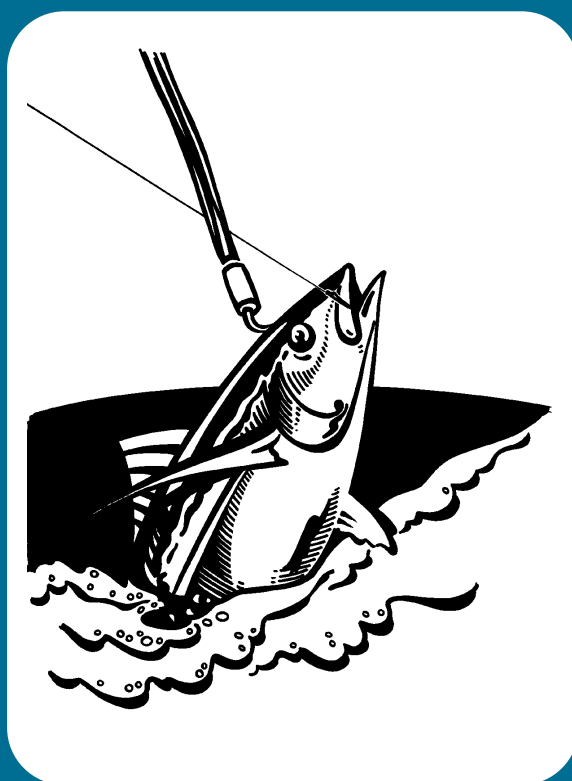


ON-BOARD HANDLING OF SASHIMI-GRADE TUNA

A Practical Guide for Crew Members



SOUTH PACIFIC COMMISSION

ON-BOARD HANDLING OF SASHIMI-GRADE TUNA

A Practical Guide for Crew Members

BY
MICHEL BLANC
&
AYMERIC DESURMONT

This handbook was produced
with financial support from
the Governments of Australia and France

COASTAL FISHERIES PROGRAMME
TRAINING SECTION
INFORMATION SECTION



SOUTH PACIFIC COMMISSION
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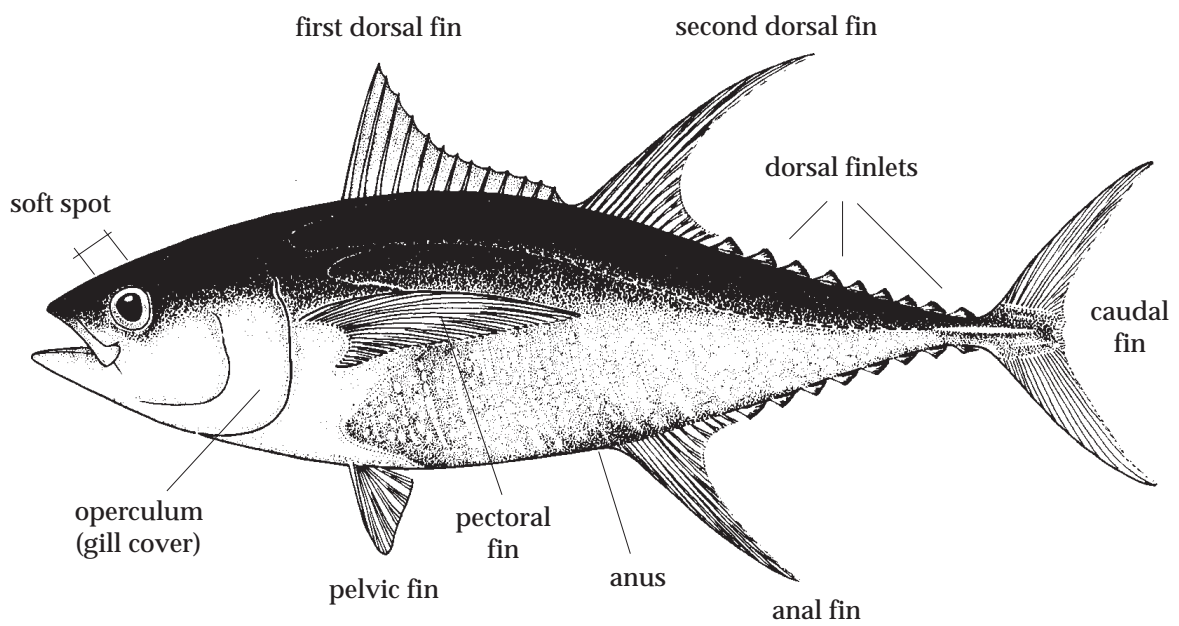


Figure 1: External anatomy

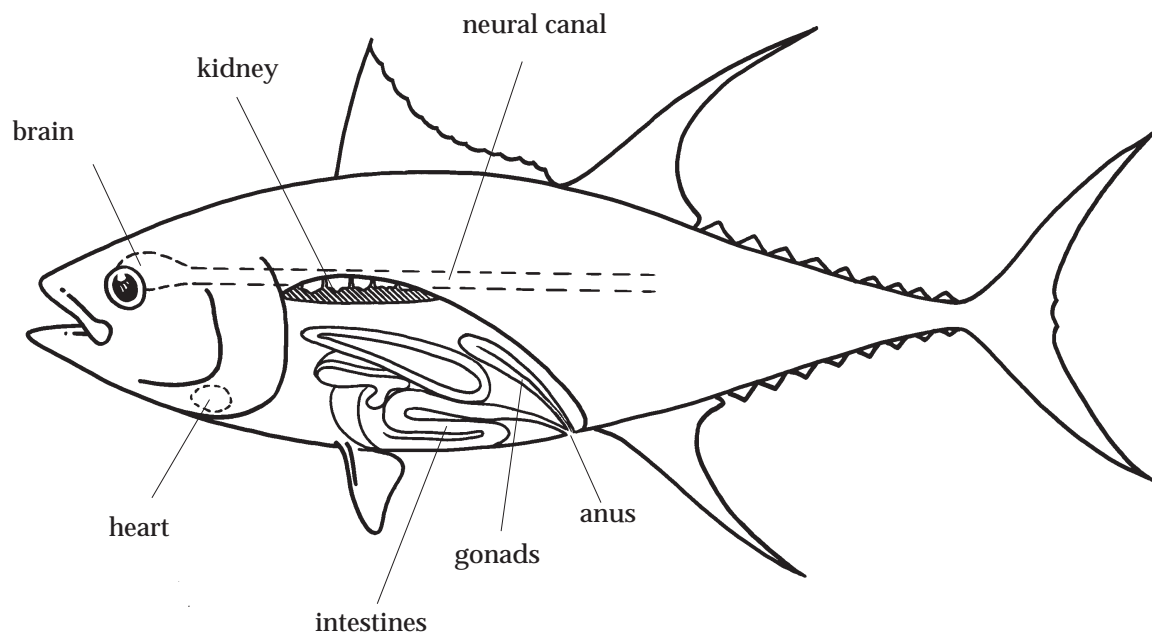


Figure 2: Internal anatomy

INTRODUCTION

Sashimi is a traditional Japanese dish, made from thin slices of premium-quality raw fish. The most popular sashimi fish are the red-meat species, particularly tunas and skipjack. 'Sashimi' in fact means much more than just 'raw fish'; the term implies specific requirements regarding freshness, appearance, presentation, texture and taste.

