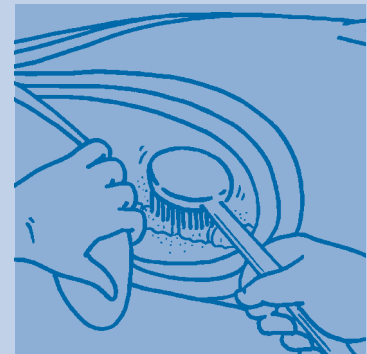
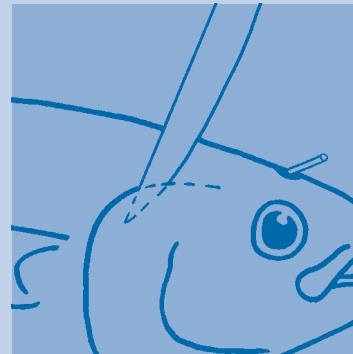
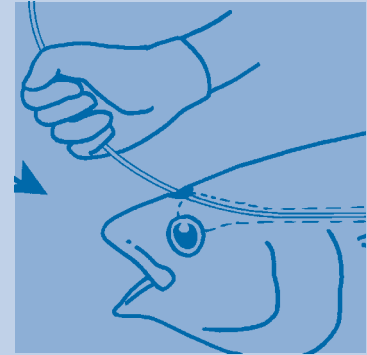
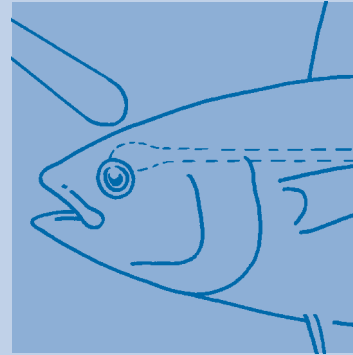
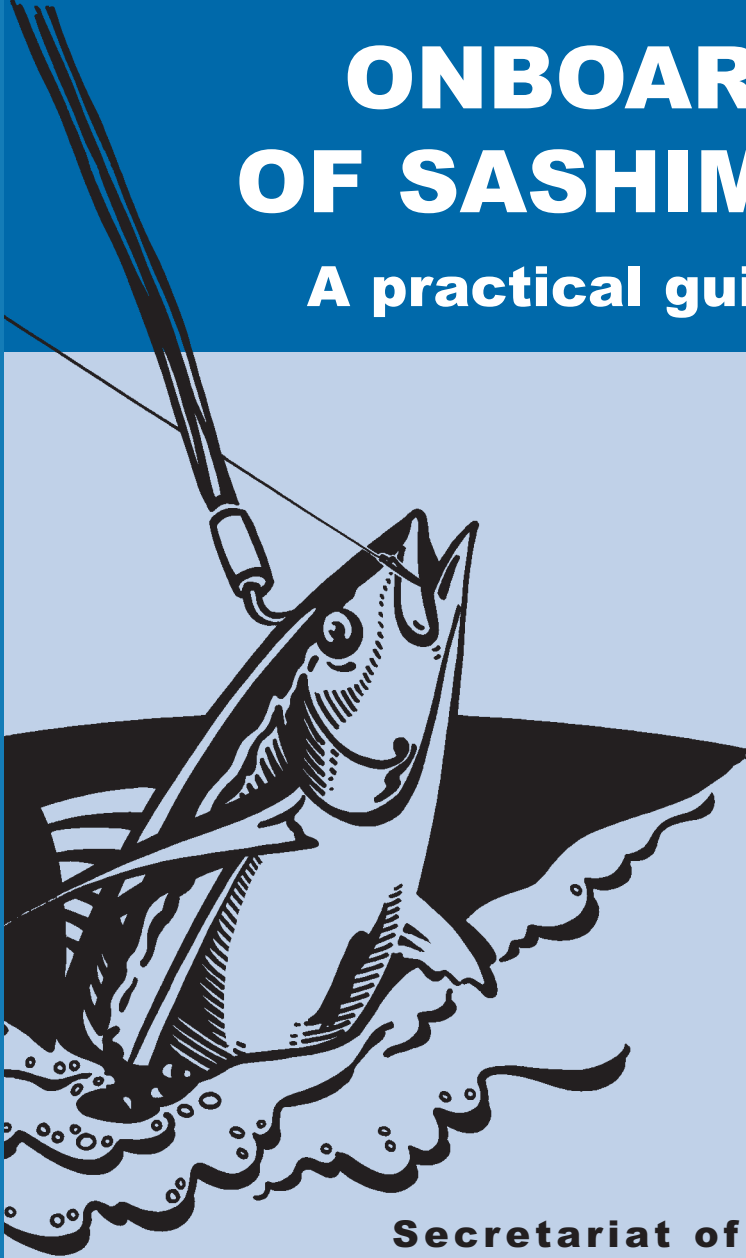


# ONBOARD HANDLING OF SASHIMI-GRADE TUNA

A practical guide for crew members



# ONBOARD HANDLING OF SASHIMI-GRADE TUNA

**A PRACTICAL GUIDE FOR CREW MEMBERS**

by  
Michel Blanc  
Aymeric Desurmont  
and  
Steve Beverly



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the Australian Agency for International Development (AusAID)  
and the government of France*

