

Brown Crab

(*Cancer pagurus*)

Handling and Quality Guide



Bord Iascaigh Mhara
Irish Sea Fisheries Board

Introduction

The fishery for brown crab (*Cancer pagurus*) also known as edible crab or common crab, is one of the most valuable in Ireland.

The main fishing zones for brown crab are the western coasts of the North Atlantic, from Scandinavia to Morocco and particularly around the Irish coast.



The distribution of the brown crab (*Cancer pagurus*). Source: Food and Agriculture Organization of United Nations (FAO).

Brown crab is landed in all major and many smaller ports around the Irish coast. Although traditionally an inshore fishery, a significant proportion of landings are from the offshore fleet of live-holding or vivier vessels, which predominately fish off the northwest coast of Ireland.

Brown crab was traditionally sold as a live product. Processors now offer a range of fresh and frozen crab products, particularly crab claws, extracted meat and whole, vacuum packed, pasteurized crab.

The processing sector and the live export trade require vessels to deliver live crab with a high meat content, that are clean, uninjured and have both claws intact. Crab supplied to the live export market must be capable of surviving the stress associated with onward transport and movement between holding tanks.

Crab destined for the live export market, have to survive for up to 20 days from the time they leave the fishing vessel. Poor handling and grading of crab on the fishing vessel, can result in increased mortality during the transport process.

Optimal handling and storage practices at sea and ashore are essential elements in the management of brown crab quality and the achievement of maximum return on national and international markets.

The aim of this guide is to provide practical and contemporary guidelines on the handling and quality of brown crab, at all stages, from capture to the first point of sale.

DISCLAIMER

The information contained within this Handling and Quality Guide is solely for guidance purposes and does not purport to be a legal interpretation of the legislative instruments referred to.

Reproduction and Meat Yield

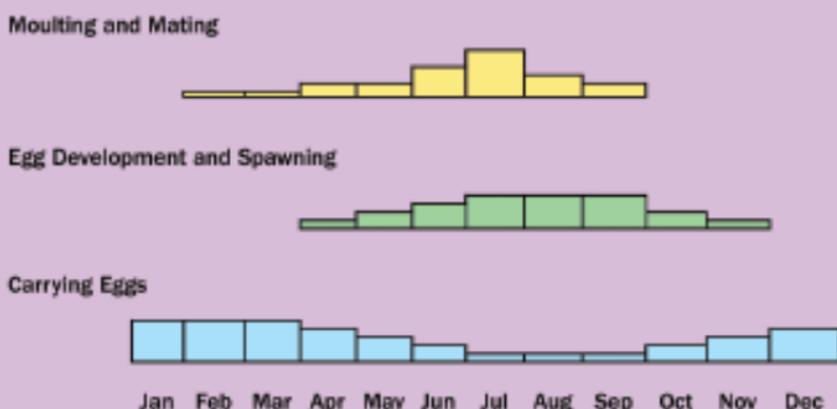


Figure 1. The reproductive cycle of a mature, female, brown crab.

The typical reproductive cycle of a mature, female, brown crab starts when the female moults and is mated. She then develops and spawns an egg mass of between 1 and 4 million, orange-coloured eggs. This is carried and protected under her abdomen for seven to eight months, until the eggs hatch during the spring and early summer and are released as larvae into the plankton (Fig. 1). The female does not feed during the brooding period and relies entirely on body reserves for her survival. In this condition the female is referred to as berried.

Not all female crab will follow this pattern exactly and the timing of each phase of reproduction may be earlier or later than presented. This will depend on the age and health of the individual, water temperature, food availability and the behaviour of local populations.

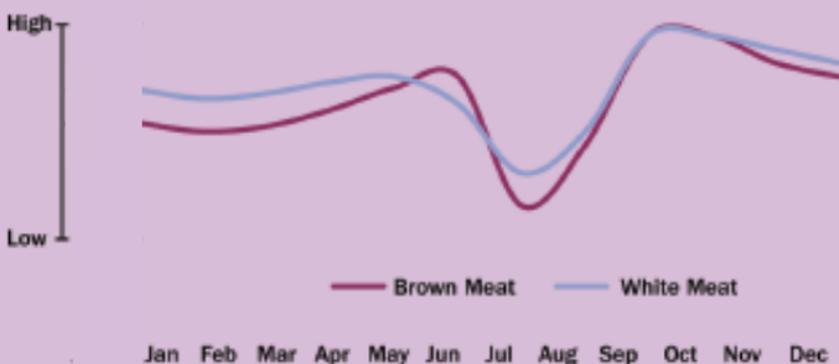


Figure 2. The typical cycle of meat yield from a mature, female, brown crab.

