where it is caught in baited pots. Armed with two strong claws, the larger one is used for crushing and the smaller for feeding. The lobster fiercely guards its own territory. It has a slow growth rate which is dependent on water temperature. The lobster is blue/black in colour on an orange background, paler and mottled underneath and turns red when boiled.

Crawfish

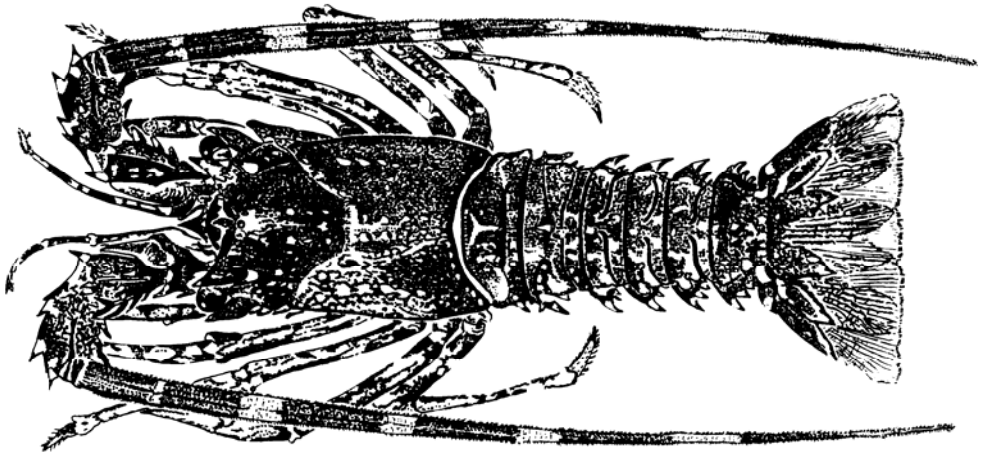


Figure 6 Crawfish

Average length of 300-400mm with a maximum length of 500mm. This shellfish is caught off the South West coast of the British Isles, Western Wales, Western Scotland and the Hebrides. It is without claws. The crawfish lives on rocky bottoms between 50-100m. migrating from North to South in winter, hence the fishery is seasonal. It is caught mainly in traps. It is red/brown in colour with stripped antennae.

Nephrops

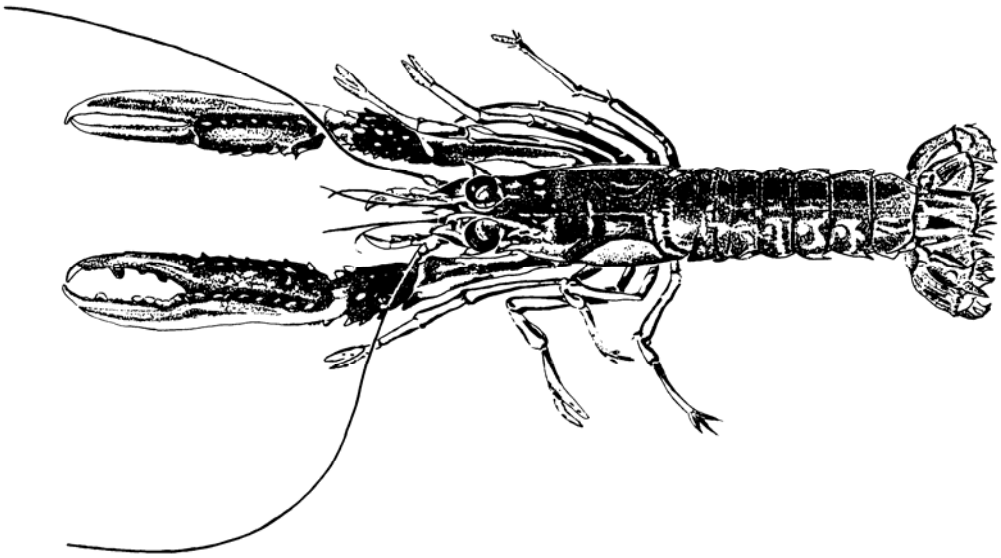


Figure 7 Nephrops

Average length of 120mm with a maximum length of 190mm. The Norway Lobster lives all around the UK in depths of between 10-250m on soft bottoms, usually spending the day in burrows and coming out at night. Caught in both baited pots and trawls. Bright orange/red in colour.

THE IMPORTANCE OF ENERGY TO LIVING ANIMALS

- All animals use energy.
- They need energy to work.
- They need energy to stay alive.

Where do animals get their energy from?

We all know that the energy source for a car engine is petrol. Any idea what the energy source for an animal is? The answer is food.

Food is broken down inside an animal to release energy. More energy is released from food if oxygen is present. Oxygen is found in the air we breathe. In the presence of oxygen a chemical reaction takes place which is known as **combustion**.

COMBUSTION

Let's look at a well known example of combustion.

A Burning Candle

Figure 8

- candle wax burns in air, which contains oxygen, to give;
- light and heat (forms of energy);
- a waste gas called carbon dioxide.

This reaction can be summed up as:

CANDLE WAX + OXYGEN ----► CARBON DIOXIDE + WATER + ENERGY

In animals the combustion of food is summed up as:
FOOD + OXYGEN ------► CARBON DIOXIDE + WATER + ENERGY

Now let's compare a non-living machine, a car, with a living machine, a crab:

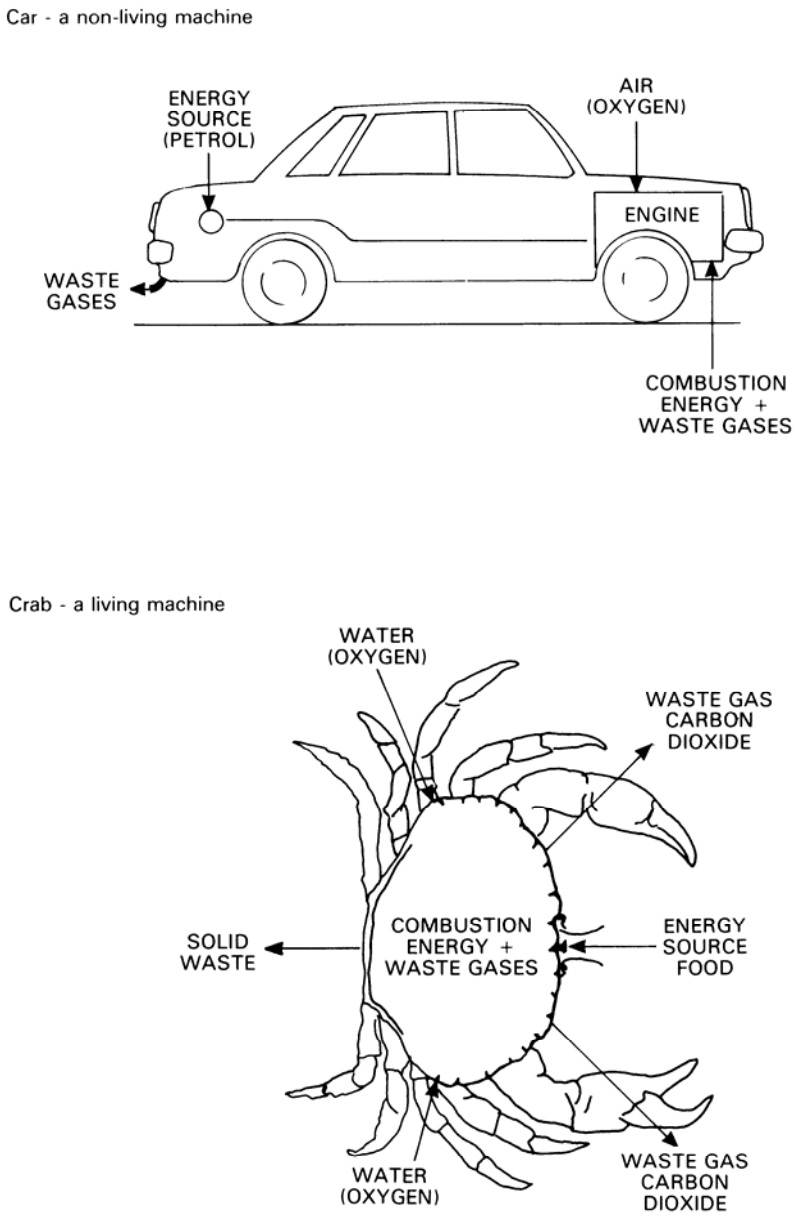


Figure 9 Combustion in Living and Non Living Machines

In a car, combustion takes place in the engine. In a crab, like all other animals, combustion takes place in the cells.

The cells are small units that make up the organs in the body. Muscles, heart and brain, to name just a few, are all made up of these units.

BREATHING

By now you should know that:

- animals need energy all the time to stay alive;
- energy is obtained from food when it is broken down by combustion in the presence of oxygen.

You will also know that animals get their food and oxygen from their surroundings. However, combustion takes place inside the body. Food and oxygen have to be taken in and carried to the cells.

Animals take in food when they eat and oxygen when they **breathe**.

Breathing is the exchange of oxygen and carbon dioxide between the animal and its surroundings.

When an animal breathes, oxygen passes into the blood. The blood then carries the oxygen to the cells where combustion takes place. The carbon dioxide that is produced passes back into the blood to be taken back to the outside.

Look at the diagram below. We have drawn the crab as a box to make things easier for you to understand. It is important to remember that the real life situation is much more complicated. But this simple diagram tells you all you need to know.

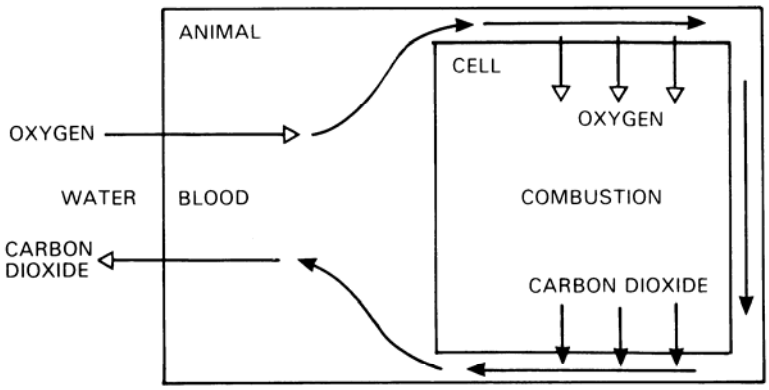


Figure 10 Combustion in an animal cell

Follow the arrows through to sort out the story.

Start with oxygen in the water outside the animal. It is carried in the blood to the cells.

It passes into the cells where combustion takes place.

Carbon dioxide passes back into the blood to be carried to the outside.

The closed arrows show the flow of blood around the cells.

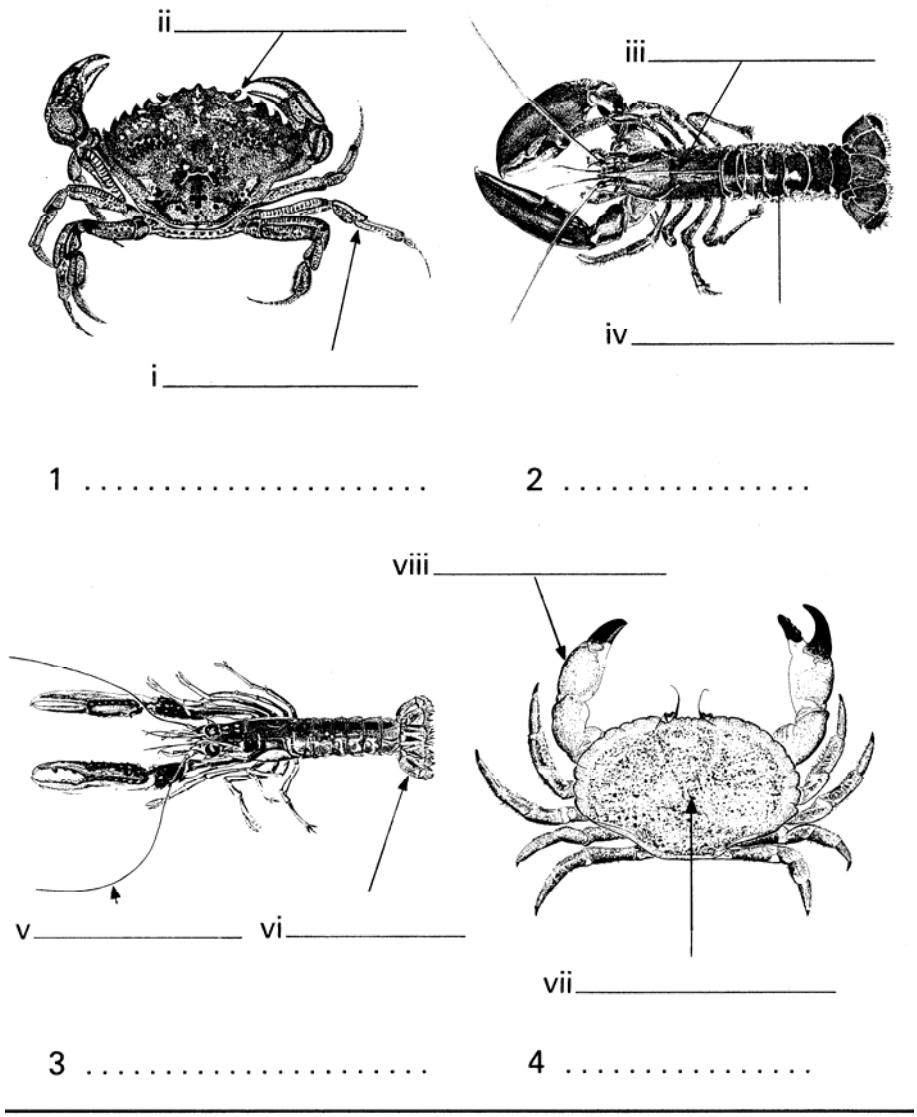
RESPIRATION

The word **respiration** is used to describe all the processes involved with the release of energy. It includes both **combustion** and **breathing**.

Now try the followings SAQs to see if you have understood the information so far.

? SAQ5

Identify the species (1-4) of the crustaceans shown below. Fill the blank labels (i – viii) on the diagrams.



? SAQ9

Decide whether each statement is true or false and put a circle around T or F.

1)	All animals make energy.	T	F
2)	All animals need energy.	T	F
3)	Energy is used for work.	T	F
4)	A dead animal needs energy.	T	F
5)	To stay alive, animals must have food and oxygen.	T	F
6)	Combustion of food gives carbon dioxide, water and energy.	T	F

? SAQ13

Fill in the missing word in each of the following.

A. …….. is the breakdown of food in the presence of oxygen to release carbon dioxide and energy.

B. ……. is the exchange of oxygen and carbon dioxide between the animal and its surroundings.

C. ……. is the process involved with the release of energy.

GILLS

The simple cell diagram, figure 10, showed that oxygen passed from the water into the animal and was taken into the cell by the blood. Similarly, carbon dioxide, a waste gas, is carried from the cell by the blood to be released into the water.

What is missing from this diagram?