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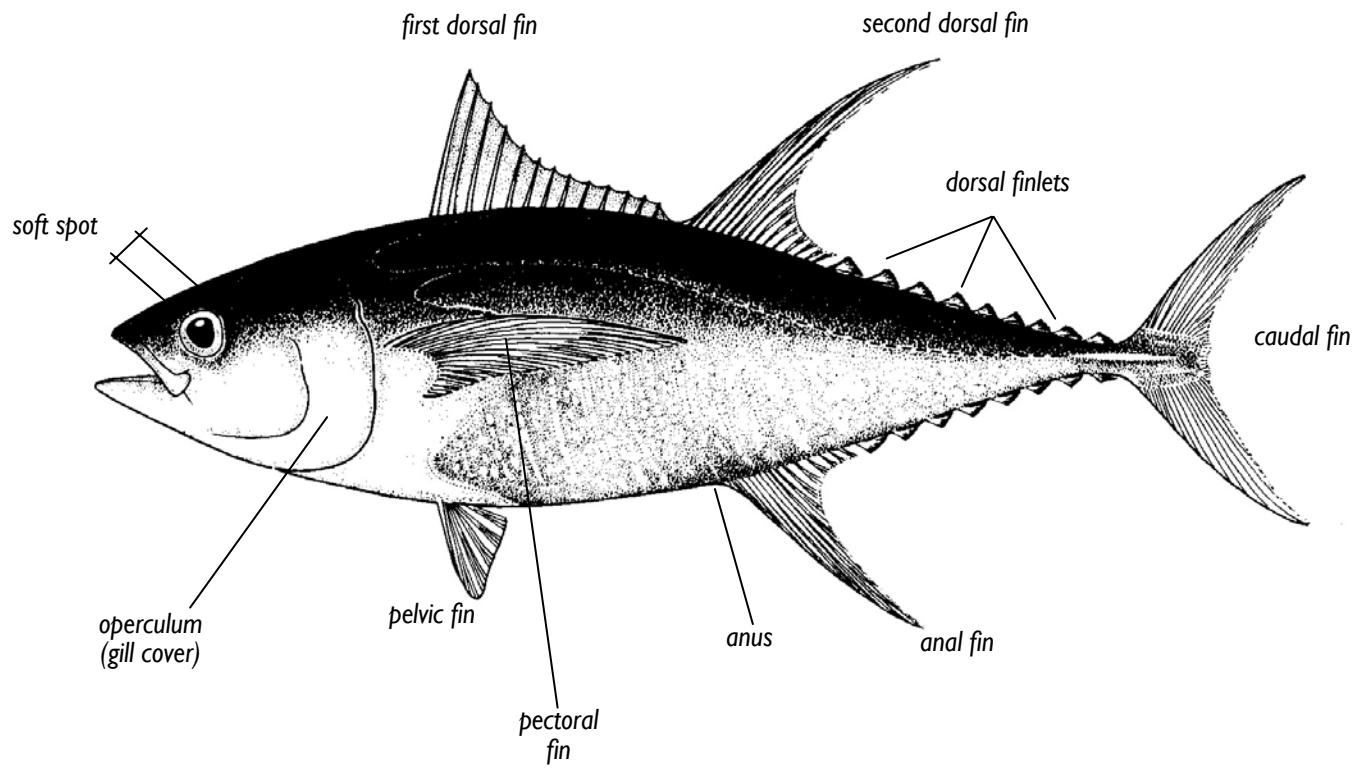
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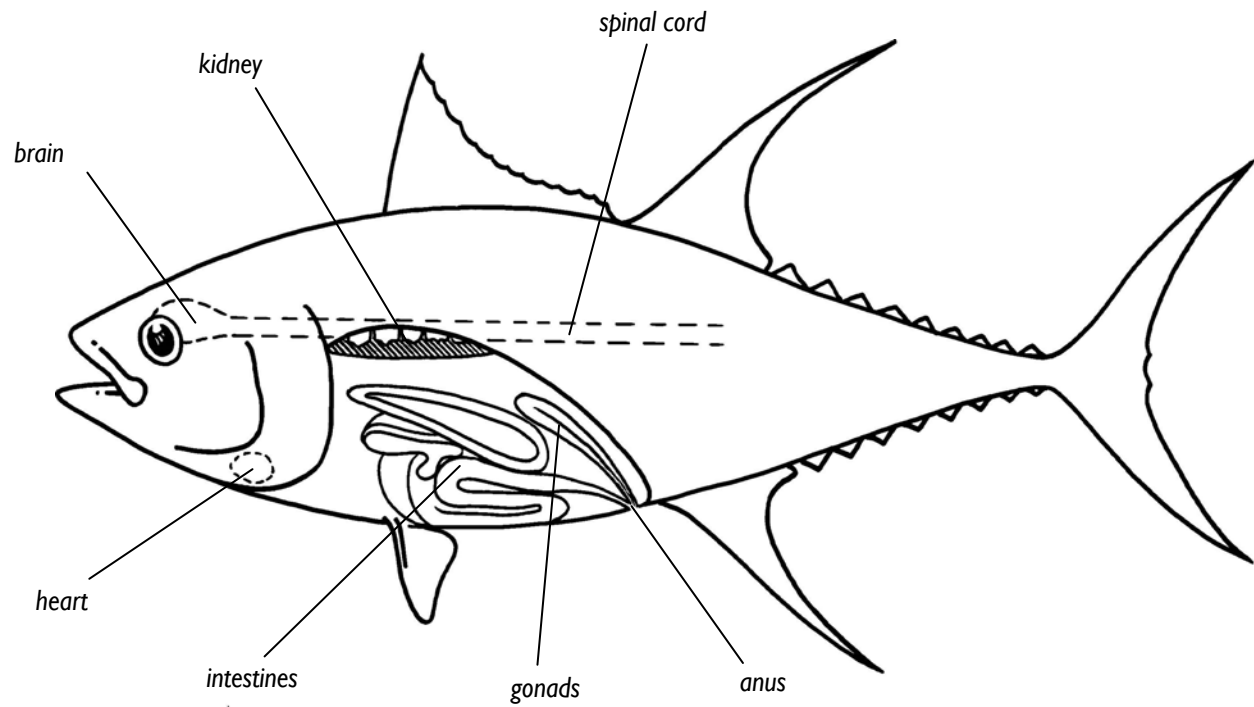
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All drawings are by Jean-Pierre LeBars and Youngmi Choi.



**Figure I.** External anatomy



**Figure 2.** Internal anatomy



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## 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 skipjacks. “Sashimi” in fact means much more than just “raw fish”; the term implies specific requirements regarding freshness, appearance, presentation, texture and taste.

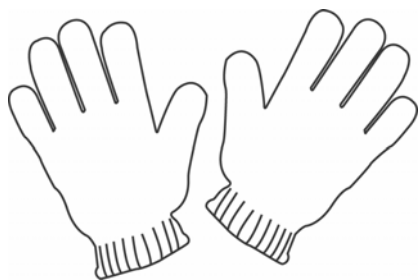
Only genuine premium quality fish will fetch a good price on the sashimi market. Fish quality is determined by several factors, both biological and non-biological:

- Biological factors such as species, age, size, degree of sexual maturity, and the presence of parasites or diseases, are not within the fishing crew’s control. The size, species and stage of sexual maturity are very important because they influence the fat content of the fish. The tuna with the highest fat content attract the best prices in the sashimi market.
- Non-biological factors are within the crew’s control. They include fishing method, and handling and chilling techniques used after capture.

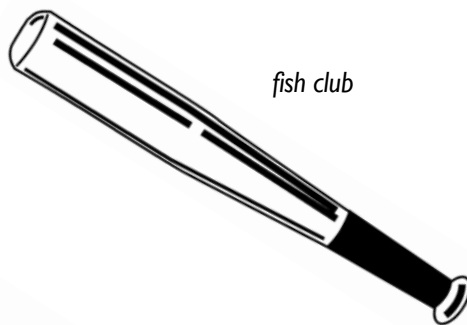
There are many ways of handling and packing fresh tuna, but only a few are suitable for exporting high-grade product to sashimi markets. This booklet is primarily intended for crew members on tuna longliners, and attempts to describe in detail a handling and refrigeration method that meets the exacting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

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

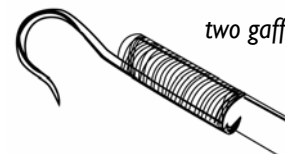
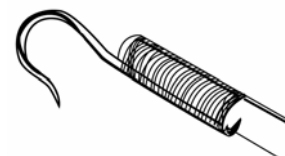
Some fishing boat operators export to several international markets (e.g. the largest and highest-grade tuna are exported to Japan, while others are exported to Hawaii or the US mainland); crew members may therefore need to handle each fish according to its intended market.



cotton gloves



fish club



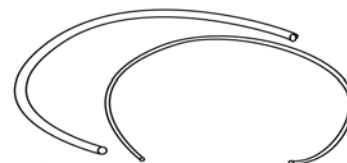
two gaffs



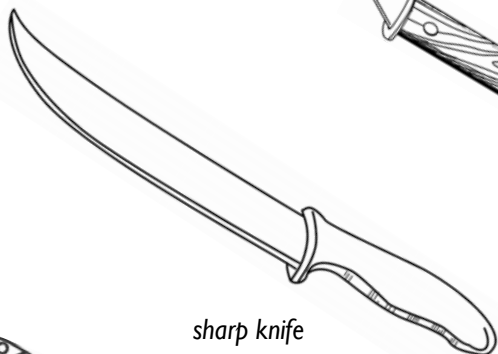
spike



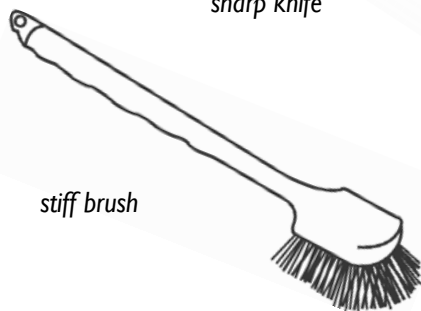
drop blood  
knife



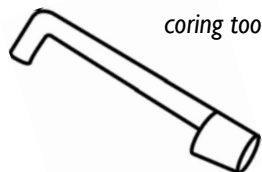
length of monofilament  
nylon or stainless steel wire



