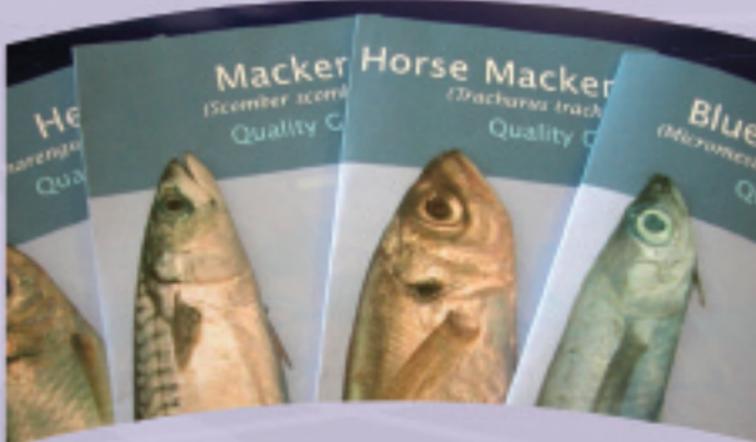


Pelagic Handling Guide

Best Practice



Bord Iascaigh Mhara
Irish Sea Fisheries Board

Introduction

Optimal handling and storage practices at sea and ashore, are essential elements in managing fish quality and achieving maximum financial return on national and international markets.

The focus of this guide is to outline best handling and hygiene practices for pelagic vessels and associated transport from vessels to pelagic fish processors.

The guide is divided into 3 sections:

Section 1. Deals with the legal requirements with regard to handling and hygiene, and also provides associated best practice recommendations.

Section 2. Provides background information on spoilage and quality.

Section 3. Outlines quality and responsible fishing assurance schemes.



DISCLAIMER

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

Section 1

Hygiene and Handling; Requirements and Recommendations

As food handlers, all fishermen are legally obliged to meet the minimum hygiene and handling requirements contained in the EC 'Hygiene Package', which came into effect on the 1st January 2006.

The 'Hygiene Package' consists of five pieces of legislation [Regulations (EC) No. 852/2004, (EC) No. 853/2004, (EC) No. 854/2004, Directives 2002/99/EC, 2004/41/EC], which replace 17 older EC Directives and simplify the requirements for all food handlers. The legislation can be found on the Food Safety Authority of Ireland website (www.fsai.ie).

The requirements of the 'Hygiene Package' are clearly stated and place the responsibility on fishermen for the production of safe food, under hygienic conditions.

This guide outlines the vessel layout, structural, training, hygiene and handling requirements along with additional specific requirements set out in Regulation (EC) No. 2406/96, Regulation (EC) No. 178/2002, Commission Regulation (EC) No. 2073/2005, Regulation No. 2074/2005 and Council Regulation (EC) No. 2076/2005 for pelagic vessels.

The guide is supported by the BIM 'User Friendly Guide to Food Safety Requirements for Vessels' (No. 6.0 2008), which outlines specific requirements in a simple-to-use, checklist format.



Vessel requirements

Layout, structures and fittings

A well laid out vessel with sound structures and fittings is very important in order to minimise the potential for the contamination of product and to facilitate the cleaning and maintenance of a hygienic fish handling area. In particular, the following vessel requirements under the 'Hygiene Package' (i.e. Regulation (EC) No. 852/2004 & Regulation (EC) No.853/2004): are required:

- The fish handling areas must be separate from the crew quarters and engine compartments;
- The layout of the fish handling area must prevent the contamination of fish by bilge water, sewage, smoke or other objectionable substances;
- The intake of seawater should be positioned so that it avoids all possible sources of contamination;
- Surfaces and equipment, which fish come into contact with, must be easy to clean, corrosion-resistant, smooth, durable and non-toxic;
- Fish must be protected from contamination;
- Fuel or bilge water must not contaminate fish storage areas or containers;
- If ice is used onboard, it must be made from clean drinking water (i.e. potable water) or clean seawater (*Council Regulation (EC) No. 2076/2005*).
- Vessels, which hold fish for more than 24 hours, must be designed and equipped to hold fish between 0°C and 2°C.

