INTRODUCTION

Fish aggregating devices, or FADs, are floating rafts or buoys anchored in deep water which, for reasons not yet fully understood, cause tuna and other types of oceanic fish to gather around them. FADs were first introduced into Pacific Island countries and territories in the late 1970s, and are likely to be a continuing feature of fisheries development in the region.

The introduction and growing use of FADs have opened up new fishing opportunities for the region’s fishermen, but in many cases these have not yet been taken full advantage of. Fishermen are often unaware of the potential yields that can be generated by fishing around FADs, and may not know of suitable fishing techniques or have access to the right gear and equipment.

SPC Masterfishermen working on fisheries development projects in the region were some of the first to begin adapting fishing gear and principles to the special conditions of FADs in order to help small-scale fishermen benefit from this new resource. Combining the principles of traditional mid-water tuna handlining and industrial tuna longlining, they began to experiment with multi-hook mainlines set around FADs. These ‘vertical longlines’ were fished directly from the boat, tied off to the FAD, or allowed to drift free suspended from floats or buoys. This gear arrangement simultaneously got numerous baits into the water, focussed the fishing effort close to the FAD, and allowed fishing over a range of depths.

Gear used in the early SPC trials was bulky, with mainlines usually being rigged from the 6 or 7 mm tarred Kuralon rope used by large-scale longliners. The lines were stored in boxes on the fishing vessel, with setting and hauling being done by hand. Later trials made use of braided nylon, and then monofilament nylon, for the mainlines. These smaller diameter lines were less bulky and could be stored, set and hauled using different types of fishing reels. This made fishing quicker and easier and kept the lines neatly stowed without tangling. These smaller lines were also less affected by currents and so required smaller sinkers to keep them hanging straight up-and-down in the water.

With the successful development of this lighter, more compact gear, SPC Masterfishermen began working on techniques to concentrate more hooks in the fishing area. At first they tried setting multiple free-drifting lines, but found that it was often hard to keep track of the gear because individual lines frequently drifted far apart. This led to the practice of attaching the individual mainlines together using sections of floating rope short enough to keep the lines within a fishing area, but long enough to prevent them from tangling with each other.

This fishing method, which had by now become known as vertical longlining is still evolving, with SPC continuing its work on streamlining the gear and increasing the number of hooks that can be concentrated within a particular area. In addition, fishermen who have adopted the technique have also incorporated their own innovations and ideas in response to the conditions in their own particular areas.

This manual provides the basic information that a fisherman will need in order to try vertical longlining. In providing this information, the authors recognise that the technique will need to be varied in response to the wide range of different fishing vessels and conditions in the Pacific Islands region. We have therefore tried to avoid being too prescriptive and giving specific recommendations. Instead, where there are a range of options we have tried to present all of these so that the fisherman can make up his own mind as to which suits him best.

Vertical longlining is not restricted to FADs, and should be productive anywhere where more traditional forms of tuna fishing, such as mid-water handlining or trolling, are successfully used to catch tunas and other oceanic fish types. These other fishing methods are also described briefly in this manual, in order to provide fishermen with a full set of background information on ways of catching tuna around FADs and elsewhere.

As well as the present document, SPC has produced a number of other manuals, handbooks and training materials on fishing and FADs. Trolling Techniques for the Pacific Islands: A Manual for Fishermen provides complete information on trolling methods and gear, while the three volumes of the SPC FAD Handbook are aimed at helping Fisheries Departments to establish FAD programmes which will provide maximum benefits for the local fishing industry. Various SPC training and public information materials (including lecture notes, videos, overheads and posters) on fishing, FADs and safety at sea are available, as also are construction diagrams and specifications for the fishing reels described in this manual. Further publications are planned dealing with other aspects of fishing not so far covered by the above materials. For more information write to SPC at the address on the last page of this document.
CHAPTER 1

BASIC INFORMATION AND TECHNIQUES

A. WHAT ARE FADS?
B. FAD FISHING METHODS
C. SAFE NAVIGATION
D. AVOIDING ACCIDENTS AND INJURIES
E. HANDLING AND PREPARING ROPE
F. ROPE SPlicing
G. JOINING LINES USING KNOTS AND CRIMPS
H. KNOTS FOR ATTACHING HOOKS AND SWIVELS
I. BAIT
J. USING A SEA ANCHOR

INTRODUCTION

This chapter provides background information on FADs, the fish they aggregate, and a summary of some of the fishing methods used around them. It also gives information on the main safety considerations that relate to FADs—reliable navigation to and from the FAD, and prevention of accidents and mishaps while fishing. In addition, the chapter describes basic techniques that apply to many FAD fishing methods, not just vertical longlining. Knots and splices suitable for making up fishing lines are shown, and information on bait types and the best ways to bait the hook is given. The correct use of a sea anchor, which is both a useful aid in drift fishing and a valuable piece of safety equipment, is also described.
CHAPTER 1: Basic information and techniques

Oceanic fishes such as tunas are often found gathered around floating logs and other drifting objects, sometimes in very large numbers. Having observed this behaviour, fishermen learned that finding and fishing near floating objects often produced higher catches than when fishing in the open ocean. Some industrial fishing techniques rely on this tendency for tuna to gather near natural floating objects to improve their catch. Many tonnes of tuna have sometimes been taken around even small bodies of floating debris.