Only genuine premium-quality fish will fetch a good price on the sashimi market. Fish grading is determined by several factors, both biological and non-biological:

- A fishing crew can exercise little control over the biological factors, which include species, age, size, degree of sexual maturity and the presence of parasites or diseases. The size, species and stage of sexual maturity are very important because they determine the fat content of the fish. The tuna with the highest fat content attract the best prices in the sashimi market.
- The non-biological factors are within the crew's control. They include the fishing method used and the handling and chilling techniques applied to the fish after capture.

There are many ways of handling and packing fresh tuna, but only a few permit the export of a high-grade product to the sashimi markets. This booklet, primarily intended for crew members on tuna longliners, attempts to describe in detail a handling and refrigeration method which will meet the exacting standards of the Japanese fresh tuna market.

For certain stages of the handling process, various alternative techniques are described, since requirements may vary from importer to importer. It is therefore essential that the fishing boat operator be aware of his buyer's specific requirements.

Some fishing boat operators export to several international markets (for example, the largest and highest-grade tuna are exported to Japan, while smaller, lower-grade tuna are marketed in Australia); crew members may therefore need to handle each fish according to its intended market.

THE TOOLS NEEDED

Before hauling in the longline, the crew should prepare the necessary equipment to deal rapidly with the fish which will be hauled aboard:

- gloves, preferably cotton, for all handling purposes,
- a mat or a foam pad to lay the fish on,
- a club to stun the fish,
- a spike to kill them,
- lengths of monofilament nylon cord to destroy the spinal cord ('Tanaguchi' method),
- a sharp knife with a guard and very short blade (3 cm maximum) to bleed the fish,
- a sharp knife to gut the fish,
- a stiff brush to scrub out the gill cavity,
- elasticised cloth sleeves or 'socks' to protect the fish when they are placed in brine.

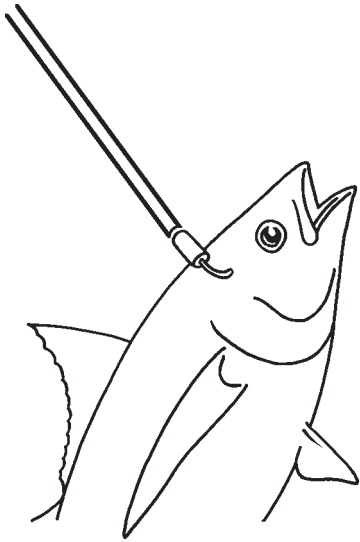


Figure 3: Always gaff the fish through the head

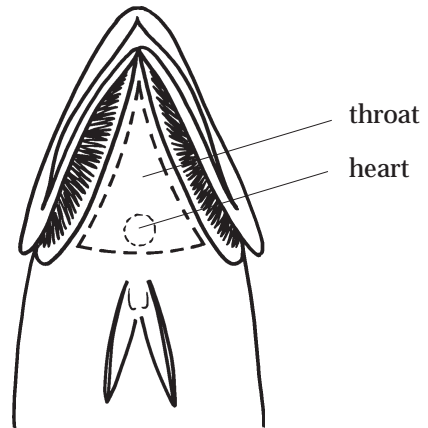


Figure 4: Never gaff the fish through the throat or in the heart

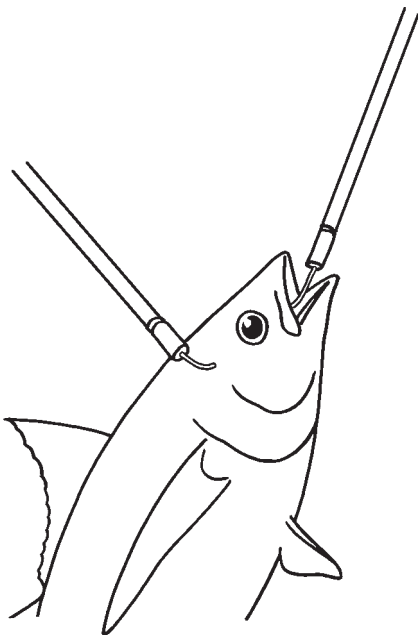


Figure 5: Use 2 gaffs for big fish

GAFFING THE FISH AND LANDING IT

The appearance of the fish is an important factor in the price which can be obtained for it. Always treat your fish with great care and always wear gloves when you are handling it ¹.

- Always gaff the fish through the head (Figure 3).
- Never gaff the fish through the body, the throat or the heart ² (Figure 4).
- Use two gaffs for big fish, the second through the mouth (Figure 5).
- It is advisable to lift the fish's tail to help haul it on board.
- The fish should be landed on a foam pad or a mat ³.
- Take care to fold the pectoral fins under the fish so that they are not damaged.
- Carry out all subsequent handling on the foam pad or mat.

¹ *Handling without gloves will leave marks on the tuna due to heat and the fatty substances on the palm of the hand.*

² *A gaff mark in the tuna's body reduce its retail value, not only because it makes its appearance less attractive but also because the part of the flesh damaged by the gaff will have no value on the sashimi market; the throat is too fragile an area; the heart is a small blood pump which must continue to function during bleeding for the fish's blood to be properly drained.*

³ *The slightest impact will leave a mark on the fish's body; the foam pad or mat protects the fish's skin from bruising and scale loss during the handling process.*