If a chilling system operates onboard:

- A temperature gauge must be easily visible for checking tank temperatures and records should be retained to show adherence to temperature management requirements;
- The chilling system must cool the water throughout the tank;
- The chilling system must ensure that the temperature of the fish and the seawater reaches 3°C, six hours after loading and 0°C after 16 hours.

Training

It is essential that all crew are in good health and undertake induction training in basic hygiene and handling.

In addition to hygiene and handling being covered in the FETAC approved 'Care Of The Catch' course facilitated by BIM, induction training in this area can be carried out for new crew by the skipper or experienced crew members. BIM also provides a specific course on 'Seafood Hygiene Management', which provides basic hygiene and handling training for pelagic fishermen.

Further information on these and other courses offered by BIM can be obtained by contacting BIM, Marine Services Division (Tel. +353 (1) 2144 100).

This guide along with the Pelagic Quality Guides developed by BIM, and the 'Guide to Food Safety Training- Level 1' available from the Food Safety Authority of Ireland (www.fsai.ie), can be used as information sources for skippers and experienced crew when providing induction training to crew in hygiene and handling practices.

Following training, all crew should:

- Be aware of their legal responsibilities in 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;
- Be aware of appropriate waste management, pest control and any other measures to minimise contamination.



Hygiene Recommendations

A clean and uncontaminated working environment coupled with an effective chill-chain management system are vital components in the production of superior quality, safe seafood.

Cleaning

- It is essential to keep your vessel clean at all times; To prevent contamination, use clean drinking water (i.e. potable water) or clean seawater when cleaning.

At the start and end of every trip:

- Wash the deck, pipes, water separator, refrigerated seawater (RSW) tanks, fish storage areas, oilskins and other equipment, using a power hose and food safe detergent to remove fish blood, scales, dirt and any other fouling substances;
- Remove all residual detergents or sanitizing agents by rinsing with clean seawater;
- Pump waste RSW back into the RSW tanks and dispose off it outside the harbour;
- Remove debris from fishing gear;
- Clean the galley, toilets and living quarters.

After every haul:

- Wash the deck, pipes, water separator and all other equipment, with seawater to remove fish blood, scales, dirt and any other fouling substances.

Waste management

- Ensure waste cannot contaminate fish, by locating waste storage areas away from fish handling and storage areas;
- Dispose of waste in specific designated areas at your landing locations.

Pest control

- Minimise contamination from pests, such as seagulls, by maintaining clean surfaces and closing hatches;
- Store rubbish securely so that it does not attract pests.

Chemical use

- Use food safe detergents and sanitizing agents according to suppliers instructions;
- Keep product specifications for detergents and sanitizing agents onboard;
- Store chemicals in a secure and separate location from the fish handling and storage areas.

Handling Recommendations

Careful handling of fish reduces the potential for damage and quality loss.

Pelagic fish species are prone to physical damage as they are generally handled as a bulk commodity.

In addition, the temperature of fish at boarding is generally between 11°C and 14°C, depending on the ambient sea temperature.

In order to optimise the quality of pelagic fish, the most important actions are to:

- Keep the volume of batches handled to a minimum;
- Rapidly chill the fish once boarded;
- Maintain good chill-chain management throughout the trip and on discharge.