Answer: It does not show how the transfer of the gases between the water and the blood takes place.

The important parts that figure 10 did not show are the special structure called **gills**.

At the gills:

- oxygen is taken up from the water into the body;
- carbon dioxide is released from the body into the water.

Figure 11 shows you what we mean.

This is a gill from a crab. You may know them as dead man's fingers. It has been cut in half to show the flow of blood inside the gill. Look at the arrows. Each gill has many branches. Exchange of oxygen and carbon dioxide takes place over all the branches.

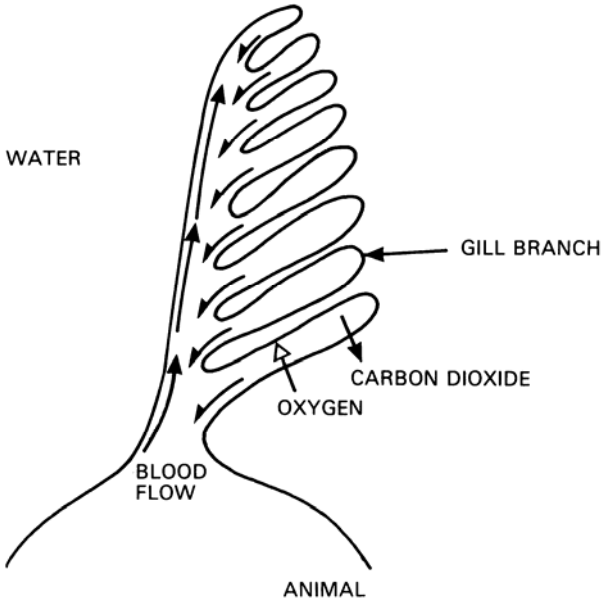


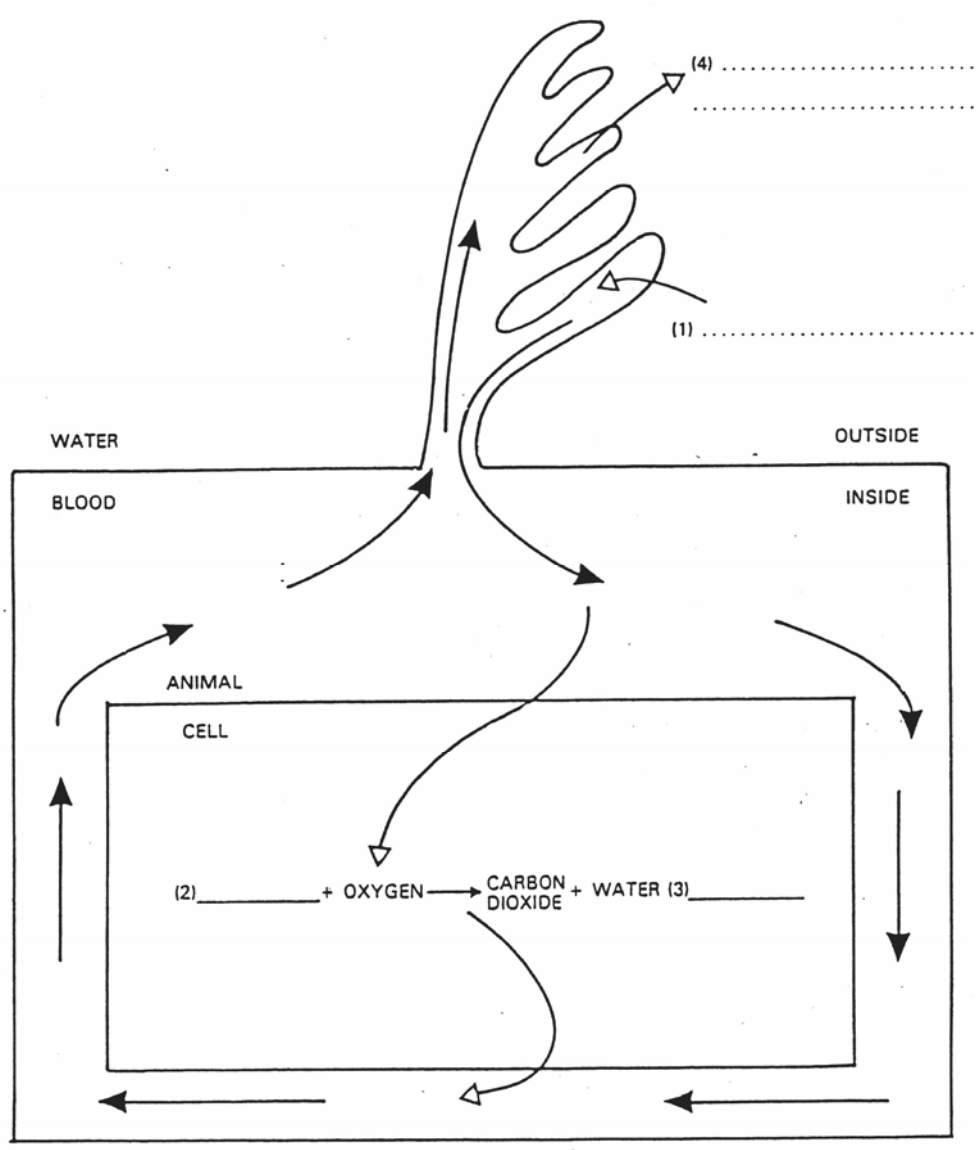
Figure 11 Gill of a Crab

Gills are designed to work when surrounded by water. Oxygen dissolved in the water passes through the gill and into the blood. Carbon dioxide, the waste gas, passes in the opposite direction. This process is called breathing. We covered this in the response to SAQ2.

Now try another SAQ:

? SAQ17

The diagram below summarises the process of respiration in a crab. Test your knowledge of the terms we have talked about by filling in the spaces for the list. Remember, this diagram is not drawn to scale.



FOOD	COMBUSTION	BLOOD
ENERGY	CARBON DIOXIDE	OXYGEN

Location of the gills
Where are the gills?

In shellfish the gills are very delicate organs and lie along the body just underneath the shell.

They occupy their own protective chambers which are open to seawater.

Each crab or lobster has two gill chambers. One on either side of the body. Look at the diagrams below. The shells have been cut away to show you the gills.

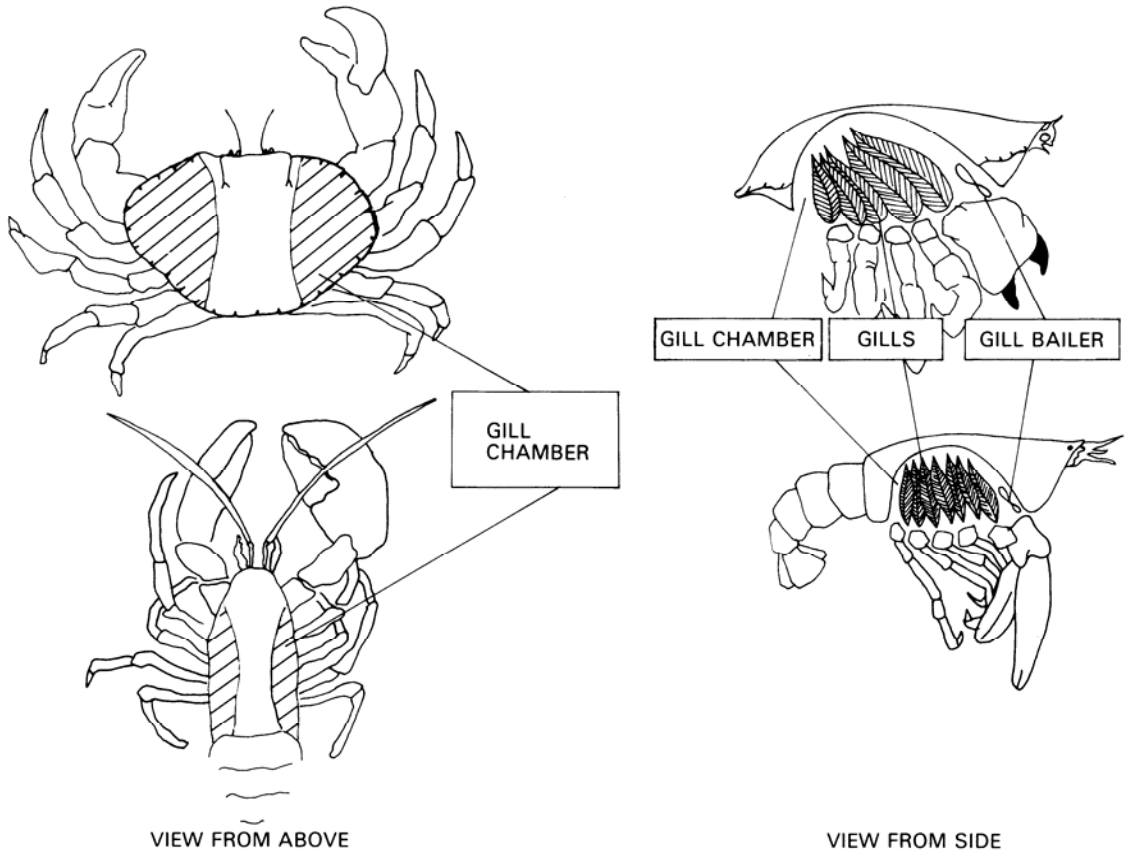


Figure 12 Location of Gills in Crabs and Lobsters

Sometimes the gills are called “dead man’s fingers”. Most people think they are poisonous to eat but this is not true.

The gills take up a lot of room.

They are an important part of the body.

Paddle like structures called gill bailers pump water over the gills. This sets up water currents in the gill chamber to :

- bring in a fresh supply of water containing dissolved oxygen;
- carry away the carbon dioxide.

The gills also get rid of ammonia, another waste gas. This gas is produced when proteins are broken down in the cells. Shellfish eat other animals so their diet is high in protein.

If we removed one side of the gill chamber in a lobster this is what we would see:

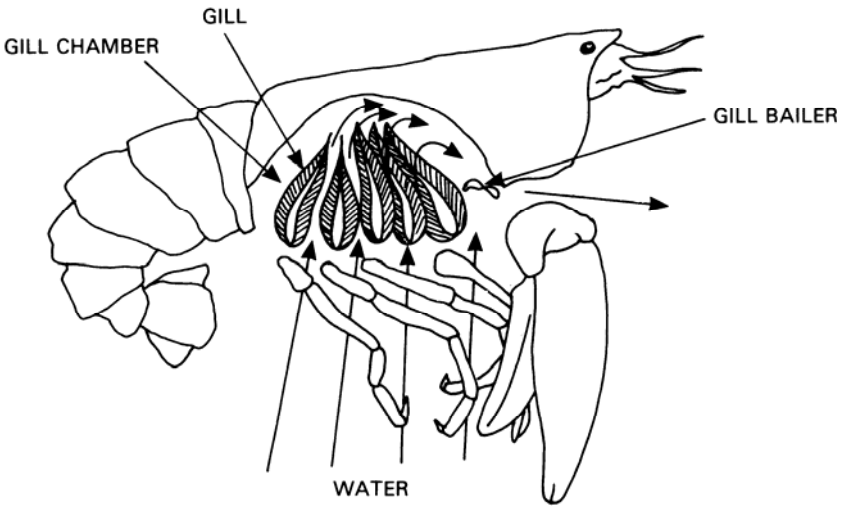


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Figure 13 Lobster Gill Chamber

The arrows show which way the water is drawn into and out of the gill chamber.

It is important that crabs and lobsters get a continuous supply of fresh water to:

- bring oxygen to the gills;
- carry carbon dioxide and ammonia away from the gills.

Because the gills are thin and delicate they are easily damaged. In crabs and lobsters, gills are protected by the outer shell. In the sea, gills are supported by the water.

SHELLFISH OUT OF WATER

What happens to the gills when shellfish are removed from the sea?

They clump together. Remember that they are thin and delicate and need support from the water.

- Without water, gills are poor at taking up enough oxygen.
- They are also poor at getting rid of carbon dioxide and ammonia.

We can say that shellfish find it difficult to breathe when they are in air. There is a shortage of oxygen in the blood and a build up of carbon dioxide and other waste products.

Carbon dioxide and ammonia are waste gases. When the levels build up in the blood they can kill the shellfish. Other waste substances also build up in the blood when shellfish are in air. You don't need to know what these substances are, just remember:

When shellfish are in air they find it difficult to breathe and waste substances build up in the blood to a level which can kill them.

Without oxygen the animals suffocate.

They drown in air. Yes, this is the same problem that you would come across if you were drowning in water. Your lungs would be unable to use the dissolved oxygen. Lungs can only work in air. Gills work best in water.

When shellfish are removed from water their gills clump together. They find it difficult to breathe. They also lose water through their gills. This can lead to serious problems because:

- The gills dry out and the shellfish find it even more difficult to breathe;
- The blood becomes more concentrated;
- The shellfish lose weight.

These changes will eventually kill the shellfish if they are not returned to water.

As you can see, shellfish have problems staying alive when they are in air. Given time they will die because:

- they find it difficult to breathe in air;
- waste substances build up in the blood;
- they are losing water.

You'll be hearing about these problems again in segment four when we talk about transporting live shellfish in air.

Although shellfish find it difficult to breathe in air, they can survive much longer than we can under water. Some shellfish can survive out of water longer than others. Green crabs, brown crabs and lobsters cope much better out of water than velvet swimming crabs, spider crabs and nephrops.

Green crabs are usually the best at surviving out of water. They can usually survive for at least two days if they are kept in the right conditions. Brown crabs and lobsters will usually survive out of water for at least 24 hours or even longer under favourable conditions. They won't suffocate if they are treated correctly. We will be looking in Segment Four at the best conditions in which to keep live shellfish when they are out of water.

Velvet swimming crabs, spider crabs and nephrops will suffocate and die if they are left in air for any length of time. Velvet swimming crabs will often die within four hours of being out of water. These crabs lose water and accumulate waste products very quickly when they are in air. Their gills dry out and become permanently damaged. It is **very important** that velvet swimming crabs are kept in water as much as possible and never left in a dry atmosphere.

TEMPERATURE AND STRESS

Two very important considerations when trying to maintain the shellfish in good condition are:

- maintaining a suitable temperature for the animal;
- ensuring they are not in a condition of stress.

The common factor between both of these is that they can lead the animal to consume more oxygen.

Temperature

You now know that animals need energy to do work. The energy comes from food when it is broken down in the presence of oxygen to give carbon dioxide as a waste product.

When shellfish are warmed up, they use up more energy and also produce more carbon dioxide and other waste substances.

This is why warm shellfish suffocate more quickly in air than cold shellfish.

Temperature is also an important factor when shellfish are in water. Warm water can carry a smaller amount of dissolved gases, such as oxygen, than cold water.

When the water temperature is high, shellfish use up more oxygen and there is less available to them. If the water is not aerated it will stagnate and the shellfish will die. They will drown in water without oxygen.

Stress

Handling leads to stress which may lead to death. Stressed shellfish are more active and use up more oxygen and energy. They produce more carbon dioxide and other waste substances. This is more of a problem if the shellfish are out of water. These internal changes can kill the animals as we have explained on pages 20 and 21.