The volume and quality of brown and white meat in a mature, female crab of marketable size, varies throughout the course of the season (Fig. 2) and is directly linked to the reproductive cycle.

Although this graph illustrates a typical meat yield cycle, the exact timing is influenced by the same physiological and environmental factors that affect reproduction.

Note: *The quality and content of white meat over the course of the year is based on the scientific analyses of blood protein content of female crab, from a number of Irish locations*¹. *The brown meat content is based on the professional experience of the Irish crab industry and market sources.*

¹ *Optimising Systems for the Post-harvest Survival of Crustaceans*. Final report of project O1.SM.T1.04, funded by the Irish Government and part-financed by the European Union under the National Development Plan 2000-2006 through the Supporting Measures in the Fisheries Sector.

Cancer pagurus

Irish	- Portán
English	- Brown crab
Spanish	- Buey de mar
French	- Tourteau
Portuguese	- Sapateira
Polish	- Krab kieszeniec
Russian	- Краб обыкновенный

The brown crab is usually reddish-brown above with a characteristic pie-crust edge to the shell, also referred to as the carapace. The underside of the body ranges from pale yellow to light brown and the pincers of the claws are tipped black.

The typical shell size of male brown crab, landed by fishermen, is 90 mm long and 150 mm wide. Very large individuals are relatively uncommon but crab have been recorded with shells up to 250 mm in width.



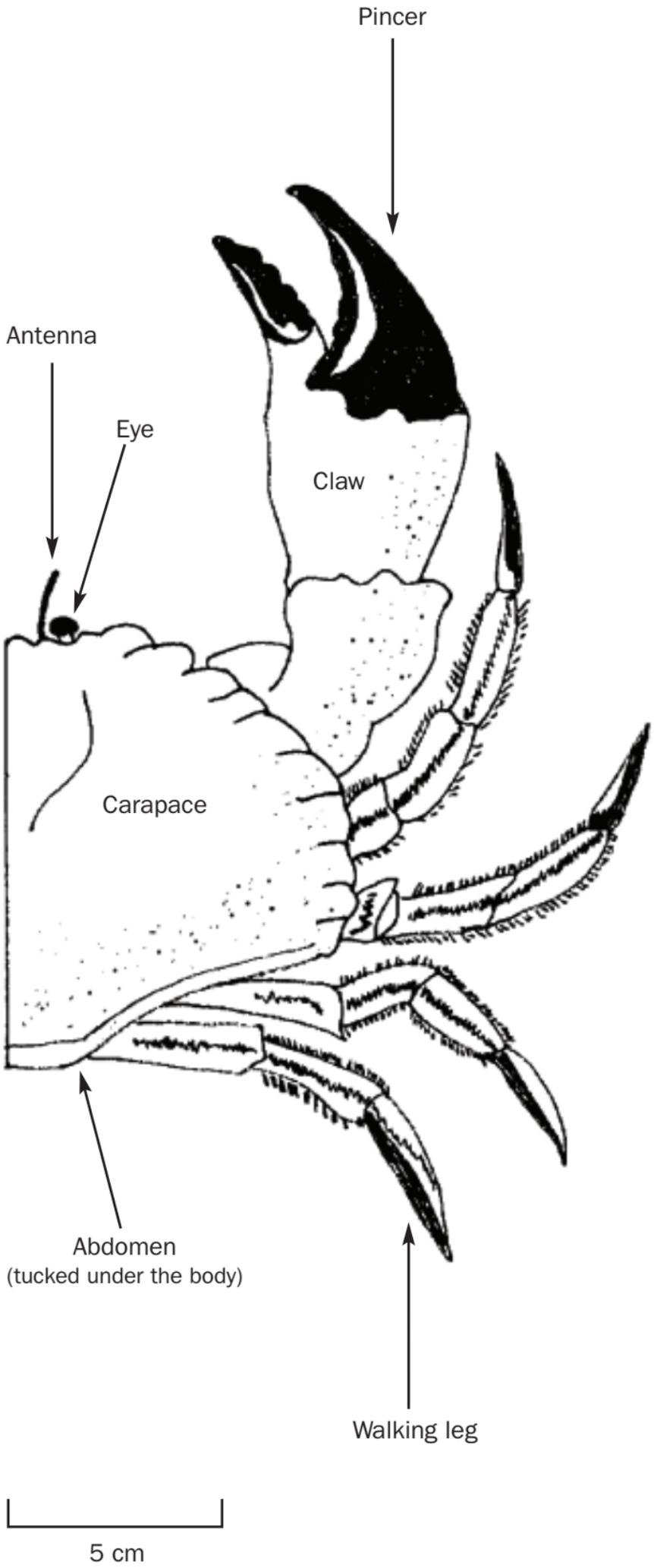
Photo: Dr. Ian Lawler

Brown crab are found over a wide range of substrates, such as sand, gravel and rock. They are found in depths between 6 m and 200 m, but more usually between 6 m and 80 m, with the larger crab occurring offshore.