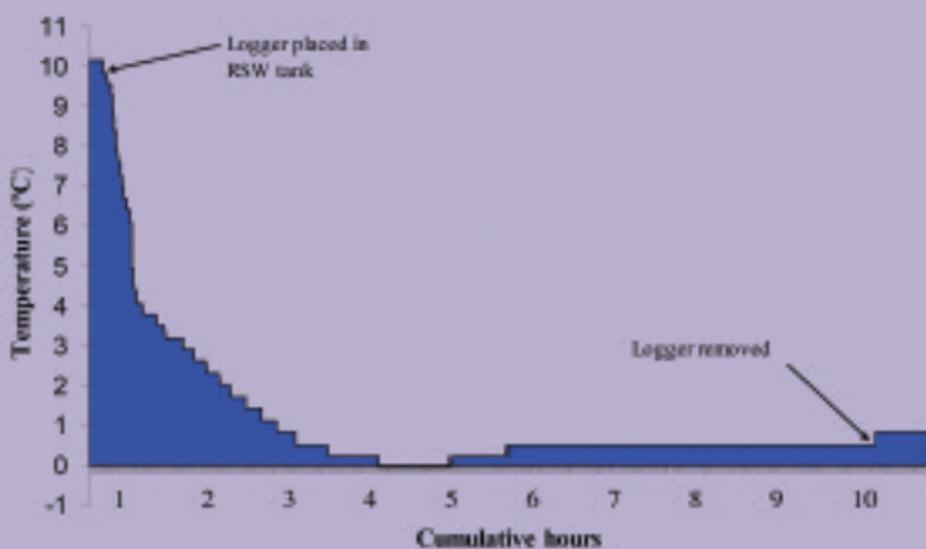


Fig. 1. An illustration of good temperature management; The temperature within the RSW tank, recorded using a temperature logger, rapidly chills the fish to between 0°C and 2°C in a little over 2 hours and maintains them at this temperature from this point onward.

Specific Handling Recommendations

Tank boats:

- Minimise tow durations to avoid crush damage from excessive bulk;
- Pre-chill relevant RSW tanks to 0°C before boarding fish;
- Reduce the core temperature of fish to 3°C within 6 hours;
- Reduce the core temperature of fish to 0°C within 16 hours;
- Do not discharge fish until their core temperature reaches 3°C or below;
- Avoid mixing batches from different hauls within RSW tanks, as this has a significant impact on quality and chill-chain management through the mixing of fish of different core temperatures, freshness and qualities;
- Do not discharge water from RSW tanks while steaming ashore, as this will reduce the chilling and protective capacity of the water in the RSW system;
- Use the following volume ratio of fish to RSW to minimise crush damage and maximise chilling efficiencies:
 - mackerel 80:20;
 - horse mackerel 70:30;
 - herring 80:20;
 - blue whiting 80:20.

Dry hold boats:

- Minimise tow durations to avoid excessively large bulk causing crush damage;
- If vessels are unable to ice or chill at sea, the trip (i.e. time of departure from port to the time of discharge) should be no longer than 8 hours;
- If trips exceed 8 hours, the fish should be chilled, by icing in either insulated bins, fish boxes or fish lockers;
- Ensure that containers used for storing fish, are water resistant and allow melt water to drain away;
- Avoid mixing batches from different hauls, as this has a significant impact on quality and chill-chain management through the mixing of fish of different core temperatures, freshness and qualities.

Discharging

Tank boats:

- Retain fish in chilled RSW tanks until processors are ready to receive the catch;
- Ensure that equipment used to unload fish is clean and well maintained;
- Avoid contamination of fish, by unloading as quickly as possible into clean, pre-chilled tankers or appropriately numbered bins that comply with traceability legislation;
- Ensure that the chill-chain management regime is adhered to by checking temperatures and re-icing during subsequent transport and storage, as necessary;
- Ensure that there is sufficient information to allow each batch* of fish to be traced from the vessel to the customer (Regulation (EC) No. 178/2002).

Dry hold boats:

- Ensure only numbered, clean, undamaged bins are used to store fish;
- Ensure that each bin is not overfilled in order to prevent crush damage;
- Ensure sufficient ice is used in order to optimise chilling;
- Ensure that equipment used to unload fish is clean and well maintained;
- Ensure that no more than a maximum of 400kg (equivalent to half a bin) is brailled in a single operation;
- Transport adequately chilled bins to processors immediately after landing;
- Ensure that there is sufficient information to allow the customer to trace each batch* of fish back to the vessel (Regulation (EC) No. 178/2002).

*A batch is defined as a group or set of identifiable products obtained from a given process under practically identical circumstances and produced in a given place within one defined production period (Commission Regulation (EC) No. 2073/2005).

Section 2

Spoilage

Once a fish dies it immediately begins to spoil. Spoilage is caused by the action of bacteria and enzymes and rapidly increases as temperature rises.