Stress can occur at any point in the journey from fishing vessel to customer. The effects of stress can't be seen straight away. Death may take several hours or even days.

That is why it is so important to **reduce stress** at all stages of the journey.

Live shellfish must be treated with respect. Remember, you are dealing with living creatures. They must be handled carefully, especially when the animals are out of water. That means they must not be thrown around or picked up by the claws or legs. We will talk about bad handling practices in more details in Segments Four and Five.

Now here are two final SAQs for you to work your way through.

? SAQ21

1. Place a tick against the answer which is the odd one out.

   Shellfish can only survive in air for a short time because:

   A. Their gills clump together
   B. Waste substances build up in their blood
   C. They find it easy to breathe in air
   D. They lose water

2. Place a tick against the crab which is the best at surviving out of water:

   A. Spider crab
   B. Brown crab
   C. Velvet swimming crab
   D. Green crab

? SAQ1

Shellfish will die if they are left in air too long. Name three causes of death from the list below. Some words have already been put down to help you decide.

1. Shortage of

2. Build up of

3. Loss of

air waste substances oxygen energy water

SUMMARY

By now you will be familiar with some basic biological terms. Here is a reminder of the ones we have been looking at:

- all animals need **energy** to stay alive;
- energy is released during **combustion** of food in the presence of oxygen;
- animals take up oxygen and get rid of carbon dioxide when they **breathe**;
- **respiration** is the term used to describe the total process involved in the release of energy.

Shellfish find it difficult to stay alive when they are in air. They have problems breathing because their gills clump together. Gills do not work well in air. Shellfish suffer from shortage of oxygen, and waste substances, including ammonia, build up in the blood.

High temperatures and stress can cause heavy losses when shellfish are in air because they:

- need more energy;
- need more oxygen;
- produce more waste substances.

These points are very important. They will help you later on when we talk about the problems that shellfish come up against when they are out of water.

You have now achieved Objective One given on page xiii. Now you have a good background knowledge ready for the next four segments.

Time to take a well earned break and think over what you have read so far.

Segment Two

The Best Conditions for Holding Live Shellfish in Water

Segment Two – The Best Conditions for Holding Live Shellfish in Water

INTRODUCTION

This segment deals with the main factors contributing to the successful storage of shellfish in water.

They are:

- the quality of the holding water;
- the quality and handling of the shellfish.

AIMS OF THE SEGMENT

The main aim of the segment is to help you to achieve Objective Two given on page xiii.

When you have completed this segment you should be able to:

- list the most important factors that influence water quality;
- state the levels at which these factors must be maintained;
- describe the methods used to check water quality;
- state the main problems that can lead to heavy losses during storage and transport in water.

QUALITY OF THE HOLDING WATER

The survival of live shellfish during storage and transport in water mainly depends upon the quality of the water.

It is important that the quality of the water is similar to that of the open sea.

Changes in water quality are very small in the open sea. Similarly, changes are also small in storage units which have a continuous supply of fresh seawater available.

However, changes can be greater in:

- storage systems which use recirculating water;
- small volumes of water used in the special lorries which can be used for transporting the animals. These are called **vivier lorries** and are described in Segment Five.

In both of these cases, the water quality **must be regulated**.

FACTORS AFFECTING THE QUALITY OF WATER

There are four main factors which influence water quality. They are:

- oxygen supply;
- temperature;
- salinity;
- pollution.

Changes in the levels of these factors from those found in the open sea can seriously damage the health of the catch. Large changes will weaken and kill the shellfish.

Let us now look at the reasons why these factors are so important and also how they are sometimes dependant on each other.

Oxygen Supply
You found out in Segment One that shellfish need oxygen to stay alive. They take up oxygen all the time. Oxygen must be added to the water to stop the supply from running out. This is usually done by aerating the water with a supply of compressed air.

Ideally, the water should be filled with air bubbles which should be as small as possible. Smaller bubbles are more effective at aerating the water.

If the water runs short of oxygen it stagnates. This causes many problems. We will be talking about these later on.

Temperature
Temperature can influence water quality in several ways.

- Shellfish are more active at high temperatures. They move around and use up more oxygen. So the oxygen dissolved in the water runs out more quickly.

- Warm water holds less dissolved oxygen than cold water.

- Crabs and lobsters produce more waste substances at high temperatures. If these substances are allowed to build up and foul the water, they can poison the shellfish. **This dangerous situation must be avoided**.

- Bacterial build up is greatly increased in warm water.

The water temperature should be low during storage and transport. High water temperatures cause too many problems. In particular, the shellfish should not be subjected to sudden large temperature changes as they are moved between water and air; this would cause shock and stress to the animals.

You must be careful that the temperature does not fall below 5°C. This would cause the shellfish to go into cold shock. Below 0°C they will freeze. This will lead to many deaths.

The casting off of claws is a common response to a large temperature change. This lowers the commercial value of the product.

The correct range of water temperature is between 5°C and 10°C.

Between 5°C and 10°C:

- there is more oxygen in the water;
- shellfish are less active;
- shellfish take up less oxygen;
- shellfish produce less waste substances.

It is also important to make sure that the water temperature remains steady. **Sudden changes in temperature will shock the animals and cause more deaths**.

Salinity
Salinity is the word used to express the salt content of the seawater. We use the symbol ‰ to mean parts per thousand.

The salinity of the water should be close to that of the open sea. That is 30-35 ‰.

If shellfish are placed in water which has a salinity outside of this range, they will start to die.

Pollution
Live shellfish produce waste substances. If the waste substances are not removed they build up in the water and cause it to stagnate. The water becomes polluted. This can be avoided by making sure the water is:

- well aerated;

- at a correct temperature.

The water can also become polluted by damaged or dead shellfish.

Damaged animals will bleed and weaken. The blood will foul the water and cause it to foam. Dead shellfish will rot and release toxic substances into the water which will kill the other animals. We will deal with these problems later on in this segment.

Certain metal fittings can cause pollution problems. Suitable materials for holding storage facilities are mentioned in the next segment.

MAINTAINING THE QUALITY OF THE WATER

To keep water quality at its best, it is important to check the levels of oxygen, temperature, salinity and pollution in the water at frequent intervals. Checks are particularly important when the same water supply is used again and again.

In recirculating systems, the water should be checked at least **every day** and more often in periods of very warm weather.

During transit in vivier lorries, the water may need checking **several times in one journey**.

Checks are less important in storage units using natural seawater where the action of the tides brings in a fresh supply of good quality seawater.

Here is a check list that you could follow.

- Check oxygen levels by making sure that the water is well aerated. Make sure that the air bubbles are small and reaching all parts of the tanks. Shellfish will congregate around the aerated areas. Look to see where your animals have concentrated. If they have collected together in one small area, the water is badly mixed and the aerated water is not reaching all parts of the tank. Fan tails and angle pipes produce currents in the water and help reduce this problem.

- Check that the pressure of the compressed air supply hasn't fallen. If the oxygen supply fails completely it is safer to drain all the water away and keep the animals in air. You must remember that these animals find it difficult to breathe in air and some find it more difficult than others. **Make sure they are kept moist and cool**.

- Check water temperature by using a thermometer. Recirculating water systems may include a cooling unit which maintains the water temperature at 5°-10° as required.

- Check salinity by using a **salinometer**. The salt content of the water affects both the **density** and the **electrical conductivity** of the liquid. Salinometers which respond to one or other of these factors can be used.

  The most simple salinometer is one which responds to the changes of density. This is a weighted tube which floats in the liquid. It has a graduated scale on the upper stem. If there is more salt in the water then it has a greater density. The tubes will not sink so far into the liquid and the salinity can be read from the scale which is level with the surface of the water.

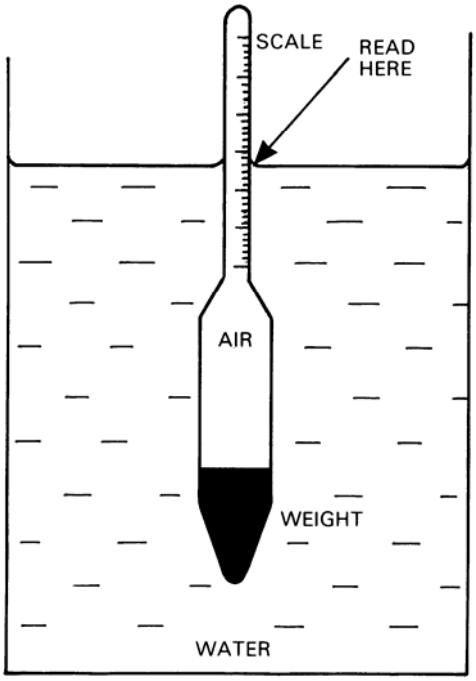


Figure 14 Salinometer

Make sure that your storage units or tanks are sheltered from rain water. Fresh water mixing with seawater will weaken the shellfish and cause them to die.

Beware of evaporation. Aerated water will concentrate the salts. The salinity may rise above 35‰. We talk about this problem in Segment Four.

Preparing artificial seawater to replace water which is too weak or too strong, is dealt with in Segment Three.

Check pollution by looking for signs of fouling such as:

- dirty, turbid water;
- scum along the water line;
- foam on the water surface.

These are tell-tale signs that some of the shellfish are damaged or dead. This is more common when the temperature is too high. Damaged shellfish can be rescued if they have lost less than three legs. If the legs are damaged the bleeding can be stopped by removing the whole leg. This is done by applying pressure to the base of the leg with a pair of pliers or similar object. This causes the crab or lobster to drop the leg and form a seal at the open joint. Shellfish with more than three legs missing can't be sold. These animals will have to be removed from the tanks.

REMEMBER: Good selection and handling practices are very important to the success of an operation. More on this subject appears in the remaining segments.

Dead shellfish and cast legs must always be removed. If they are left in the tanks they will rot, foul the water and eventually kill the healthy animals.

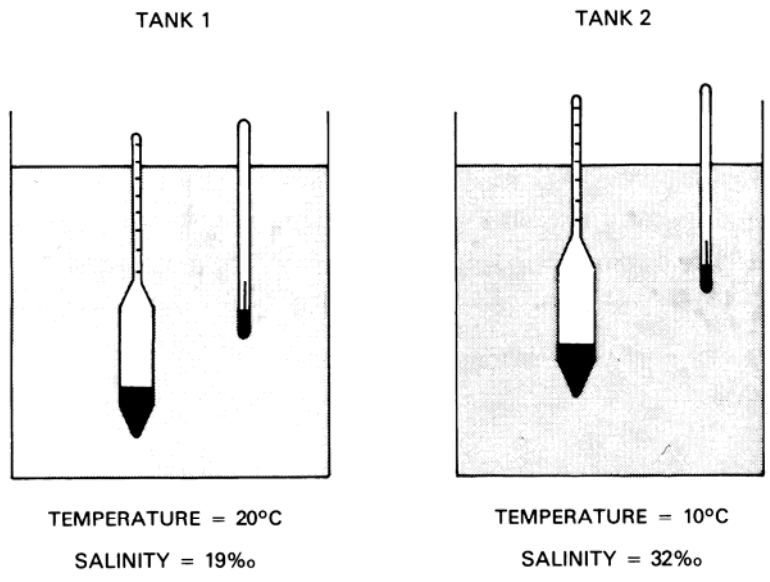
As well as removing dead or damaged shellfish, pollution can be prevented by:

- replacing the holding water at regular intervals; this is most important a few hours after loading the tanks;
- using an effective filtering system;
- paying good attention to hygiene by hosing and scrubbing the tanks at every opportunity;
- Using antifoaming agents.

Now try the following SAQ

? SAQ6

There are two holding tanks in the diagram below. Only one of the tanks contains water of a good enough quality to store live shellfish. Which one is it, Tank One or Tank Two?



DISEASED SHELLFISH

Disease can spread rapidly through a storage system or holding tank and can cause heavy losses.

The biggest problem seems to be a disease called Gaffkaemia, which infects American lobsters. It can be passed on by mixing American and European lobsters or by the re-use of water contaminated by infected animals.

The threat of disease is less if the tanks are cleaned regularly. Every time the tanks are emptied, great care must be taken to remove bits of shellfish and any other rubbish that remains. The tanks must then be hosed and scrubbed. Clean tanks are less likely to promote the spread of disease between batches of shellfish. Low water temperatures also prevent disease from spreading. **Gaffkaemia will not spread at temperatures lower than 6°C**.

Of course it will also help if diseased shellfish are removed from the rest of the catch.

REMEMBER: Never store or transport diseased shellfish. The disease will spread and infect the healthy animals.

If you find that your stock of live shellfish is diseased, ring up the Ministry and they will advise you on how to deal with the problem. There are specified procedures for getting rid of infected holding water and diseased animals.

DAMAGED SHELLFISH

Only store or transport shellfish that are in good condition. If you start off with a good quality product, you are more likely to benefit when the shellfish are sold. Unfortunately, many shellfish are damaged or killed on the journey from fishing vessel to customer. These animals must be removed from the water. Shellfish with damaged legs can be rescued as we described on page 33. Badly damaged or dead shellfish will rot, foul the water and kill the healthy animals.

Shellfish can also damage each other by fighting. Make sure that lobsters have their claws **banded** and brown crabs have their claws **nicked**.

Examples of nicked claws are shown in Segment Four.

Soft shelled shellfish must be returned to the sea. If they appear in the batch of animals that you are storing or transporting, they must be removed. These animals are more likely to get damaged and die. We told you about the problems dead animals cause earlier on.

Great care must be taken when removing damaged, dead, diseased and soft shelled animals from the catch. Careless treatment during sorting will cause even more deaths. Do not stand on the shellfish. Do not throw them about. Remember they are living creatures. They will die if they are treated badly.

OVERCROWDING

Avoid overcrowding. The number of animals that can be stored in a given volume of water will depend on the effectiveness of the storage system. If the water is well aerated and the temperature closely controlled then more animals can be held. For short term storage and journeys higher densities can be used.

We recommend about 11 litres of water per lobster in a recirculating system. Smaller shellfish will need less water. The smallest amount of water for any animal is about two litres. If you overcrowd your tanks, you risk losing more shellfish from other problems.

Overcrowding is more of a problem in a badly controlled recirculating system or tank where oxygen levels are low. Each animal will then need more water. In a badly run system large losses can occur if the shellfish are stored several layers deep.

If the system is well run then brown crabs and spider crabs can be stored several layers deep in well aerated water.

However, lobsters should be stored in one layer only.

FEEDING

Shellfish can survive for days without food. However, if they are stored for months they should be fed. In this way the catch will remain strong and healthy. Long term storage is usually only for lobsters which can be bought cheaply in the summer and sold for a higher price in the winter.

Shellfish are usually fed with salted herring or mackerel.

The amount they eat depends on:

- the water temperature, shellfish eat more when the water is warmer;

- the time of year, in winter and early spring, shellfish eat little or nothing at all.

Overfeeding must be avoided. Unused food starts to rot and fouls the water. This leads to heavy losses. It should be removed within a few hours. Animals which have been fed produce more waste products and this fouls the water.