Crab are predominately caught using baited soft-eye, side-entry pots. This fishing method has a low impact on the environment and is very selective, thereby greatly limiting the by-catch of other species.



Crab Morphology



Identifying the Sexes

The user of this guide must be able to differentiate between male and female brown crab. This is important, as male and female crab have different uses as consumer products.

Male brown crab

- The male, or cock, brown crab has a narrow, triangular pointed abdomen, which fits tightly to the underside of the body;



- The male has larger claws than the female and is marketed, primarily, for its white meat content;
- Male crab typically make up 5 to 10 % of the total brown crab catch.

Identifying the Sexes

This section will help the user to identify female crab with a high meat yield. These crab should be kept aboard and females of poor meat yield should be returned alive and undamaged, to the sea.

Female brown crab

- The female, or hen, brown crab has a broad, beehive-shaped abdomen or apron, which fits tightly to the underside of the body;



- High quality, female, crab are determined by the quantity and quality of brown and white meat known as the yield;
- Female brown crab are marketed as a processed product or in the live state. It is important to note that both these market forms require the crab to have a high meat yield.

Live Returns

Certain crab should not be landed and should be returned, alive and undamaged, to the sea. These are referred to as live returns and include the following:

- **Berried females:** The preservation of the next generation is good husbandry, best practice and a responsible action in the management of the fishery;



- **Cripples:** Brown crab that are physically damaged through the loss of a claw or claws, are commonly referred to, by the industry, as cripples;



- A crab is still considered to be a cripple when claws are in the process of regeneration.



Live Returns

Blackspot is a condition, which causes minor shell and meat damage. Although levels of blackspot may vary, all affected brown crab should be returned, alive to the sea. In some cases, blackspot of the shell can cause the underlying white meat to be discoloured.

- Visible blackspot on the claw of this otherwise healthy, female, brown crab;



- A male brown crab heavily affected by blackspot. These claws would not contain good quality white meat;



- A female brown crab heavily affected by blackspot. Brown and white meat quality and yield would be low.



Live Returns

Brown crab with the following characteristics should also be returned, alive and undamaged, to the sea:

- Crab that are below the legal minimum size (i.e. a carapace width of 130 mm south of 56 °N and 140 mm north of 56 °N);



- Soft-shelled brown crab: Crab grow by replacing their shell, which is referred to as moulting. The colour, particularly of the underside, varies during the moult cycle and is an indicator of quality. Newly moulted crab have a soft or pale shell and are likely to have a very poor meat yield;

Soft-shelled crab are identified by putting light pressure on the underside of the carapace. If the shell is pliable and bends slightly under pressure, then the crab is considered to be soft-shelled. It is important to release these crab to allow them to mate, harden their shell and improve their meat yield;



- Excessive Fouling: Crab that have excessive fouling of the shell from barnacles and calcareous tube worms are unsuitable for processing and may return a poor price. Buyers specifications should be sought in this regard.



Nicking

Nicking involves severing the tendon at the base of the pincers of each claw, so that the pincers are rendered powerless and cannot damage other crab during communal storage and transport. Crabs that are intended for immediate processing do not need to be nicked.

If nicking is not done correctly, the crab can suffer significant blood loss and die, either immediately or later during transport and storage.

Crab should be nicked using the French technique, as follows:

- The claw is fully opened by pushing it against a wedge-shaped piece of metal. Tapping the inside surface of the claw will cause the claw to open slightly;
- The tendon at the base of the claw is cut cleanly with a sharp knife, making as small an incision as possible. A snapping sound will be heard as the tendon is cut;



- To encourage blood clotting at the nicking site, the crab should be immediately placed in seawater or hosed with seawater.

Clawing at Sea

Brown crabs should not have their claws removed at sea.

Council Regulation (EC) No. 724/2001 on the *Conservation of fishery resources through technical measures for the protection of juvenile and marine organisms* does, however, permit a maximum of 1 % of the weight of the catch retained aboard to be made up by separated claws.

This tolerance is to facilitate the landing of claws, which have been accidentally lost during handling, storage and transport.

Discarding clawed brown crab or using them as bait, has the potential to introduce serious disease into the crab stock.