Pelagic fish are particularly prone to spoilage because of their small size and high fat content.

Spoilage is accelerated by the fact that pelagic fish are handled in large volumes and remain ungutted for extended periods.

Bacteria

Bacteria are microscopic organisms that live on the skin, gills and in the gut of healthy fish in their millions, largely without causing harm.

Once a fish dies, however, it loses its defence mechanisms, and these bacteria can begin to multiply to very high levels, leading to spoilage, if appropriate preventative measures are not carried out.

Disease causing or pathogenic bacteria also exist and are most commonly found on surfaces contaminated through fouling (e.g. bird droppings), unclean surfaces or poor personal hygiene. These bacteria can result in serious risks to food safety and public health if they are not eliminated.

Enzymes

Enzymes are proteins involved in the building and breaking down of bodily substances (i.e. converting food into energy or building cells, tissues and flesh).

Pelagic fish have high levels of enzyme activity, which reflects the fact that they are highly mobile.

Once a fish dies, the enzymes within the bacteria living in or on the fish, and those produced by the fish itself in its gut and tissues, are no longer controlled by normal body function and start a process of 'self-digestion', which leads to the spoilage of the entire fish.

Chilling fish immediately after they come onboard and holding them at temperatures between 0° and 2°C, greatly reduces bacterial spoilage and ultimately maintains fish quality and shelf life.

Feeding and belly-bursting

If fish are captured during feeding, enzyme spoilage can be very problematic, and can result in splitting of the gut known as 'belly-burst'. Belly-bursting is largely influenced by the volume of digestive enzymes that are released when fish are feeding on zooplankton.

The breakdown of the gut wall, and subsequent degradation can be so severe that fish are no longer suitable for human consumption a few hours after capture.

Discolouration of the fillets and the gut wall, in addition to flesh flavour changes, can also occur when the products of the spoilage process (i.e. peptides and amino acids) are released from degraded fish tissue.



Fig. 2. A herring showing splitting of the belly (belly-burst) due to enzyme spoilage.

Although super-chilling of fish in RSW tanks, through the addition of slush ice, can be used to reduce the rate of belly-bursting, avoiding fishing grounds at times when fish are feeding heavily on zooplankton is advisable.

Fat content

Fat content has a large bearing on quality. If the fat content is too high, the fish can be too delicate to handle, whereas pelagic fish with low fat content are often post spawning and are in poor condition. Fat content varies throughout the fishing season and it is important to understand the best time to exploit the fishery, in order to maximise the quality and financial returns. Pelagic fish have a high fat content (% of the total round weight) due to their diet, which provides energy for migration and milt and roe development.

Mackerel start their southerly migration from feeding grounds off Norway with a fat content of >35% in July and August. This is too high for processing, as the fish are so delicate that a largereduction in the yield would occur through wastage and damage. As mackerel are actively feeding at this time, their gut cavities are also filled with zooplankton, which makes them prone to belly-bursting. In January and February, the fat content is between 18% and 22% and up to 85% of the Irish quota is landed from this period of the season, which is known as 'The spring fishery'. The majority of this fish is purchased by Russian and Ukrainian markets for smoking purposes. The remaining Irish quota is landed during the autumn fishery often into Norway and Scotland.

Herring travel within distinct regions feeding on plankton during the summer months. They invest heavily in milt and roe production from October, bringing their fat content down from a high of 18% -22% in June and July, to 4% in January and February when spawning. Half of the Irish quota is caught in the spring fishery in January and February, and the remainder is caught in the autumn fishery off the North West of Ireland and in the Celtic Sea.

Horse mackerel fat content ranges between 12% and 14% from August to mid - November. Once the fat content falls below 10%, Japanese buyers are less interested in the product although it will be accepted on African markets. Seventy percent of the Irish quota is caught in the spring fishery from January to March, and the remainder is caught between October and December in the autumn fishery.

Blue whiting have a very low fat content as they are a gadoid species, related to cod, haddock and whiting. Their maximum fat content ranges between 6% and 7% during August when feeding, and falls to 2% in March and April after spawning. The limited Irish quota is caught in February and March.