Now try these four SAQs

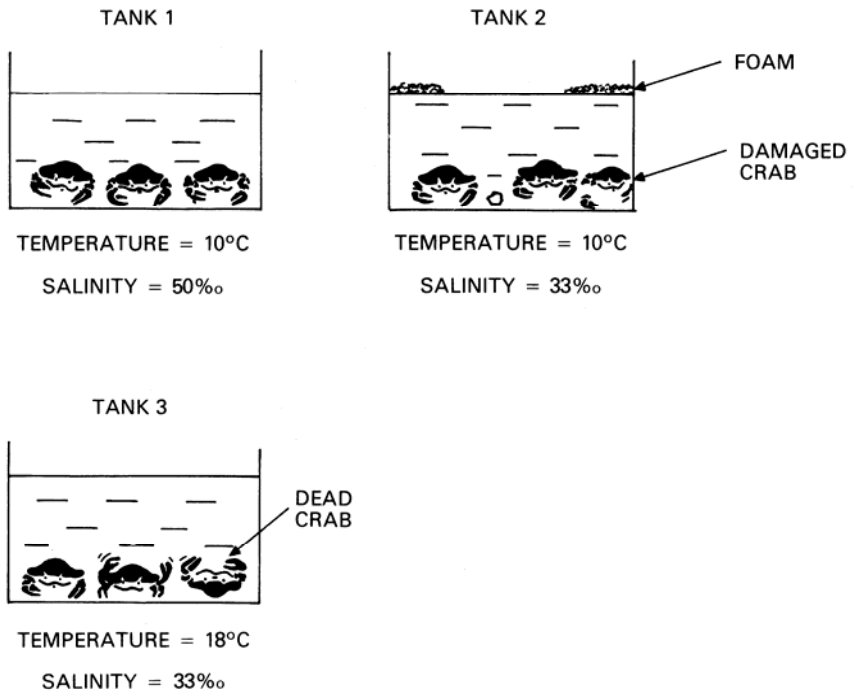
? SAQ10

The diagram below shows three tanks. In every case the water is aerated.

On checking the tanks the following situation was found:

None of them were anything like ideal.

What are the particular faults in each case?



TANK 1:

TANK 2:

TANK 3:

? SAQ14

State one sign that might indicate that the oxygen supply in a tank of holding water is inadequate.

? SAQ18

Assume that you are using a simple salinometer as shown in Figure 14 and the salt content of the holding water is too low. Will the tube float higher in the water than it would in a correct strength solution?

? SAQ22

Complete the following sentences.

1. In order to stop lobsters fighting you should ……. their claws.

2. To stop healthy crabs polluting the water the temperature should not be allowed to rise above …..… °C.

3. Overcrowded tanks cause a lack of …… for each shellfish.

4. Overactive shellfish occur in tanks where the water is too ……..

5. Always ……. badly damaged or dead shellfish from the holding water.

SUMMARY

Here is a summary of the problems that cause heavy losses when live shellfish are held in water.

- Changes in oxygen supply, temperature and salinity of the seawater.
- Holding damaged or dead shellfish.
- Holding lobsters without bands on their claws and Brown crabs without nicking.
- Holding diseased shellfish.
- Holding soft shelled shellfish.
- Careless treatment during sorting procedures.
- Overcrowding.
- Overfeeding.

All of these problems can and must be avoided if good quality animals are to be offered at the final point of sale.

You have now achieved Objective Two given on page xiii.

Time for a well earned break?

Segment Three

Storage Facilities For Live Shellfish

Segment Three – Storage Facilities for Live Shellfish

INTRODUCTION

This segment describes two types of units.

- those which use a continuous supply of natural seawater;
- those which recirculate the holding water which may be artificial or natural seawater.

AIMS OF THE SEGMENT

The main aim of the segment is to help you to achieve Objective Three given on page xiii.

By the end of this segment you should be able to:

- state the main advantages of storing shellfish immediately after landing;
- list points to look for when selecting a storage site;
- list the main features of a well designed inland storage system (or onshore system).

ADVANTAGES OF STORING AFTER LANDING

Once shellfish have been landed it may be necessary to hold them in shore-based storage units before transport to inland markets. This could be for a short time, such as overnight, or for much longer.

Long-term storage, which may last up to several months allows fish merchants to:

- make up numbers so that the value of the catch covers the cost of transport to market;
- make up numbers to fill a truck when transport is infrequent;
- take advantage of changing prices.

The third point is more important when the catch is seasonal. Prices are low when landings are up. This happens during the summer. Prices are high when landings are down which happens:

- during the winter;
- during spells of bad weather.

These factors affect lobsters in particular.

Long term storage also allows inland market dealers to supply local buyers on a daily basis.

Long-term storage will only make profits if the difference in price is great enough to cover:

- operating costs;
- losses during storage.

STORAGE UNITS USING NATURAL SEAWATER

Fish merchants storing live shellfish by the coast can make use of:

- large quantities of fresh seawater;
- the rise and fall of the tides.

There are two types of storage units using natural seawater:

- ponds;
- tanks (which may be floating, 'pontoon' type tanks).

Ponds

These are used to store larger shellfish such as lobsters. They are built by damming off small bays or sections of beach where the conditions are favourable.

Here is a list of what to look for and what to avoid when selecting a site.

What to look for:

- A sheltered area of the coast. Strong wave action will damage the pond and the stored shellfish.
- An area where the rise and fall of the tide is great enough to flush out the pond. We will talk about this point again later on.

What to avoid:

- Freshwater. Keep the pond away from areas where rivers and streams empty into the sea. Shellfish left in diluted seawater will slowly die.
- Polluted water. Keep the pond away from harbours, sewage outlets and other stretches of sea that are likely to be polluted. Avoid estuaries; not only is the water too diluted, it also carries industrial waste.

Shellfish must have a supply of clean seawater. Polluted water will kill the animals.

Have a look at the diagrams below. They show three different types of pond used to store live lobsters.

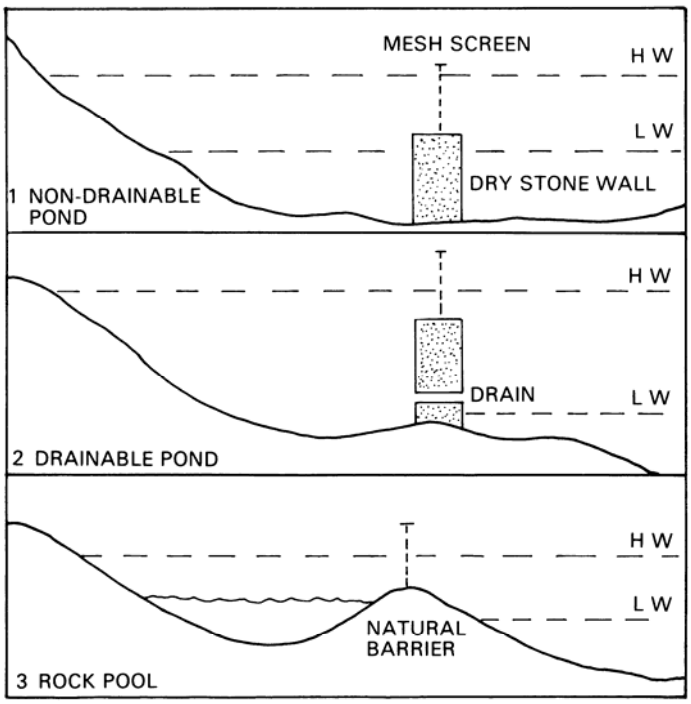


Figure 15 Storage Ponds

In all three cases the seawater flows in and out with the tide. The water should never drain away completely at low tide. The lobsters must remain well covered. At low tide the water should be one to two metres deep.

The rise and fall of the tide has to be great enough to:

- flush out the pond;
- mix the water that remains.

If the water is too shallow, the shellfish will be:

- easily attacked by predators such as gulls;
- more likely to suffocate due to overcrowding.

Shallow water warms up quickly and is more likely to be diluted by rain. If this happens, the shellfish will slowly die.

The mesh screen stops lobsters escaping at high tide.

The dry stone wall, which is naturally perforated, must be solid enough to hold water at low tide.

Tanks

In the simplest units, water is pumped from the sea, through the tanks and back into the sea as waste. This system will only work if there is a continuous supply of fresh seawater.

Sometimes the seawater may be in short supply. This can happen at low tide. In such cases the seawater will have to be recirculated.

A recirculating system is very similar to the one using artificial seawater and this is described in a later section of this segment.

During shore-based storage, it is a good idea to separate different catches into different sections of the pond or tank. This is a useful way of checking the quality of each batch of shellfish. We talked about the importance of quality in Segment Two. Good quality animals are more likely to survive to market and fetch a high price. By separating the shellfish into different catches you can tell which fisherman sells you good quality animals.

REMEMBER: Thoroughly clean the tank between storing of catches. The liberal use of disinfectants and of steam cleaning is recommended.

INITIAL LOSSES

Heavy losses are more likely to occur during the first two days of storage.

- Crabs and lobsters tend to die slowly. They may die two days after they have been inspected for damage.

- Also it takes this long for the shellfish to empty their gut contents into the water. The resulting waste material pollutes the water. Extra steps may have to be taken to maintain a good water quality. During the first two days of storage it is very important that the water is checked regularly by the methods described in Segment Two.

Now try the following SAQ

? SAQ2

Read the passage below and then try and answer the question.

2,000 lobsters were held in a pond during the summer to sell in the winter. Losses were heavy in spite of the pond being on a good site. It was decided to run a check to root out the problem.

The following were checked.

- The rise and fall of the tide was effective enough to flush out the pond and supply fresh seawater.
- The quality of the seawater in the pond was the same as the open sea.
- The seawater wasn't polluted or diluted by fresh water.
- Any lobsters that were damaged, weak, dead, soft-shelled or diseased were removed from the pond.
- Claws were banded.
- The water was two metres deep at low tide.
- The pond was not overcrowded.

But the lobsters continued to die.

Write down the reason that you think caused the lobsters to die.

ADVANTAGES OF INLAND STORAGE

By the time the shellfish have reached the market they may have travelled a long way.

They are likely to be stressed and may be in a weakened condition.

They need time to recover from the journey. This is even more important if the shellfish have been shipped out of water. You will find out in Segment Four that lobsters and brown crabs are usually transported in this way.

It is **very important** that lobsters, brown crabs and velvet swimming crabs are returned to water as soon after delivery as possible.

Inland storage is important because the animals:

- recover from the ordeal of transport;
- regain weight if they have been out of water.

You will have a better quality product if you store the shellfish before selling.

Storage also allows for changes in consumer demand. It allows you to build up numbers for large orders.

STORAGE UNITS USING ARTIFICIAL SEAWATER

Preparing the Water

If the unit is far away from a supply of natural seawater or, if the local seawater is not a guaranteed good quality, then you will have to use artificial seawater. This can be made up by using the mixture of salts listed on Table 1.

Common Name of Salt	Weight of salts per				
	100 gallons (450 litres)			1000 gallons (4500 litres)	
	lb	Oz	(kg)	lb	(kg)
Sodium chloride (common salt)	23	8	(10.66)	235	(106.6)
Magnesium sulphate (Epsom salt)	5	12	(2.61)	57	(25.9)
Magnesium chloride	4	9	(2.07)	46	(20.9)
Flake calcium chloride	1	3	(0.54)	12	(5.5)
Potassium chloride		9	(0.35)	6	(2.7)
TOTAL	**33**	**41**	**(16.23)**	**356**	**(161.6)**

Table 1

Salts of common industrial or agricultural grade are adequate.

If the salts are mixed in the proportions given in Table 1, the artificial seawater will have a salinity of 30‰.

When you make up artificial seawater, it is **very important** that you use the correct mixture of salts in the correct amounts. If the seawater is too weak or too strong, the crabs and lobsters will slowly die.

Beware! Make sure all the salts have been mixed and dissolved so that the seawater is clear before you place crabs and lobsters into the tanks. This usually takes two hours.

A SIMPLE RECIRCULATING SYSTEM USING ARTIFICIAL SEAWATER

REMEMBER: This basic system may also be used to recirculate natural seawater.

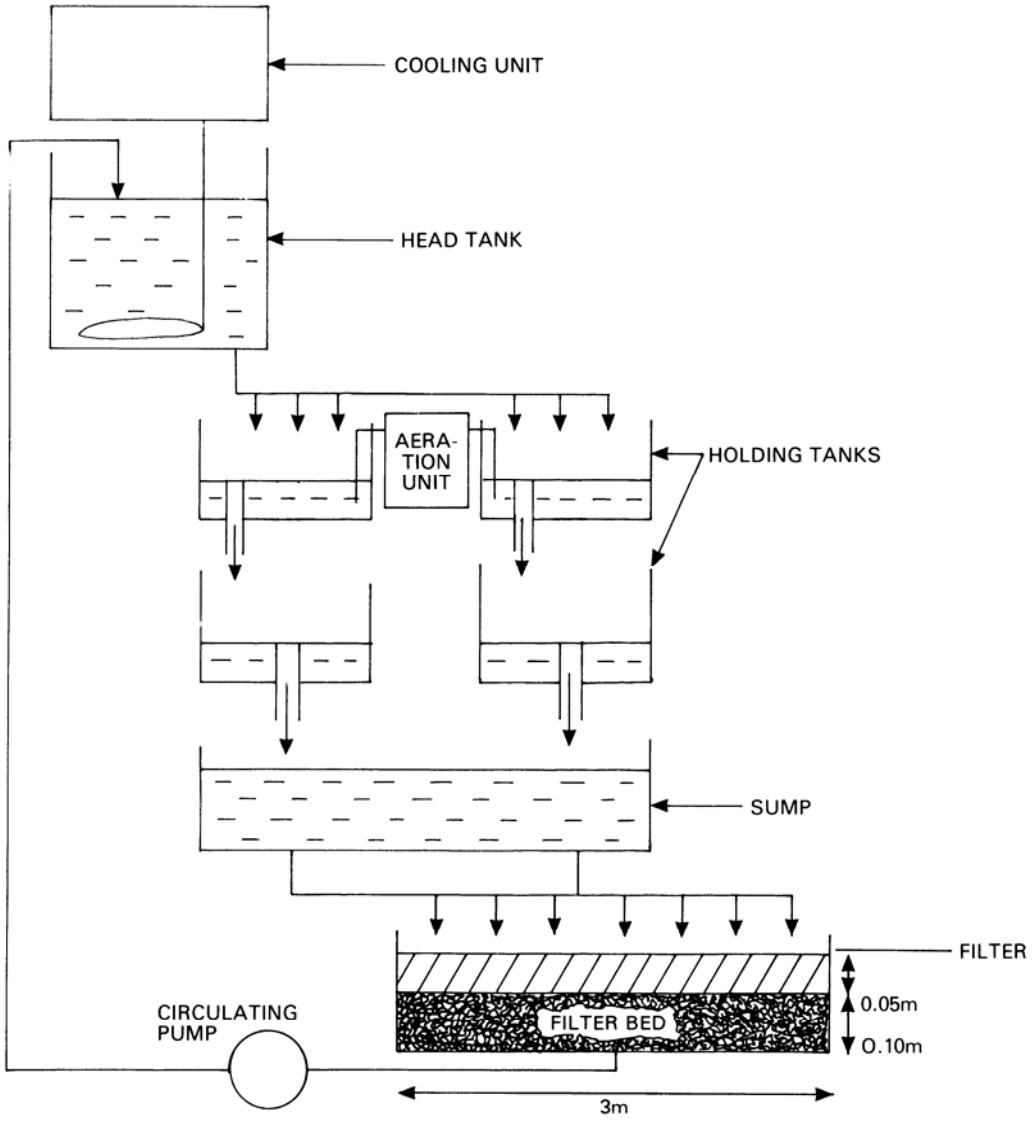


Figure 16 Recirculating System

This storage system has seven important features:

- a series of tanks;
- a circulating pump;
- a cooling unit;
- an aeration unit;
- a filter;
- a head tank;
- a sump.