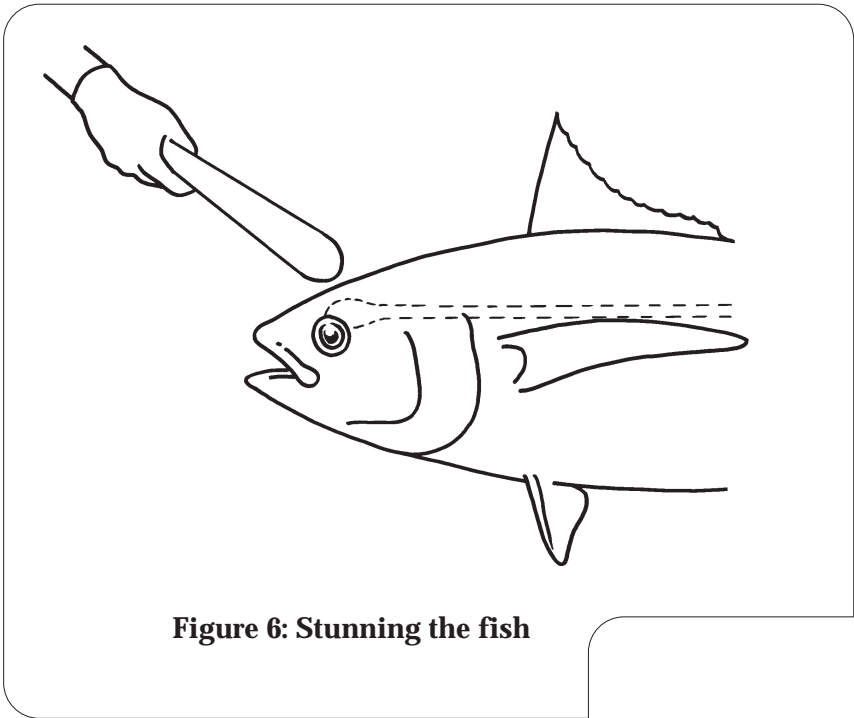


Figure 6: Stunning the fish

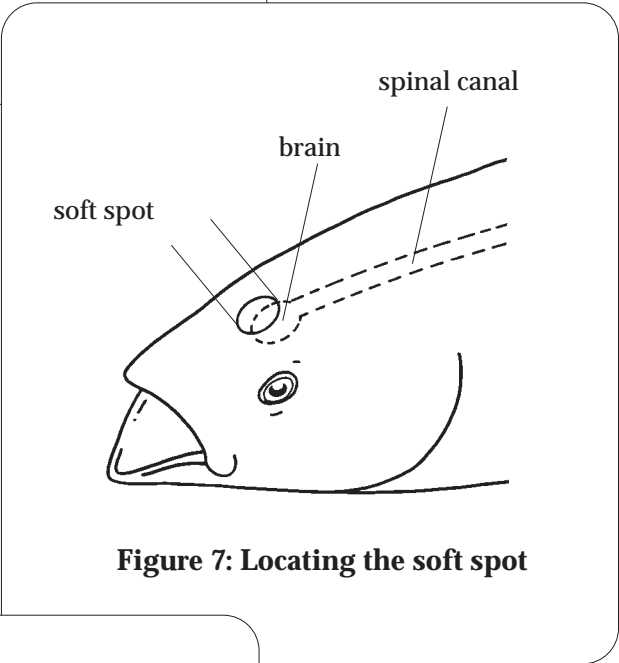


Figure 7: Locating the soft spot

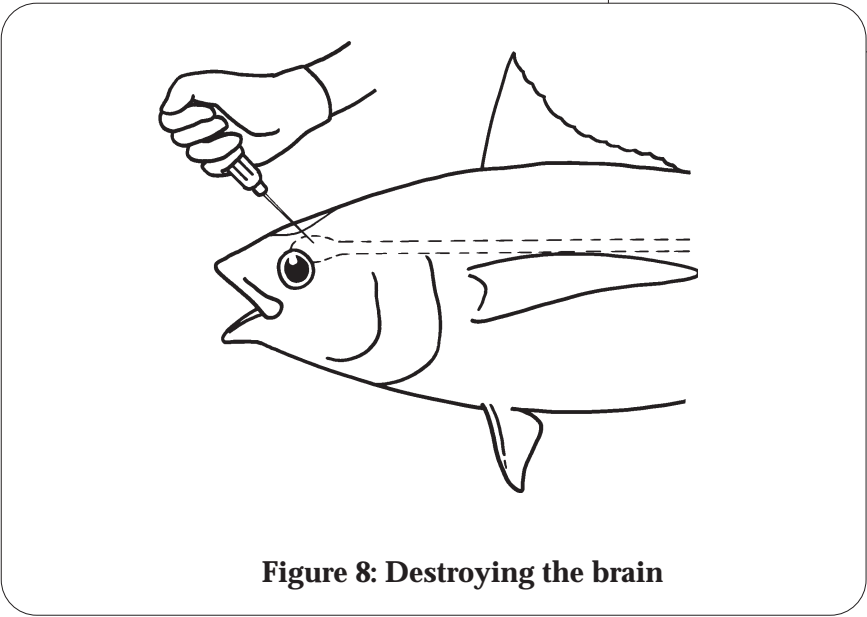


Figure 8: Destroying the brain

KILLING THE FISH

On arrival in Japan, each sashimi-grade tuna will be very closely inspected. Any fish which has not been killed in the way described below will inevitably be down-graded. To avoid such loss of value, the destruction of the brain and neutralisation of the nervous system should be performed on all sashimi tunas (yellowfin and bigeye weighing over 30 kg).

Once aboard, the fish should be killed immediately¹ :

- Stun the fish with a sharp blow to the top of the head, between the eyes, using a fish club or other such blunt instrument (Figure 6).
- Use the fish club to disengage the hook from the fish's mouth.
- Stand over the fish, steadying it firmly with your legs braced against the pectoral fins.
- Locate the soft spot (Figure 7) by running your thumb over the top of the head.
- Insert a spike into the soft spot at a 45° angle. If the spike is inserted in the right place, the fish will give one last shudder (the body will stiffen, the mouth will fall open and the first dorsal fin will open) before going limp (Figure 8). If this does not happen, the soft spot should be spiked again.
- The spike should be moved around to destroy the brain until the body stops moving and the jaw goes slack.

¹ *If the fish is killed quickly in this way, it will stop struggling and damage due to thrashing around on the deck will be avoided.*

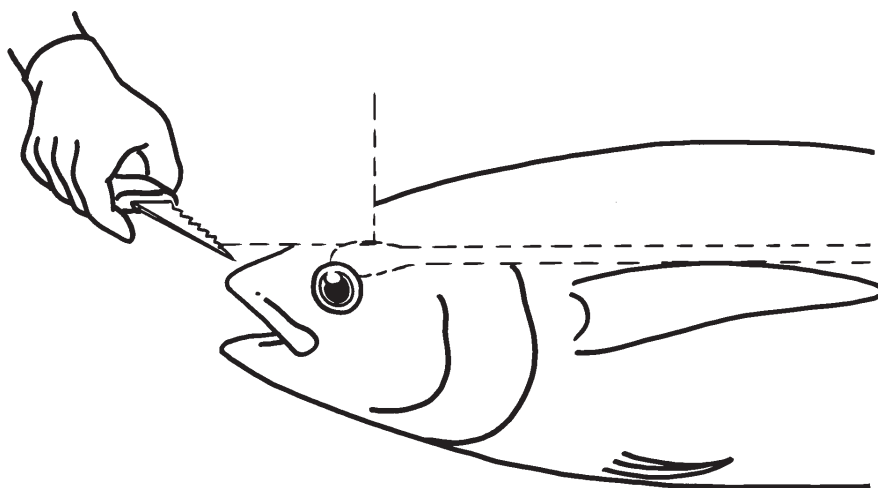
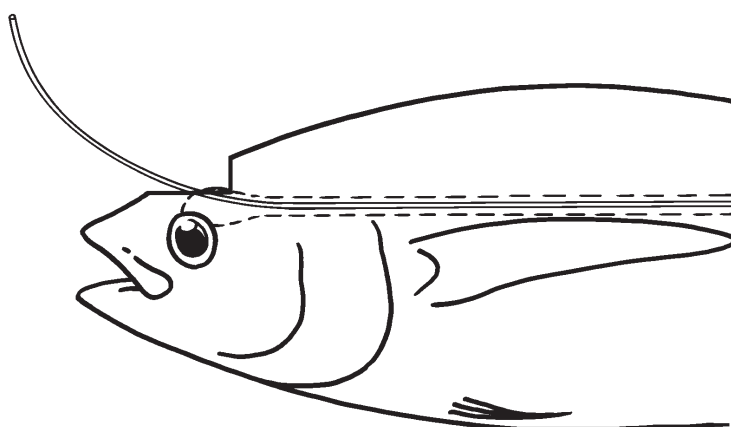