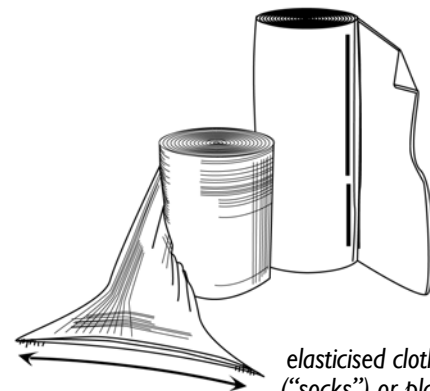
sharp knife



stiff brush



coring tool



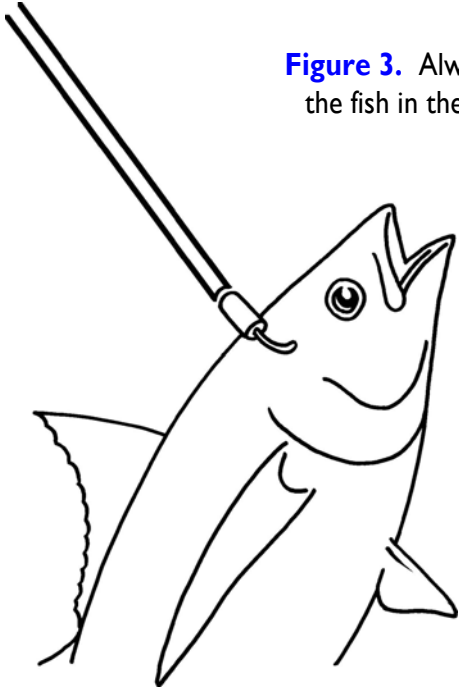
elasticised cloth sleeves  
("socks") or plastic body  
bags

## THE ESSENTIAL TOOLS

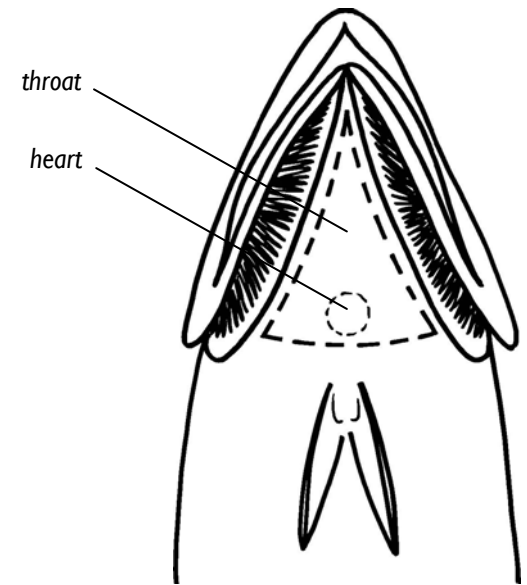
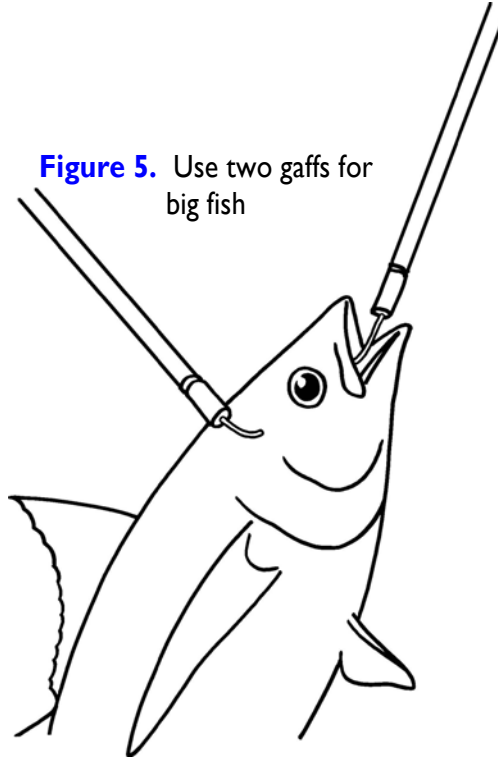
Before hauling in the longline, the crew should prepare the necessary equipment so that the fish that will be hauled aboard can be dealt with quickly.

- gloves, preferably cotton or nylon, for all handling purposes,
- two gaffs, to haul the fish aboard,
- a mat, a carpet or a foam pad to lay the fish on,
- a club to stun the fish,
- a spike to kill it,
- lengths of monofilament nylon or a stainless steel wire to destroy the spinal cord (“Taniguchi” method),
- a drop blood knife, with a very short blade, to bleed the fish,
- a sharp knife to gill and gut the fish,
- a stiff brush to scrub out the gill cavity,
- a seawater hose, to force the bleeding of the fish and to rinse away all blood and slime,
- elasticised cloth sleeves (or “socks”) or plastic body bags to protect the fish once in the slurry (chilled sea water - CSW) or in the refrigerated sea water (RSW).

**Figure 3.** Always gaff the fish in the head



**Figure 5.** Use two gaffs for big fish



**Figure 4.** Never gaff the fish in the throat or in the heart

## GAFFING AND LANDING

The tuna's external appearance is one of the important factors that determines its market value. Always treat your fish with great care and always wear gloves when you are handling it.<sup>1</sup>

- Always gaff the fish in the head (Fig. 3).
- Never gaff the fish in the body, the throat or the heart<sup>2</sup> (Fig. 4).
- Use two gaffs for big fish; insert the second gaff in the mouth (Fig. 5).
- If the boat doesn't have a gate in the bulwarks, it is advisable to lift the fish by the tail to help haul it on board.
- The fish should be landed on a foam pad, a carpet or a mat.<sup>3</sup>
- Take care to fold the pectoral fins under the fish so that they are not damaged, especially when turning the fish from one side to the other.
- Carry out all subsequent handling on the foam pad, carpet or mat.

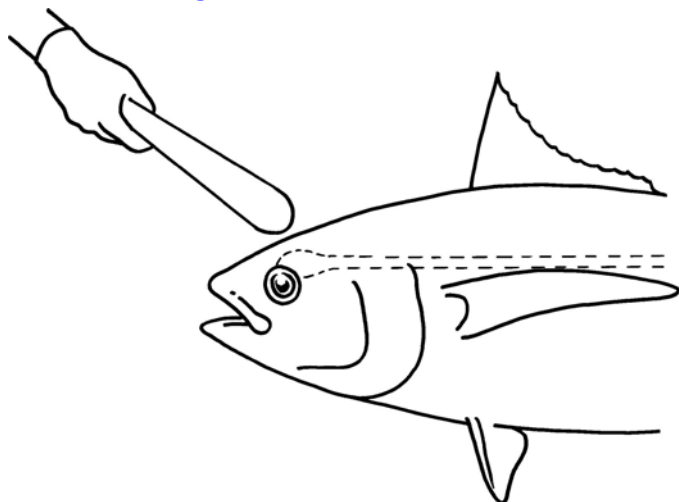
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<sup>1</sup> Not using gloves will leave marks on the tuna from the heat and fatty substances on the palm of your hand.