Note: *The survival rate of brown crab, which have had their claws removed, is likely to be low and ultimately reduce the potential yield from the fishery.*

Grading

The meat content of a crab varies depending on the time of year, the length of time since the last moult and the length of time since spawning.

Recently moulted crab have a very poor meat yield due to the high water content of the meat.

Crab with low meat yield should be returned alive to the sea, as they will improve condition over a number of months and may then be recaptured as marketable crab.

Meat quality and yield is highest during autumn and spring and lowest during the summer months.

Visual grading for meat yield is a skill developed over time and learnt by experience. Experienced fishermen rely heavily on physically gauging the weight of the crab in the hand (a.k.a. 'hefting') in order to grade them at sea.



The colour and firmness of the shell is the main indicator used to determine if a brown crab is likely to yield a commercial quantity of meat.

Brown crab should be graded when removed from pots. Commercially valuable, high-yield, crab should be retained and the non-commercial, low-yield, crab returned alive, to the sea, as soon as possible.



Note: *If non-commercial, poor quality and low-yield grades of crab are landed and sold they damage the market reputation of Irish brown crab and reduce the price, which the vessel owner receives for the catch.*

Meat Yield

The following table and photographs provide guidelines for determining the expected meat yield based on the appearance of the crab:

SUMMARY		
Expected meat yield	High 	Low 
Topside	Shell darkly coloured throughout. Pie-crust edge is dark in colour.	Shell lightly coloured throughout. Pie-crust edge is light in colour with pale indentations.
Underside	Abdomen or flap darkly coloured.	Abdomen or flap lightly coloured.
	Shell pale yellow to light brown in colour with visible hairs.	Shell white or cream in colour with no visible hairs.
	Shell hard when the underside of the shell is pressed.	Shell soft when the underside of the shell is pressed.
Claws	Claws dark brown in colour with cream underside.	Claws light brown in colour with off-white underside.

Meat Yield

HIGH ✓

- The topside of the crab is darkly coloured throughout;



- The pie-crust edge is dark in colour;



- The underside of the crab's abdomen or flap is darkly coloured.



Meat Yield

LOW X

- The topside of the crab is lightly pigmented at the back of the shell;



- The pie-crust edge has pale indentations;



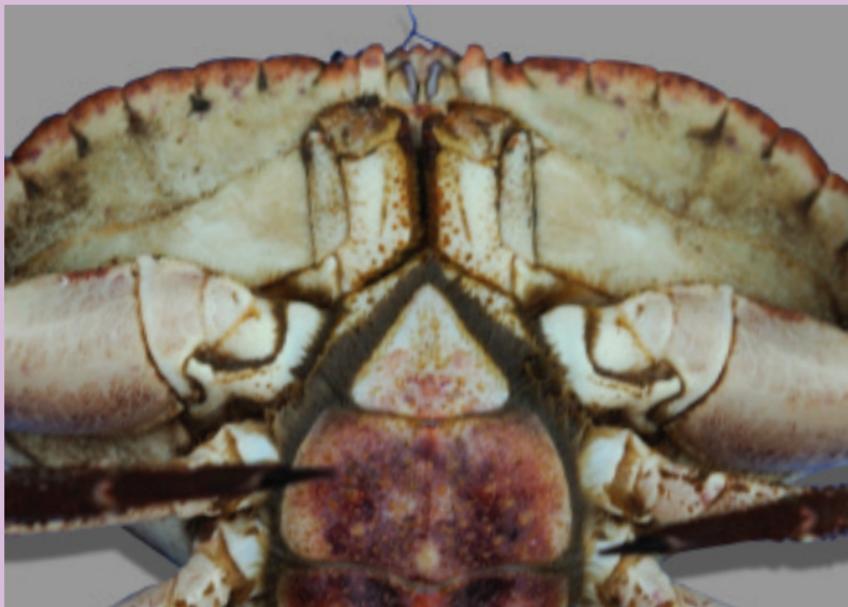
- The underside of the crab's abdomen or flap is very pale or lightly coloured.



Meat Yield

HIGH ✓

- The underside of the shell has a light brown shading, visible hairs and is hard to the touch. The hardness of the shell can be checked by holding the crab on its back and pressing either side of the mouthparts with the thumbs;



- The claws are dark brown in colour;