Figure 9: Cut out a piece of flesh just above the soft spot



**Figure 10 : Push
a length of monofilament nylon
into the neural canal**

KILLING THE FISH (CONTINUED)

It is advisable to pith¹ the fish ('Tanaguchi' method) after killing it :

- Using a saw-edged knife or a small saw, cut out a piece of flesh just above the soft spot (Figure 9) to expose the brain.
- Insert a length of rigid monofilament nylon² into the brain and push it as far as possible into the neural canal to destroy the spinal cord (Figure 10). The fish should give one last shudder.
- Leave the length of monofilament in the neural canal, but cut it off to leave the last ten centimetres emerging from the fish's head³.

¹ To 'pith' is to completely destroy the spinal cord running in the neural canal. This stops the biochemical reactions which contribute to deteriorating the flesh. Pithing therefore produces a higher-grade tuna.

² The use of a length of nylon monofilament 2 to 2.5 mm in diameter is recommended for the 'Tanaguchi' method. The crew can prepare lengths of nylon from old longline snoods.

³ Leaving the monofilament nylon in the fish will prove to the buyer that it was killed using the 'Tanaguchi' method.

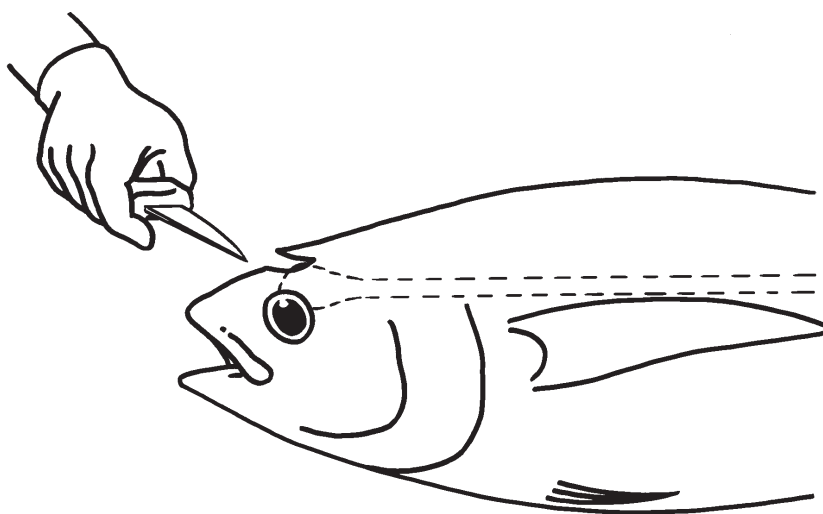
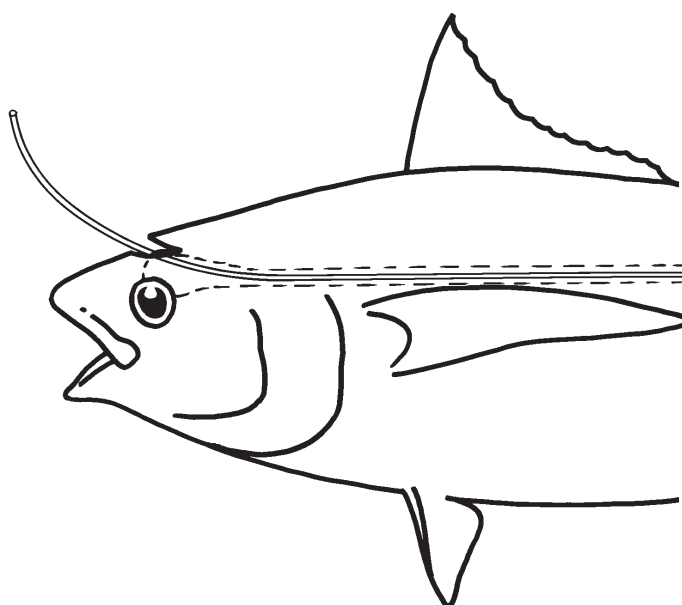


Figure 11: Make a cut over the soft spot



**Figure 12 : Push a length
of monofilament nylon into the neural canal**

KILLING THE FISH: ALTERNATIVE METHOD

A second method makes it possible to kill and core the fish in a single operation. Cleaner¹ and quicker, it may be required by some Japanese buyers.

- Stun the fish with a sharp blow to the top of the head, between the eyes, using a fish club or other such blunt instrument (Figure 6).
- Use the fish club to disengage the hook from the fish's mouth.
- Stand over the fish, steadying it firmly with your legs braced against the pectoral fins.
- Locate the soft spot (Figure 7) by running your thumb over the top of the head.
- Use a very sharp knife to make a cut three to four centimetres long over the soft spot. The incision must be deep enough to expose the skull (Figure 11).
- Insert a length of monofilament nylon into the skull to destroy the brain and then push it as far as possible into the neural canal (Figure 12).
- Leave the length of monofilament in the neural canal, but cut it off to leave ten centimetres emerging from the fish's head.

¹ *With the first method, the spike is moved around in the skull to destroy the brain; if the spike is pushed in too deeply there is a risk of damage to the entrance to the neural canal. This can make the insertion of the monofilament nylon difficult or even impossible. With the second method, the skull and the entrance to the neural canal remain intact when the nylon is pushed in; insertion of the nylon into the neural canal is always very easy. In addition, with the alternative method, the incision on the top of the head is less obvious and the fish therefore retains a better appearance.*