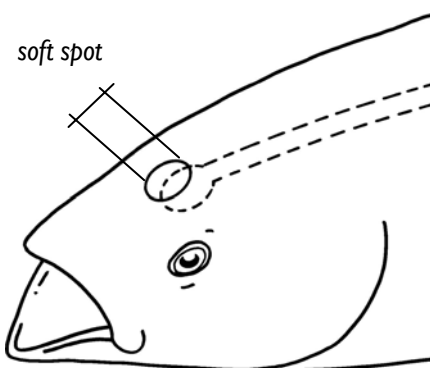
<sup>2</sup> A gaff mark in the tuna's body will reduce its value, not only because it makes its appearance less attractive but also because the block of meat damaged by the gaff will not be saleable; the throat should not be gaffed because it is important not to sever the isthmus (connection of the throat to the lower jaw); the heart must continue beating during bleeding to help completely drain the fish's blood.

<sup>3</sup> 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.

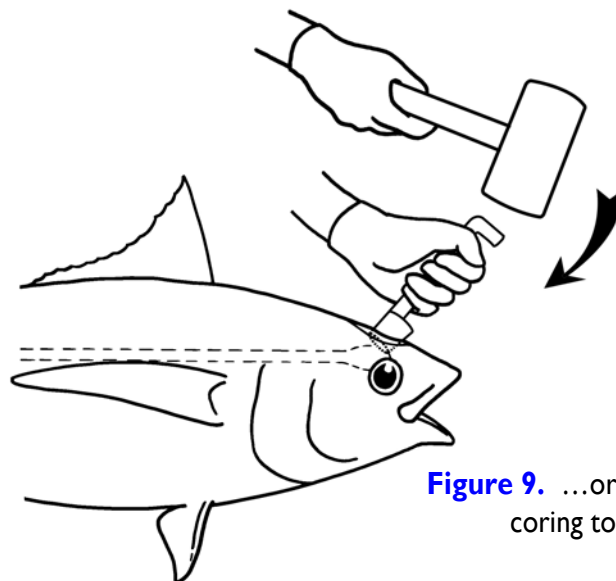
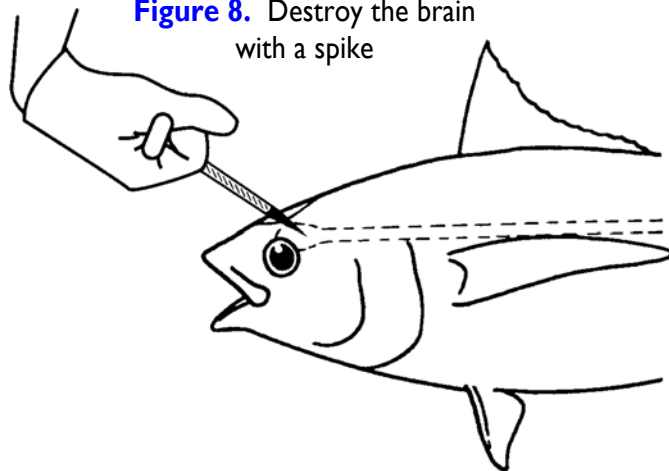
**Figure 6.** Stun the fish



**Figure 7.** Locate the soft spot



**Figure 8.** Destroy the brain with a spike



**Figure 9.** ...or with the coring tool

## KILLING

*On arrival at the export market, each sashimi-grade tuna will be very closely inspected. Fish that have not been killed in the way described below will be down-graded, and will lose value. To avoid this, the brain and the central nervous system (spinal cord) should be destroyed in all tunas potentially exportable as sashimi-grade (yellowfin and bigeye weighing over 25 kg).*

Once aboard, you should kill the fish immediately:<sup>1</sup>

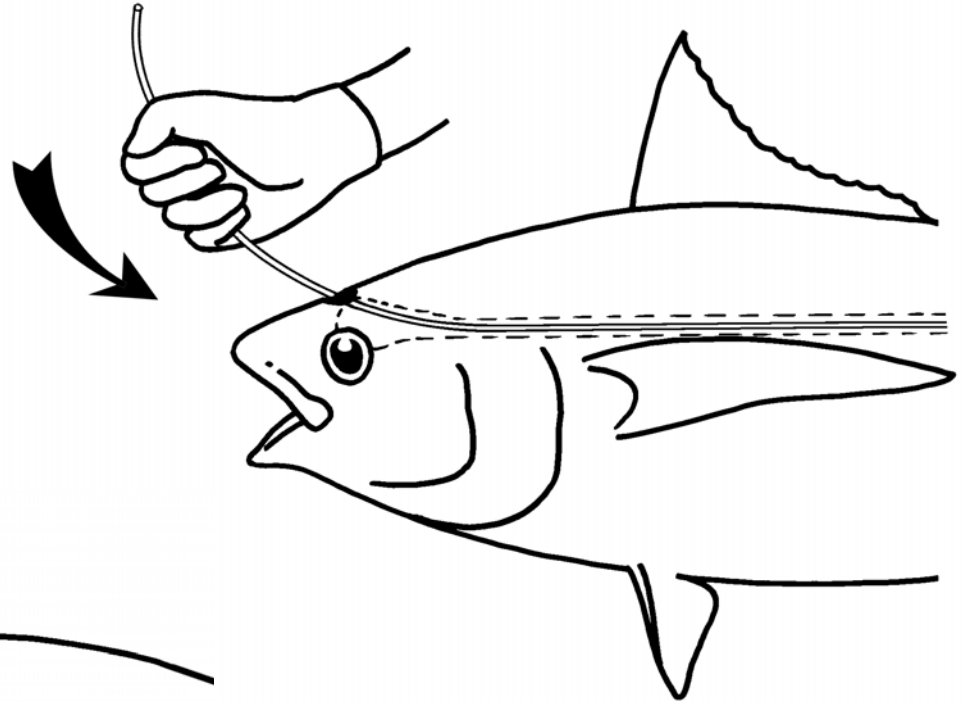
- Stun the fish with a sharp blow to the top of the head (between the eyes) using a fish club or other blunt instrument (Fig. 6). Alternatively, you can calm a fish down by covering its eyes with a gloved hand or a piece of cloth.
- Use the fish club to remove the hook from the fish's mouth.
- Stand over the fish, steadying it firmly with your legs braced just behind the pectoral fins.
- Locate the soft spot (Fig. 7) by running your thumb over the top of the head, between the eyes.
- Insert a spike into the soft spot at a 45° angle and push it down into the brain cavity. If the spike is inserted in the right place, the fish will give one last shudder (the body will quiver, the mouth will fall open and the first dorsal fin will spread) before going limp (Fig. 8). If this does not happen, the soft spot should be spiked again.
- Move the spike around (to destroy the brain) until the body stops moving and the jaw goes slack. Make sure you don't push the spike too deep as it could damage the entrance of the neural canal.
- Some operators use a coring tool to destroy the brain and make a hole for the Taniguchi wire or nylon monofilament. The coring tool is usually struck with a mallet (Fig. 9).

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<sup>1</sup> *If the fish is killed quickly by this method, it will stop struggling, and damage from it thrashing around on deck will be avoided.*



**Figure 10.** Push a length of monofilament nylon or stainless steel wire into the neural canal



**Figure 11.** Leave the monofilament nylon into the neural canal

## KILLING (continued)

It is advisable to pith<sup>1</sup> the fish (Taniguchi method) after killing it:

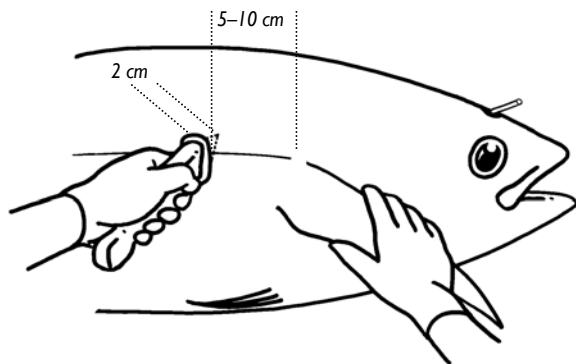
- Insert a length of rigid monofilament nylon<sup>2</sup> or stainless steel wire into the brain through the hole made by the spike or the coring tool, and push it as far as possible into the neural canal to destroy the spinal cord (Fig. 10). The fish should quiver again as the Taniguchi tool goes down the neural canal.
- If using monofilament nylon, leave it in the neural canal, but cut it off to leave the last 2–3 cm emerging from the fish's head<sup>3</sup> (Fig.11).