The whole system holds 4500 litres of water and, allowing 11 litres per lobsters, a system of this size can hold up to 400 lobsters of average market size. Smaller shellfish such as velvet swimming crabs and nephrops will need less water. The minimum amount of water for these smaller animals is about two litres per animal.

The tanks can be made from fibre glass, plastic, aluminium or some types of stainless steel. The pipes joining the system together are plastic.

BEWARE! Avoid copper, iron, lead and most stainless steel tanks or pipes. These metals will react with the seawater and poison the animals.

The circulating pump makes sure that the water is moving through the system all the time. In this way the water is aerated, cooled and filtered before it passes over the shellfish again.

The cooling unit keeps the water temperature at 5 - 10°C. In general, 4500 litres of water need a cooling unit with a compressor of 1½ h.p.

The aeration unit blows air through the water to add oxygen to the system. Sprays of water falling from one tank into the next will have the same effect.

The filter helps to clean the water.

Inland storage systems should be built in a covered and sheltered area away from bright light.

Filter
Most systems of this kind use a gravity filter. This filter is made up of two parts:

- a layer of filter material;
- a filter bed.

Filter material traps waste particles. It is usually spongy or fibrous and up to 5cm thick.

A good material to use is brewery foam. Felts such as those used for roof insulation or carpet underlay are cheaper and work well.

Filter material should be changed four or five times a year to prevent it becoming clogged up.

The filter bed is a layer of stones or coarse sand or cockle shells.

It supports the filter material and improves the quality of the water by breaking down waste products.

MAFF recommend one cubic metre of filter bed for 4500 litres of water.

STARTING UP THE RECIRCULATING SYSTEM

If you are setting up a system for the first time, you must make sure that the system is conditioned. We suggest that you follow the procedure below.

- Was the system through with tap water to clean the tanks, pipes and filter.
- Add artificial seawater of the correct strength. Leave for two days.
- Put a few shellfish in to the system. Leave for at least one week. Feed the animals and check their condition.
- If these first few animals survive then stock the system and start the regular checks.
- If they die, replace the artificial seawater and try again.

It is very important to condition a new storage system because:

- it removes any poisonous substances found on the surface of plastics and fibre glass;
- it soaks the filter material in seawater and makes it ready for use.

RUNNING THE SYSTEM

A storage system that is running effectively will keep the water:

- well aerated;
- at a temperature of 5 – 10°C;
- at a salinity of 30-35%;
- unpolluted.

Even if the storage system is working well there will come a time when the water will have to be replaced. A good filter system can't stop waste substances from building up in the water forever. When the water becomes too polluted it will have to be changed.

Replacing the Water

The number of times the water is replaced will depend on:

- the capacity of the system;
- the number of shellfish passing through the system.

If the system holds a small volume of water then waste substances will build up faster. The water will become polluted and will have to be changed.

If there is a large turnover of shellfish then they will produce more waste substances. Again, the water will become polluted and will have to be changed.

It is important that you get to know the limits of your own storage system. The time it takes for the water to become too polluted or too strong will vary from place to place. This is why it is so important to check the quality of the water in your own storage system regularly.

If the seawater needs to be replaced we suggest that you do this between batches of shellfish or when trade is slack and your stock has been run down. This will give you the opportunity to clean the tanks out. Remove any bits of shellfish or other rubbish that have been left behind. Hose and scrub the tanks down to remove dirt and scum.

Instead of draining all the water from the system you could try replacing 10% of holding water at regular intervals. In this way you can cover up for any mistakes that may occur when making up the artificial seawater. In cases of serious pollution, however, it is better to drain all the water.

Loss by Evaporation

One common problem in inland storage systems is loss of water by evaporation. This will cause salinity to rise, which will kill the shellfish. Check salinity regularly and if it rises above 35‰ add some freshwater to bring it back to normal.

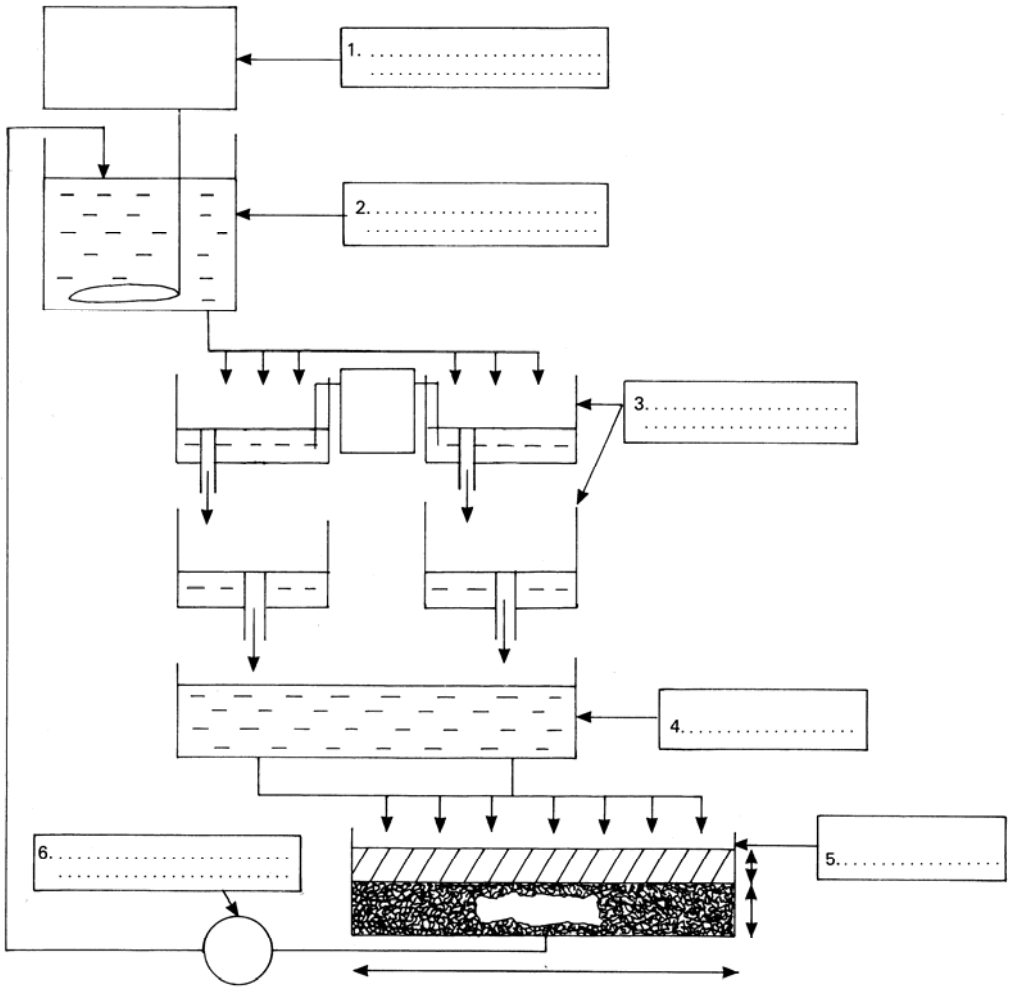
Finally, a word of advice.

Try to avoid feeding shellfish when they are being stored for short periods. They don't need any food, unless you are conditioning a new system.

Now here are some more SAQs for you to attempt

? SAQ7

Here is a diagram of an inland storage system. Label the main features by filling in the spaces.



? SAQ11

Read the passage below and fill in the spaces using the words in the list.

Dennis is in charge of an inland storage system. He sells live crabs and lobsters to local customers. He buys his stock from Scotland and stores them for a short time before selling.

He finds that the animals store well. He sells a high quality product and has a good reputation.

Dennis uses _____ seawater.

The tanks are made from _____ glass and the pipes are _____.

He checks the water every day for _____ and _____ .

He makes sure that the water is well _____ and not polluted.

He doesn't overcrowd the tanks.

He removes any animals that are damaged or _____ .

Dennis is successful at storing live shellfish. He is proud of his good reputation.

dead
artificial
fibre
aerated
plastic
temperature
salinity

? SAQ15

State two advantages of placing crabs and lobsters into storage ponds or tanks before transporting them inland.

1

2

? SAQ19

What are the main reasons for short-term inland storage of crabs and lobsters?

1

2

? SAQ23

State two conditions to avoid when choosing a site for a storage pond using natural seawater.

1

2

SUMMARY

Storing live shellfish before transporting them inland can:

- be economical in transport costs;
- allow advantage to be taken of changing prices;
- allow supplies to match local demand.

Live shellfish store well in a continuous supply of clean, moving seawater.

Great care must be taken when selecting a storage site. A bad choice will mean heavy losses.

Many problems can be avoided if the supply of natural seawater is continuous.

Inland storage is important because it allows shellfish, especially lobsters, to:

- recover from the ordeals of transport;
- regain weight if they have been out of water.

Shellfish store well in artificial seawater if the water is:

- made up correctly;
- well aerated;
- circulated;
- filtered.

It is important to control the quality of the water. The water must be checked every day for oxygen, temperature, salinity and pollution.

Many problems can be avoided if the quality of the water remains the same as that of the open sea.

REMEMBER: You can seek advice to help solve problems which you may encounter. This assistance is available by contacting organisations such as:

- Sea Fish Industry Authority;
- Local Aquarists;
- Universities;
- Public Health Laboratories;
- Local Fish Farmers.

You have now achieved Objective Three on page xiii. You are doing well.

Segment Four

Transport in Air

Segment Four – Transport in Air

INTRODUCTION

Shellfish live in water but some can survive in air long enough to be transported to market.

Transporting live shellfish without water is easier and cheaper. But problems occur and some animals may die. In this segment we will outline these problems for you. We will show you how to keep your shellfish alive and well during transport in air.

AIMS OF THE SEGMENT

The main aim of the segment is to help you to achieve Objective Four given on page xiii.

By the time you have worked your way through this segment you will be able to:

- describe a good method for packing live shellfish;
- list three factors that will stress live shellfish during transport in air;
- describe the best conditions for transporting live shellfish in air;
- describe the correct method for unpacking live shellfish at the market place.

SHELLFISH THAT CAN BE TRANSPORTED IN AIR

Some shellfish can survive out of water longer than others. Green crabs, brown crabs and lobsters cope much better in air than velvet swimming crabs and spider crabs.

Lobsters can survive in air for 24 hours or more, as long as they are treated correctly. Brown crabs travel less well than lobsters. **Transit time for all shellfish should be as short as possible.**

All of these shellfish were described in Segment One. If you can't remember what they look like, refer to Segment One again.

SELECTING THE BEST QUALITY SHELLFISH FOR TRANSPORTATION

It is very important that shellfish are selected for quality before transport. Only animals in good condition will survive and fetch a high price at the market. Weak and damaged animals are likely to die during transport. Dead shellfish will begin to decompose and affect the survival of the others packed in with it. One death could lead to many others and ruin the taste and value of the ones that remain alive.

Remove any shellfish that are:

- weak;
- damaged;
- soft-shelled;
- diseased.

These animals must not be packed. They will not survive the journey to market.

Shellfish must be treated carefully during the selection process. We will talk about this point again later on.

PACKING THE SHELLFISH

More shellfish will survive the period in air if they are properly packed. Badly packed shellfish are more likely to die on the way to market.

The following points should be remembered:

Space Requirements

Crabs that have far too much space in which to move about will walk around. This means they will need more oxygen.

They may also end up fighting which leads to a damaged product. Damaged crabs will bleed. They are less likely to survive.

- Make sure crabs are packed close together to stop them from moving around.

- Make sure the claws on brown crabs have been nicked. This can be done by cutting the tendon either between the claw (the French Method) or above the claw (the English Method). The French Method is often preferred because it results in less bleeding. The use of a nicking bar to assist this procedure is shown in Figure 18 and the two methods of nicking the claw are shown in Figure 17.

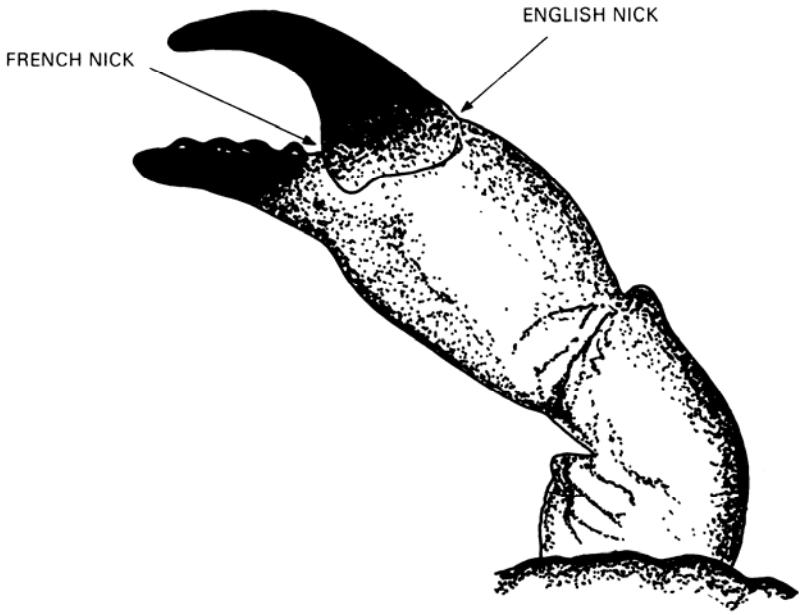


Figure 17 French and English Nicking

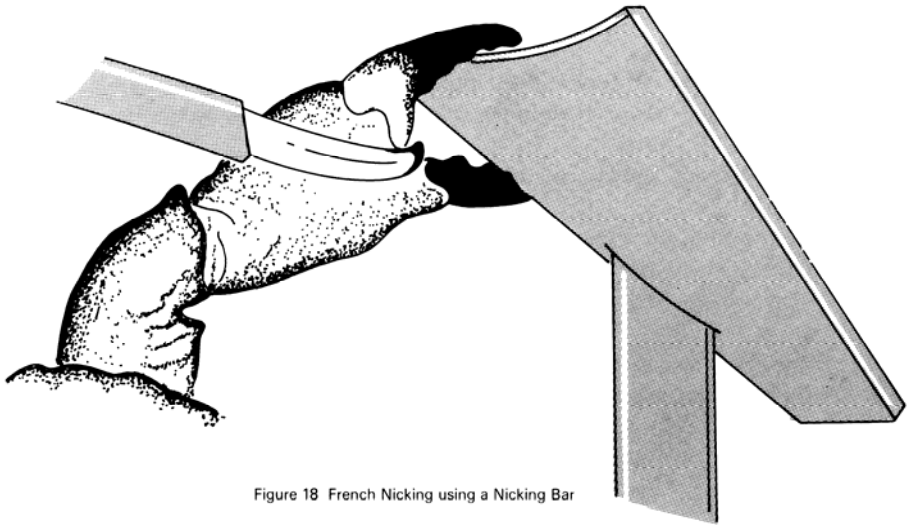


Figure 18 French Nicking using a Nicking Bar

The animals must be returned to water immediately. They should never be nicked immediately before transport in air.