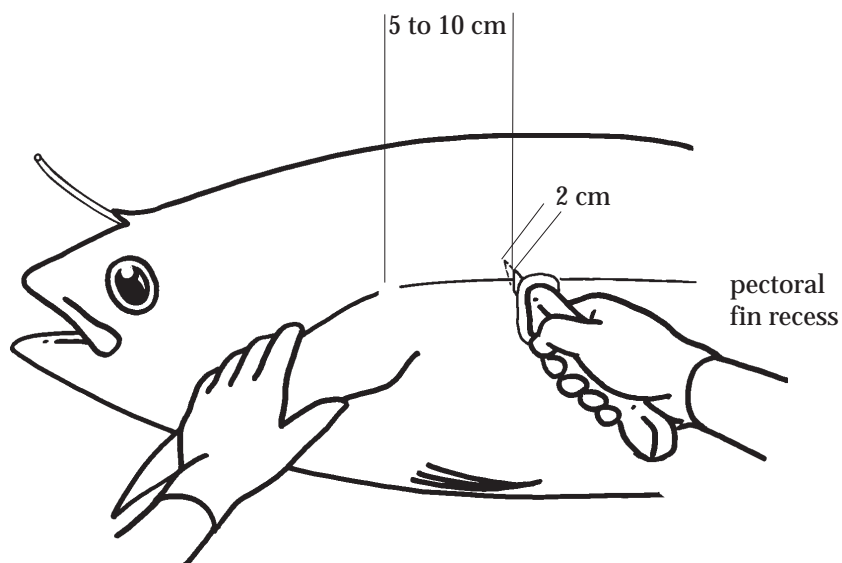


Figure 13: Make a cut in each side of the fish behind the pectoral fin

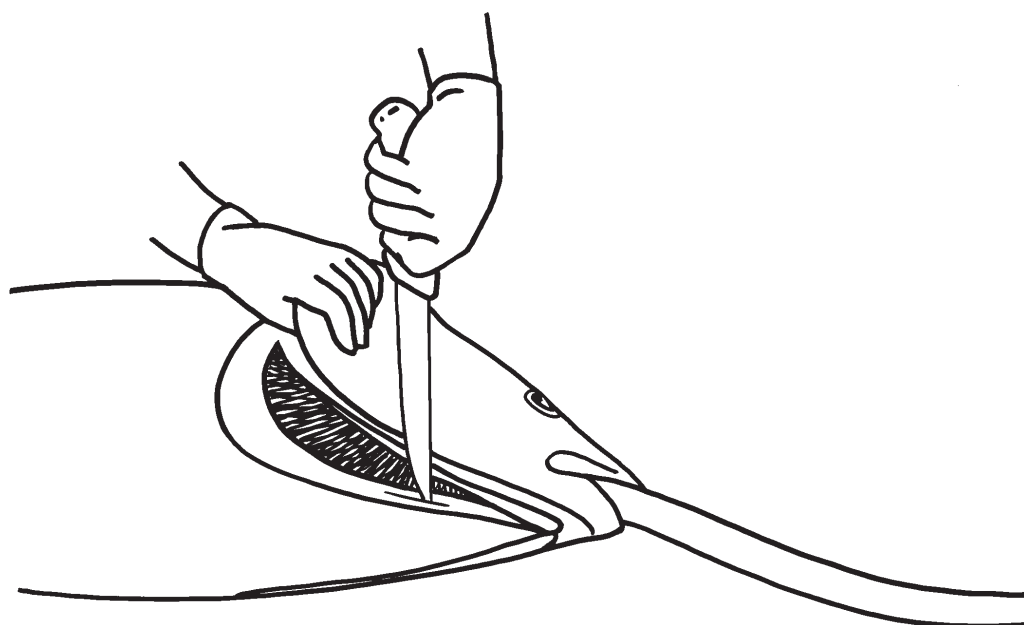


Figure 14 : Make a cut between the gill collar and the gills and place a hosepipe carrying seawater in the mouth

BLEEDING THE FISH

Bleeding the fish immediately after killing it¹ improves the appearance of the flesh² and keeps it fresh³. This is a vital stage for the quality of the fish and its subsequent value on the sashimi market.

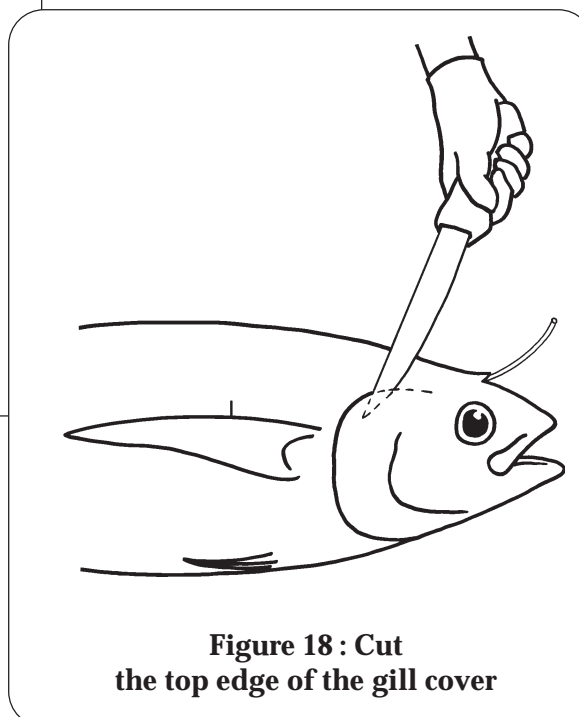
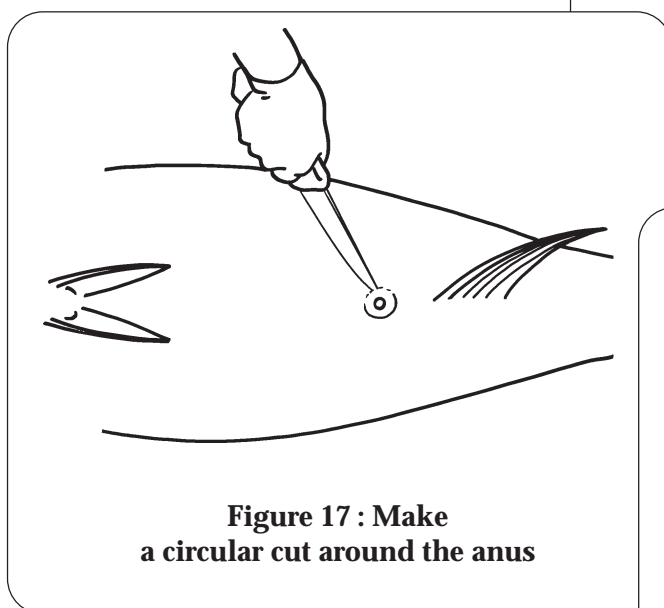
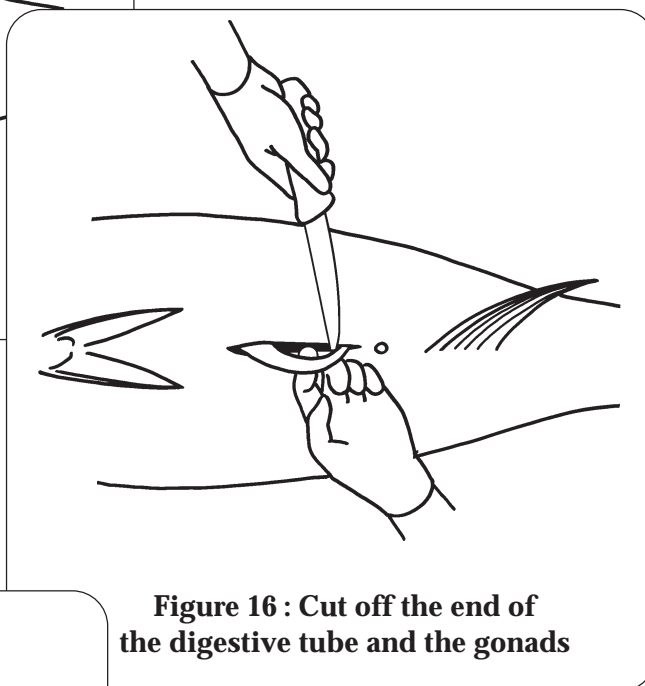
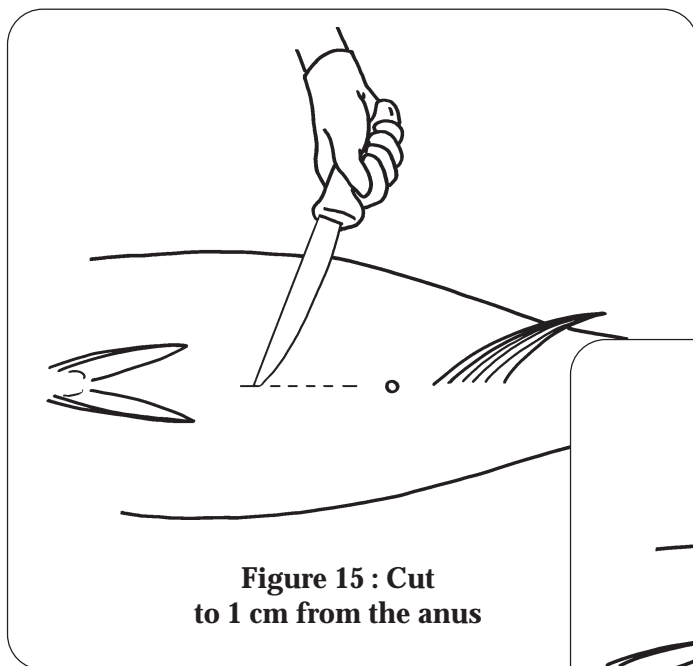
- Bleed the tuna by making a cut in the side of the fish with a knife, five to ten centimetres behind the base of the pectoral fin. The cut, two centimetres deep at most, should be made perpendicular to the pectoral fin recess⁴, on both sides of the fish (Figure 13). Blood should flow freely from these cuts.
- Make a cut in the membrane between the gill collar and the gills in order to sever the arteries supplying the gills, then place a hosepipe carrying sea water in the fish's mouth in order to wash the blood out of the gill cavity (Figure 14).
- Leave the fish to bleed for five to ten minutes.
- Some buyers may also require that the fish be cut on either side of the tail. This cut, between the third and fourth tail finlet from the tail (see Figure 1), is not very efficient for bleeding purposes. It should only be done if the buyer requests it.