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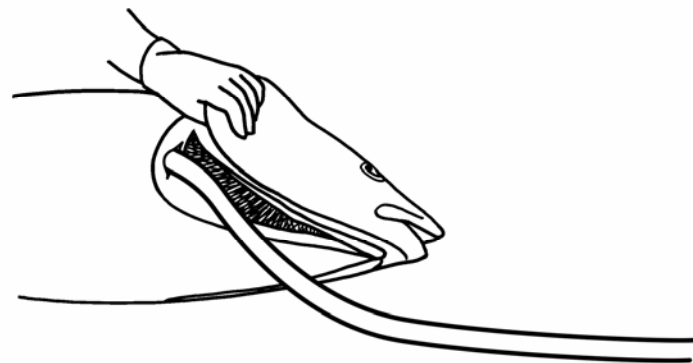
<sup>1</sup> To “pith” is to completely destroy the spinal cord in the neural canal. This stops the biochemical reactions that contribute to flesh deterioration. Pithing therefore produces a higher-quality tuna.

<sup>2</sup> Lengths of nylon monofilament (2 to 3.5 mm in diameter; 1 to 1.5 m in length) are recommended for the Taniguchi method. Crew can prepare those lengths from scraps of mainline and old longline snoods.

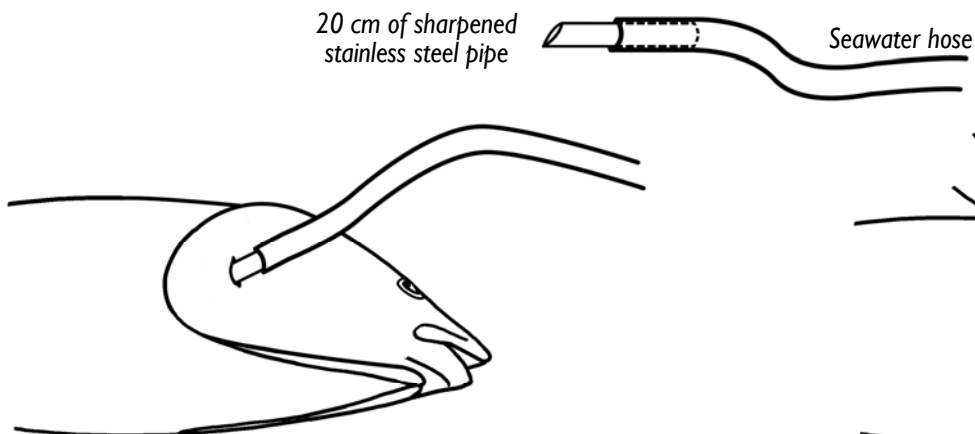
<sup>3</sup> Leaving the monofilament nylon in the fish will show the buyer that the Taniguchi method was used.



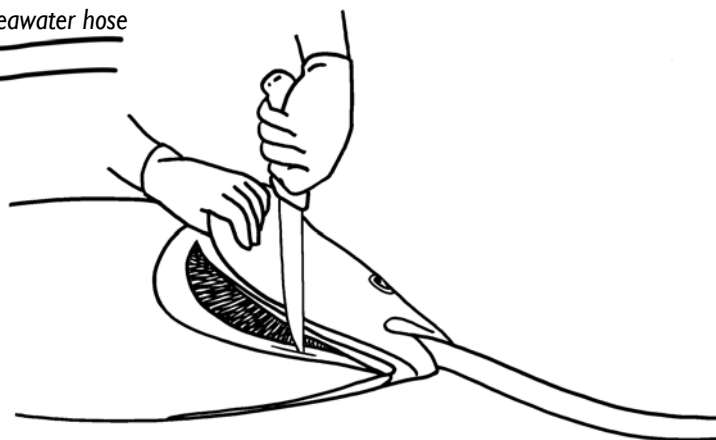
**Figure 12.** Make a cut with the drop blood knife on each side of the fish, behind the pectoral fin



**Figure 13.** Then make a cut in the membrane between the gill collar and the gills and place a seawater hose in the cut...



**Figure 14.** ...or shove a piece of sharpened stainless steel pipe, inserted at the end of a seawater hose, into the gill cover



**Figure 15.** Alternative method: Make a cut in the throat just in front of the heart and put a seawater hose in the mouth

## BLEEDING

*Bleeding the fish immediately after killing it<sup>1</sup> improves the appearance of the flesh<sup>2</sup> and extends its shelf life<sup>3</sup>. 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 its sides with a short-bladed knife, five to ten centimetres behind the base of the pectoral fins. The cut, two centimetres deep at most, should be made perpendicular to and across the pectoral fin recess<sup>4</sup>, on both sides of the fish (Fig. 12). Blood should flow freely from these cuts.
- Leave the fish to bleed for three to five minutes. We recommend this bleeding technique for tunas exported to Japan.
- To accelerate the bleeding process, you can make a cut in the membrane between the gill collar and the gills. Place a seawater hose in this cut to accelerate bleeding and rinse away all blood from the gill cavity (Fig. 13).
- Alternatively, use a hose with a short length of sharpened stainless steel pipe inserted in the end. Shove the pipe into the gill cover in the region where a cut would normally be made. The pipe makes a hole and a seal to pressurise the gill cavity (Fig. 14).
- Another bleeding technique involves making a cut in the throat just in front of the heart and putting the seawater hose in the mouth. Blood should flow freely from the throat cut (Fig. 15). This technique is acceptable for tunas exported to the US mainland and Hawaii.

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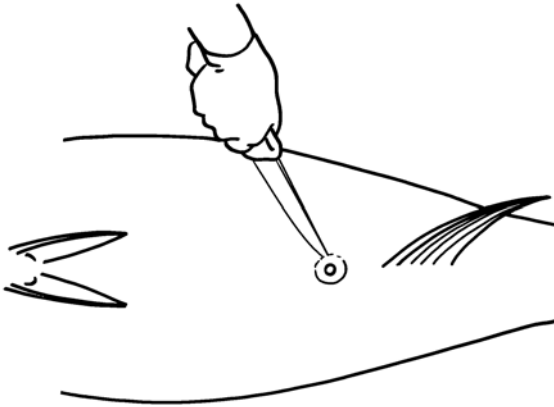
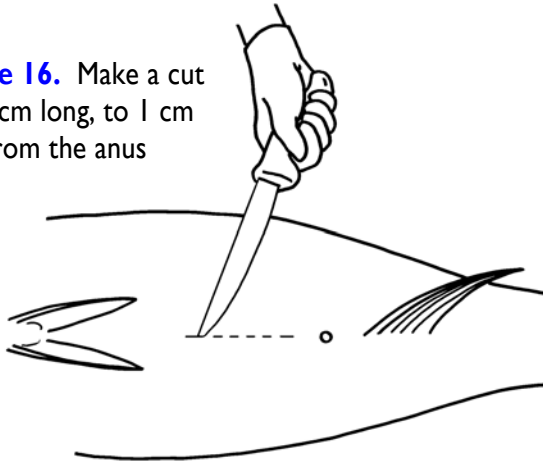
<sup>1</sup> After the brain has been destroyed, the heart continues to beat for a few minutes. These cuts should therefore be made as quickly as possible to allow the last heartbeats to pump the blood out through these wounds.

