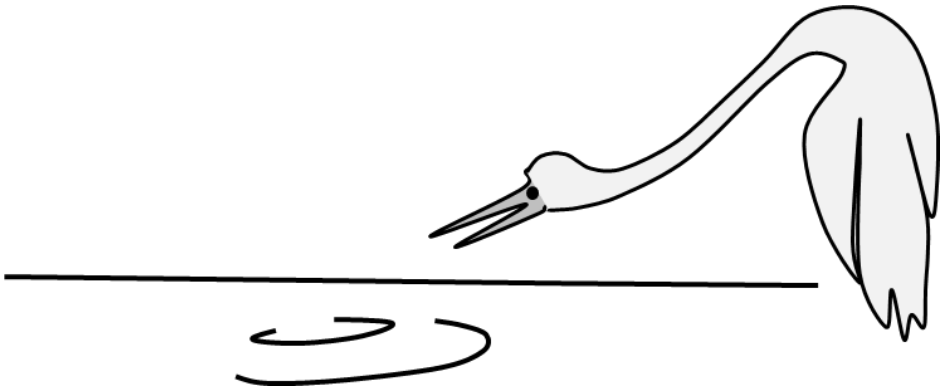
Specified Skills
Educational Textbook for the Fishing Industry Skills Proficiency Test (Fishing)
(General Fishing Section)



Japan Fisheries Association
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1. Global Fishing and Aquaculture Yield

The combined global yield of fishing and aquaculture continues to increase. This combined yield has reached 218.47 million tons (as of 2021), although the fishing yield from fishing vessels has stayed around the same level since the second half of the 1980s. The countries with the highest fishing and aquaculture yields, starting with the highest, are China (approximately 89 million tons), Indonesia (approximately 22 million tons), and India (approximately 16 million tons). (Figure 1)

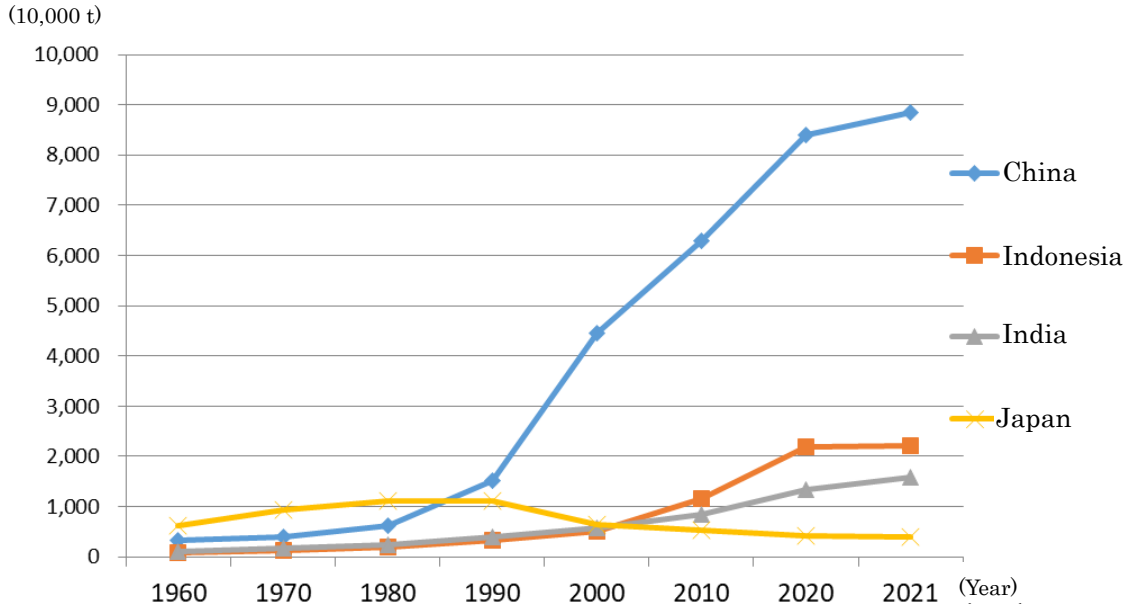


Figure 1: Fishing and Aquaculture Yields (by Country)

(Source: Based on the FY2024 White Paper on Fisheries)

2. Japan's Fishing and Aquaculture Yield

Fishing developed as an industry that widely supplies seafood as animal protein sources to the people of Japan, and has formed a unique culinary culture. In addition, fishing, which involves collecting and catching living creatures underwater, is strongly influenced by natural conditions. Accordingly, due to the variations in fishing vessels and fishing tools used depending on the targeted species, fishing techniques also vary. Japan's fishing industry mainly consists of coastal fishing, offshore fishing, deep-sea fishing, sea aquaculture, and inland fishing and aquaculture. Yields peaked in 1984, then dropped rapidly until around 1995. A gradual decreasing trend has continued ever since. (Figures 2-1 and 2-2)

・Coastal fishing

Fishing conducted along the coast using a small fishing vessel. This includes fixed netting and aquaculture.

・Offshore fishing

Mainly refers to fishing operations carried out in waters within 200 nautical miles of Japan.

・Deep-sea fishing

Mainly refers to fishing operations carried out over 200 nautical miles from Japan.

・Sea aquaculture

Fishing involving using fish tanks and similar equipment arranged in the sea to artificially raise and catch seafood.

・Inland fishing

Fishing conducted in fresh water (rivers and lakes).

・Inland aquaculture

Fishing involving using fish tanks and similar equipment arranged in fresh water (rivers and lakes) to artificially raise and catch seafood.

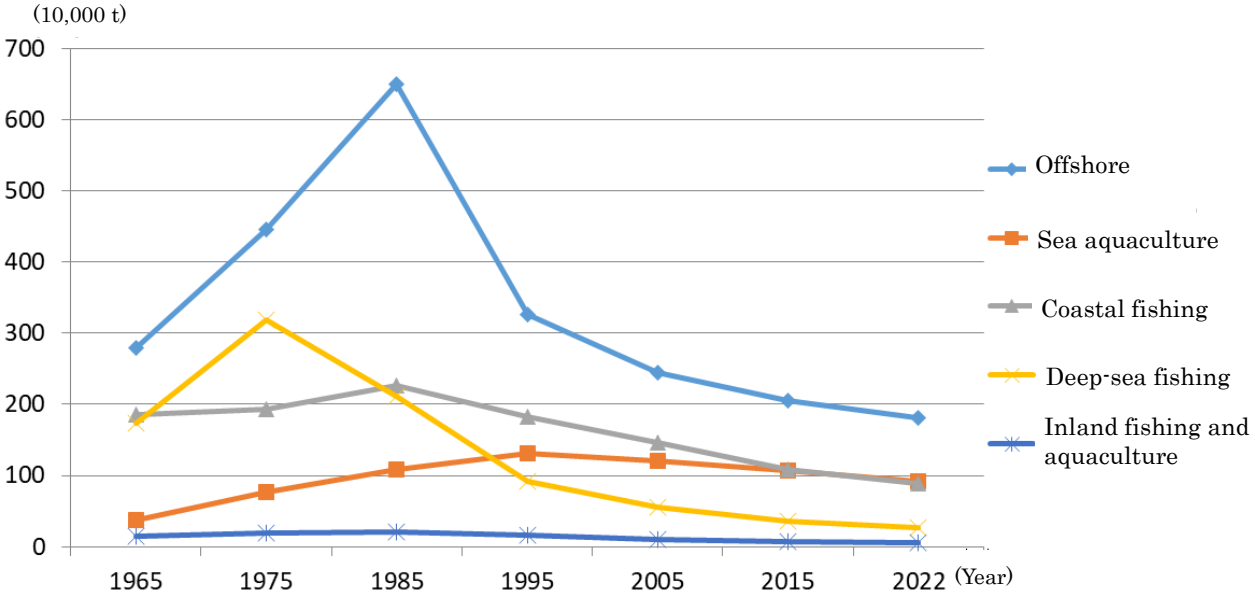


Figure 2-1: Japan's Fishing and Aquaculture Yield
(Source: Based on the FY2024 White Paper on Fisheries)

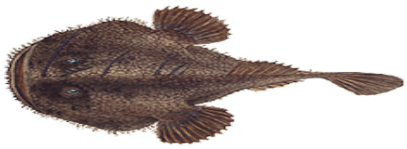
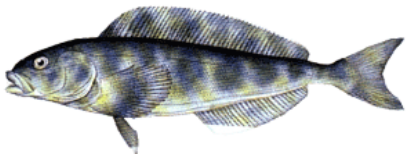
	Yield (10,000 t)
Offshore fishing	180
Sea aquaculture	91
Coastal fishing	89
Deep-sea fishing	26
Inland fishing and aquaculture	5

Figure 2-2: Fishing and Aquaculture Yields in Japan (2022)
(Source: Created from FY2024 White Paper on Fisheries)

3. Main Fish Caught in Japan

Japan's coasts stretch a long distance from north to south, with many warm and cool ocean currents flowing together along them, and various kinds of fish are caught in the surrounding waters. Different fish species inhabit different ocean depths. Bonito, sardines, tuna, and sea bass are some of the main inhabitants near the surface, while crabs, cod, shrimp, and squid are the most common species near the ocean floor.

Below are some of the main types of fish caught in the oceans off the coast of Japan.

	
Monkfish	Herring
	
Crab	Atka mackerel
	
Shrimp	Yellowtail
	
Horse mackerel	Mackerel
	
Sardine	Sea bream

	
Salmon	Halibut
	
Cod	Bonito
	
Tuna	Blowfish
	
Swordfish	Saury
	Spanish mackerel
	Squid

Figure 3: General fish caught in the oceans off the coast of Japan

4. Fishing Vessels

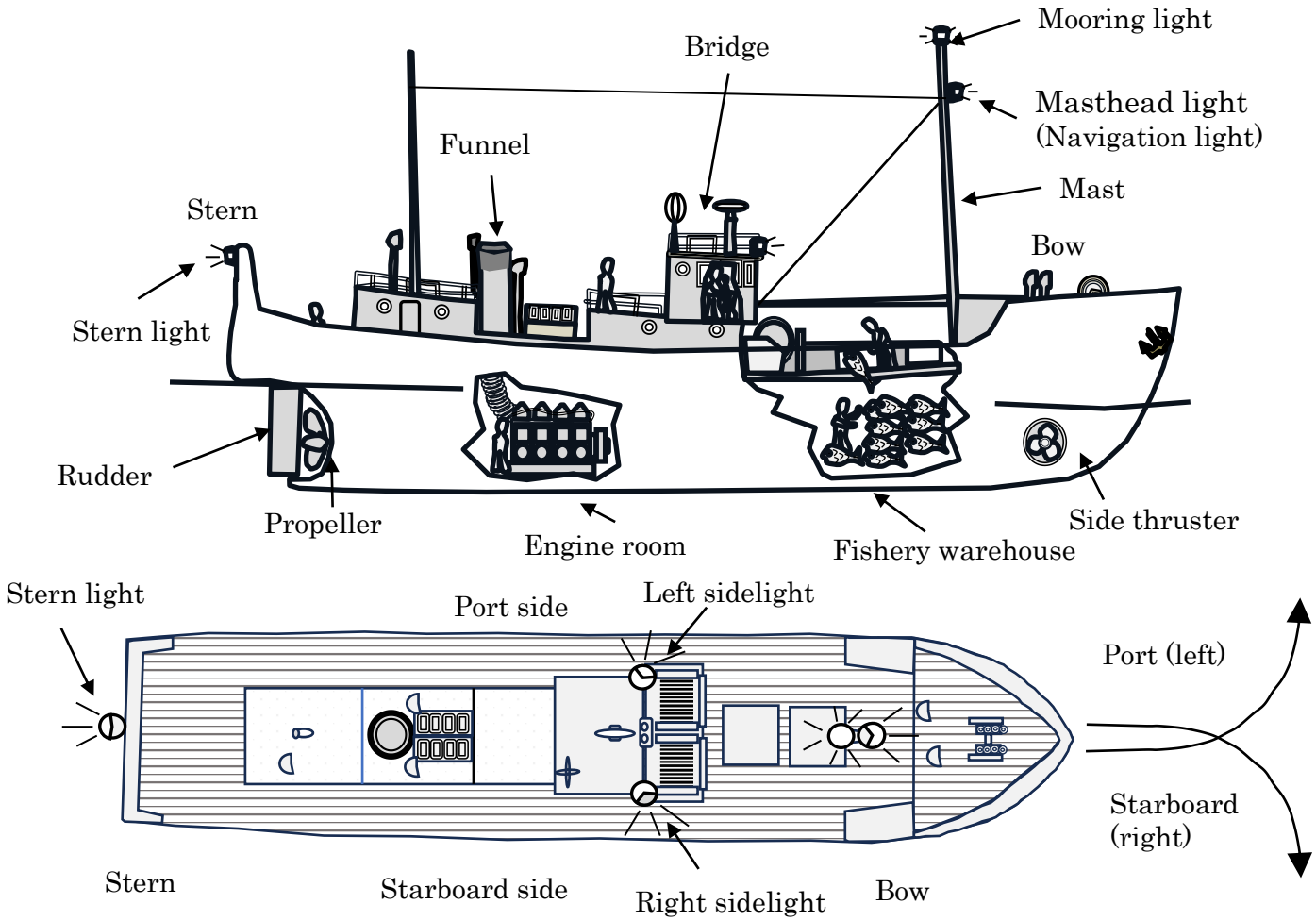


Figure 4 Example of fishing vessel

Steering

Starboard: steer the rudders to the right

Port: steer the rudders to the left

Colors of navigation lights

Masthead light: white Stern light: white

Left sidelight: red Right sidelight: green

Ship swaying

Vertical swaying: pitching Horizontal swaying: rolling

5. Fishing Vessel Crew

Chief fisherman	The person responsible for overall operations. The captain may double as the chief fisherman.
Captain	The person responsible for navigation of the ship.
Chief engineer	The person responsible for the engine, the refrigeration system, and other equipment.
Navigation officer	Assists the captain in performing ship navigation tasks.
Engineer	Assists the chief engineer in managing the machinery.
Chief radio operator	The person responsible for radio communications.
Boatswain	Directs the deckhands.
Chief of refrigeration	Processes caught fish and manages the refrigerator(s).
Chief steward (Head cook)	Prepares meals for the crew members.
Deckhand	Conducts ship watches and performs deck tasks, fishing tasks, refrigeration tasks, and other work.
Engineering crew	Performs engine tasks and assists with fishing and refrigeration tasks.