¹ *After the brain has been destroyed, the heart continues to beat for a few minutes. These cuts should therefore be made as quickly as possible to allow the last heartbeats to pump the blood out through these wounds.*

² *Any sashimi-grade tuna specialist will recognise a tuna which has not been bled (or which has only been partly bled) because of the presence in the flesh of unattractive dark red veinlets.*

³ *During the tuna's struggle before it is hauled aboard, the blood attains a high organic waste (lactic acid) content and rises in temperature (up to 35° Celsius in some cases). Bleeding removes the waste and cools the fish's body. The fish can then be refrigerated more quickly and will have better-quality flesh.*

⁴ *A pair of major blood vessels runs along the pectoral fin recess immediately under the tuna's skin. These vessels will easily be severed if the knife is inserted at 90° to the recess. Also, the mark left on the fish will be perfectly visible to the buyer, who will not have to lift the pectoral fin to look for it.*



GUTTING

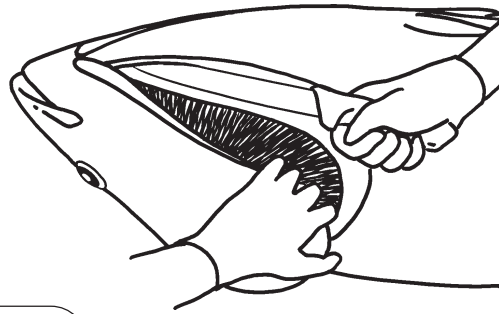
The internal organs (intestines, gills, etc.) contain a lot of bacteria which accelerate the process of deterioration in fish. They should therefore be removed as quickly as possible.

- Make a lengthways cut ten to fifteen centimetres¹ long in the fish's stomach up to one centimetre in front of the anus. This cut should be made in the direction in which the scales lie, in other words towards the anus (Figure 15).
- Pull the digestive tube and the gonads out through this cut.
- Cut off the end of the digestive tube and the gonads near the anus (Figure 16).
- Another method involves making a circular cut around the anus (Figure 17), without severing the digestive tube and the gonads.²
- Insert a knife behind the gill cover and cut ten centimetres towards the eye (Figure 18). Repeat the procedure on the other side.³

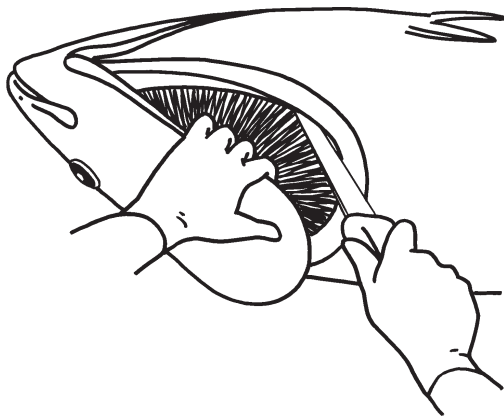
¹ *It is important to make the ventral cut as short as possible so that heat exchanges between the ambient air and the fish's abdominal cavity are as limited as possible during transport to the place of sale. For the same reason, it is recommended that the fish's gill covers not be cut off. This practice, which is only used for sashimi tuna for freezing, makes it easier for air to circulate in the gill cavity and would therefore accelerate the process of heating when the fish is unloaded.*

² *This method makes it possible to remove the intestines without having to cut them out. It is therefore recommended because it avoids spreading bacteria around the fish's abdominal cavity.*

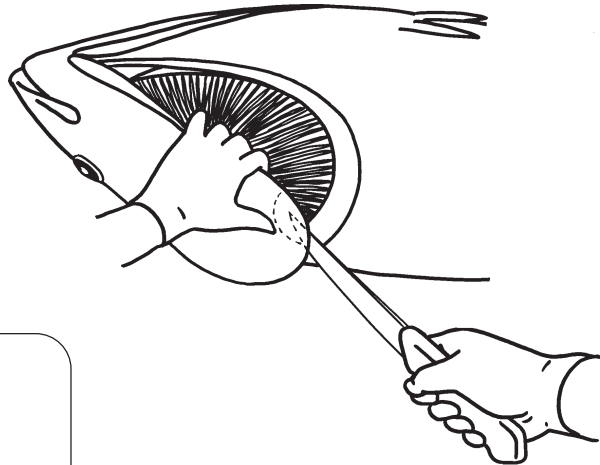
³ *This cut gives better access to the gill cavity and thus eases the next steps of the gutting process.*