Make sure the claws on lobsters have been banded. This will stop the animals from fighting each other and causing damage.

The best arrangement is to pack the crabs gently and firmly with their backs uppermost. For lobsters, the tails should be curled under the banded claws and point forward. In both cases, make sure that the animals can't move around.

Type of Container

Although wooden boxes are often used successfully to transport live shellfish in air, polystyrene or plastic boxes are better. Boxes made from this material are light, tough and able to absorb shocks during handling. They can be stacked one on top of each other. This has the added advantage of cutting down the amount of light that enters the boxes. It also stops too much moisture from escaping.

With cool blocks inside they have good insulation properties, which reduce temperature changes.

The box should provide good ventilation by allowing some air to enter from the top and sides.

It is important to make sure that sufficient air can reach the shellfish.

Be careful though, you must not let too much air pass through the box. The draught will dry the animals out.

Moisture
It is a good idea to keep the shellfish moist or humid during their time in air. If shellfish dry out in air they will die. A good way of keeping live shellfish moist is to place damp paper over the top of the box. Make sure that the paper is soaked in seawater. **Freshwater is harmful and should not be used**. To prevent the moisture from escaping, it is a good idea to stack the boxes or to give each box a lid.

Too much water can also cause problems. If water collects in the bottom of the box, it will stagnate and the shellfish will die. Drainage holes in the bottom will allow the water to drain away.

Temperature
High air temperatures are harmful. Shellfish are more active at higher temperatures. They need more oxygen and produce more waste substances. These animals are more likely to suffocate and die.

More shellfish will survive if the air temperature is kept between 5-10°C.

It is very important to keep live shellfish cool when they are in air.

Beware, in very cold weather, that very low air temperatures do not harm the animals.

The best way to keep live shellfish at 5-10°C during transport is to use a **refrigerated lorry**.

Shellfish can also be kept cool by placing freezer packs into the packing boxes. Freezer packs can be made by freezing plastic bags filled with wet sawdust. Place the freezer pack on top of the newspaper.

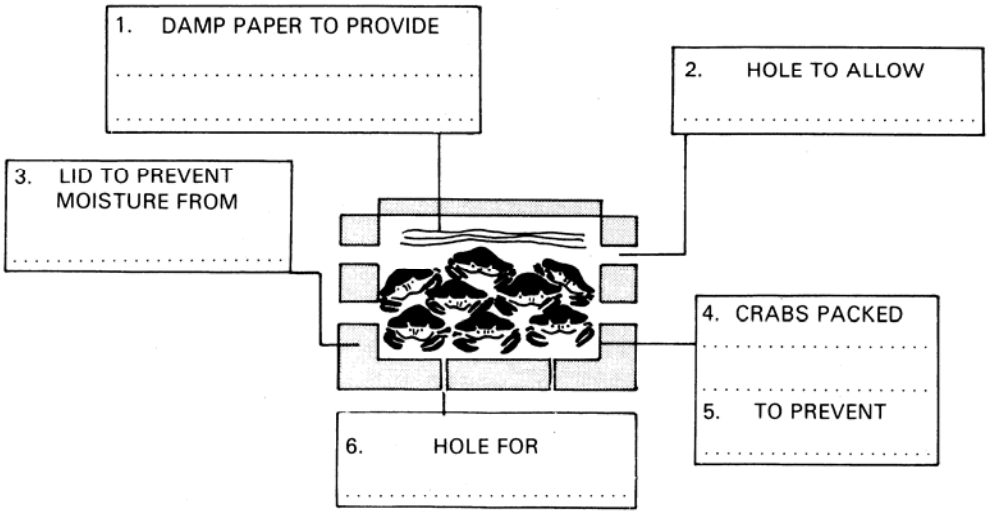
⚠

Never use ice to cool the shellfish down. The ice will melt, collect in the bottom of the box and stagnate. The animals will die.

Now for the first SAQ in this segment

? SAQ3

See if you can complete the labels by choosing the correct words from the list below:



close together	escaping	ventilation
moist surroundings	movement	sunlight
drainage	draught	temperature

STRESS

Stress leads to suffocation when shellfish are in air.

Some shellfish may die or drop their claws during the journey or within a two day period of arriving at their final destination.

The most common cause is **thermal stress**. If this type of loss is occurring it is important to check the conditions, **especially temperature**, back through the delivery chain.

Every attempt must be made to keep a reasonably constant temperature (5-10°C) at every stage. This avoids the animals being heated up or cooled down excessively whenever they are moved from one phase of the transport operation to another.

Shellfish which are particularly liable to suffer are those which are in a poor condition due to being:

- poorly nourished with low reserves of energy;
- badly nicked on the claws.

If you obtain your shellfish from a number of sources then you should separate them into different lots. This will enable you to confirm if a particular supply is the main source of your losses.

It is very important not to stress live shellfish at any stage of the journey so:

- do not throw live shellfish around during sorting and packing;
- do not crush or stand on the shellfish;
- do not pick them up by the legs;
- do not drag boxes full of live shellfish along the floor. Pick the boxes up and place them down carefully;
- cut handling down to a minimum.

REMEMBER: Live shellfish must be treated with respect especially when they are in air. They are finding it difficult to breathe. They are easily stressed. They will die if they are treated badly.

Always put an animal down gently, never drop or throw it.

Before we look at unpacking the shellfish, here is a summary of the right conditions for transporting live shellfish in air.

During transport in air it is important that live shellfish are kept:

- Undisturbed. That is, packed with the minimum of handling and stress. Repacking should be avoided. Try not to move the shellfish during the journey;
- Cool. That is, at a temperature of between 5-10°C. The air temperature must remain the same throughout the journey;
- Well ventilated but away from draughts;
- In moist surroundings.

UNPACKING LIVE SHELLFISH AT THE END OF THE JOURNEY

When boxes of live shellfish are unloaded at the market, the animals have been out of water for a long time.

- they are highly stressed;
- they are short of oxygen and waste substances have built up;
- they are close to suffocation;
- things could get worse if the shellfish are not seen to straight away.

During unloading the driver may be tired. The market staff may be busy, but live shellfish must still be treated carefully.

So many things can go wrong at this stage. If you are not careful, more animals will die. Great care must be taken when the animals are unpacked.

It is very important that handling is kept to a minimum as these animals must be treated carefully. Do not throw them around or pick them up by the legs.

REMEMBER: Stress and damage lead to death.

Take your time unpacking the shellfish. It will be worth it in the end as more shellfish will survive and remain in good condition.

- Shellfish that have been transported in air must be returned to water as quickly as possible. They can only survive in air for a limited amount of time.

- Do not leave boxes of live shellfish lying around on the shop floor.

- Do not leave boxes of live shellfish in bright sunlight, rain or wind.

- The shellfish will last longer if they are placed in a chiller at a temperature between 5-10°C. But only do this for short periods when the shellfish can't be returned to water.

- Make sure the water temperature is similar to the air temperature used during transport.

- Heavy losses are caused by placing warm shellfish into cold water and vice versa. The animals will suffer from temperature shock and die.

Now attempt the last three SAQs in this segment

? SAQ8

Complete the following sentence by choosing the correct statements from the list. Beware! There is more than one correct answer. Put a tick in the boxes for the statements you think are correct.

Live shellfish are more likely to suffocate in air when:

1)	they are picked up and thrown around;	☐
2)	they are shut in an air-tight box;	☐
3)	the air temperature is between 5-10°C;	☐
☐☐	the air temperature is 20°C;	☐
5)	they are packed close together in a box;	☐
6)	there are too few animals in a box.	☐

? SAQ12

Read the passage below:

During the summer, temperatures are high and Dennis has trouble keeping his boxes of lobsters alive on their way to market. After reading this module he came up with a plan to improve his transport conditions and found that more lobsters survived. This is what he did

- Kept the back of his lorry at a temperature of 5-10°C all the time.
- Loaded the boxes carefully and did not move them during the journey.
- Kept the boxes away from draughts.

Dennis found that conditions during transport were important.

Now try the multiple choice questions to test your knowledge on the improvements that Dennis made.

Put a ring around the answers you think are correct.

1) Dennis kept the temperature of his lorry:

    a) changing all the time;
    b) high during transport (20°C);
    c) low during transport (5-10°C).

2) Dennis kept the boxes undisturbed:

    a) to stop lobsters from escaping;
    b) to stop cold air from getting to the lobsters;
    c) to stop any movement or rough handling;
    d) to stop boxes from getting mixed up.

3) Dennis kept the boxes away from draughts:

    a) to stop lobsters receiving too much oxygen;
    b) to allow temperature in the boxes to rise;
    c) to prevent the moist conditions in the box from drying out.

? SAQ16

Read the passage below and fill in the spaces with words from the list.

Shellfish stand a better chance of surviving transport in air if they are kept under certain conditions and treated _____. At market, boxes should be loaded as gently as possible. It is _____ practice to leave boxes of live shellfish out in the _____, rain or wind. It is also unwise to pick the animals up and _____ them around. Any sudden change in _____ must be avoided. It is best to return crabs and lobsters to _____ as soon as possible.

To do this the animals should be gently returned _____. This needs more care but avoids damage and gives a quality product.

bad	temperature	water	high
cold	lobsters	roughly	throw
sun	carefully	free	air
one by one			

SUMMARY

Shellfish are more likely to survive in air if they are packed close together in polystyrene or plastic boxes and kept:

- cool (5-10°C);
- moist;
- undisturbed.

These points are very important.

In this way, your catch will survive the journey to market and fetch a good price because of its good condition.

You have now completed Segment Four and achieved Objective Four given on Page xiii. Well done!

Time for another well earned break.

Segment Five

Transport of Live Shellfish in Water

Segment Five – Transport of Live Shellfish in Water

INTRODUCTION

In this segment we will be looking at the best way to transport live shellfish when they are in water. We will also be looking at the problems that arise and suggesting ways in which these can be tackled.

AIMS OF THE SEGMENT

The main aim of the segment is to help you to achieve Objective Five given on page xiii.

By the time you have worked your way through this segment you should be able to:

- give reasons for transporting live shellfish in water;
- describe the best conditions for transporting live shellfish in water;
- list and describe factors that cause high mortality rates during the journey.

WHICH SHELLFISH REQUIRE TRANSPORTING IN WATER?

Some shellfish find it very difficult to survive in air, especially:

- Velvet Swimming Crabs;
- Spider Crabs.

Velvet swimming crabs are small and very active. You found out in Segment One that this crab will suffocate and die if it is left in air. If velvet swimming crabs are in air for longer than about four hours, they may not die immediately, but will not recover when returned to water. Spider crabs will often die within eight hours.

Brown crabs and lobsters can survive reasonably well when they are in air, but they can't live much longer than about 24 hours out of water, even when the surroundings are cool and moist. Therefore, when a journey time is involved, these species must also be transported in water.

Recently, new markets have been developed abroad, particularly in Spain. This means that live shellfish caught in Britain have to be transported over long distances. The whole journey may take two days or longer. Shellfish must be kept in water if they are to survive the journey to the Spanish markets. This includes all shellfish covered by this module, **apart from green crabs**.

Shellfish should be kept in favourable conditions before transport. Velvet swimming crabs should be held in tanks of aerated water for at least 24 hours before they are selected and packed. In this way more shellfish will survive the journey.

? SAQ20

Match up the crab names in the list to the statements below.

A) Velvet swimming crabs
B) Brown crabs
C) Green crabs

1) These crabs are very good at surviving out of water if the surroundings are cool and moist.

2) These crabs are small and active. They find it difficult to survive out of water.

3) These crabs can survive out of water for about 24 hours.

Put your answers in the spaces below. Each statement describes one of the crabs given in the list. You have to sort out which statement refers to which crab.

1 _____

2 _____

3 _____

CORRECT WATER CONDITIONS

Keeping live shellfish in water doesn't guarantee survival. Heavy losses can still occur. When water is used to transport live shellfish it must have the following qualities. It must be:

- well aerated;
- at a temperature of 5-10°C;
- at a salinity of 30-35‰;
- unpolluted.

These are the best water conditions for transporting live shellfish. We talked about them in greater detail in Segment Two. They are **very important**.

To keep the shellfish alive and in good condition the water quality must be **kept the same throughout the journey**.

Changes in water quality can have serious and often fatal results.

VIVIER LORRIES

Shellfish are transported in water vivier lorries. These lorries must have the facilities to keep the seawater:

- well aerated;
- at a temperature of 5-10°C.

One of the most common arrangements is shown in figure 19.

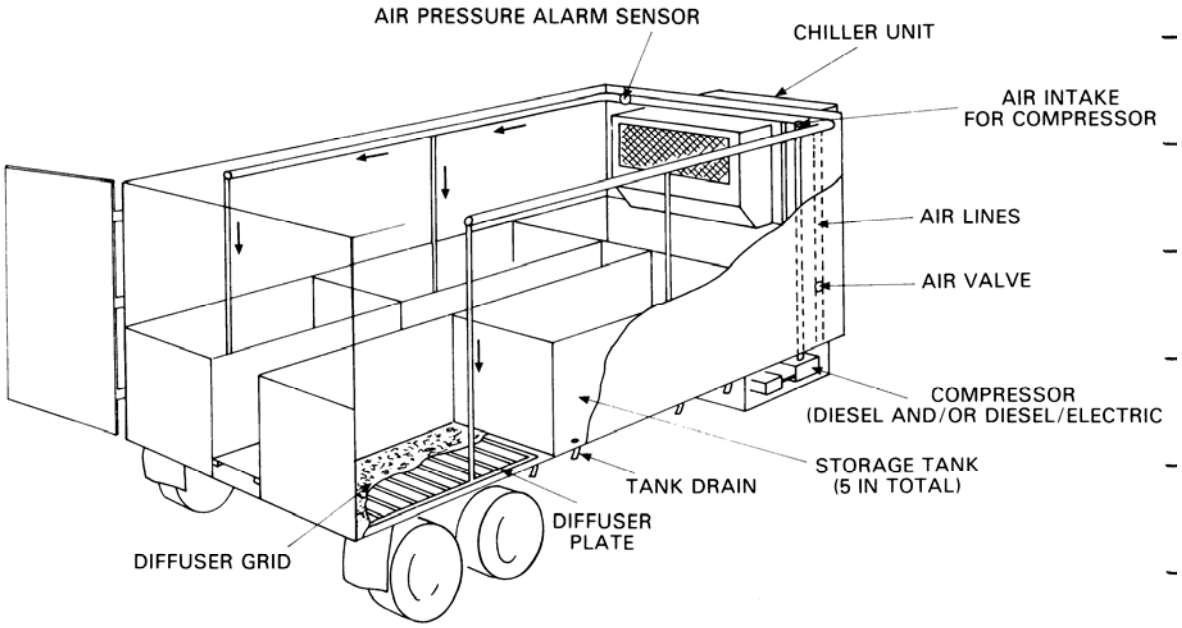


Figure 19 Vivier Lorry

The tanks are made out of aluminium which helps to keep the water cool in the chilled lorry. Insulating materials, such as wood covered in fibre glass, must be avoided. Tanks made from these materials will prevent the water from cooling down to the correct temperature. In some vivier lorries, each tank incorporates its own individual recirculating system. This consists of a submerged pump and an external jet spray placed diagonally opposite to help filtering and recirculation.