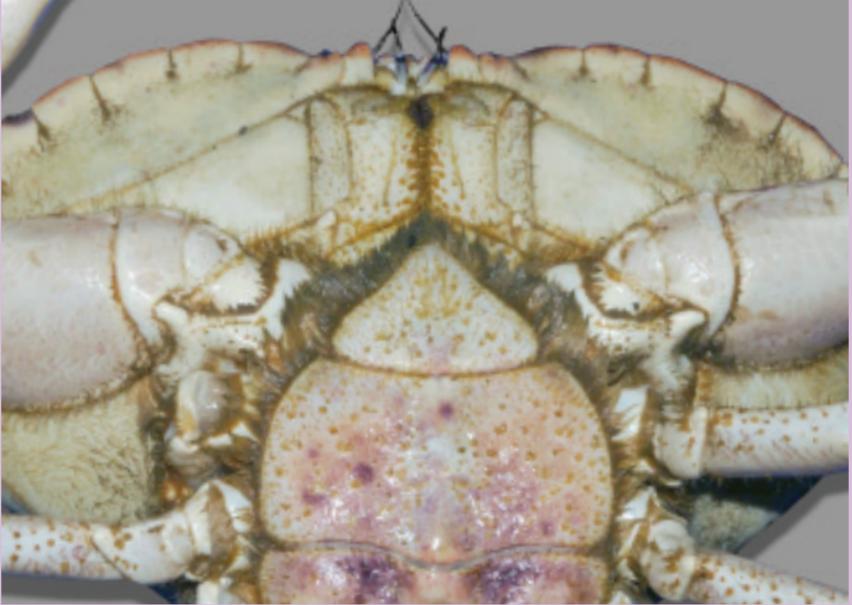
- The underside of the claws are cream in colour.



Meat Yield

LOW X

- The underside of the shell is white or cream in colour, with no visible hairs and is soft to the touch. If the shell is pliable and bends under pressure, then the crab is considered to be soft-shelled;



- The claws are light brown in colour;



- The underside of the claws are off-white in colour.



Hauling and initial Handling

When crab are removed from the water, their ability to take up oxygen is much reduced and they cannot excrete waste products. This causes changes in blood acidity and ammonia levels to increase within the crab. Rough handling and high temperatures will increase the rate, at which this happens. Some of these effects can be reversed when the crab is re-immersed in seawater.

Even short-term exposure to wind and low humidity, can lead to gill damage. In such cases, when crab are re-immersed in seawater, the gills will no longer be able to function properly. Prolonged exposure to the air will lead to permanent, internal damage and the eventual death of the crab.

Although losses in transport or in storage may not occur for a number of days or weeks, the cause of death in many crabs can often be traced to poor handling or storage conditions on the vessel. Crab that are roughly handled or stressed by sudden temperature changes can also react to the shock by casting off or shedding their legs and claws.

The following guidelines for handling brown crab, are based on practical and scientific knowledge:

Handle crabs as gently as possible

- Place crabs gently into boxes with their backs facing upwards. Avoid throwing crabs into boxes when removing them from pots;
- Do not overfill boxes. Boxes should rest on the stacking points, rather than on the crab in the box below.

Minimize the length of time crabs are exposed to air

- Minimize the time that the crab is exposed to the air after removal from the pot. If the crab has to be stored out of water during fishing operations, they should be placed in boxes with their back facing upwards;
- Where boxes are stacked, the top box should be covered with porous, water absorbent cloth such as hessian sacking, which is kept damp by periodically spraying it with seawater from a deck hose. Air circulation through boxes must be allowed, otherwise the crab will suffocate. Boxes should not be covered with tight fitting, windproof covers.

Maintain a low temperature

- Where crab are not being held in vivier tanks but rather in fish boxes, the temperature should be regulated and kept as low as possible. This can be achieved by covering the boxes with porous, water absorbent cloth such as hessian sacking, which is kept damp by periodically spraying it with seawater from a deck hose;
- It is preferable to stack boxes of crab in the hold where they are out of direct sunlight. Seawater, periodically sprayed over stacked boxes from a deck hose, will assist in keeping the temperature down through evaporative cooling;
- If stacked boxes of crab cannot be put in the hold, proper covering of the boxes with porous, water absorbent cloth and regular hosing down with seawater, becomes essential.

Storage on Dry Hold Vessels

Dry hold storage is stressful to live crab, but unavoidable for many inshore vessels.

Mortality levels after landing and during transport and storage, are related to the conditions and duration of dry hold storage.

There is an increased risk of damage to the gills and stress to the crab when it is out of water, particularly if humidity is low and the air temperature is high.