Measuring fat content

Torry fat meter

The fat /oil content of fish is related to the water content of the natural fish and the measurement of one parameter serves in determining the other. The *Torry Fat Meter* uses a micro-strip sensor to determine water content which allows the fat content to be estimated. The meter is placed on the surface of the fish and the fat content is displayed as a digital readout. It is a non-destructive and a non-invasive way of measuring the fat content.

Accelerated Solvent Extraction Method

Accelerated Solvent Extraction is a method that is commonly used to determine fat levels in fish. This method takes longer than the *Torry Fat Meter* test, but it is suggested to be more accurate. The sample must be dried and placed in an Accelerated Solvent Extractor (ASE), which then provides a fat content reading.

Rigor

Rigor is a natural process that occurs after death, during which the muscles of fish contract, causing the fish to become rigid and inflexible. After a period of time, the muscles pass through rigor and the fish becomes flexible again.

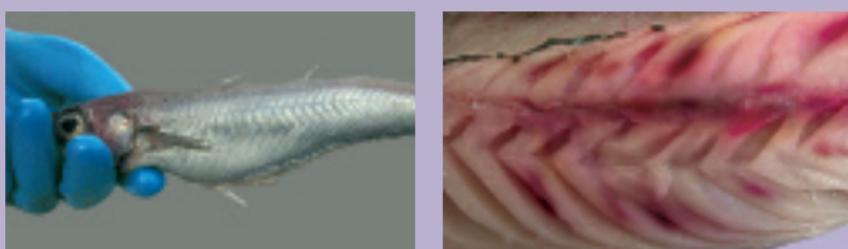


Fig. 3. a) A blue whiting in rigor; b) Fillet gaping in mackerel.

When in rigor, enzyme activity and spoilage are slowed and the shelf life of fish is prolonged. Temperature is the most important factor that affects the time a fish spends in rigor.

At lower temperatures, fish are held in rigor longer and the muscle contractions are more gentle. At higher temperatures, however, fish undergo strong, rapid, muscle contractions, which can result in the tearing of the muscle blocks, and gaping of the fillet.

Rough handling of fish in rigor will also cause fillet gaping. Severe gaping, resulting from poor onboard temperature management and rough handling, is not immediately obvious on the vessel and will only be evident at the processing plant, during filleting.

Fish Quality

Quality is a broad term that is difficult to define as it depends largely on market preferences. Species type, freshness, size, fat content, feed content and degree of damage are all considered important quality attributes, and each, to varying degrees, will determine the market price for the product.

In commercial trading, the most common quality aspects used, are, however, based on freshness and degree of damage from commercial handling, as these are more readily assessed and are attributes that the industry has some control over.

Sensory (organoleptic) schemes

Several international schemes have been developed for commercially important pelagic fish species that allow the assessment of freshness, where the assessor uses smell, touch and sight to assess the condition of the gills, skin, eyes and flesh.

There is a legal requirement for sensory assessment to be carried out when fish are marketed for human consumption (Regulation (EC) No. 2406/96). In 2005, BIM published, four species-specific, pelagic quality guides resulting from laboratory trials, onboard studies and industry consultation.

These guides include all relevant commercial criteria used for the quality assessment of pelagic fish, and are useful tools, for the comprehensive industry-focused quality assessment of pelagic fish.

The image shows a 'Mackerel Assessment Sheet' form. It is a detailed checklist for assessing the quality of mackerel. The form is divided into several sections:

- General Information:** Includes fields for 'Species', 'Batch No.', 'Date', 'Assessor', and 'Location'.
- FRESHNESS ATTRIBUTES:** This section contains six columns: 'GILLS', 'SKIN', 'EYES', 'FLESH', 'SMELL', and 'WEIGHT'. Each column has a list of criteria to be checked, such as 'Gills are pinkish-red', 'Skin is shiny and moist', 'Eyes are clear and protrude', etc.
- QUALITY CRITERIA:** This section contains six columns: 'GILLS', 'SKIN', 'EYES', 'FLESH', 'SMELL', and 'WEIGHT'. Each column has a list of criteria to be checked, such as 'Gills are pinkish-red', 'Skin is shiny and moist', 'Eyes are clear and protrude', etc.
- Summary:** A section at the bottom with a grid for recording scores for each attribute and a total score.