In a well-designed vivier lorry, the intake for the compressor is inside where the air is cool and not outside, where the air is too warm. The compressor action will heat the air through the machine and it is important that the air input is as cool as possible.

New systems have been developed which continuously monitor the conditions inside the vivier lorry. Some are fitted with alarms which call attention to a fall in air pressure. Other systems monitor the levels of dissolved oxygen and temperature of the water and display the results in the cab next to the driver. More information on these systems is available from the Sea Fish Industry Authority.

Cascade System

Major problems are caused by breaking a journey up into different stages. If the journey involves both transport in water and in air then the animals must be treated with extreme care. You should:

- cut repacking and handling down to a minimum;
- try and avoid disconnection between different forms of transport;
- try and keep the holding conditions as constant as possible.

The **cascade system** avoids a lot of these problems. This system can be mechanically loaded and offloaded from the back of a vivier lorry. In this way, handling and exposure to air are cut down to a minimum, so more animals survive in good condition. More information on cascade systems is available from the Sea Fish Industry Authority.

Figure 20 shows some details of a vivier lorry loaded with a cascade system.

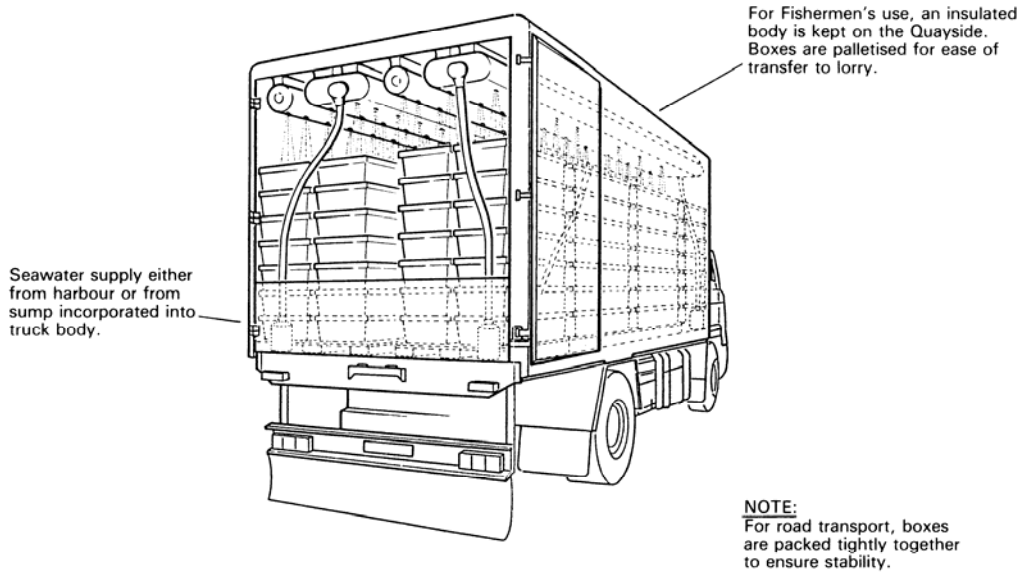


Figure 20 Schematic Diagram of Cascade Holding or Transport Unit

The basic system consists of a series of trays with water running down through the trays and then recirculated. This principle ensures that:

- the gill chambers are adequately covered although the animals are not submerged in water;
- the weight of the water required is considerably less than in a conventional vivier system. This allows a more profitable cargo to be carried;
- the trays can occupy much more of the space within the vehicle than the conventional tanks occupy.

CONDITIONS DURING TRANSPORT

REMEMBER: Before the start of a journey the shellfish should have been held for 24-48 hours. This allows time for:

- weak animals to die;
- stomach and gut contents to be emptied into the water;
- the animals to recover from stress.

At the Start of the Journey

- make sure the tanks are clean. Remove any bits of crab or seaweed that may remain. Hose and scrub the tanks to remove any pollutants left on the walls.
- Fill the tanks with full strength seawater. That is, seawater at a salinity of 30-35‰. Make sure the seawater is clean. It must not be polluted.
- Cool the seawater to 5-10°C before loading the shellfish into the tanks. Use seawater ice to speed this process up.
- Make sure the seawater is well aerated and reaches all parts of the tank. We will talk about aeration systems in more detail later on.

Volume of Water
Shellfish need plenty of water during transport. A good guide line for velvet swimming crabs is:

40 litres of water per 8-9kg of crabs.

Lobsters and brown crabs will need more water per animal than velvet swimming crabs. Ideal conditions are 3-5 litres per animal.

These recommendations may not be commercially viable and you may be tempted to pack more animals into the tanks, but remember **overcrowding can lead to heavy losses**. If you decide not to follow the guide lines recommended above, the chances of something going wrong during transit is greater.

Aerating the Water
It is very important that the holding water is well aerated. This is one of the factors that affects water quality. We talked about the importance of water quality in Segment Two.

Well aerated water is particularly important when live crabs are packed into crates and densely stacked together in vivier tanks. In poorly aerated tanks the crabs in the centre will run short of oxygen. They will suffocate and die. Heavy losses are caused in this way.

The aeration system must be effective. The level of oxygen in the water should be as high as possible. The air bubbles should be as small as possible.

Aerated water must reach all parts of the tank. This is achieved by using an air lift or by recirculating the holding water with a suction pump and spraying the water back into the tank at the opposite end.

Even with an effective aeration system, water penetration to the centre of the crates can be poor. This problem can be solved in a number of ways.

One solution is to pack the crabs into perforated trays that can be stacked on top of each other. These trays are made out of plastic and are divided up into sections to prevent the crabs from fighting.

Another solution is to use a cascade system. This system is just coming into operation. A third idea is to pack perforated plastic tubes in with the crabs. In this way water and oxygen is forced through the crates.

If you are interested in developing some of these ideas you should read the two technical reports mentioned at the end of this Segment.

These problems apply to velvet swimming crabs. Brown crabs are usually left loose in the tanks. Lobsters are packed into trays for protection.

Temperature
It is very important that the temperature of the water is kept between 5-10°C.

It only takes small changes in temperature to cause large problems. If the temperature of the holding water increases to beyond 15°C, the shellfish will begin to die. These problems can be avoided for a short while by vigorously aerating the water but the deaths will soon continue.

It is essential that the vivier lorry has an effective cooling system to keep the water temperature at 5-10°C.

Pollution
Tests for pollution are particularly important during vivier transport. During the journey, waste substances such as ammonia build up in the holding water. This happens because no filters are present to remove these substances. In a well aerated tank, most of the ammonia will be removed to the atmosphere. But dead shellfish rot. This process produces ammonia and other substances such as nitrites. These substances are toxic. If they build up to high levels they will kill the healthy animals.

Simple test kits are available for testing various properties of the water such as:

- pH;
- nitrate content;
- nitrite content
- ammonia.

They are easy to use and you should get into the habit of testing water quality by using these kits.

REPLACING THE HOLDING WATER

Make sure that the incoming water is:

- at a temperature of 5-10°C;
- at a salinity of 30-35‰;
- unpolluted.

The incoming water must be about the same temperature and salinity as the water it is replacing. If this is impossible then it is better not to change the water. Sudden changes in temperature and salinity will kill the shellfish. Polluted water will also kill the shellfish.

When replacing the holding water, remember the following points:

- do not replace with water of a higher temperature (2-3°C higher is about the limit);
- do not replace with diluted seawater or freshwater;
- do not replace with polluted water.

UNLOADING LIVE SHELLFISH AFTER VIVIER TRANSPORT

At the end of the journey, the shellfish will be stressed. They must be treated carefully or more could die.

The shellfish must be seen to as soon after delivery as possible. They must be placed into tanks of clean, full strength seawater at the same temperature as that of the lorry holding water. If the water temperature of the reception tanks is higher or lower than that of the holding water, the shellfish will suffer from shock. More will die.

Do not leave the animals in the vivier tanks when the aeration and cooling systems have been switched off. The holding water will warm up, stagnate and kill the shellfish.

When the shellfish are unloaded, **rough handling must be avoided**.

Once the shellfish have been delivered, the vivier tanks must be cleaned before the next consignment is loaded onto the lorry.

⚠

REMEMBER: The vivier tanks require the same care and attention to hygiene as holding tanks in any other part of the system.

These cleaning requirements were emphasised in Segment Three.

Finally here are the last two SAQs in this module

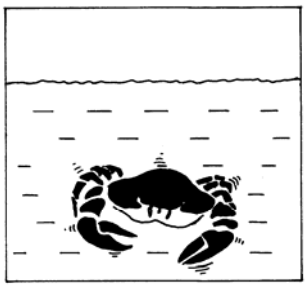
? SAQ24

Here are two crabs travelling in a vivier lorry.

Each crab is transported in a different tank. One tank is at a higher temperature than the other.

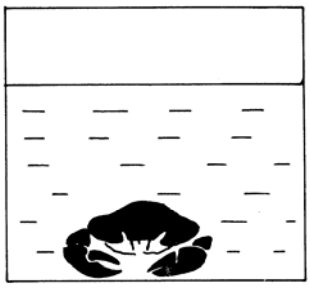
Look at the diagrams and try and answer the questions:

A
High Temperature
18°C



This crab is active.
It is moving around.

B
Low Temperature
10°C



This crab is not active.
It is staying still.

1) Which tank is going to run out of oxygen first? A or B?

2) Which crab is producing more waste substances? A or B?

3) Which crab stands a better change of surviving the journey? A or B?

Put a ring around the letter you think is correct. The letters refer to the diagram.

? SAQ4

Fill in the blank spaces with words from the list below:

Dennis owns a _____ lorry. He transports velvet swimming crabs from Scotland to Spain where they are sold. This journey takes 60 hours.

Dennis must make sure that crabs arrive _____ and in _____ condition. If the crabs die, Dennis loses money and gains a bad reputation.

Dennis has a lot of problems keeping his catch alive. In the past he has experienced heavy losses.

After reading this module he thought up a plan to prevent as many deaths as possible.

Here is the plan he followed.

- He handled the crabs as _____ as possible.
- He cut down on repacking.
- He cut down on the time crabs spent in air.
- He filled the tanks with clean, full strength seawater.
- He made sure the water quality was correct. That is well _____, at a temperature of _____ and a salinity of _____.
- He made sure the _____ quality remained the same during the journey.
- He avoided replacing the water with water of a different quality;
- He did not delay the journey but delivered the crabs as soon as he could;
- He treated the crabs _____ when they were unpacked.

aerated	little	quality	carefully
good	same	alive	30-35‰
vivier	5-10°C	water	oxygen

SUMMARY

Apart from green crabs, which have the ability to remain alive in moist conditions for a considerable length of time, all other shellfish mentioned in this module find difficulty if left in air for too long.

This means that, for longer journeys, it is essential to transport these animals in water. Velvet swimming crabs and spider crabs find it particularly difficult to survive in air. These crabs must always be transported in water, even for short journeys.

To do this successfully requires the use of vivier lorries, which should have monitoring facilities to maintain correct water conditions.

In addition to the traditional vivier lorry, which uses storage tanks in a chilled interior, there is also a cascade system under development. This is a free standing system of trays subjected to recirculating water which cascades through them. This system can be off loaded without disturbing the animals, in each stage of the journey.

Successful transportation in water, as in air, depends upon good handling practices and correct conditions.

Remember that the advice in Segment Three on cleaning tanks and obtaining assistance to solve problems with water quality etc, also applies when you are transporting shellfish in vivier systems.

The handling and transport of velvet swimming crabs and brown crabs is covered in much more detail by two technical reports. These have been produced by the Sea Fish Industry Authority. They are worth reading and provide a lot more information.

- S Whyman, R Uglow and P MacMullen
  A study of mortality rates of the velvet swimming crab during holding and transport.
  SFIA Technical Report No 259
  January 1985

- R Uglow, D Hosie, I Johnson and P MacMullen
  Live handling and transport of crustacean shellfish: an investigation of mortalities.
  SFIA Technical Report No 280
  January 1986

This completes the segment and the module.

You have now achieved all objectives set out on page xiii.

Well done and remember:

Shellfish are valuable. They'll fetch a good price if they are delivered alive and in prime condition. It is important that these expensive shellfish are looked after carefully from the moment they are taken out of the sea to the moment they are eaten by the consumer. The basic guide lines that we've given you in this module should help you to supply shellfish in prime condition.

Appendices

APPENDIX 1 - Technical Reports and Statutory Regulations

SEA FISH INDUSTRY AUTHORITY TECHNICAL REPORTS

259 A study of mortality rates of the velvet swimming crabs during holding and transport.

280 Live handling and transport of crustacean shellfish: an investigation of mortalities.

294 An assessment of damage and mortality of the brown crab in vivier transport.

The live storage of lobsters, MAFF Laboratory Leaflet No 37.
P A Ayres and P C Wood.
MAFF Lowestoft 1977.

STATUTORY INSTRUMENTS

Orders under the Act are:

- Lobsters (Control of Deposit) Order 1981
- Lobsters (Control of Importation) Order 1981

These define the licence requirements and make it compulsory to have:

- separate seawater systems for European and North American lobsters;
- strict controls on tank effluent discharges, including sterilisation with Sodium Hydroxide;
- restrictions on sales other than for direct human consumption.

APPENDIX 2 - Useful Points of Contact

MAFF (ENGLAND AND WALES)

First point of contract for fishing regulations is the local, or nearest, Fishery Office. It will be listed in the telephone directory under:

- Agriculture, Fisheries and Food, Ministry of Fisheries, District Inspector's Office

Enquiries relating to fish diseases should be made to:

- MAFF
  Fish Diseases Laboratory
  The Lookout House
  The Nothe
  Weymouth
  Dorset DT4 8UB Tel: 03057 72137

DAFS (SCOTLAND)

DAFS exercises the same functions in Scotland as MAFF does in England and Wales and they also have a network of Fishery Offices in the larger ports.

Diseases are dealt with by:

- DAFS Marine Laboratory
  PO Box 101
  Victoria Road
  Aberdeen
  Grampian Region AB9 8DB Tel: 0224 876544

DANI (N IRELAND)

Fishery Offices in the larger ports and:

- DANI Fisheries Division
  Hut 5
  Castle Grounds
  Stormont
  Belfast BT4 3PW Tel: 0232 63939

Responses to the Self Assessment Questions

Responses to the Self Assessment Questions

SAQ1 The answer to this SAQ sums up the causes of death for shellfish in air. The correct answers are:

1. shortage of oxygen;
2. build up of waste substances;
3. loss of water.