To reduce the amount of stress to the crab, during dry hold storage, the following procedures should be followed:

- After each string of pots is hauled, the catch should be stored and covered with porous, water absorbent cloth such as hessian sacking, which is periodically sprayed with seawater from a deck hose;

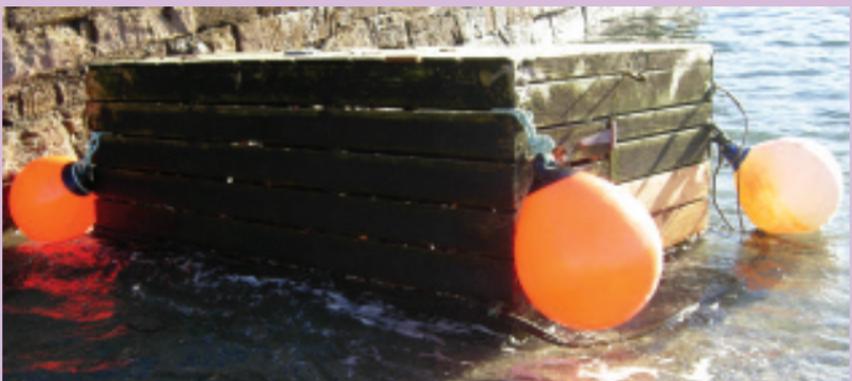


- Boxes should not be stacked more than five high;
- Water absorbent cloth such as hessian sacking, should cover all the crab in the top box, in such a manner that ensures that clean seawater, from a deck hose, can flow through the stack of boxes;
- Do not overfill boxes as this may result in crushing, when the boxes are stacked.

Storage Prior to Sale

Storage at sea is a necessity in many cases, given the logistics involved in the transport and marketing of brown crab.

- Crab from dry hold vessels may sometimes be stored at sea in keeps or storage boxes, for between 1 and 2 weeks prior to onward sale;
- Storing brown crab, involves at least two additional handling events i.e. transfer to and removal from the keep or storage box. Handling should be conducted with care in order to avoid losses due to shock and stress;
- Crab keeps or storage boxes should be located in an area of good quality seawater with stable temperature and salinity;



- Keeps or storage boxes should be suspended one metre off the seabed, particularly if the seabed is muddy, anoxic or prone to re-suspension. Local conditions must be considered when siting keeps or storage boxes (e.g. outflows, freshwater run off);
- Keeps or storage boxes should not be within 2 m of the surface if there is a significant freshwater source nearby (e.g. river, storm drain).

Landing and Onward Dry Hold Transport

If crabs are to be sold immediately on landing then:

- Keep the crab on the vessel with clean, full salinity seawater flowing through the stack of covered boxes, until the transport vehicle arrives;
- Where clean, full salinity seawater is not available, ensure that the crab is covered with wet, water absorbent cloth such as hessian sacking, when steaming ashore;
- Keep crab covered until the transport vehicle arrives;



- Handle the boxes gently when unloading and loading;
- Transport the crab in a temperature controlled, dry or vivier transport vehicle;
- In the case of dry transport, keep the crab in the same box used on the vessel to avoid stress caused by further handling;



- In all cases, crab should be transported under hygienic conditions.

Storage on Vivier Vessels

Under the right conditions, storage of brown crab in vivier tanks, is preferable to dry hold storage, as it minimizes the amount of time that crab are exposed to air.

Storage in vivier tanks, requires the maintenance of good water quality in the tanks during the fishing trip (Fig. 3). This is achieved by constantly flushing seawater through the tanks, which reduces waste byproducts, such as ammonia and maintains a high oxygen content and low temperature.

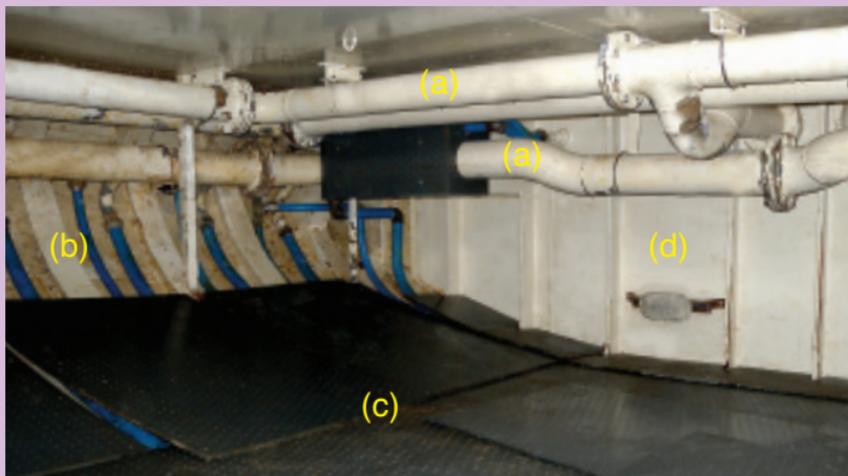
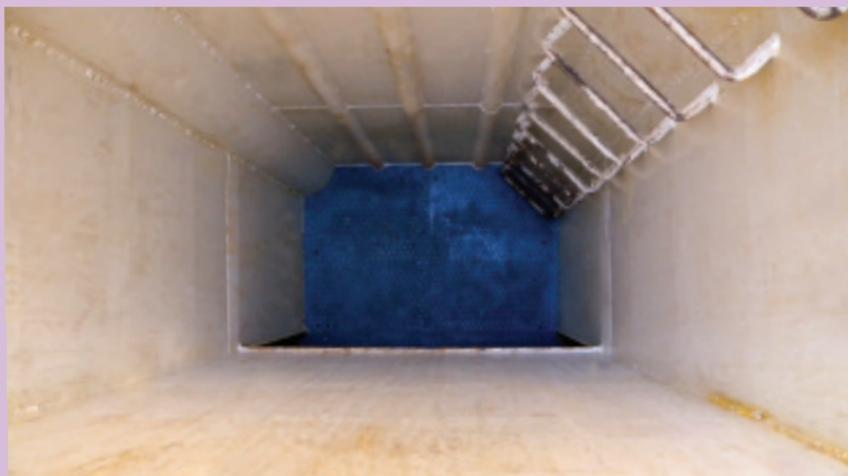