<sup>2</sup> Any sashimi-grade tuna specialist can recognise a tuna that has not been bled (or which has only been partly bled) by the presence of unattractive dark red veinlets in the flesh.

<sup>3</sup> When the tuna is struggling in the water, before being hauled aboard, the blood attains a high organic waste (lactic acid) content and rises in temperature (up to 35°C in some cases). Bleeding removes the organic waste and helps to cool the fish's body. The fish can then be refrigerated quicker and will have a better-quality flesh.

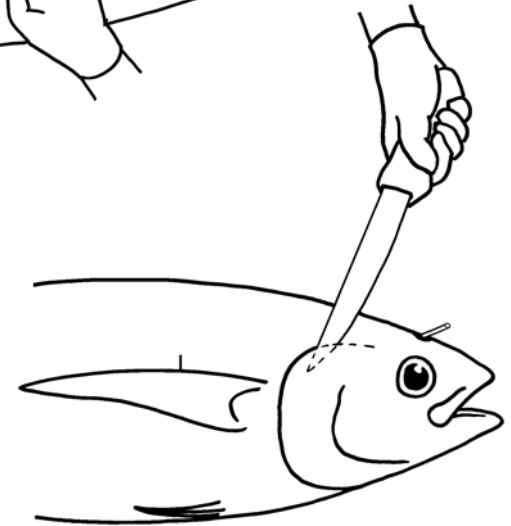
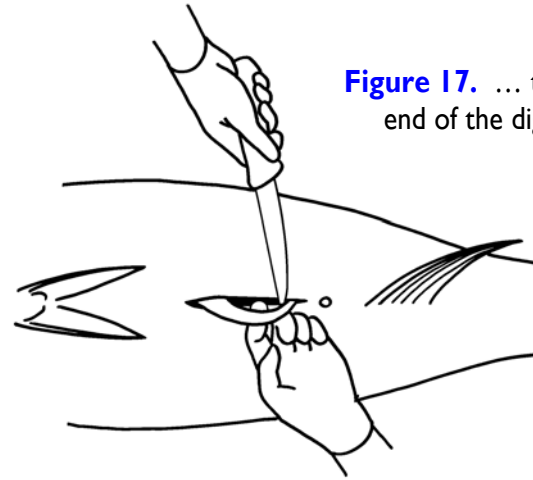
<sup>4</sup> A pair of major blood vessels run along the pectoral fin recess immediately underneath the tuna's skin. These vessels will easily be severed if the knife is inserted perpendicularly to the fin recess. Also, the mark left on the fish will be perfectly visible to the buyer, who will not have to lift the pectoral fin to look for it.

**Figure 16.** Make a cut  
5-10 cm long, to 1 cm  
from the anus



**Figure 18.** Alternatively, make  
a circular cut around the anus

**Figure 17.** ... then cut off the  
end of the digestive tube



**Figure 19.** Insert your knife behind the gill  
cover, and cut forward until the knife hits  
bone (the skull). Repeat on the other side

## GILLING and GUTTING

*The internal organs (intestines, gills, kidneys, etc.) contain bacteria that accelerate the deterioration process in fish. They should therefore be removed as quickly as possible, in order to extend the fish's shelf life.*

- Make a cut, 5-10 cm-long<sup>1</sup>, in the fish's belly, up to 1 cm in front of the anus. This cut should be made in the direction in which the scales lie, in other words, towards the anus (Fig. 16).
- Pull the digestive tube through this cut.
- Cut off the end of the digestive tube near the anus (Fig. 17).
- We recommend another method called the “donut” cut. It involves making a circular cut around the anus<sup>2</sup> (Fig. 18), without severing the digestive tube. The resulting plug or “donut” is then pushed into the gut cavity.
- Insert a knife behind the gill cover and cut towards the eye until the knife hits bone (the skull) (Fig. 19). Repeat the procedure on the other side<sup>3</sup>.

---

<sup>1</sup> *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, we recommend not removing the fish's gill covers. This practice, which is only used when handling sashimi tuna on freezer longliners, makes it easier for the air to circulate in the gill cavity. If applied on chilled tunas, it would accelerate the process of heating when the fish are unloaded and during transport to the market.*

<sup>2</sup> *This method makes it possible to remove the intestines without having to cut them out, and is recommended because it avoids spreading bacteria inside the fish's abdominal cavity.*

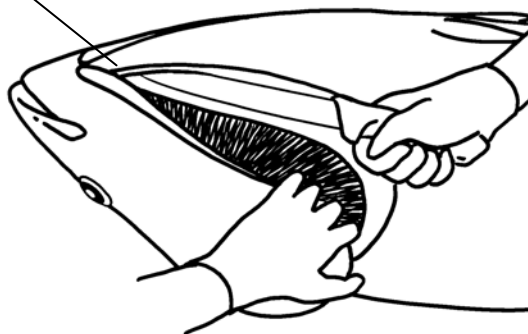
<sup>3</sup> *This cut gives better access to the gill cavity and thus eases the next steps of the gilling and gutting process.*

**Figure 20.** Cut the membrane between the gills and the gill collar, on both sides

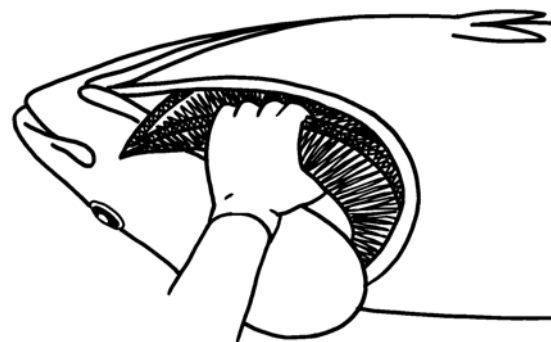
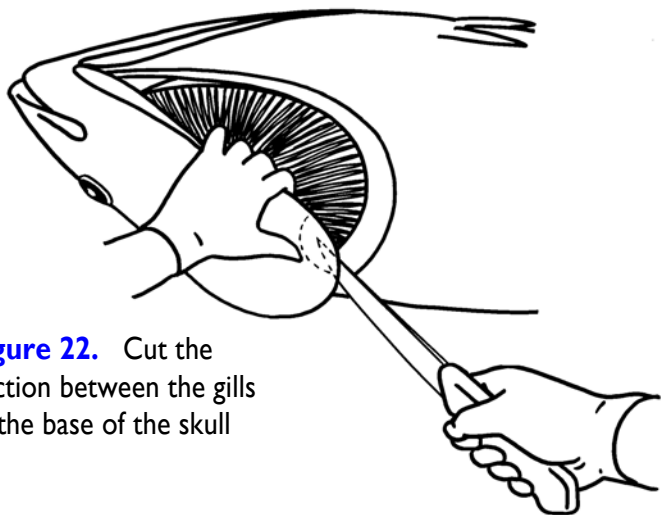


*Isthmus (don't cut)*

**Figure 21.** Cut the connection between the gills and the lower jaw



**Figure 22.** Cut the connection between the gills and the base of the skull



**Figure 23.** Remove the gills and the internal organs in one piece then remove the heart

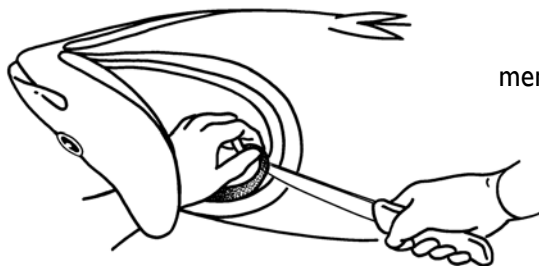
## GILLING and GUTTING (continued)

- Cut the membrane between the gills and the gill collar along its whole length on both sides of the fish (Fig. 20).
- Cut the connection between the gills and the lower jaw (Fig. 21). Do not cut the connection between the throat and the lower jaw (the isthmus). If this is cut or broken, it must be tied back to the jaw, using a short piece of line or rope, otherwise gaping<sup>1</sup> will occur.
- Cut the connection between the gills and the base of the skull (Fig. 22).
- Remove the gills and internal organs in one piece through the gill opening (Fig. 23). This stage is sometimes difficult because of the membranes connecting some organs to the abdominal wall. Remove the heart.
- Rinse thoroughly.