6. Compasses, Nautical Charts, and Navigation

(1) Compasses

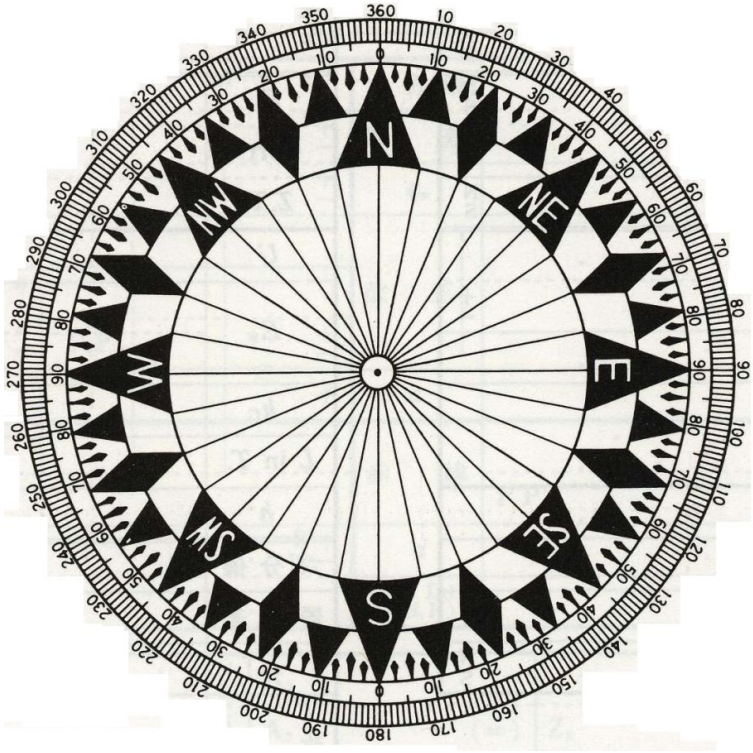


Figure 5: Compass

Compasses are essential tools that assist in calculating the location of the ship and determining the course (route). The main positions are marked with letters of the alphabet.

N: (north)	NE: (northeast)
E: (east)	SE: (southeast)
S: (south)	SW (southwest)
W: (west)	NW (northwest)

(2) Nautical chart

Nautical charts are diagrams with essential information for navigation, such as ocean depth and current direction, written on them.

Nautical charts also describe the characteristics of the seabed.

S: sand, M: mud, R: rocks

Nautical charts are maps of the sea used for navigation, and contain information necessary for navigation including coastal geometry, certain landmarks, ocean depth, bottom sediment, and obstacles. The sea level rises and falls with the tides, but the "height" and "depth" shown on a nautical chart are based on the standards indicated below.

As shown in the figure below, the height of mountains and lighthouses on land represents the height above the mean water level. On the other hand, the ocean depth represents the depth from the lowest water level. Since a rock which covers and uncovers is exposed above the water level at the lowest water level, its height represents the height above the lowest water level.

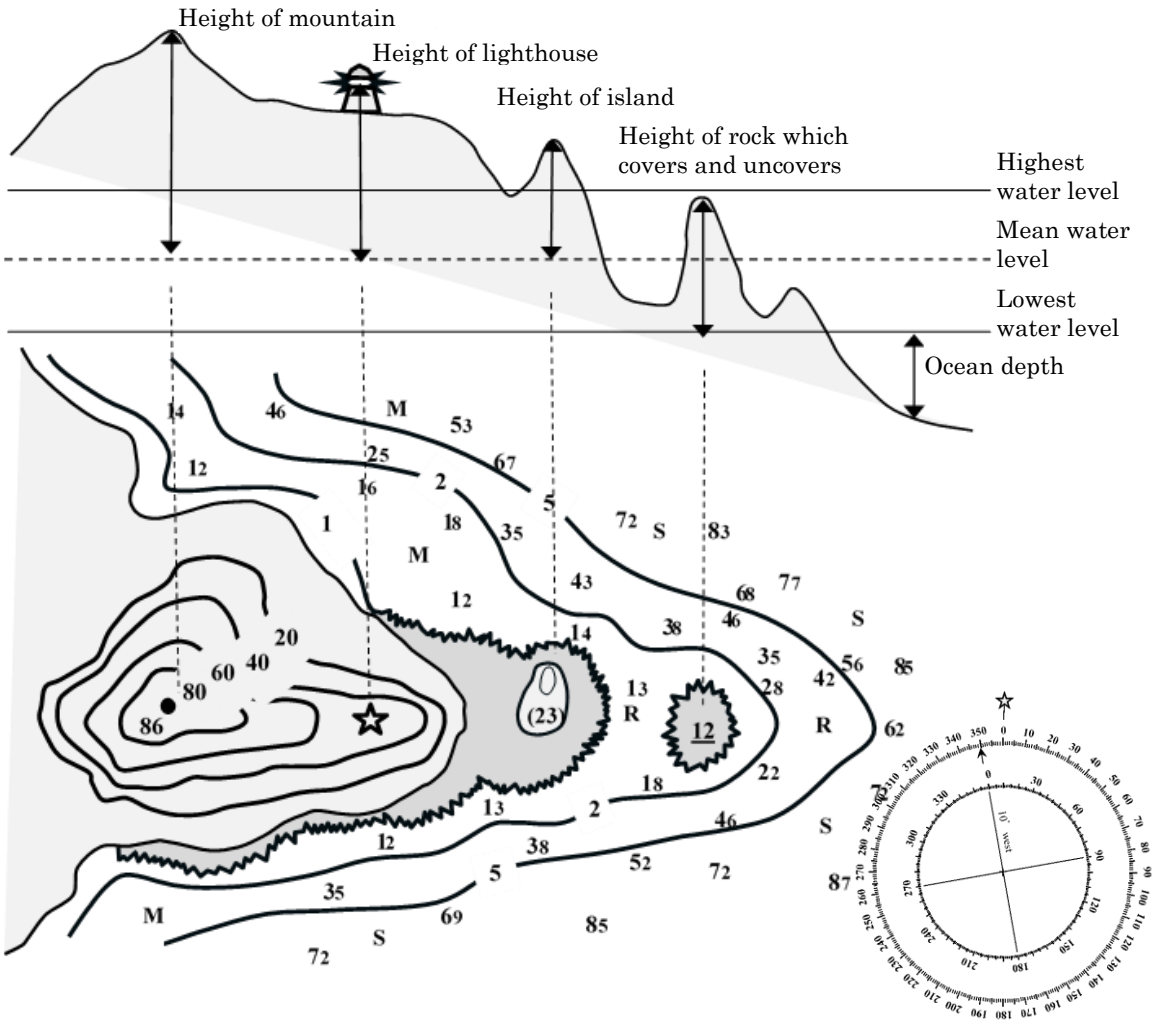


Figure 6: Example of nautical chart

A compass rose on a nautical chart is a directional map showing directions on the chart. It is represented by two concentric circles. The outside circle denotes true cardinal directions while the inside circle denotes magnetic cardinal directions. True north refers to the geographical location of the north pole while magnetic north refers to the north magnetic pole (pointed by a magnetic needle). The angular difference between true and magnetic north is called variation, which varies depending on the location and year.

The compass rose below shows a variation of 10 degrees to the west. To find the direction to a mountain or lighthouse on land using the magnetized needle of a compass, it is necessary to correct it to the true cardinal direction.

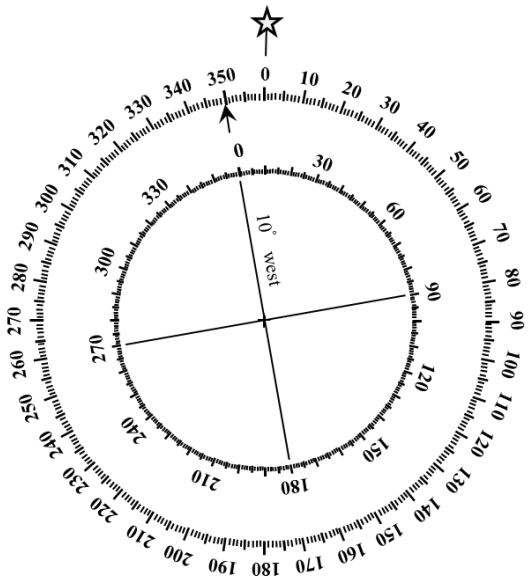
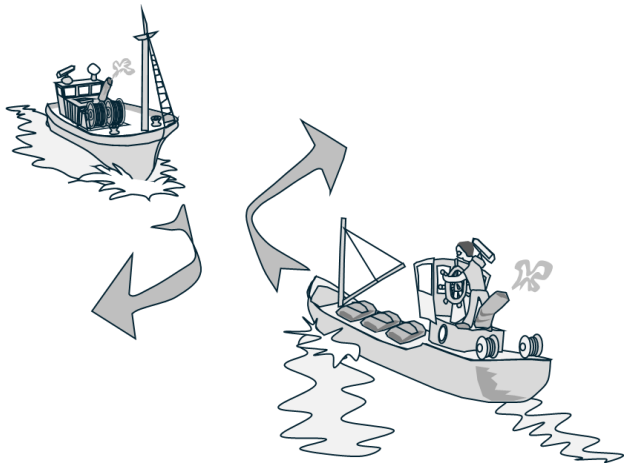
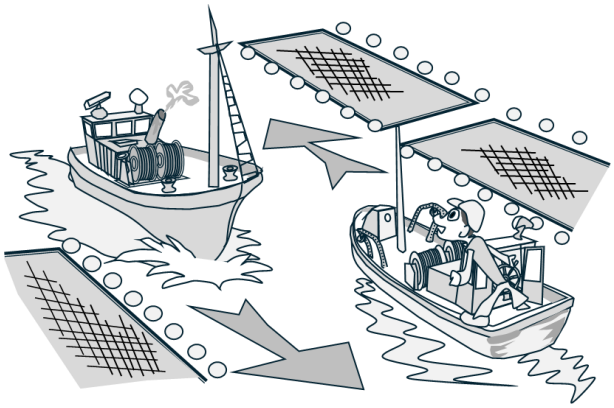


Figure 7: Example of compass rose on nautical chart

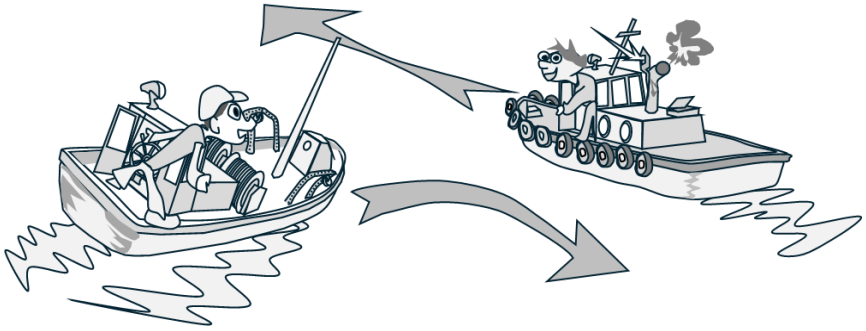
(3) Navigation



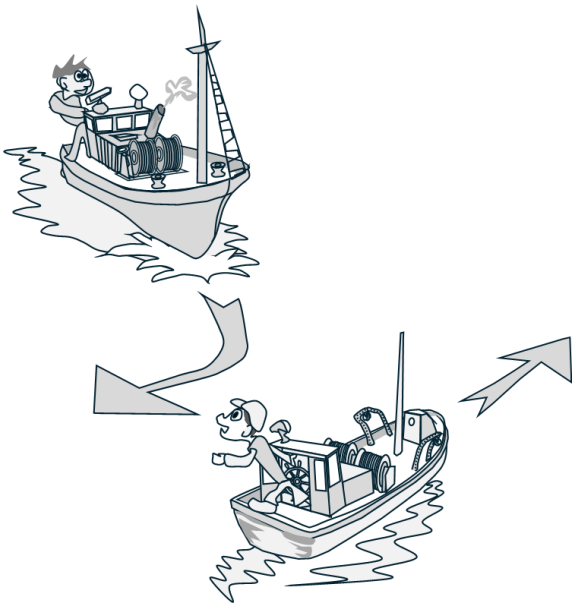
・When a ship is approaching from the front, steer the rudders to the right to avoid it.



・Ships are generally required to keep to the right side of the waterway.



・When a ship is crossing in front, avoid it by either steering the rudders to the right when the ship is to the right of your ship or by slowing down your speed.



・When a ship appears from the left, proceed straight ahead as this ship will avoid yours. However, sufficient caution should be taken to ensure that the other ship correctly avoids your ship.