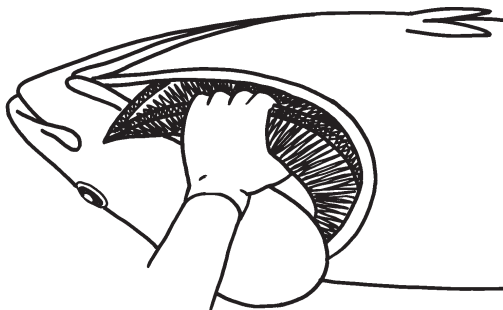
**Figure 19: Cut
the connection between
the gills and the lower jaw**



**Figure 20: Cut
the membrane between
the gills and the gill collar**



**Figure 21: Cut
the connection between
the gills and the base of the skull**



**Figure 22 : Remove
the gills and the internal organs**

GUTTING (CONTINUED)

- Cut the connection between the gills and the lower jaw¹ (Figure 19).
- Cut the membrane between the gills and the gill collar along its whole length on both sides of the fish (Figure 20).
- Cut the connection between the gills and the base of the skull (Figure 21).
- Remove the gills and internal organs in one piece through the gill opening (Figure 22). This stage is sometimes made difficult by the presence of membranes connecting the gonads to the abdominal wall.
- Rinse thoroughly.

¹ *For aesthetic reasons, it is very important not to cut the connection between the fish's throat and its lower jaw.*

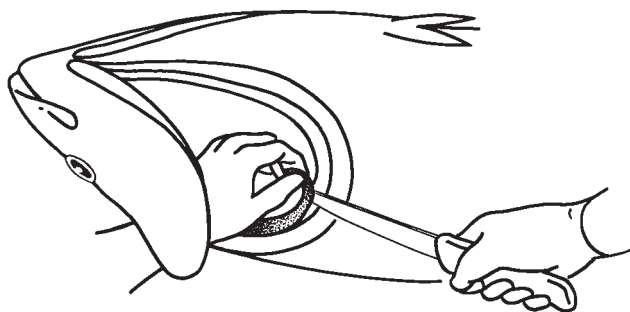


Fig.23: Cut the membrane adhering to the gill collar

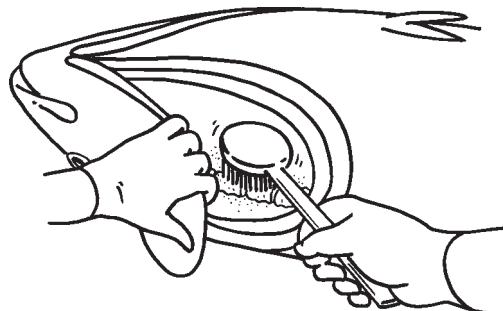


Figure 24: Scrub the base of the skull and the vertebrae

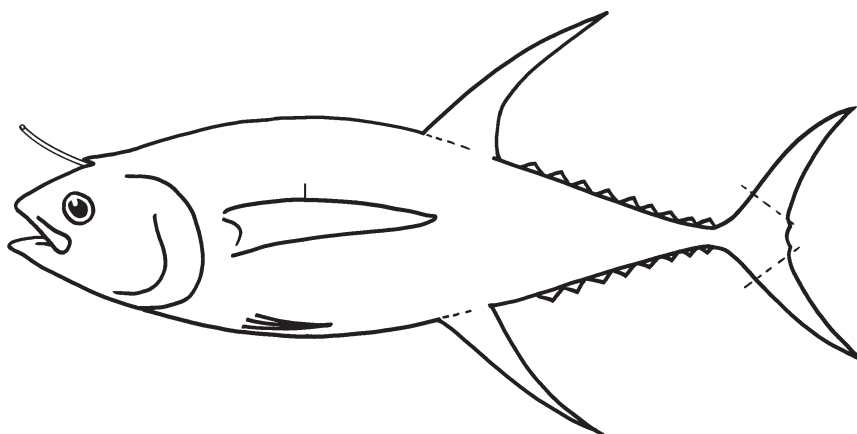


Figure 25: Sever the lobes of the caudal fin and, with large yellowfin tuna, make a cut in the dorsal and anal fins

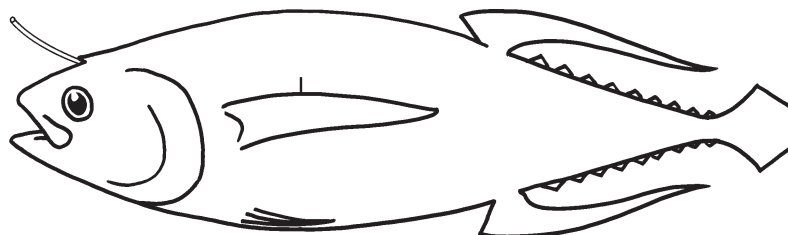


Figure 26: The fish is ready for refrigeration

CLEANING

- Carefully cut the membrane adhering to the gill collar. With the knife, scrape the edge of the collar until you get down to white bone¹ (Figure 23).
- Remove all the pieces of flesh, tendon and membrane from the gill cavity.
- Scrub the base of the skull and the vertebrae, so as to remove all coagulated blood and kidneys (Figure 24).
- Scrub the inside of the abdominal cavity without removing the white membrane (the swim bladder) which covers the backbone.
- Carefully rinse the fish, inside and outside.
- The two lobes of the caudal fin may be cut off. Some buyers request a special way of preparing large yellowfin tuna: the second dorsal fin and the anal fin, which are very long in adults, should be cut half way through at their base using a saw-edged knife or a saw² (Figure 25).
- The fish is now ready to be placed in brine or ice (Figure 26).

¹ *This membrane turns black if it is not removed, giving the fish an unhealthy appearance.*

² *With bigeye tuna, dorsal and anal fins are short, even in adults. It is recommended that these fins be left intact so that the buyers can recognise the species at a glance.*

ON-BOARD STORAGE

Tuna are 'warm-blooded' fish, i.e. their internal temperature remains constant (about 28°C) for their whole life. This temperature can rise for short periods of time to 35°C or even 40°C under certain conditions (stress, struggle during capture, etc.). In order to keep the fish in pristine condition, the internal temperature must be lowered as quickly as possible to 0°C and then maintained during all the following stages (storage on board, unloading, packing, transport).

To obtain a top-quality product, we recommend the use of the following two-stage procedure:

- Lower the internal temperature of the fish by placing it in brine (a slurry of crushed ice and seawater).
- After 24 hours, put the fish in ice and keep it there until arrival in port.

CHILLED BRINE

The main advantage of brine is that the entire surface of the submerged fish (including the abdominal cavity) is in direct contact with the cooling medium. This is the most efficient technique for rapidly lowering the core temperature of the fish.

- How is the brine prepared?

Make a slurry of crushed ice and seawater in a fish box, using a ratio of 2 parts ice to 1 part seawater.

- How long should the fish stay in the brine?

The length of time the fish should be left in the brine depends on its size. 6–12 hours is advisable for small sashimi tuna (30 to 40 kg). It is preferable to leave larger fish in the brine longer (up to 24 hours) to be sure that they are chilled to the core.