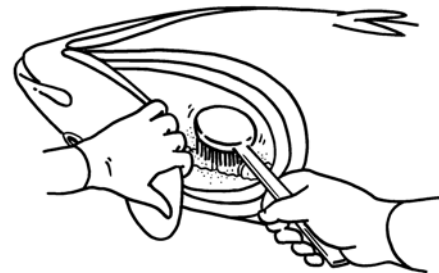
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<sup>1</sup> *Gaping occurs when individual muscle layers in the tuna flesh separate like the pages in a book. This usually happens after the fish was bent. The flesh will still be good, but the finished sashimi or sushi product will not be very attractive, and real connoisseurs will know that the fish was mishandled. If the isthmus is cut during the gutting process, the head will bend upwards, giving the chilled fish an odd shape, and gaping will occur in the front dorsal muscles.*

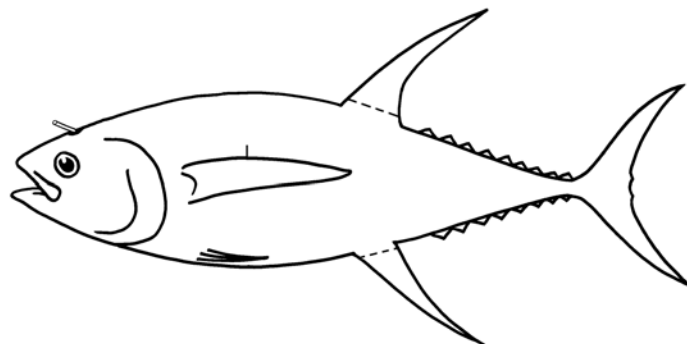




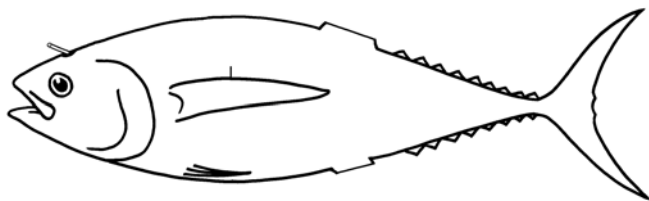
**Figure 24.** Cut the membrane adhering to the gill collar, on both sides



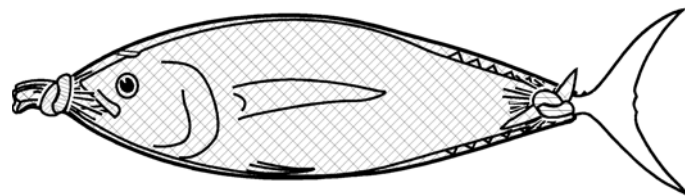
**Figure 25.** Scrub the base of the skull and the vertebrae, removing all blood and kidney.



**Figure 26.** Some buyers want the dorsal and anal fins cut off on large yellowfin tunas.



**Figure 27.** The fish is ready to be put on ice



**Figure 28.** The fish is ready to be put in the slurry or in RSW

## CLEANING

- Carefully cut the membrane attached to the gill collar. With the knife, scrape the edge of the collar until you get down to white bone<sup>1</sup> (Fig. 24).
- With a stiff brush, scrub the base of the skull and the vertebrae to remove all coagulated blood and kidneys (Fig. 25).
- Cut off all loose pieces of flesh and tendons inside the gill cavity.
- Carefully rinse the fish, inside and outside.
- Some buyers request that the long dorsal fin and anal fins of large yellowfin tunas be cut off at their base using a saw-edged knife or a saw<sup>2</sup> (Fig. 26).
- The fish is now ready to be iced (Fig. 27).
- If slurry (CSW) or refrigerated seawater (RSW) are used, the fish should be protected by an elasticised cloth sleeve (or “sock”) or a plastic body bag<sup>3</sup> (Fig. 28).

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<sup>1</sup> After a couple of days this membrane would turn brown if it is not removed, giving the fish an unhealthy appearance.

<sup>2</sup> Dorsal and anal fins are short in adult bigeye tuna. We recommend that these fins be left intact so that buyers can recognise the species at a glance.

<sup>3</sup> When several fish are placed in slurry or refrigerated seawater, they move around and rub against one another, especially in heavy seas. If they are not protected by a mutton cloth or a plastic body bag, their skin and fins will become damaged.

## ONBOARD STORAGE

Tunas are the most evolved species of fish in that they control their internal (body) temperature<sup>1</sup>. This internal temperature can even rise to 30°C+, for short periods of time, under certain conditions (e.g. during a feeding frenzy or during capture). 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 onboard storage, unloading, packing and transport.

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

- Lower the internal temperature of the tuna by placing it in a slurry of flake ice and seawater (2 parts ice to 1 part seawater).
- After 24 hours, transfer the tuna to the fish hold and ice it. No further handling is required until you arrive in port.

### Slurry or chilled seawater (CSW)

The main advantage of the chilled seawater 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.

- To prepare a slurry of flake ice and seawater in a fish box, use a ratio of 2 parts ice to 1 part seawater.
- The length of time the fish should be left in the slurry depends on its size: 6–12 hours is advisable for the smallest sashimi tuna (25 to 40 kg); larger fish should be left in the slurry longer (up to 24 hours) to be sure that they are chilled to the core. Although fish can be left longer in the slurry, we recommend removing them after 24 hours at the most, otherwise their colour will begin to fade and their eyes will go white.
- Use a large (2 m<sup>3</sup> or more) insulated box with several compartments and a drainage hole. In heavy seas, the compartments will help reduce the rocking of the fish inside the box. It is advisable to have two slurry boxes on board.

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<sup>1</sup> Unlike other fish, tunas are “warm-blooded” or endothermic fish. This means their internal temperature can be kept above the temperature of the sea water surrounding them – other fish do not control their internal temperature which is constantly equal to the ambient temperature. This is especially important for tunas leaving in cold waters as this mechanism keeps the body temperature at a level where the bio-chemical reactions that control the muscular activity of the fish are the most efficient.

## Some comments and advice

- Before placing them in the slurry, each fish should be individually wrapped in a cotton gauze “sock” or in a plastic body bag with holes in it. This avoids damage caused by the fish rubbing against one another. This sock or bag is removed before the fish is packed for export.
- Adding salt to the brine lowers the temperature by several degrees and makes it possible to chill the fish more rapidly. The temperature of the slurry should not be lower than  $-2^{\circ}\text{C}$ , temperature at which the fish start freezing.
- Check the slurry regularly and add ice whenever necessary. Stir the slurry often to keep it well mixed and to avoid pockets of warm water forming.
- 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 measures the fish’s core temperature (the temperature of the meat immediately surrounding the backbone). We recommend using one as it makes it possible to check the core temperature regularly in order to transfer the fish to the hold at the correct time (transfer to the hold should take place when the fish’s core body temperature is near  $0^{\circ}\text{C}$ ).

## Icing

- When the fish have been sufficiently chilled ( $0^{\circ}\text{C}$  at the centre), they must be removed from the slurry box.
- Carefully transfer the fish to the fish 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.). Whenever possible, have no more than three layers of fish (otherwise, the fish at the bottom of the hold may become damaged 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, no further handling is required until the unloading.
- Fish prepared in this way (placed in slurry, then stored in ice) can be left in ice for up to two weeks.