Figure 8: Navigation

7. Ocean Currents and Continental Shelves

(1) Ocean currents

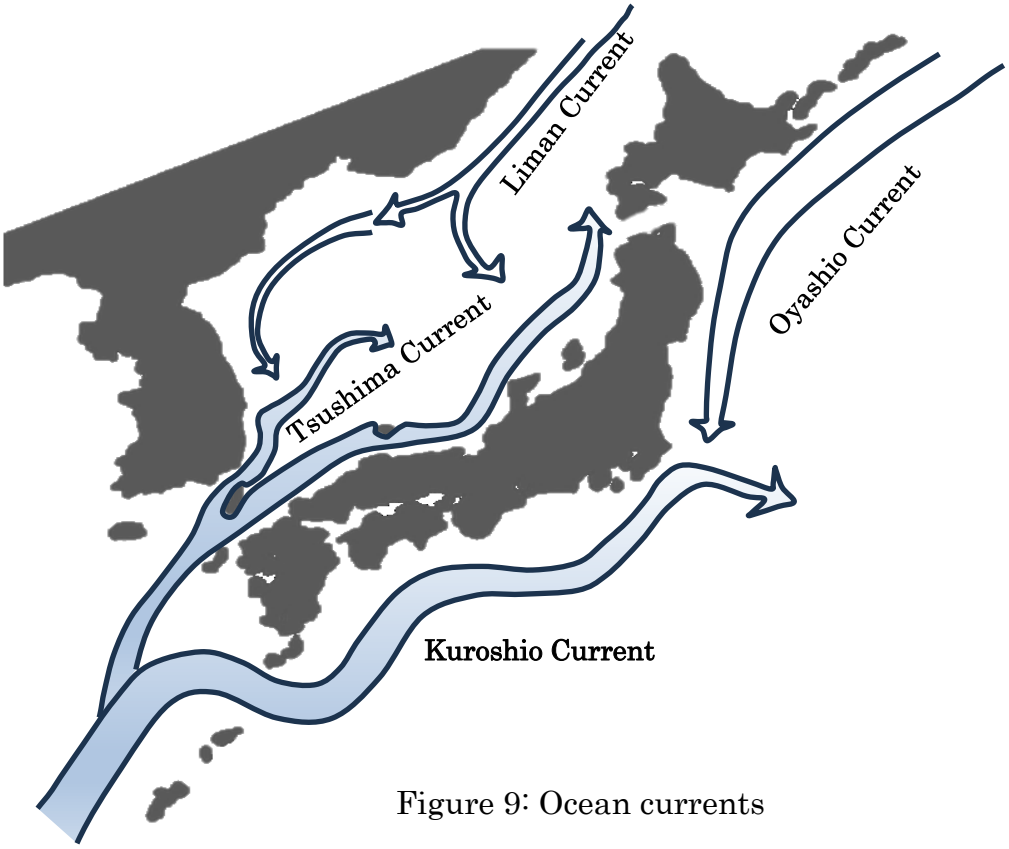


Figure 9: Ocean currents

A natural phenomenon that ocean water flows in a certain direction is called an "ocean current. " There are two main types of ocean currents: warm and cold. A typical warm current in the oceans off the coast of Japan is the "Kuroshio Current" flowing north from the South China Sea along the Japanese archipelago. The Kuroshio Current splits into two currents, the Kuroshio Current (Japan Current) and the Tsushima Current, at the border of Kyushu. The Japan Current flows toward the Pacific Ocean, while the Tsushima Current flows toward the Sea of Japan via the Tsushima Strait.

On the other hand, typical cold currents in the oceans off the coast of Japan are the Oyashio Current (Kuril Current) flowing south along the Kuril Islands, and the Liman Current flowing south from the direction of Sakhalin along the Eurasian continent.

At the coasts, there are currents which flow in a direction opposite to the main current of the open sea which are called countercurrents.

(2) Continental shelves

The areas around islands and continents are surrounded by shallow seas called continental shelves. Continental shelves are important locations for a country, and they are also spots with good fishing grounds

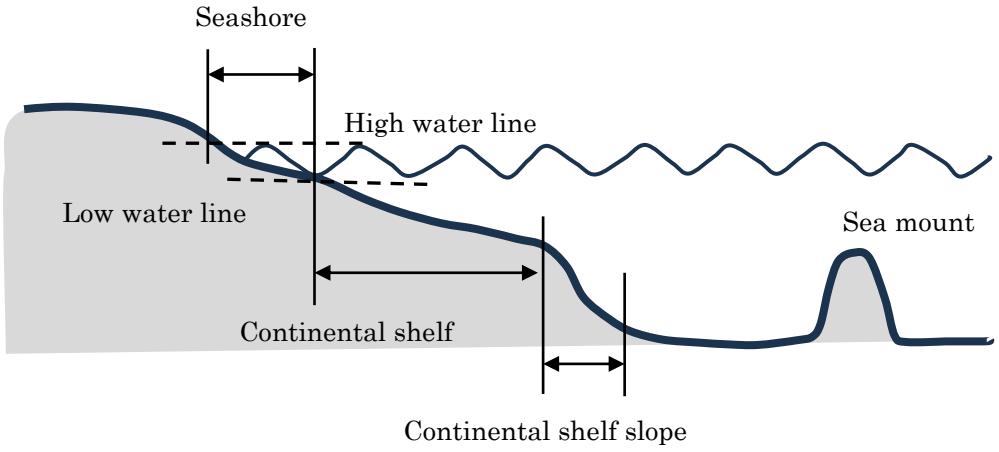


Figure 10: Continental shelf

8. Fishing Terms

Red tide:

A state in which plankton (particularly phytoplankton) are present in excessive numbers and the color of the water changes to red or brown is called a red tide. This has a major impact on fishing due to the increased plankton using large amounts of oxygen in the water and the plankton becoming stuck in the fish gills, which can cause fish and shellfish to die.

Nutrient salt:

Nutrient salt refers to minerals such as nitrogen (N), phosphorus (P), silicon (Si), which are essential for sea life to survive.

Eutrophication:

Eutrophication refers to an excessive increase in minerals such as nitrogen (N), phosphorus (P), and silicon (Si). This state is caused by the disposal of water from factories or households which contains an abundance of these minerals.

Prevention of marine pollution:

The disposal of contaminants such as oil, dirt, plastics, garbage, and fishing equipment no longer in use into the ocean causes water pollution. In order to prevent pollution, disposal of these types of items into the ocean is prohibited by law.

Upwelling current:

An upwelling current refers to water near the ocean floor rising up to the surface. The water that has risen to the surface has a low temperature and is high in nutrient salt. Due to these factors, large quantities of plankton gather, which makes the surrounding area a good fishing ground.

Salinity of sea water:

This refers to the amount of salt contained in sea water. It is displayed as a number of grams (‰, per mille) in 1 kg of sea water. Generally, the salinity of sea water ranges from 33 to 37‰ (33 to 37 g per kg).

9. Netting Fabric

(1) Netting fabric structure

Netting fabric is categorized into knotted netting and knotless netting depending on whether there are knots present. Knotted netting is made up of four knots and four legs per mesh (Figure 11). Knotless netting has an intersecting portion of netting threads in place of the knots. A flat knot slips out of place easily, while an Englishman's knot tends to stay in place.

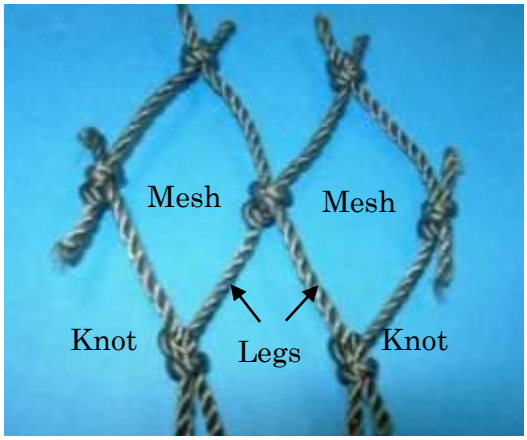
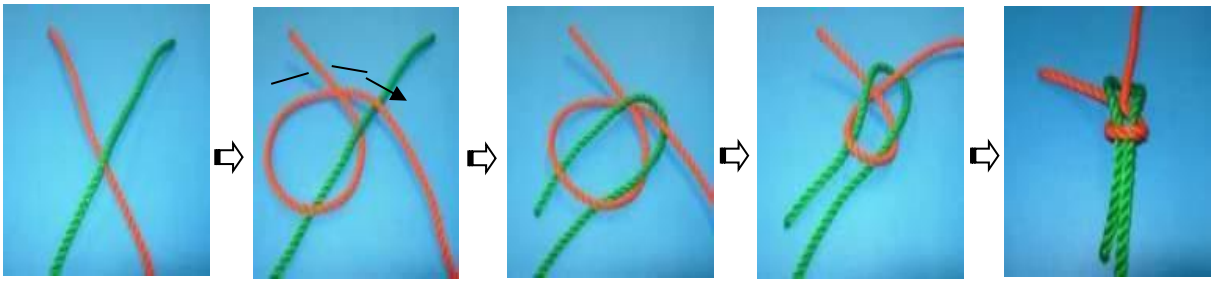


Figure 11: Name of each part of knotted fabric

(2) Methods for tying threads

The simplest and most common tying method is shown in Figure 12. It results in an Englishman's knot, which is the same as a sheet bend for a rope. In the case of threads that tend to slip, a double knot with the ring in (2) of Figure 12 formed twice is used.



(1) (2) (3) (4) (5)

Figure 12: Common tying method

(3) Direction for connecting netting fabric

Hana joining (lengthwise direction):

When joining the lengthwise directions together as shown on the left in Figure 13, the netting threads on the knotted portion of the ends of the netting fabric are one continuous thread. In this case, tie the material with an Englishman's knot, using a double Englishman's knot for the first and final knots. For fishing line, since the knots tends to slip out of place, so tie the thread firmly using a double Englishman's knot.

Side-joint joining ("yarn over" direction):

When tying in the "yarn over" direction as shown on the right in Figure 13, tie with a flat knot, and for the first and final knots, use a double Englishman's knot. In this case, the threads of the two legs for the knots on the end are not continuous, so be sure to tighten by interposing the knots.

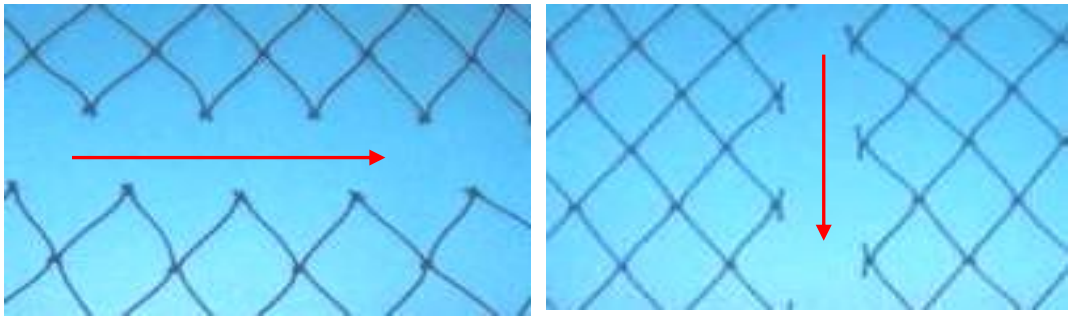


Figure 13: Way of tying netting fabric: *hana* joining on the left, and side-joint joining on the right

(4) Netting fabric sewing method

There are two main methods of sewing together two pieces of netting fabric: "joining" and "wrap-joining." Joining is a method of sewing together the two pieces of netting fabric with the end knots tied together, while wrap-joining is simply sewing without tying. Different methods of connecting the two pieces are used, and some examples are "mountain," "mountain-valley," and "valley" methods (Figure 14).

"Mountain" wrap joining (wrapped three times)

"Valley" wrap joining (wrapped three times)

"Mountain" joining

"Mountain-valley" joining

Figure 14: Wrap-joining method for sewing netting fabric

In addition, the basic repair methods for regular and crossing repair of torn netting fabric are as shown below.

・Regular repairing

Using a thread the same thickness as the netting fabric, conduct a repair using the same knots and mesh sizes. The sewn portions blend in with this method, but the repair process is time-consuming (Figure 15).

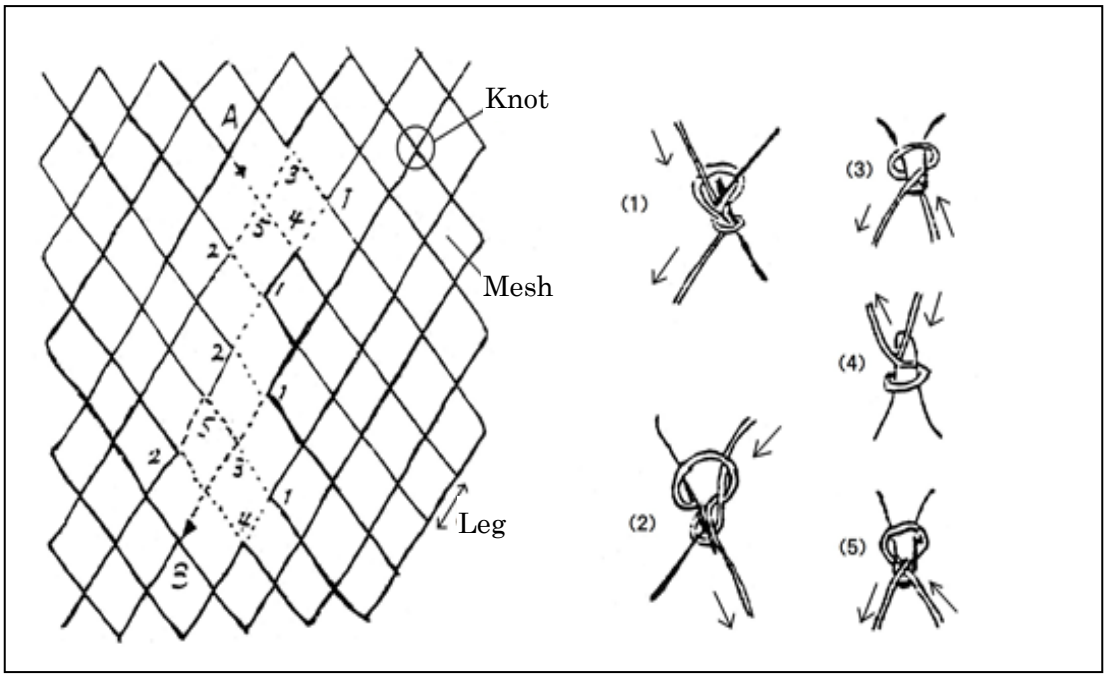


Figure 15: Regular repairing and netting needle movement

・Crossing repairing

This is a method of repairing without organizing the area around the torn netting. The sewn portion stands out, but repairs can be completed more quickly with this method (Figure 16).