Although fish can be left in the brine for several days, we recommend that they be removed after 24 hours at the most, otherwise their colour will begin to fade and their eyes will go white.

- What kind of brine box?

It is preferable to use a large (2 m³ or more) insulated box with several compartments and a drainage hole. In heavy seas, the compartments will help limit the rocking of the fish inside the box. It is advisable to have two brine boxes on board.

Some comments and advice

- Before placing it in the brine, each fish should be individually wrapped in a cotton gauze 'sock' (or in a plastic bag with a lot of holes in it). This avoids damage due to the fish rubbing against one another. This 'sock' is removed before the fish is packed for export. It can be washed and used again.
- Adding salt to the brine lowers the temperature by several degrees and makes it possible to chill the fish more rapidly.
- Check the brine regularly and add ice whenever necessary. Stir the slurry often to keep it well mixed and to avoid the formation of 'pockets' of warm water.
- Too little ice in the slurry leads to poor cooling and loss of quality.
- Too many fish in a box also leads to poor cooling and loss of quality.
- A probe thermometer allows measurement of the fish's core temperature. Its use is recommended as it makes it possible to transfer the fish to the hold at the correct time (transfer to the hold should take place when the fish's body core temperature is between 0°C and +3°C).

ICING

- When the fish have been sufficiently chilled (0°C to 3°C at the centre), they must be removed from the brine box and rinsed quickly with sea water to wash off any impurities or blood which were present in the brine.
- Carefully transfer the fish to the ship's hold. Avoid gaffing the fish, dragging them along the ship's deck or damaging their eyes.
- Cover the fish with ice in successive layers (a layer of ice, a layer of fish, a layer of ice, etc.). It is preferable, whenever possible, to have no more than three layers of fish (otherwise, the fish at the bottom of the hold run the risk of damage from the weight of the ice and other fish placed on top of them).
- The heaviest fish should be placed at the bottom of the hold.
- Once in the ice, the fish does not need to be handled again.
- A fish prepared in this way (placed in brine, then stored in ice) can be left in the ice for up to two weeks.

OTHER METHODS OF ON-BOARD STORAGE

Direct icing

Some longliners do not use brine and ice their catch immediately.

In order to use this method properly you should proceed as follows:

- Place one layer of fish, belly downwards, on a thick layer of ice. Completely surround each fish and fill its gill and abdominal cavities with ice.
- Avoid piling up more than three layers of fish.
- Avoid placing fish in contact with the edges of the ice box (or hold) or in contact with one another.
- When the fish is iced immediately, the heat it gives off melts the layer of ice in direct contact with it. This creates air pockets which isolate the fish and prevent it from being properly refrigerated.
- After twenty-four hours, it is important to eliminate these air pockets by starting the icing procedure all over again.
- Contrary to freezing in brine, this method does not require the use of a gauze 'sock' to protect the external appearance of the fish.
- A sashimi-grade tuna can be kept on ice for up to two weeks.

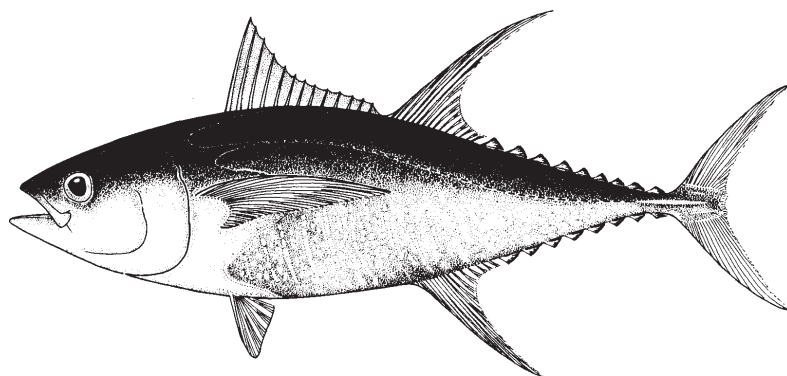
Refrigerated sea water

Some longliners are equipped to store fish in refrigerated sea water (RSW). Sashimi-grade tuna may be kept in refrigerated sea water for several days, but not more than one week.

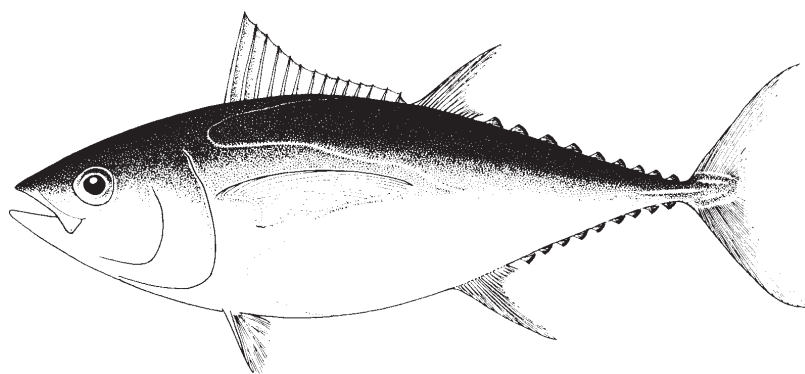
UNLOADING

The following rules are important during unloading.

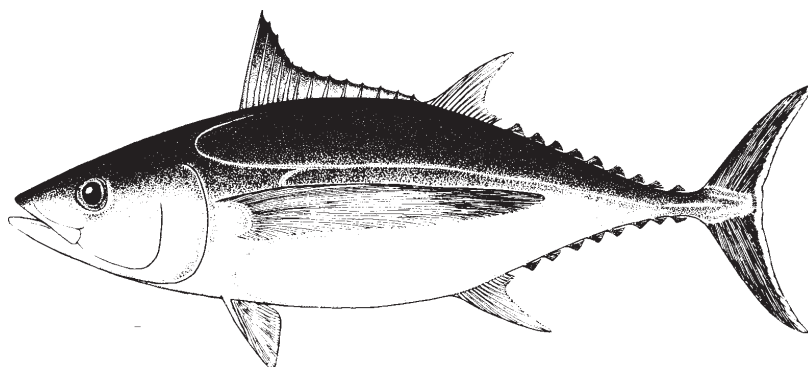
- Do not twist the fish when removing them from the ice, as this entails a risk of making the fillets an odd shape and damaging the fish's external appearance. They should be grasped by the head rather than the tail.
- Handle the fish gently. Do not throw them or drag them along the deck or the ground.
- Do not leave the fish too long in the open air or sunlight. Put the fish on ice or pack it for export as soon as possible



***Thunnus albacares* (yellowfin)**



***Thunnus obesus* (bigeye)**



***Thunnus alalunga* (albacore)**

**WHATEVER METHODS
OF HANDLING AND PRESENTATION
ARE REQUESTED BY THE BUYER,
DO NOT FORGET TO KILL, BLEED AND CHILL
TUNA WEIGHING OVER 30 KG
AS QUICKLY AS POSSIBLE.**