Figure 3. A drained vivier tank undergoing maintenance. Seawater is supplied to the tank and emptied from it, through the white pipes (a). In areas of poor quality seawater, air is pumped into the tank through the blue pipes (b), which are normally under the removable floor grating (c). A galvanic or sacrificial anode (d), prevents the corrosion of the tank by seawater.

Water temperature in vivier tanks may be up to 10° C higher than the bottom water temperature during the summer months, especially when fishing in deep water.

Poor water circulation in vivier tanks can result in ‘dead’ areas, containing low oxygen and high ammonia levels. These conditions are made worse by any crab that die in the tank. Tank design should minimize dead spaces.

- Tanks should be cleaned between fishing trips and inspected for damage;



- There will be a trade off between the length of the trip and the number of dead crab in the tanks. If a high number of dead crab are a regular occurrence, the trip duration and grading criteria should be reviewed and the tank cleaning schedule checked.

Landing from Vivier Vessels

- To land crab from a vivier vessel, the holding tanks have to be drained and the crab offloaded using bongos;



- Crab are usually transferred directly into vivier transport vehicles if they are destined for the live market;



- Care should be taken not to walk, or put any excess weight, on the crab in the vivier tank during the offloading process;
- Bongos should not have any holes that allow legs or claws to protrude and be snapped off or damaged during landing;
- Delays between draining the vivier tank and removing the crab should be avoided. Blood ammonia levels begin to increase immediately when the vivier tank is drained and the crab is exposed to both air and increased temperature.

Guidelines for Vivier Transport

The transport conditions and documents required for vivier transport are contained in European legislation (i.e. EU Council Regulation (EC) 853/2004 *Laying down specific hygiene rules for food of animal origin* and Council Regulation (EEC) 2847/93 *Establishing a control system applicable to the common fisheries policy*). Guidelines for vivier transport are as follows:

- There should be a 1:1 ratio, by volume, of crab to seawater in vivier tanks;
- The best rates of survival are achieved when crab are graded and only the fittest and best quality crab are put into the vivier tanks. Limb loss and bleeding can affect the water quality within the tanks and subsequent mortality can jeopardise the entire contents;
- The levels of ammonia in the blood of the crab should be as close to normal baseline levels, as possible, at the start of the journey. This can be achieved by immersing the crab in flowing seawater for between 1 and 3 hours before loading onto the transport vehicle;
- Stress can be minimized by:
 - Keeping the crab in storage in the vivier tanks aboard the vessel until ready for transportation;
 - Running seawater down through the stack of boxes;
 - Running seawater through reception tanks;
 - Using reception tanks with a seawater circulation system.
- Water quality at the start of vivier transport should have a salinity of 34 ppt, a temperature of between 10 °C and 12 °C and oxygen levels over 9 mg per litre;
- Ammonia levels in the tanks are not controlled and will increase during the journey. This increase will occur mainly within the first twenty minutes after loading the vivier tanks, especially if crab have been dry for a period of time, prior to loading;
- Water temperature and oxygen levels should be monitored in the vivier transport vehicle. Ideally, crab should be held for no longer than 48 hours on the vivier transport vehicle;
- It is critical that the difference in temperature, experienced by brown crab when they are transferred from pot to vivier vessel and from vivier vessel to vivier transport vehicle, is not more than 6 °C. Ideally, the difference in temperature should be no more than 4 °C, as the shock caused by a sudden, large rise in temperature can result in mortalities;
- The temperature of the receiving ponds at the destination of the vivier transport vehicle should also be taken into account in order to minimize losses.