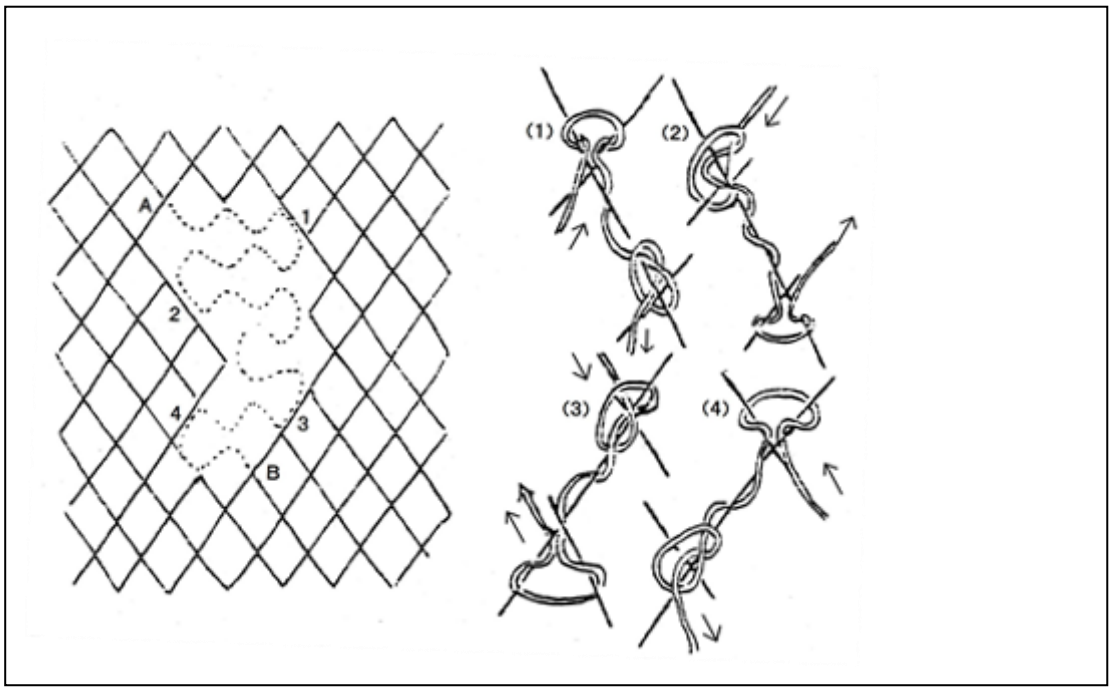


Figure 16: Crossing repairing and netting needle movement

10. Rope Knots

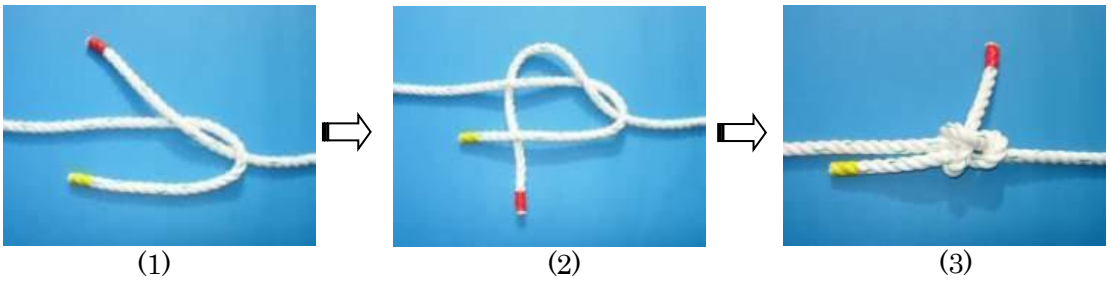
(1) Single knot

This is a simple knot in a basic shape. Once the rope is tightened, this knot is difficult to untie.

(1) (2) (3)

(2) Sheet bend

This knot is used when tying the ends of two ropes with the same thickness. It is an important knot that is used often. The top photos show a single sheet bend, and the bottom ones show a double sheet bend. In the case of ropes with different thicknesses or ropes that tend to slip, a double sheet bend is used.

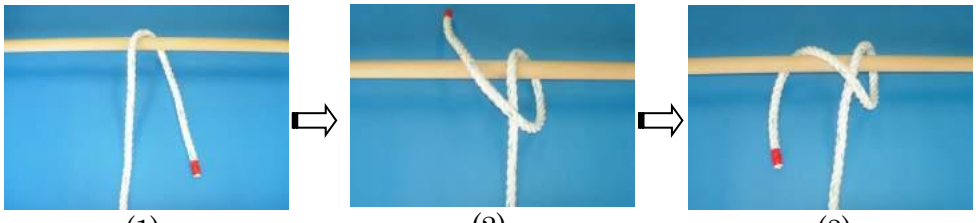


(1) (2) (3)

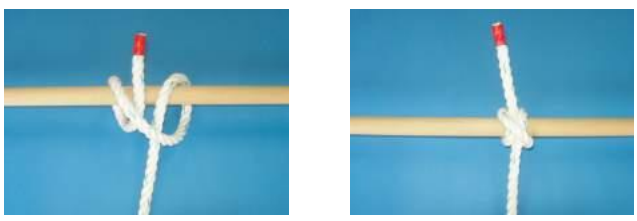
(1) (2) (3)

(3) Clove hitch

This knot is often used when temporarily tying the end of a rope to a pole-shaped object. One example is temporarily tying the rope to a bitt or similar structure on a small ship. It may be difficult to untie once it is tightened.



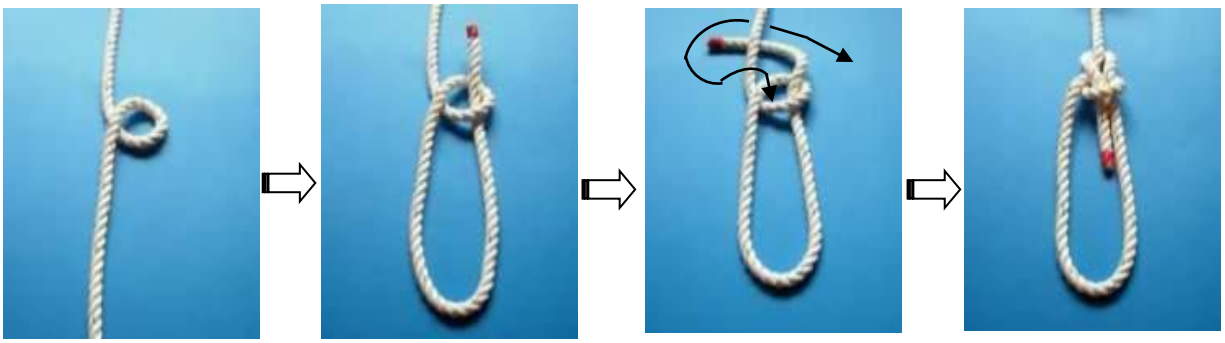
(1) (2) (3)



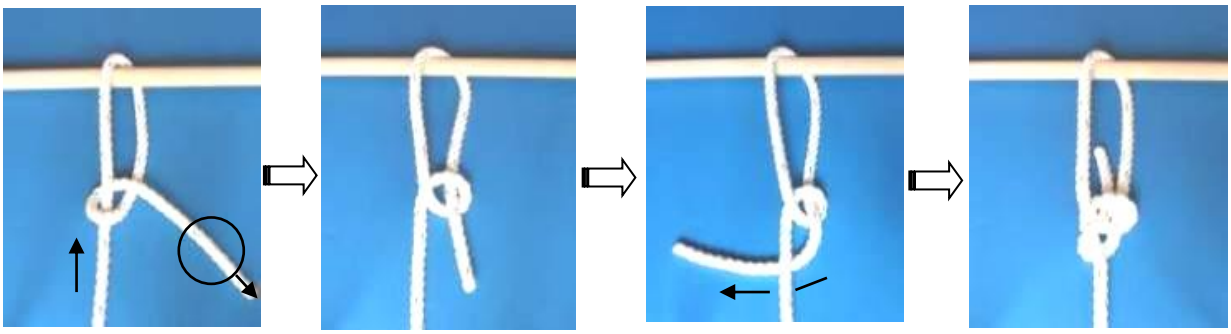
(4) (5)

(4) Bowline knot

This knot is used for applications such as tying a rope to a bitt. It is a safe, reliable knot. Another reason it is often used on ships is because it is easy to untie. The hand movements differ depending on whether the knot is used to drape the rope over an object or not.



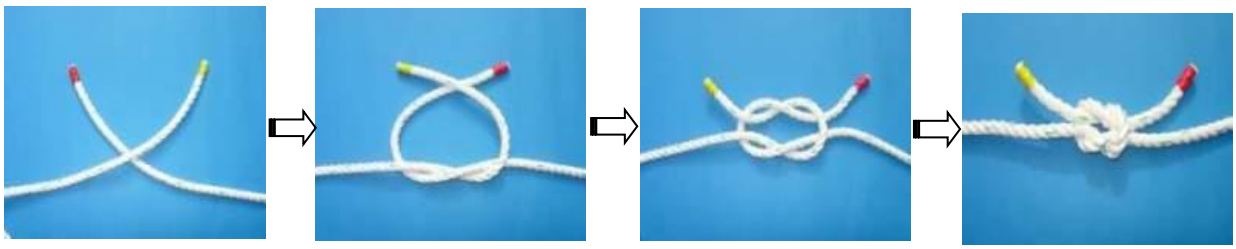
(1) (2) (3) (4)



(1) (2) (3) (4)

(5) Reef knot (regular knot or true knot)

This is an important knot used when tying together two ropes of the same thickness as a temporary measure, such as when repairing cut sections on a rope.

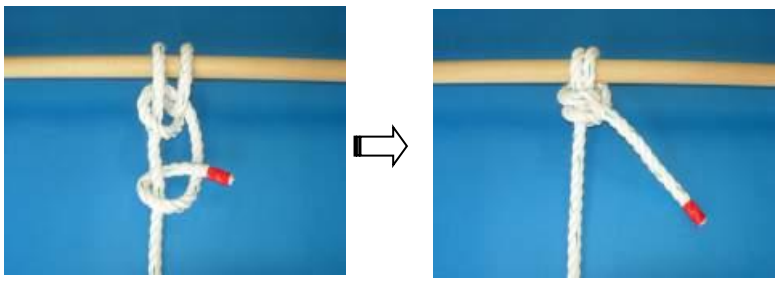


(1) (2) (3) (4)

(6) Anchor knot

This is also called a fisherman's knot, and it is used when tying a rope to the ring of a small anchor.

(1) (2) (3)



(4) (5)

(7) Cow hitch

This is effective when temporarily slinging the middle of a rope over an object.

(1) (2) (3)

11. Treatment of Rope Ends

I. Back splice

(1) Separate the strands into "a," "b," and "c."

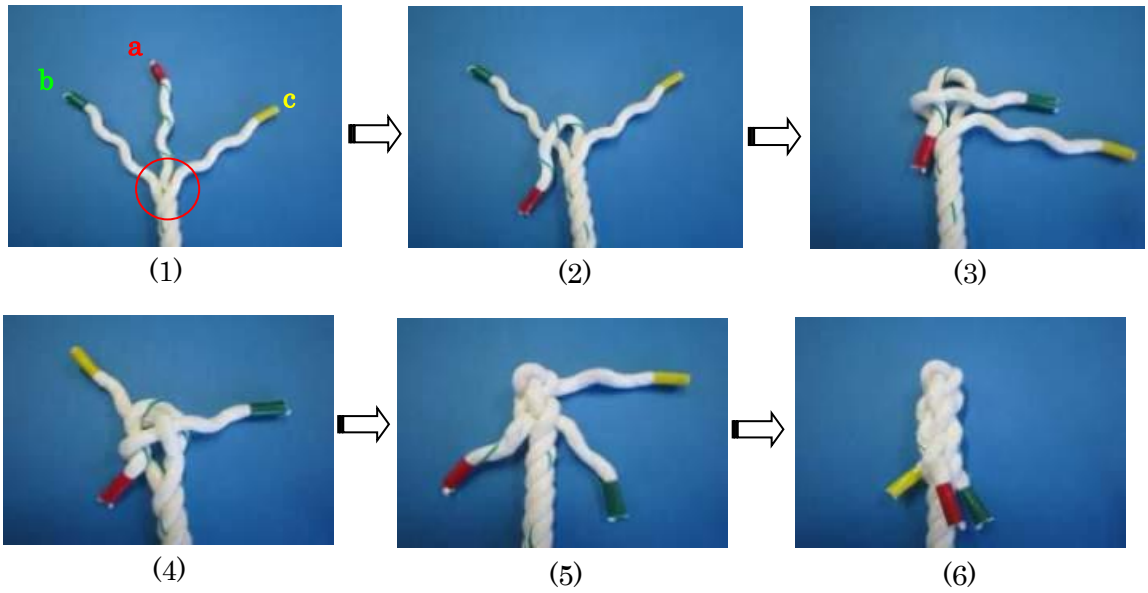
(2) Bring "a" to the front.