The form is titled 'Mackerel Assessment Sheet' and is published by BIM (BIM Fisheries Development Division).

Fig. 4. An example of the comprehensive sensory assessment sheet developed by BIM for mackerel.

Copies of the guides can be obtained by contacting BIM, Fisheries Development Division (Tel. +353 (1) 2144 100) or on the BIM website (www.bim.ie).

Laboratory tests

Although laboratory testing can be costly and time consuming, such methods provide more objective and quantitative results than sensory methods. Some laboratory tests are used by industry for verification purposes, whereas others are mandatory and must be carried out by law. Mackerel, herring and sprat must be tested for levels of histamine by processors (Regulation (EC) No 2073/2005).

Elevated levels of histamine can be indicative of bad handling practices and temperature abuse and are of importance to human health, as they can cause histamine poisoning in sensitive consumers.

Total volatile basic nitrogen (TVBN), total viable count (TVC) of bacteria and *Listeria monocytogenes* testing are often used for 'in-house' quality control and may be demanded by certain markets.

TVBN measures the key products of bacterial spoilage (ammonia, dimethylamine and trimethylamine), TVC measures the number of colony forming units (cfu) per g (or per ml) of bacteria in the sample of fish. *Listeria monocytogenes* checks test for the levels of this bacteria, which is responsible for listeriosis, a rare but lethal, food-borne infection.

Parasite assessment

Processors are obliged to check a representative sample of fish for the presence of nematode parasites (Regulation (EC) No 853/2004, Regulation (EC) No 854/2004 & Regulation (EC) No 2074/2005).

The BIM publication; 'An Industry Guide to the Assessment of Herring Worm (*Anisakis* sp.) in Pelagic Fish', describes the most commonly used assessment techniques in this area.

Market requirements

Although it is essential that legislative criteria regarding microbiological testing, parasite and freshness assessments are adhered to, certain markets will also require that higher standards or additional testing regimes be carried out. It is commercially prudent, therefore, that specific market criteria are clearly established by relevant industry sectors before entering such markets.

Section 3

Assuring Best Practice

Traditionally, the pelagic fish trade has been based on mutual trust developed between producers, processors and buyers. However, today's consumers are more educated, well travelled and affluent, and consequently, more demanding. They now seek assurances that food products, including fish, are responsibly sourced, of good quality and well handled.

To satisfy these demands in the pelagic fishing sector, international buyers now seek assurances from producers and processors. These can be achieved by benchmarking production and processing operations against internationally recognised standards, often using independent, accredited, third-party certifiers. Logos can be used on products, to demonstrate compliance when these standards are met and certification achieved.

Responsible fishing, in particular, is high on the consumer agenda, and as a result is now a major market driver. Several 'eco-label' standards are now available; the most popular of which, has been developed by the Marine Stewardship Council (MSC). Many of the large-scale, international pelagic buyers currently demand product from MSC certified sources (e.g. mackerel). The pelagic industry in Ireland is under MSC assessment for mackerel and it is anticipated that certification will be achieved in 2009. As with other fishing nations, the pelagic industry in Ireland has commenced the assessment process for mackerel and it is hoped that certification will be achieved in 2009. Other eco-labels including 'Friend of Sea' are also establishing themselves in international markets.

The BIM Stewardship scheme, developed in consultation with industry, incorporates key concerns of buyers and consumers (i.e. quality, responsibility and provenance) and satisfies the food sourcing policies of key retailers. Membership of this scheme is open and available to all industry sectors.

As further standards and schemes evolve, there is little doubt that the level of documentation, required to satisfy the demands of certification, will continue to increase. With this in mind, BIM and the fishing industry have developed a Seafood Environmental Management System, which allows fishermen to document responsible practices with regard to the environment and quality. The major advantage of this system is that it can be tailored to provide the necessary documentation for auditing any scheme or certification process.

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Pelagic



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FINANCIAL INSTRUMENT
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