Summary Recommendations

- It is commercially important to be able to identify male and female brown crab:
 - The male or cock crab has a narrow, triangular pointed abdomen, which fits tightly to the underside of the body;
 - The female or hen crab has a broad, beehive-shaped abdomen or apron, which fits tightly to the underside of the body.
- Brown crab that are below the legal minimum carapace width (130 mm south of 56 °N, 140 mm north of 56 °N) should be returned to the sea, alive and undamaged;
- Soft-shelled brown crab should be returned to the sea, alive and undamaged, so that the shell hardens and the meat yield improves;
- Brown crab that are physically damaged through the loss of a claw or claws, are commonly referred to, by the industry, as cripples and should be returned alive, to the sea;
- Egg-bearing or berried females should be returned alive, to the sea, to ensure future generations of crab and contribute to the responsible management of the fishery;
- Nicking of the tendons in the claws is carried out so that the pincers of each claw are rendered powerless and cannot damage other crab during communal storage and transport;
- Only 1 %, or less, of the weight of the catch, retained aboard may be made up by separated claws;
- Clawed brown crab carcasses should not be discarded or used as bait as they have the potential to introduce serious diseases into the crab stock;
- After each string of pots is hauled, the catch should be stowed in boxes and covered with porous, water absorbent cloth, such as hessian sacking;
 - Clean seawater from a deck hose should be allowed to flow through stacks of covered boxes;
 - Stacks of boxes should not be more than five boxes high.
- Crab keeps or storage boxes, should be located in an area of good quality seawater with stable temperature and salinity;
- Crab that are to be sold immediately on landing should be kept on the vessel with seawater flowing through the stack of covered boxes, until the transport vehicle arrives. Crab should be transported in a temperature controlled, dry or vivier transport vehicle;
- A copy of buyer's specifications should be acquired and be easily accessible aboard all vessels and transporters.

Eco-labelling and Certification

Increased consumption and promotion of seafood has developed a requirement for clear and unambiguous labelling of seafood and seafood products. Retailers, driven by the demands of consumers and environmental concerns, now seek assurances that seafood products are sourced responsibly from sustainable stocks, are of high quality and are traceable, throughout the supply chain, from producer to consumer.

International buyers are driving this process and are increasingly demanding that all the seafood supplied to them is certified to a level, which is independently accredited and internationally recognized. Consumer-facing logos and business-to-business documentation provide for the needs of buyers and identify certified product.

The demonstration of responsible fishing, in particular, is high on the consumer agenda and as a result, is now a major market driver. Although several eco-label standards are available (e.g. Marine Stewardship Council (MSC), Friend of the Sea), which certify the biological sustainability of entire fisheries, there are few that address the needs of fishermen or fleets who cannot achieve this type of certification.

BIM's *Seafood Stewardship Programme* contains a suite of internationally recognized standards, developed in consultation with the Irish fishing industry, which incorporates key concerns of buyers and consumers and satisfies the food sourcing policies of key retailers. It differs from fishery specific eco-labels in that it focuses on the individual fishing vessel and onshore facilities and defines levels of responsibility, labelling and quality, which reflect best practice and assure consumer confidence. It has been purposely designed to contribute to the sustainability of fish stocks, where fishery specific certification may not be possible.

In conjunction with the *Seafood Stewardship Programme*, BIM and the Irish fishing industry have developed a *Seafood Environmental Management System for The Irish Catching Sector*. This allows fishermen to document responsible practices and actions aboard their vessel, in readiness for the audit process required by certification schemes.

For more information on BIM's *Seafood Stewardship Programme* or *Seafood Environmental Management System for The Irish Catching Sector*, please contact the Fisheries Development Division at BIM (Tel. +353 (1) 2144 100) or visit the BIM website www.bim.ie.



Training

It is essential that all crew are trained in basic hygiene and handling and understand the food safety risks associated with the handling of brown crab and the production of safe seafood.

Following training, all crew should:

- Be aware of their legal responsibility to ensure the production of safe seafood;
- Recognise how food can be put at risk by chemical, physical and biological hazards and be aware of differences between high and low-risk activities;
- Be aware of the need to keep appropriate records, if required (e.g. temperature);
- Be aware of appropriate waste management and pest control measures necessary to minimize contamination.



Details on training are outlined in the *Guide to Food Safety Training – Level 1* available from the Food Safety Authority of Ireland (www.fsai.ie).

BIM also provide specific courses on basic hygiene and handling of seafood.

Further information can be obtained by contacting BIM, Marine Services Division (Tel. +353 (1) 2144 100).

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