(3) Wind "b" around strand "a" starting from the outer side.

(4) Wind "c" around strand "b" starting from the outer side, then insert it into the ring of "a." This is called a "crown knot."

(5) After securely tightening the combined strands, bring each strand around and insert them into each of the other strands.

(6) Insert each strand three or more times to finish.



(1) (2) (3)

(4) (5) (6)

II. Eye splice

(1) Separate the strands into "a," "b," and "c."

(2) Insert "a" into the strands.

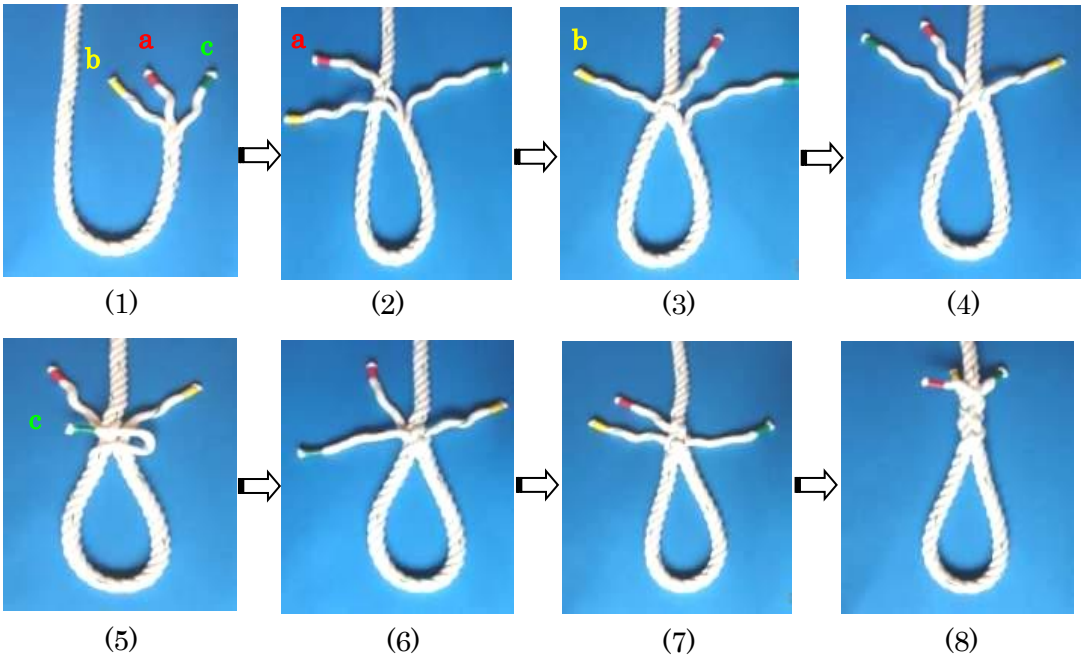
(3) Insert strand "b" under the strand into which "a" has been inserted.

(4) Turn the rope over.

(5) Insert "c" into the other strands in the direction of the arrow.

(6), (7) Firmly tighten each of the three strands, then insert them a second time.

(8) Insert each strand three or more times to finish.



(1) (2) (3) (4)

(5) (6) (7) (8)

III. Short splice

(1) Separate the strands for both ropes.

(2) Combine each of the strands.

(3) Insert each of the strands of the rope on the right into the left,

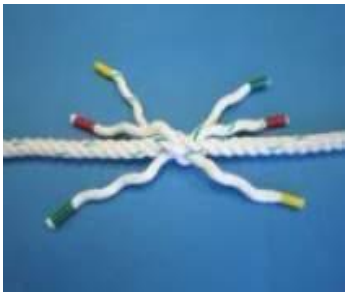
(4) for a total of three insertions.

(5) Insert the strands of the other rope three times.

(6) Insert each strand from each of the ropes three or more times to finish.

(1)

(2)



(3)

(4)

(5)

(6)

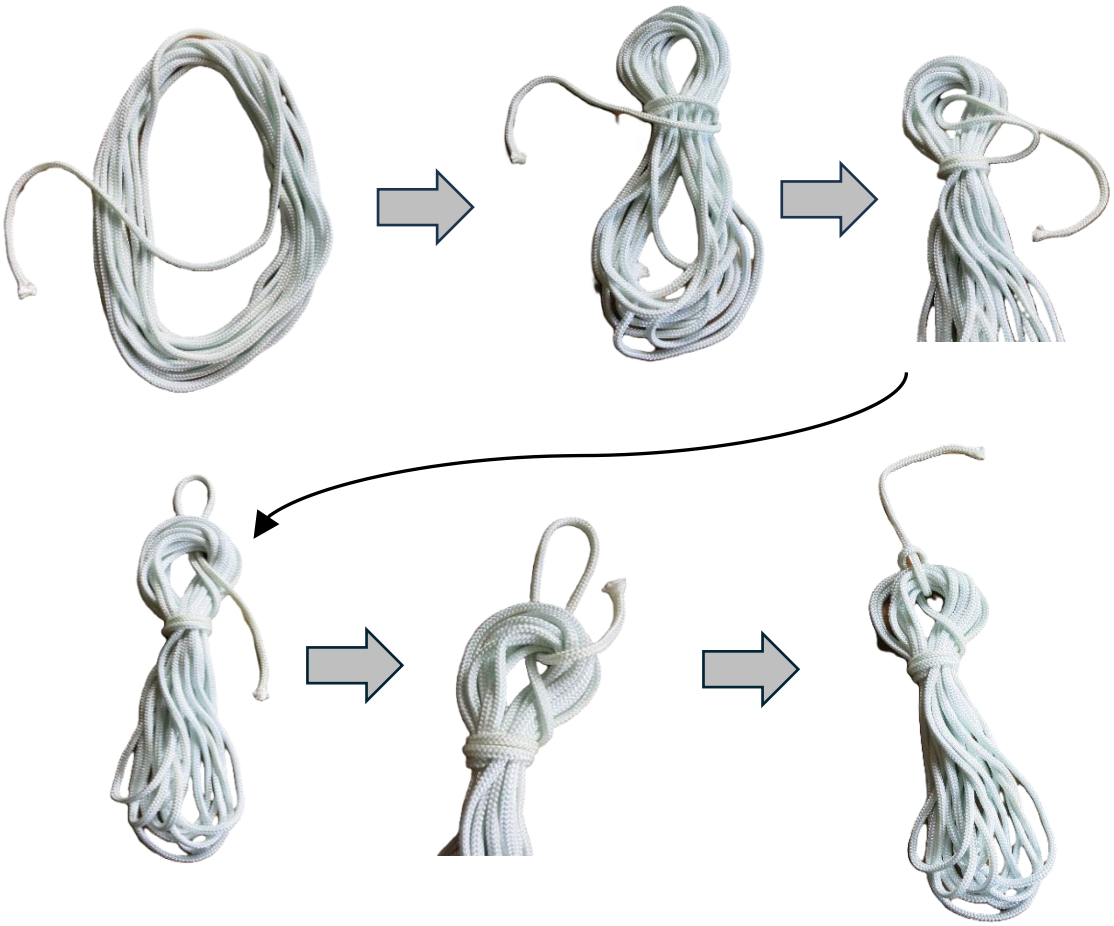
12. Rope Storage and Organization

Many ropes are used in various works on fishing vessels. If ropes are left rolled up and messy, they will be tangled and cannot be taken out for immediate use when needed. To use them immediately without getting tangled, they must be rolled and bundled. There are various methods to bundle ropes, and the major (simple) ones are as follows:

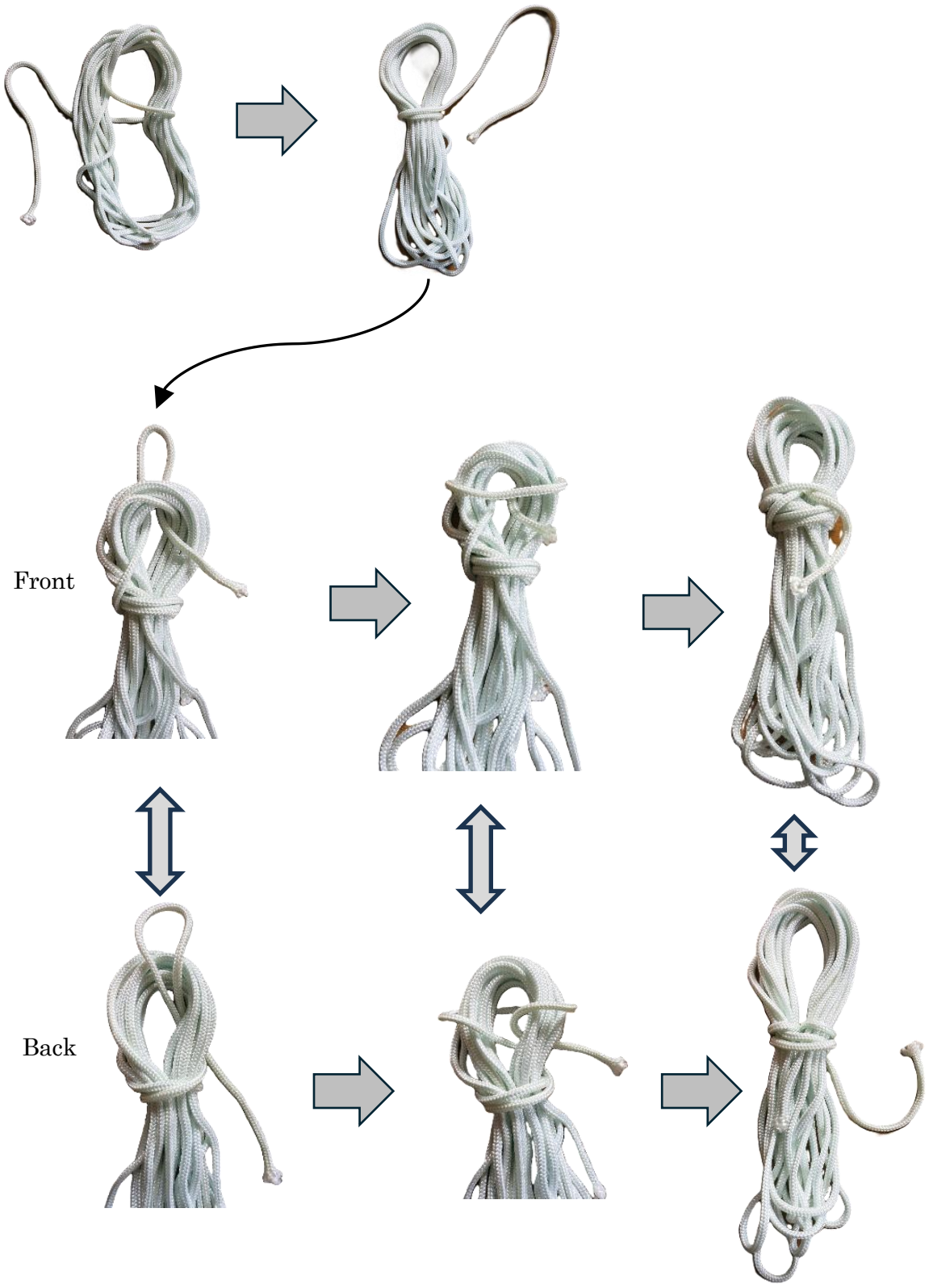
(1) Thin ropes

There are three methods to bundle thin ropes with a diameter of approx. 30 mm or less and a length up to 100 m as shown below. They can be hung on a wall or the like.