## OTHER METHODS OF ONBOARD STORAGE

### Direct icing

Some longliners do not use a slurry, but instead, ice their catch immediately. Contrary to chilling in a slurry or in refrigerated seawater (RSW), this method does not require the use of a gauze sock or a plastic body bag to protect the external appearance of the fish. Sashimi-grade tuna can be kept on ice for up to two weeks.

In order to use this method properly you should:

- Place one layer of fish, belly downwards, on a thick layer of ice. 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 fish box (or hold) or in contact with one another.
- Eliminate air pockets<sup>1</sup> after 24 hours by repeating the icing procedure.

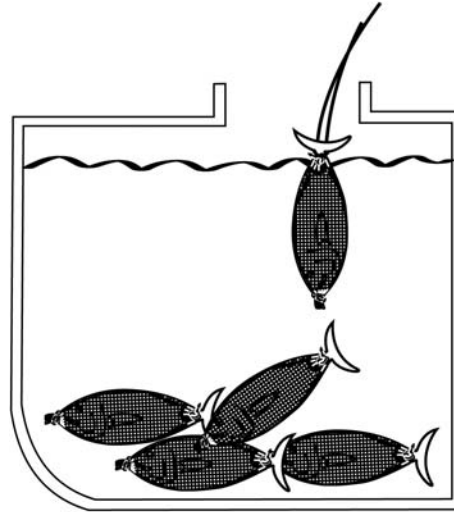
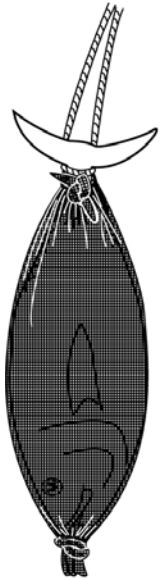
### Refrigerated seawater (RSW)

Some longliners are equipped to store fish in refrigerated seawater (RSW). The water in a RSW system is usually a mix of 80 to 90 per cent fresh water and 10 to 20 per cent seawater. Sashimi-grade tuna may be kept in RSW for up to two weeks.

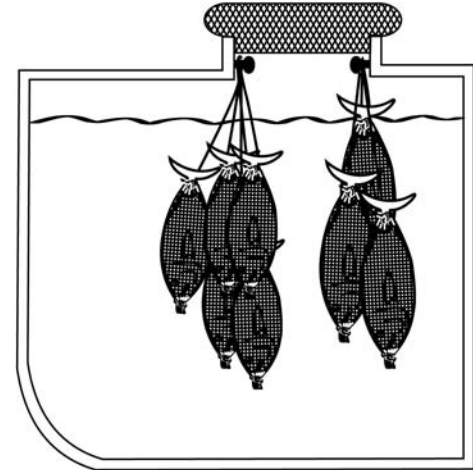
- Monitor the temperature in the RSW tank several times per day, either with a built-in temperature gauge or with a handheld thermometer. Temperature must be kept between  $-0.5^{\circ}$  and  $-1^{\circ}\text{C}$ .
- Protect the fish with a gauze sock or a plastic body bag.
- Place it carefully in the RSW tank so it doesn't get damaged on the sides or bottom. Usually, a long tail rope is used to gently lower the fish until it comes to rest (Fig. 29).
- Some RSW boats suspend the fish vertically in the tank by tail ropes (Fig. 30). Other boats have tank baffles so that fish's movement is minimised. No further handling is necessary once the fish are placed in a RSW tank.

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<sup>1</sup> When the fish are iced immediately, the heat given off melts the ice in direct contact with the fish. This creates air pockets, or “igloos”, around the fish, which prevent them from being properly refrigerated. Fish can also move around in an igloo and get damaged.



**Figure 29.** Use a tail rope to lower fish in the RSW tank

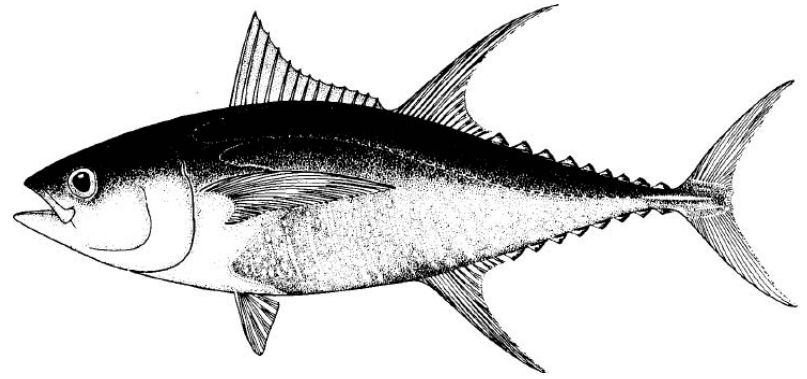


**Figure 30.** Hang fish by the tail in the RSW tank

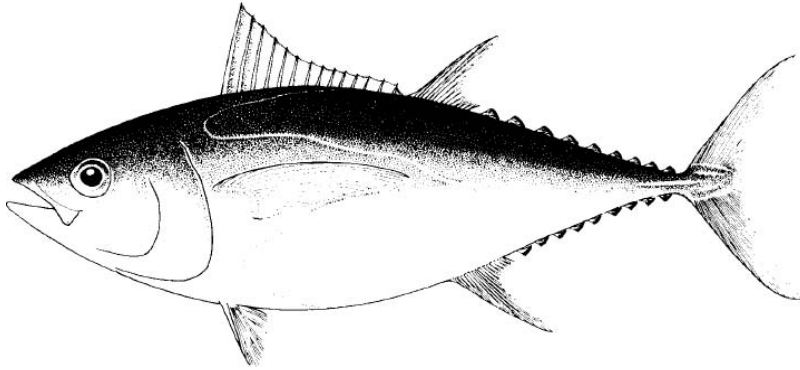
## UNLOADING

These rules should be followed during unloading.

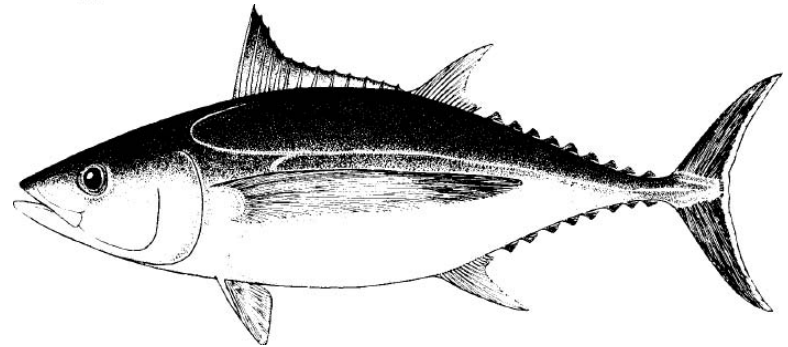
- Do not twist or bend fish when removing them from the ice, as there is a risk of making the fillets an odd shape, which causes gaping and damages the fish's external appearance.
- Handle fish gently. Do not throw them or drag them along the deck or the ground.
- Do not leave fish too long in the open air or sunlight. Put fish on ice or pack them for export as soon as possible.



yellowfin tuna (*Thunnus albacares*)



bigeye tuna (*Thunnus obesus*)



albacore tuna (*Thunnus alalunga*)



**NO MATTER WHAT METHODS  
OF HANDLING AND PRESENTATION ARE REQUESTED  
BY THE BUYERS:**

**ALWAYS KILL, BLEED AND CHILL  
TUNA THAT WEIGH OVER 25 KG  
AS QUICKLY AS POSSIBLE!**