Without oxygen shellfish suffocate. They drown in air. The build up of carbon dioxide, ammonia and other waste substances in the blood will kill the animals. Loss of water causes the gills to dry out and changes to take place in the blood. This is all explained to you on page 20. If you find this SAQ confusing read this page again.

SAQ2 The lobsters were being overfed. Unused food was left in the pond. Waste substances began to build up. The water became stagnant even though it was replaced by the tide. The lobsters ran short of oxygen and drowned.

SAQ3

1. moist surroundings
2. ventilation
3. escaping
4. close together
5. movement
6. drainage

Paper soaked in seawater keeps the crabs moist. This is important because crabs that dry out will die.

Holes in the polystyrene or plastic box allow fresh air to circulate and water to drain away.

The main words are:

temperature;
movement;
ventilation;
moisture;
drainage.

SAQ4

1. vivier
2. alive
3. good
4. little
5. aerated
6. 5-10°C
7. 30-35‰
8. water
9. carefully

SAQ5 The species shown are:

1. green crab
2. lobster
3. nephrops
4. brown crab

The labels should have been completed as follows:

i)	walking leg	ii)	eye
iii)	carapace	iv)	abdomen
v)	feeler	vi)	tail fan
vii)	carapace	viii)	claw

SAQ6 The correct answer is Tank 2.

Can you see why?

Tank 1 is no good for storing live shellfish because:

- the seawater is too diluted;
- the temperature is too high.

Shellfish live in full strength seawater which has a salinity of 30-35‰. They will die if the seawater becomes diluted.

At high temperatures:

- there is less oxygen in the water;
- shellfish are more active and take up more oxygen;
- shellfish produce more waste substances.

Tank 2 contains water of the best quality for storing live shellfish because:

- the seawater has a salinity which matches that of the open sea, that is 30-35‰;

- the water temperature is between 5-10°C.

SAQ7 The answers are:

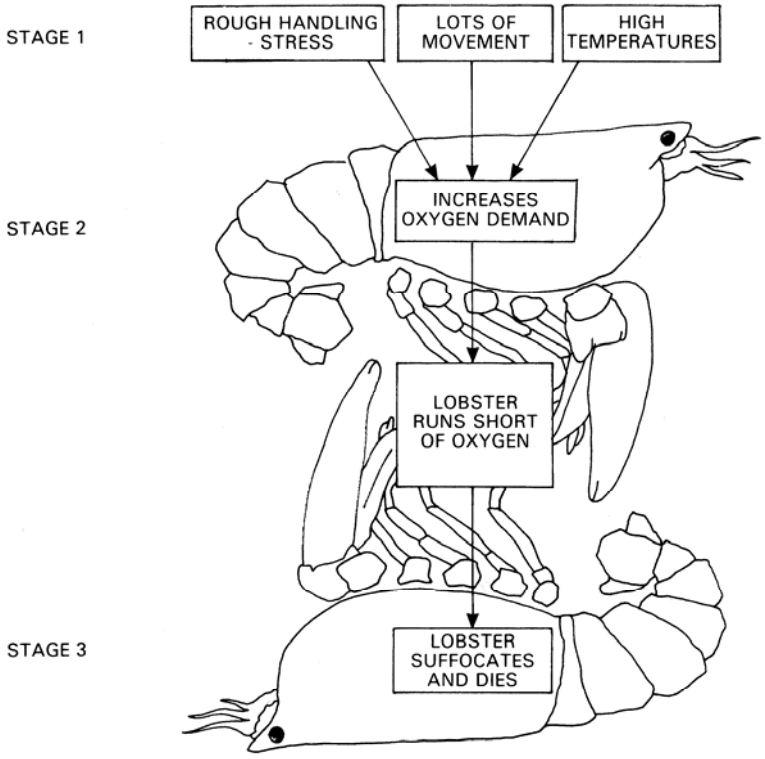
1. cooling Unit
2. head Tank
3. holding Tanks
4. sump
5. filter
6. circulating Pump

If you found it difficult to fill in the spaces, have a look at the diagram on page 50 again.

REMEMBER: A well designed inland storage system should have all these six features.

SAQ8 The correct statements are 1, 4 and 6.

If you chose these answers then you are doing well. If not, then don't worry. The story surrounding suffocation is complicated and takes time to understand. Look at the flow chart below. This will make things clearer. Follow it through and think about each stage as you go.



Start at stage (1). These three stress factors influence stage (2).

Any of these three will increase oxygen demands in stage (2).

Live shellfish can't meet the increase in oxygen demand when they are in air. Waste products build up and they suffocate.

Can you see why answers (1), (4) and (6) are correct? All three listed in stage (1) of the flow chart.

Answer (1) stands for rough handling and stress.
Answer (4) stands for high temperature.
Answer (6) stands for lots of movement.

SAQ9 Statements 1 and 4 are false. The rest of the statements are true.

Do your answers agree with this?

Let's go through each statement in turn.

1 is false because it is impossible for animals to make their own energy.

4 is also false. Energy is needed to keep animals alive. Dead animals do not work. They do not use up energy. Living animals need energy to work. This is why 2 and 3 are true.

Can you see why 5 and 6 are true? The answer follows on from the response to 4.

REMEMBER: Animals need energy to stay alive. Animals obtain their energy from food and oxygen by the process of combustion.

6 gives the equation for combustion in words. Can you remember what this equation looks like? Here it is again to refresh your memory:

FOOD + OXYGEN ----→ CARBON DIOXIDE + WATER + ENERGY

SAQ10 All three tanks are useless for storing live shellfish. Here is why:

TANK 1: The seawater is too strong.

TANK 2: The seawater is polluted.

TANK 3: The temperature of the seawater is too high.

If the salinity is too strong the shellfish will die. the best salinity for holding live shellfish is 30-35‰.

Food left in the seawater will rot. Damaged shellfish will bleed and cause the water to foam. In either case the water becomes polluted which leads to heavy losses.

If the temperature is too high the shellfish will be more active.

They will move around and use up oxygen quickly.

They will also produce waste substances quickly.

The water will become polluted. It will stagnate and kill the healthy animals.

SAQ11 The correct answers are:

1. artificial
2. fibre
3. plastic
4. salinity
5. temperature
6. aerated
7. dead

SAQ12 The correct answers are:

1. C
2. C
3. C

Dennis kept the boxes cool as live shellfish travel best at temperatures between 5 and 10°C.

Lobsters don't like changes in temperature. Sudden changes can lead to death. Dennis avoided this by keeping the temperature the same during transport. That is why C is the correct answer for question 1.

Movement and rough handling leads to more deaths. This is why Dennis kept the boxes undisturbed.

The shellfish will remain moist if kept in moist conditions. Draughts should be avoided if the animals are to remain in the correct moist conditions.

SAQ13 The complete sentences are as follows.

A) **Combustion** is the breakdown of food in the presence of oxygen to release carbon dioxide and energy.

B) **Breathing** is the exchange of oxygen and carbon dioxide between the animal and its surroundings.

C) **Respiration** is the process involved with the release of energy.

SAQ14 You could have given any one of the following signs.

- The animals were all concentrated in a small area of the tank.
- The air bubbles were not distributed throughout the volume of water.
- The size of the air bubbles was too large.

SAQ15 Storing the live shellfish allows the fish merchant to:

- assemble a sufficient quantity to fill the transporter and to reduce transport costs;
- release the shellfish for transportation when the market prices are high.

SAQ16
1. carefully
2. bad
3. sun
4. throw
5. temperature
6. water
7. high

SAQ17
1. oxygen
2. food
3. energy
4. carbon dioxide

Check words 1 to 4 against the diagrams on pages 13 and 16.

SAQ18 No. Lack of salt produces a less dense liquid and so the tube sinks lower.

SAQ19 Storage after transportation inland allows the shellfish to recover from the stress of the journey. They have usually been transported out of water and it is important to return them to water as quickly as possible.

SAQ20 Here are the correct answers.

1. green crabs;
2. velvet swimming crabs;
3. brown crabs.

Do your answers agree with these?

Green crabs and brown crabs can cope with being out of water, but brown crabs can't survive for as long as two days without water. This is how long it takes to transport them to Spain.

Velvet swimming crabs find it very difficult to survive out of water.

SAQ21 The correct answers are:

1. C
2. D

When the shellfish are removed from water their gills clump together. When this happens it becomes very difficult for the animal to take up enough oxygen and release carbon dioxide and ammonia. Waste substances build up in the blood.

Gills are not built to function in air. They function better in water. Shellfish find it difficult to breathe in air, not easy.

Green crabs last the longest in air, two days or longer.

REMEMBER: it normally spends long periods in air in its normal living conditions in the intertidal areas of the shore as explained on page 4.

Spider crabs and velvet swimming crabs find it particularly difficult to survive in air. Try and remember these points. They will help you later on.

SAQ22

1. band
2. 10
3. oxygen
4. warm
5. remove

SAQ23 When choosing a site for a pond, keep away from the following.

- Areas where rivers and streams flow into the sea. This dilutes the seawater and causes problems for the shellfish.

- Harbours and estuaries where there is a possibility of contaminated water getting into the pond.

SAQ24 These are the correct answers:

1. Tank A
2. Crab B
3. Crab B

Can you see why these answers are correct?

Tank A will run out of oxygen first because the water temperature is higher than Tank B. Because of the high temperature, Crab A is more active than Crab B.

Crab A will use up more oxygen. So the oxygen in the water will run out more quickly.

Crab A is producing more waste substances because the water temperature in Tank A is higher.

REMEMBER: Crabs produce more waste substances at higher temperatures.

Crab B stands a better change of surviving to market because the water temperature in Tank B is lower. Crab B isn't active. It is using up oxygen slower than Crab A.

Crab A will run out of oxygen first.

Other Training Programmes

There are a number of other modules which are intended to help you get a better understanding of different parts of the trade. These include:-

Hygiene and Cleaning in the Seafood Industry – Printed Text, Taught Course. Covering food poisoning, maintenance and standards, premises, materials, routines, pests and laws. Leads to Foundation Food Hygiene and Elementary Food Hygiene Certificates via examination. Available in English, Lithuanian, Polish and Portuguese.

Health and Safety in the Seafood Industry – Printed Text, Taught Course. Leads to Foundation H&S and Elementary H&S Certificates via examination.

Maintenance of Fish Quality – Printed Text
The module is about good handling practice at all stages from quayside to retailer. Advice is given on how spoiling can be minimised. It covers different quality levels, changes in fish after death, icing, effects of handling, parasites, pollution and contamination.

Fish Identification – Digital file
This will teach you how to identify a wide range of fish and shellfish used in the industry.

The Frozen Fish Chain – Printed Text
Covers common freezing processes, benefits, handling, temperature control, premises, good practice during thawing and retailing.

Chilled Fish Chain – Printed Text
This module explains the reason for keeping fish chilled. It covers the different ways of doing so and the correct methods to use. It will help you understand some of the handling problems in the distribution system, putting you in a better position to discuss supplies and quality with your supplier.

Introduction to Fish Frying Skills – Printed Text
This module explains how to prepare and cook fish and chips. Topics included are preparing and frying fish, batter preparation, potato preparation and frying skills.

Included with this module is the *Introduction to Food Hygiene and Health & Safety in Fish Frying* module. This focuses on food hygiene principles, temperature control and health & safety. Following a practical/theory assessment, these two modules can lead to a Seafish/NFFF Fish Frying Skills certificate.

Introduction to Customer Service in Fish Frying – Printed Text.
This module covers the importance of customer service in a fish frying business. Topics included are workskills, getting ready for opening, dealing with customers and how to deal with customer complaints and incidents.

Included with this module is the *Introduction to Food Hygiene and Health & Safety in Fish Frying* module. This focuses on food hygiene principles, temperature control and health & safety. Following a practical/theory assessment, these two modules can lead to a Seafish/NFFF Customer Service Skills certificate.

Introduction to Fish Monger Practice – Printed Text
This text covers the various duties expected of an assistant in a Fishmongers' premises. It stresses the importance of a correct attitude both to work and to customers.

Primary Processing of White Fish – Printed Text
Deals with hand and mechanical processes together with packaging, quality control and stock control. The need to maintain a high standard of hygiene is dealt with from the point of view of staff, equipment and buildings.

Fish Smoking – Printed Text
This module covers the basic principles of fish smoking. It deals with the choice of raw material, its preparation and packing. There is also a segment on the types of kilns and fire boxes in common use. The module includes two segments dealing with fish spoilage and the preserving properties of smoke.

Scallop Handling and Shucking Practices – Available only with the associated DVD. This incompany training pack provides all the material needed to train and inform your staff through workplace coaching.

Workplace Coaching – Ever wanted to train your own staff in how its done in your company? This easy to follow distance learning pack will help you to coach and train your own staff. Includes a supporting DVD.

Training Films – on DVD

Strikeback II - Developed in 2006 to support Seafish's hygiene and cleaning in the seafood industry open learning module and taught course. Can be used on it's own for staff induction training. A translated script is available for use with staff who speak Latvian, Lithuanian, Polish, Russian, Portuguese and Spanish.

Hand Processing of Seafood - a masterclass. Possibly the most extensive review on DVD of hand processing skills. The hand

processing of almost 50 species of fish and shellfish are demonstrated by Duncan Lucas, one of the UK's top fishmongers. Developed in 2006.

Fish Filleting Training Programme – This DVD was developed in 2006 to support the taught fish filleting training programme. Containing six demonstrations of fish filleting techniques.

Identification of Marine Fish and Shellfish – Almost 50 species shown and described in detail. Developed in 2006.

Health and Safety in the Seafood Industry - Developed in 2006 to support Seafish's H&S in the seafood industry open learning module and taught course. Can be used on it's own for staff induction training. A translated script is available for use with staff who speak Latvian, Lithuanian, Polish, Russian, Portuguese and Spanish.

Scallop Handling and Shucking Practices – Available only with the associated incompany training pack. This DVD provides powerful arguments for the correct handling and shucking of scallops and demonstrates how it should be done. Developed in 2006 with assistance from the Food Standards Agency (Scotland)

Fish Frying Skills - The Movie – This DVD takes the viewer through the process of how to prepare and cook the perfect fish and chips. Topics covered include the preparation of potatoes, batter and fish along with the frying of the fish and chips. Developed in 2005.

Misc DVDs – Various training films that were first produced as VHS videos are now available as DVDs. These older programmes include Upfront - selling skills for fishmongers. For an up to date list contact Seafish.

Training Courses

Seafish have a range of training courses in fish quality assessment, health and safety and food safety.

Our short food hygiene course (*Introductory food hygiene for the seafood industry*) is available in English, Latvian, Lithuanian, Polish, Russian, Portuguese and Spanish.

Other courses are available directly from Seafish or through our network of Group Training Associations. For an up to date list and current information see www.seafish.org or email training@seafish.co.uk