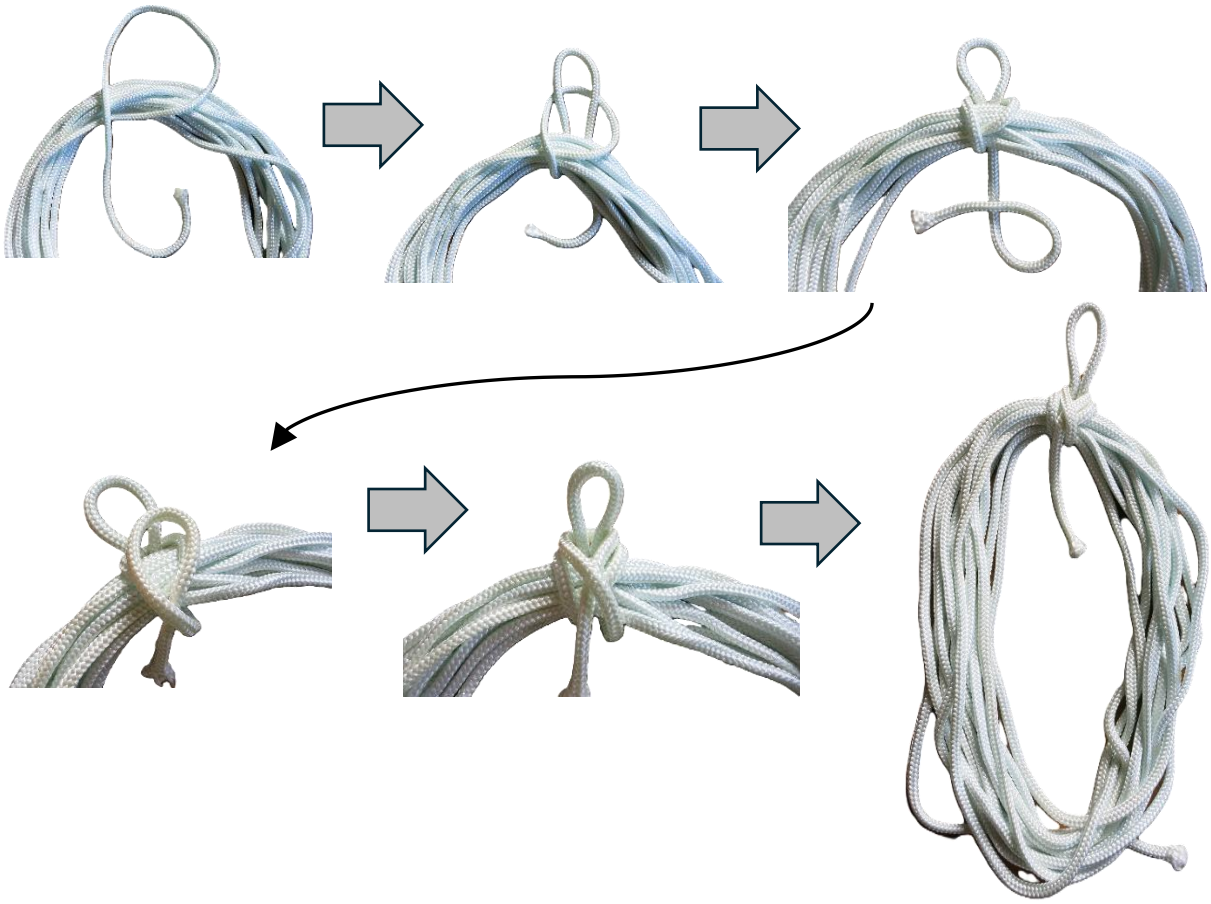
[1] Hanging bundle A



[2] Hanging bundle B



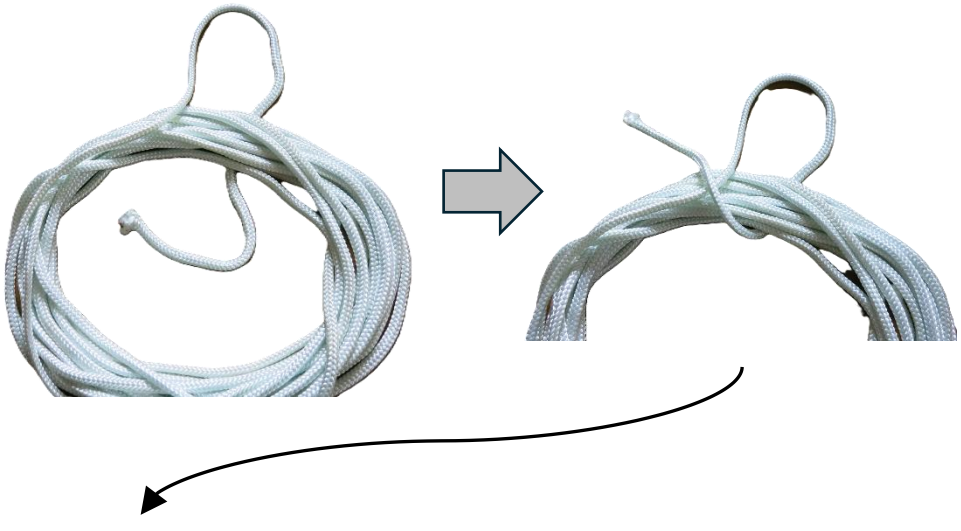
[3] Hanging bundle C

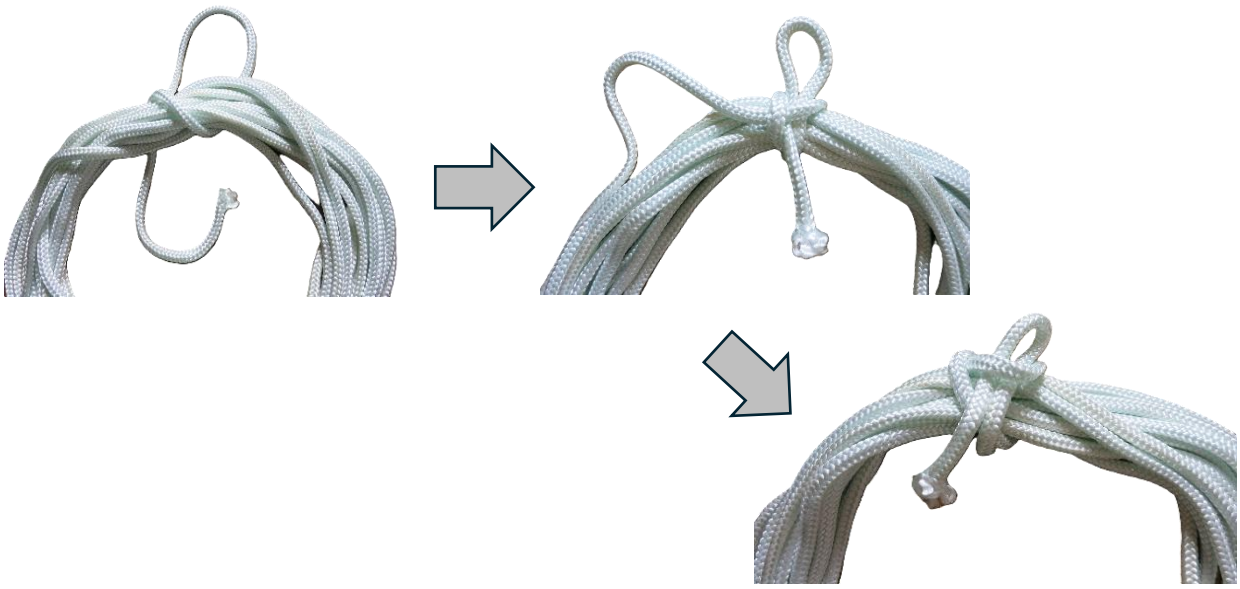


(2) Thick ropes

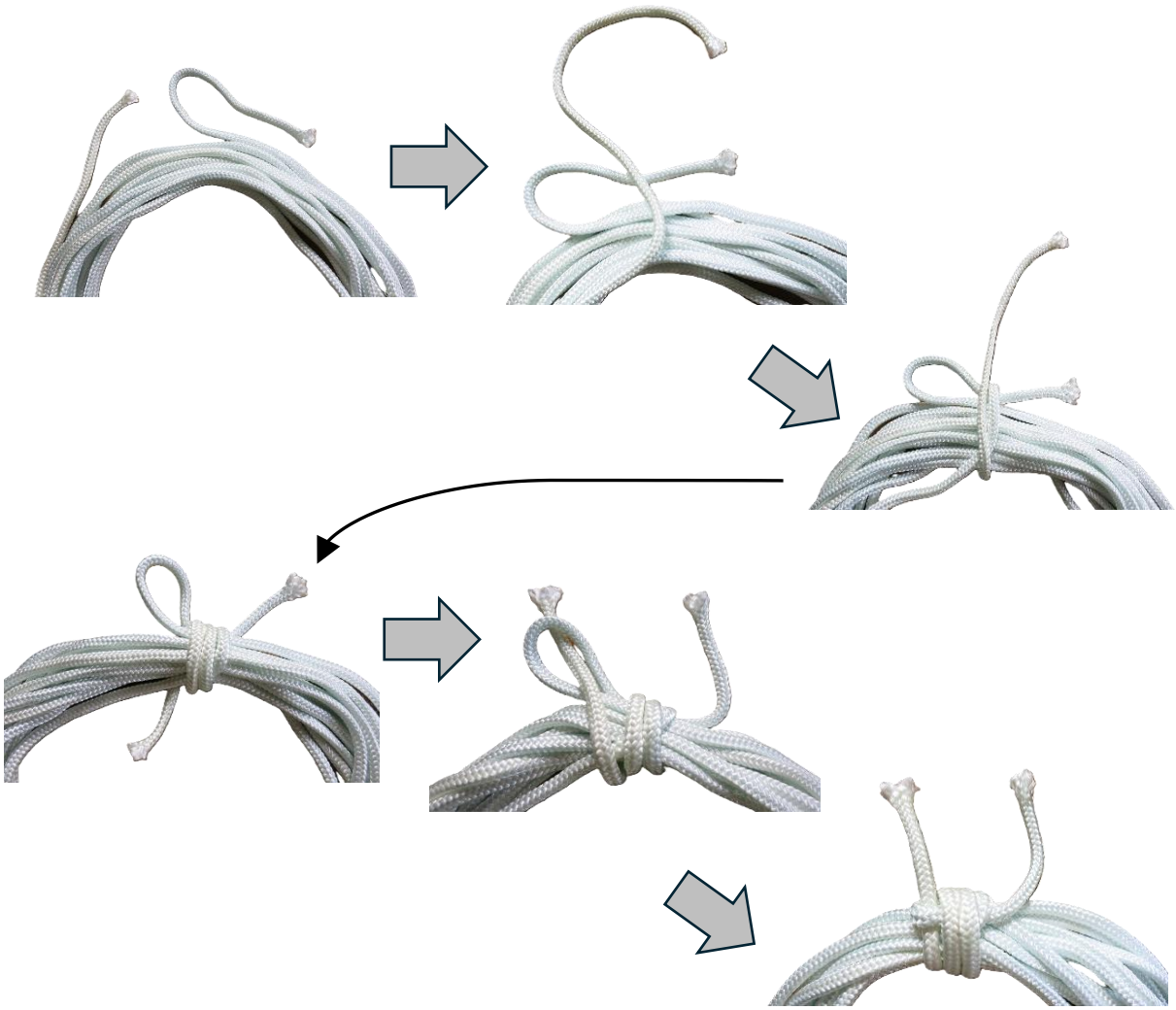
There are two methods to bundle thick ropes after being rolled up while they are still placed on deck as shown below.

[1] Flat bundle A





[2] Flat bundle B



13. Practical Ropework

(1) Securing a rope to a bollard

At fishing sites, many rope operations are conducted, for example, securing ships to each other or to a quay, securing fenders or nets, as shown in Figure 17. How to secure a mooring rope to moor the ship to the quay is shown below as a basic operation.

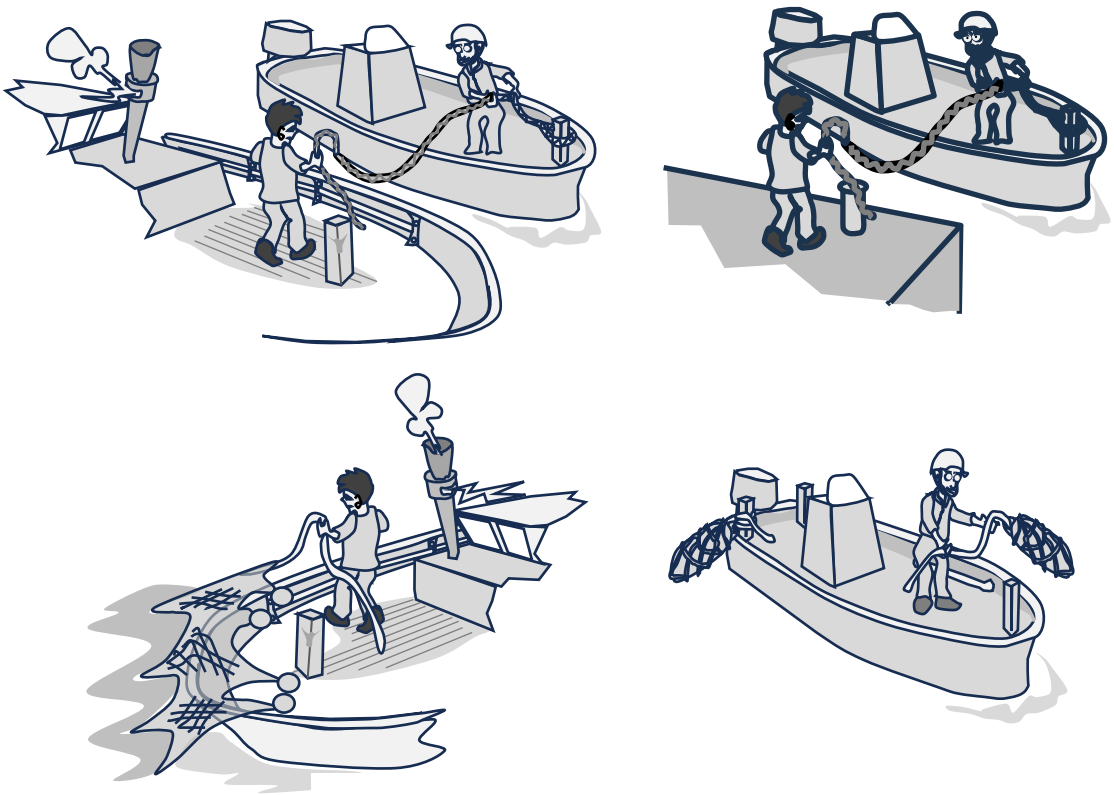


Figure 17: Ropework at fishing sites

(2) Wrapping the rope around the bollard

After catching a rope thrown from a ship at the quay, go on to the next step promptly, otherwise the ship cannot be moored. In addition, a great force is required to pull the rope directly. As soon as receiving the rope, wrap

it around the nearest bollard (ring, etc.) one or two turns. This can weaken the force applied to the rope.

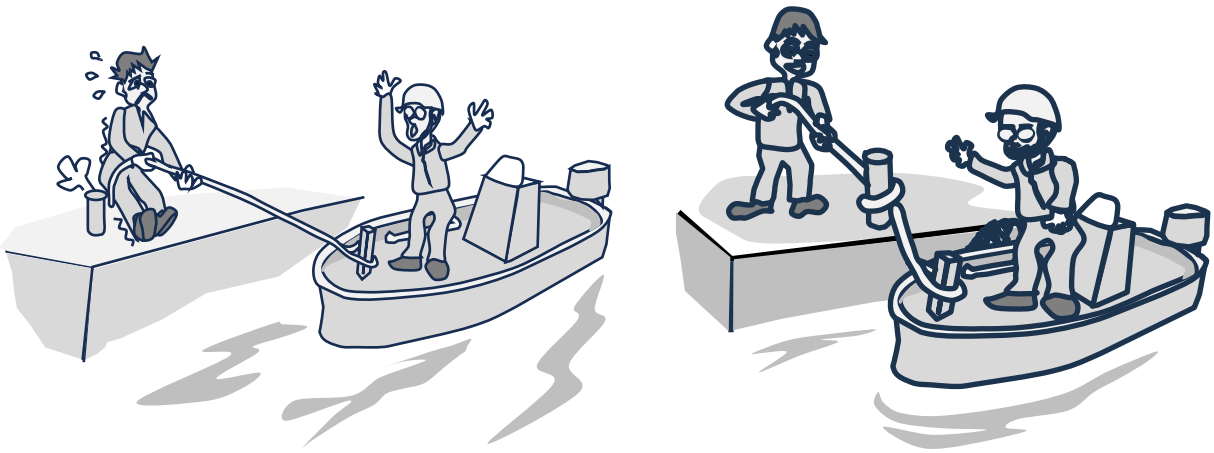


Figure 18: Left - Dangerous situation where the ship pulls the rope
Right – Weakening the force by wrapping the rope around a bollard

With the rope wrapped around the bollard one or two turns, shift the rope to adjust the length of the rope to the ship. After that, if the force applied to the rope is too great, wrap the rope around the bollard four or five turns. After this operation, if secured with clove hitch, the rope may be too tight to untie by pulling with a great force. To prevent this, the following tying method is used.

(3) Folding the wrapped rope back and additionally wrapping it

The rope wrapped around the bollard with a force applied is folded back and additionally wrapped around the bollard one to two turns. By folding the rope back, the force applied to the rope can be weakened.

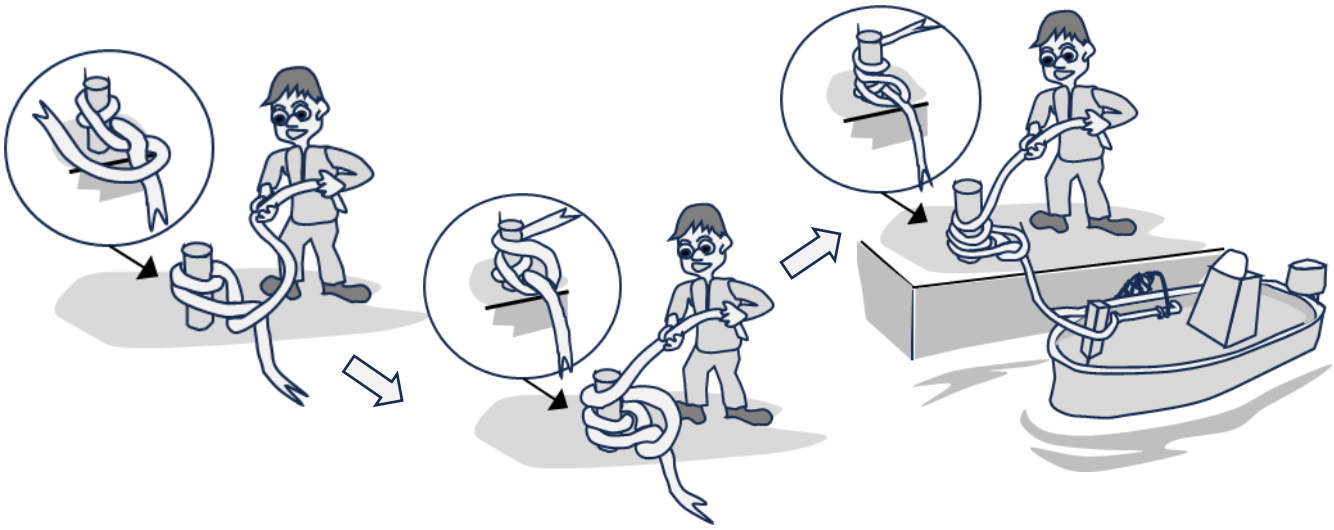


Figure 19: Ropework of folding back and wrapping

(4) Wrapping the rope with clove hitch

Usually, to secure a rope to a bollard (bitt, ring, pipe, rail, etc.), a bowline knot or clove hitch is used (Figure 20). For time-sensitive work or rope under tension, clove hitch is used.

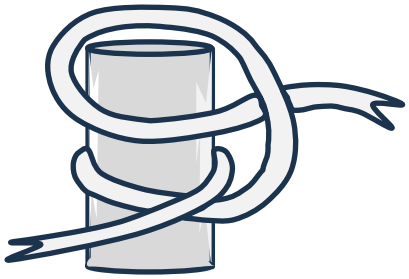


Figure 20: Clove hitch

After the rope is folded back and wrapped around the bollard additionally one or two turns in (3), secure it to the bollard with clove hitch (Figure 21). When clove hitch is made after the rope is folded back, the rope will not be too tight even if a force is applied to it, making it easier to untie.

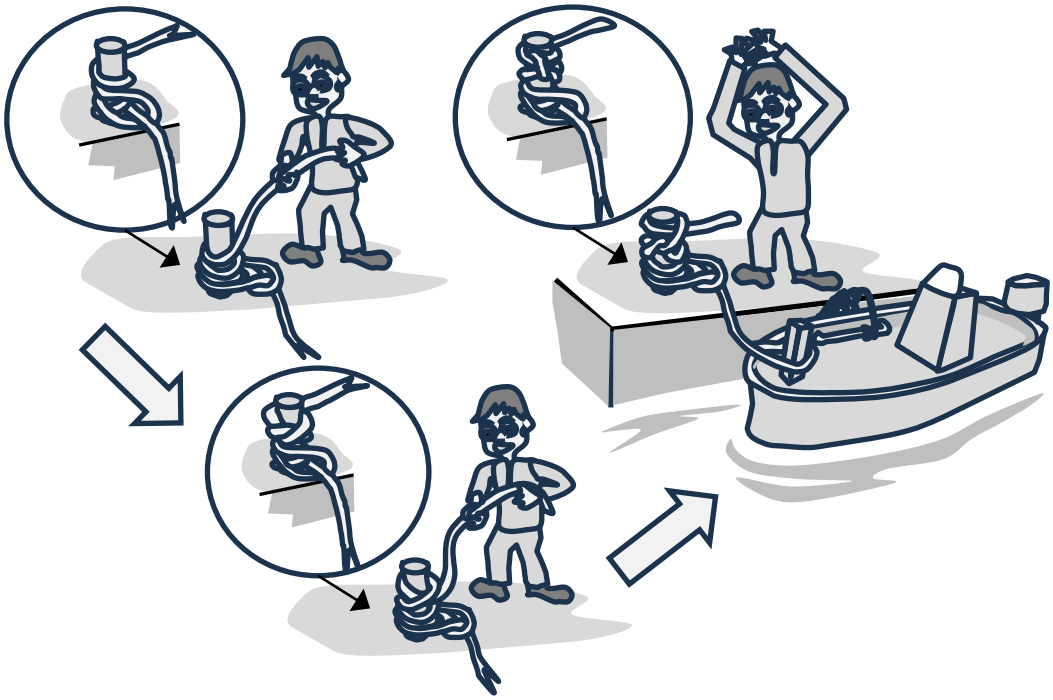


Figure 21: Making clove hitch with folded back rope

14. Fish Hooks

In Japan, many types of fishing hooks are made and used for different sizes and species of fish. The general structure of a fishing hook and the names of each part are as shown in Figure 22.

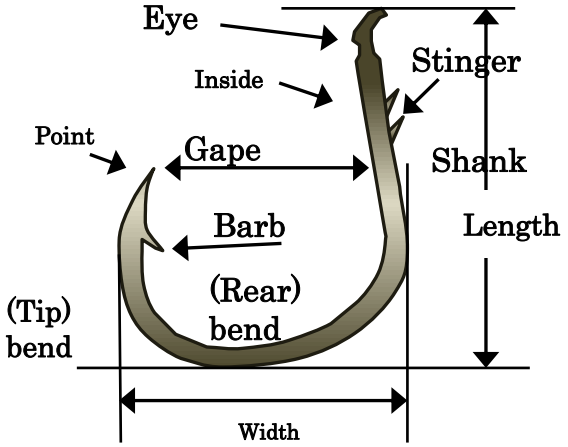


Figure 22: Structure of a fishing hook

(1) Methods for tying a hook onto a snell

The thin thread tied to a fishing hook is called a "snell." It serves the purpose of connecting the fishing hook to the main line directly or by way of a branch line. When fishing for fish species with sharp teeth such as parrot bass, blowfish, or hairtail, a metal wire is used for the snell. In this case, the wire is used for the portion closest to the fishing hook (10 to 30 cm) and fishing line is attached from there, forming a two-part snell for the hook. Two simple methods of tying which are commonly used to connect a snell to a fishing hook are shown in Figure 23.

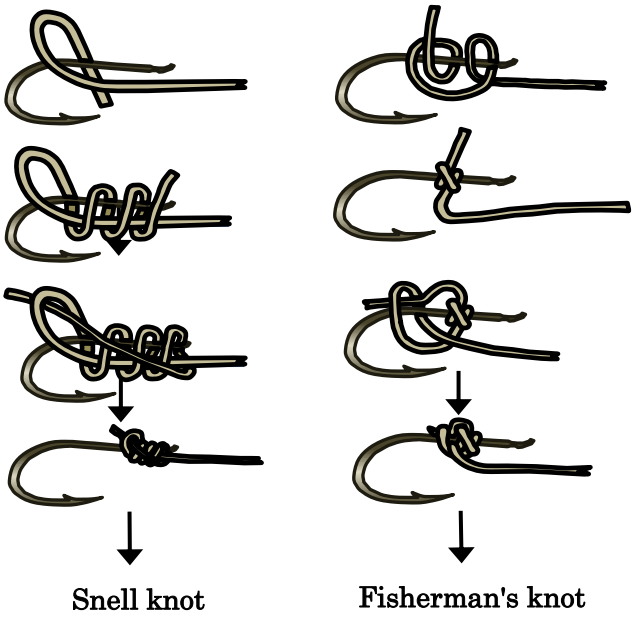


Figure 23: Simple tying methods for fishing hooks

(2) Methods for tying on a fishing swivel

A fishing swivel is a component that prevents twists from entering into main lines, branch lines, and snells. In Japanese, large swivels are generally called a *yorimodoshi*, and small ones are generally called a *sarukan*. Two simple methods for tying a fishing swivel to a fishing line are shown in Figure 24.

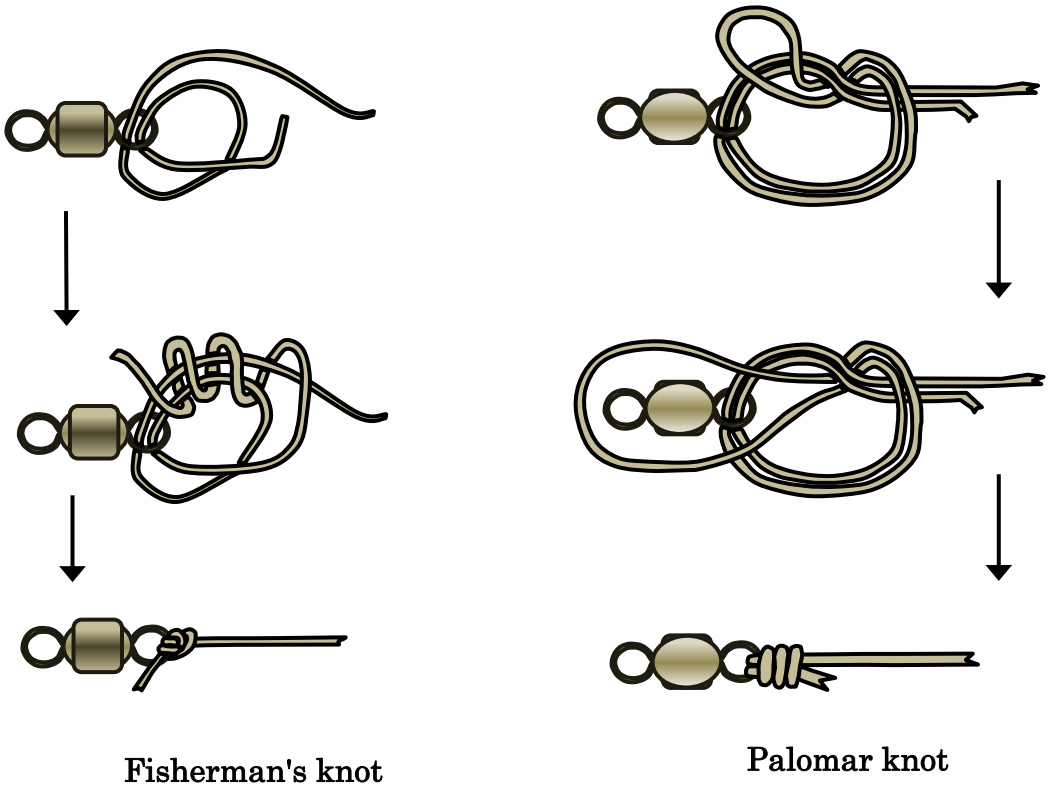


Figure 24: Tying method for a fishing swivel

15. Fishing Devices

For modern fishing vessels, mechanization has advanced, allowing for streamlining through the use of large fishing devices with a small number of crew members. Equipment such as derricks, cranes, and capstans are installed relatively commonly, but the direct fishing devices differ depending on the type of fishing. Some of the main types are as shown below.

Longline fishing

(1) Line hauler

A device for hauling in the main line of a longline.

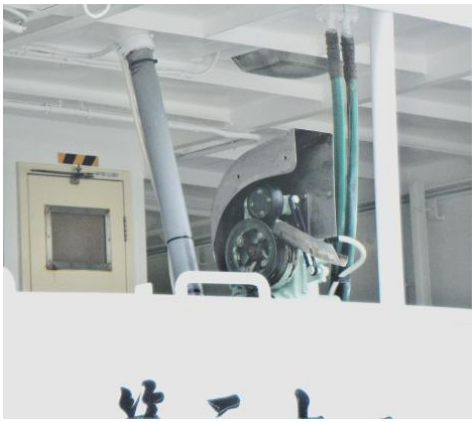


(2) Branch line winder

A device for winding a branch line into a coiled shape.

(3) Line caster

A device for casting a longline from a ship with a branch line is attached to a main line.



Gill net fishing

(1) Net hauler

A device for hauling in a gill net. Generally, the float side and the sinker side are hauled in separately, but they may also be hauled in together in some cases.



(2) Net transfer pipe

A pipe used to transfer a gill net that has been hauled onto the ship to a storage location on the stern side.

(3) Net carrier for gill net storage locations and netting production.


Pole-and-line bonito fishing

(1) Sprinkler system

A sprinkler for attracting bonito and causing them to stop in place.


Roundhaul fishing

(1) Net hauler

A device that hauls in a roundhaul net.


(2) Purse winch

A wire-winding winch for taking in the net hem of a roundhaul net.

(3) Winding davit

A davit that reels in a wire to tighten the net hem.

(4) Net-handling power block

A device that suspends a net hauled using a net hauler and is used for netting production work.

(5) Sideroller

A rotating, bar-shaped net hauler attached to the ship's side for hauling nets onto the deck.

Trawl net fishing

(1) Warp winch

A winch that winds a warp or towrope that draws in a net.



(2) Otter board

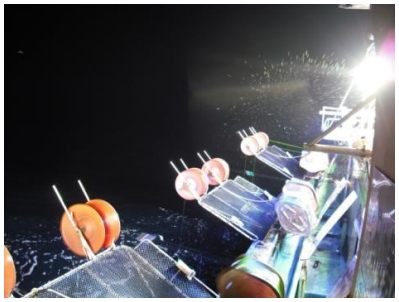
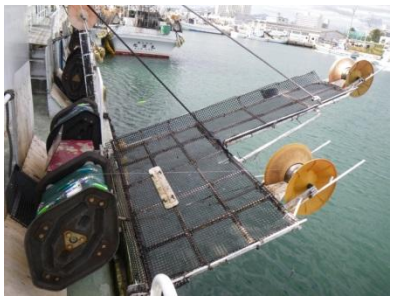
A net-spreading board that spreads the mouth of a net.


(3) Net storage area

Squid fishing

(1) Automatic squid fishing machine

A device that hangs a fishing line with multiple squid fishing implements attached in the sea and automatically moves up and down to catch squid.

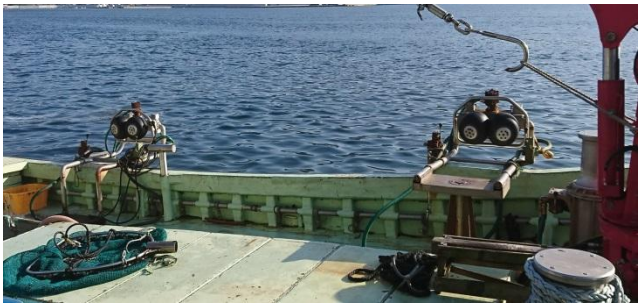

(2) Fish-luring light

A light that lures squid.

Fixed-net fishing

(1) Ball roller (catch roller)

A device that hoists netting by enclosing it within two rotating balls, used when wringing a box net for fixed netting.

(2) Rope-winding roller (standing roller)

A roller that winds a hoisting rope attached to netting which is used when wringing a box net for fixed net fishing.

Basket fishing

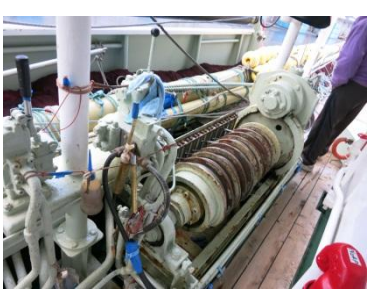
(1) Line hoister

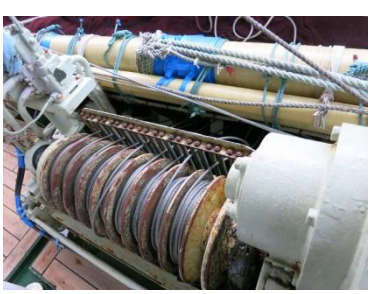
A device that winds a main line attached to a basket.

Stick-held net fishing

(1) Multi-level winding winch

A device that simultaneously winds multiple hoisting nets (wires) attached to the bottom side of nets.





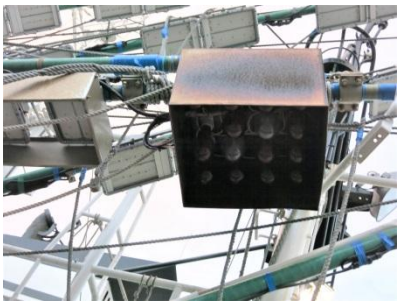
(2) *Mukaidake* (facing bamboo)

A pipe (bamboo pole) for suspending a net.



(3) Fish-luring light pole

A pole with a light attached to it used for luring fish.

16. Fishery Measuring Equipment

(1) Fishfinders

A fish finder is an electronic device that emits an ultrasonic wave in the water which strikes and reflects off objects and the device uses this data to display information such as the position and size of schools of fish, the ocean depth, and the state of the ocean floor in an image. The fishfinder image moves from the scale (tick marks for depth) side to the opposite direction on the screen, so the scale side displays the newest information.

In addition, objects with higher density produce a stronger response when struck by the ultrasonic waves. These strong responses are displayed in red or orange, while weak responses are displayed in blue or green. This makes it possible to judge the amount or size of fish based on the strength (color) of these responses. Within the image, schools of fish are displayed as cloud-like masses floating in the air and single fish are displayed with a boomerang-like shape.

Moreover, the layer-shaped response on the top of the image indicates the surface of the sea. The righthand side of the image has tick marks which indicate ocean depth and can be used to judge the depth of responses.

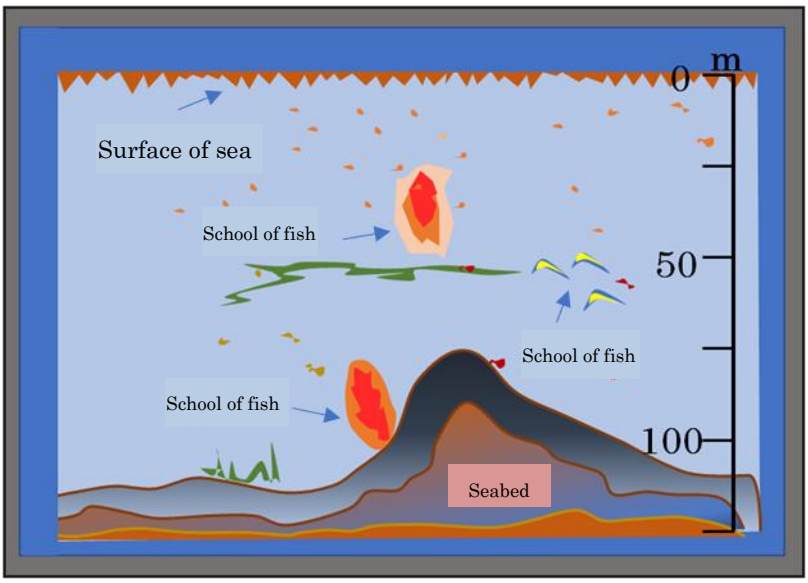


Figure 25: Fishfinder

(2) Chart plotter and fishing plotter

Traditionally, the ship location information was regularly recorded on a nautical chart and used for navigation and fishing (operations). Recently, as a result of advanced IT, a chart plotter shown in Figure 26 is in use. An electronic nautical chart is incorporated in the plotter, and by inputting GPS (position) information and radar information as electronic information about the ship, the ship's position can be displayed on the nautical chart image screen of the plotter. This makes it possible to understand the relationship with land and other ships (Figure 27). When a plotter is used for fishing, dangerous areas or fishing operations can be recorded by freely displaying and storing markers on the plotter image screen. Furthermore, by utilizing data from a fishfinder or sonar, the plotter is used in the fishing industry as a fishing information plotter. For example, as shown in the plotter diagram in Figure 28, how the ship has moved can be understood from its track. Movements of other ships can also be understood, for example, Ship A is at anchor, Ships B, C, and D are underway and Ship D is faster. By marking the locations of past operation and obstacle, the distance to the locations can also be measured (whether it is in the range of 2 nautical miles) using the range marker.

Figure 26: Chart plotter
(Photo provided by Furuno Electric Co. Ltd.)

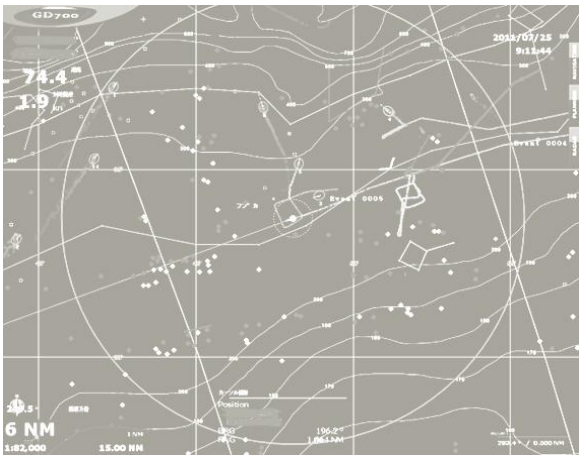
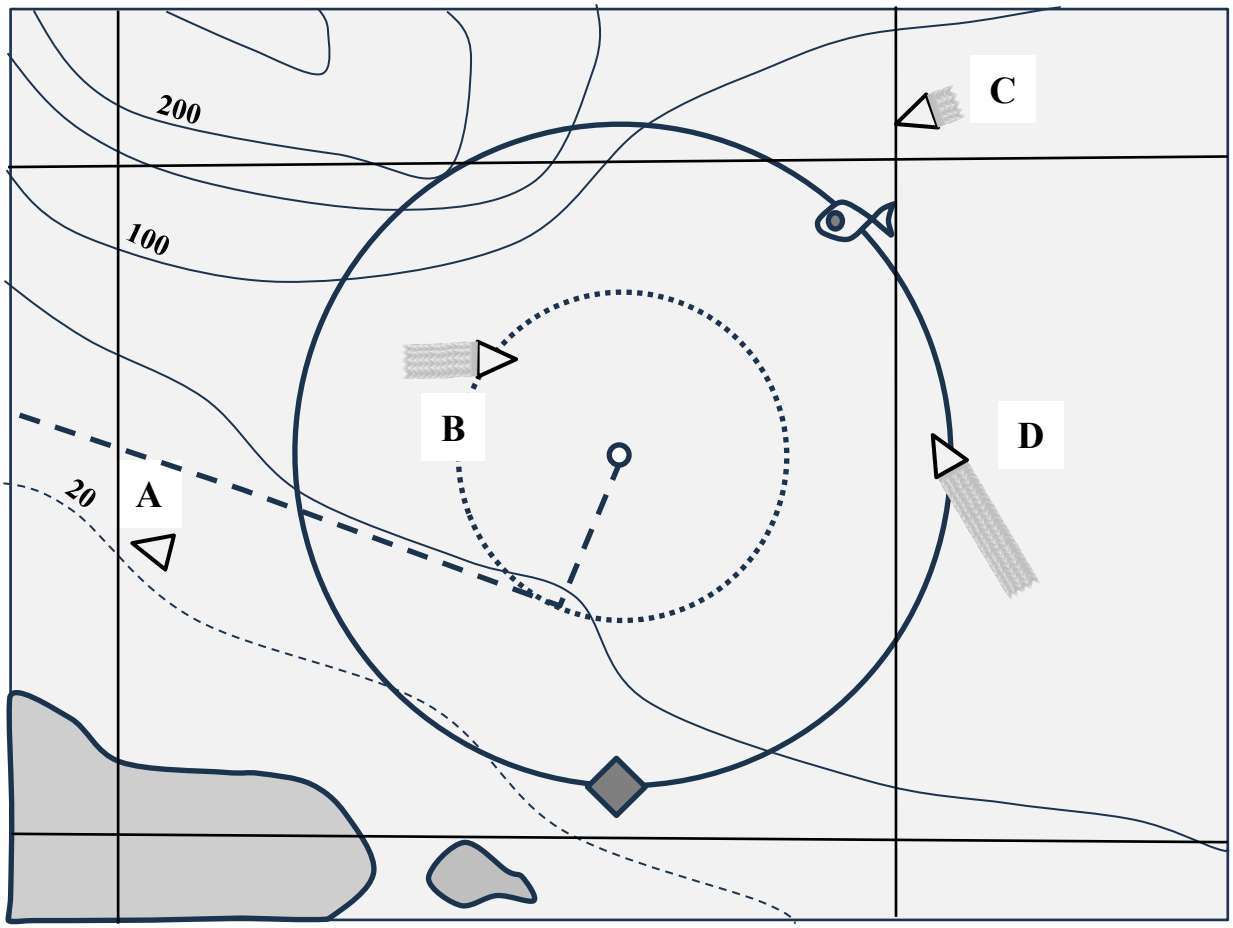


Figure 27: Potter image
(Photo provided by Furuno Electric Co. Ltd.)



Ship location: 42° ** 'N
144° ** 'E

Speed: 12 kn

Range marker: 2 nm

Marker

: Other ship

: Your ship track

: Moving ship (2-minute track)

: Location of operation

: Obstacle

Figure 28: Chart plotter image diagram