TRADITIONAL FADS

In the early 1900’s, fishermen in Indonesia and the Philippines began building floating rafts of bamboo and other materials to attract schools of fish. They moored these rafts to the sea floor with natural fibre ropes secured to baskets of stones that served as anchors. These man-made structures were the first fish aggregating devices, or FADs, to be used in the tropical Pacific Ocean.

The use of FADs by both small-scale fishermen and industrial fishing fleets is now very widespread. In the Philippines over 3,000 FADs are in use, and most yellowfin tuna production comes from them.

Much research and effort has been put into improving FAD technology over the last 15 years. Most of these efforts have concentrated on keeping FADs in place in the often harsh environment of the open ocean.

MODERN-DAY FADS

Nowadays, modern FADs may be anchored in waters over 2,000 m deep and be equipped with radar reflectors and solar-powered lights. FAD rafts that were once built from natural materials are now commonly made from steel, aluminium and fibreglass. Some modern FAD designs use rafts that will submerge without damage under the effect of strong currents or storm conditions. Carefully calculated combinations of synthetic ropes are now used to produce mooring lines designed to withstand the harsh conditions of the marine environment. The three-volume SPC FAD Manual provides information on the construction, deployment and maintenance of modern FADs.

Some of these FADs have life spans of up to five years in the ocean. However, the basic idea of fixing a floating structure in the sea, in a way that will gather fish, remains the same as 100 years ago.
CHAPTER 1: Basic information and techniques

WHY FADS ATTRACT FISH

Although fishermen have been using FADs for nearly a century and much is now known about the behaviour and biology of tunas and other pelagic fishes, the reasons why FADs attract fish still remain largely unexplained. Research into this question, mostly through observing fish behaviour in association with FADs, has suggested several possibilities, of which the most important are the ‘shelter and protection’ and the ‘orientation’ theories. The first theory suggests that both the FAD raft and the mooring line offer protection from predators to fish which remain close to or ‘hide’ behind them. The second argues that fish use the FAD as a physical reference point in an ocean generally devoid of such signals. In either case it is apparent that the fish are able to find their way to and from the FAD when they wish. Although fish may spend days or weeks associated with a FAD in this way, other urges eventually cause them to move on and subsequently be replaced by new arrivals.

SPECIES ATTRACTED

FADs aggregate different fish at various depths depending on the time of year. Small tunas are usually found schooling near the surface. Larger yellowfin, bigeye and albacore tunas generally gather near FADs at depths between 50 m and 300 m, although they can also be found closer to the surface at times, especially at night. Other fish species, including rainbow runner, mahimahi, sharks and billfish are also commonly attracted to FADs.

There is no evidence to suggest that FADs increase the overall number of tuna in a given area of ocean. Rather, they gather fish from a large area to a smaller one and so make them easier to find and catch. FADs allow fishermen to concentrate their fishing effort in an area where the fish are themselves concentrated. As a result, overall catches and catch rates around FADs tend to be higher than in open water fishing.

BENEFITS OF FADS

FADs are not always 100 per cent effective, and may be lost if the raft or mooring rope is damaged by bad weather, vandalism, or fish-bite. Those which do work, however, provide many advantages to the small-scale fisherman. He spends less time and fuel in searching for fish, and he can be more easily located, in the event of a breakdown. There may also be disadvantages to FADs, the most common one being that a lot of fishermen may go out to fish the FAD at the same time, causing competition and gear conflict.
There are numerous fishing methods that are particularly suited to use around FADs. Most of these can also be carried out in the open sea, but in most cases will be more productive around FADs.

**SECTION 1B: FAD FISHING METHODS**

**FISHING METHODS COVERED IN THIS MANUAL**

**Mid-water hand-lining**

Hand-lining for large, deep-swimming tunas and other mid-water fish is practised throughout the Pacific Islands in many forms, both traditional and modern. At its most simple, this type of fishing uses a weighted line with a baited hook which is fished at depths of 50–300 m in areas where tunas occur. A variation on the technique is to buoy the lines off and allow them to drift so that several can be set at once. A traditional form of mid-water handlining is ‘drop-stone’ fishing in which the hook is carried down to the desired depth by a stone which is then released, leaving the bait to drift naturally in the water. A more specialised variation is the Hawaiian ‘ika shibi’ night-fishing technique in which an underwater light is used to attract bait around the boat, which in turn attracts tuna. All these methods are suitable for use around FADs, and are described in detail in chapter 3.

**Vertical longlining**

Vertical longlining is based on the same principles as mid-water handlining but uses a weighted mainline rigged with a number of branch lines carrying baited hooks. This technique enables a small-boat fisherman to simultaneously fish a range of depths while also concentrating many hooks close to a FAD. The line can be fished from a boat, tied to a FAD, or set to drift, supported by surface floats, thus allowing several lines to be fished at once. Vertical longlining has been developed and improved by SPC over the past ten years, and is the main subject of the present manual. It is described in detail in chapter 2.

**Trolling**

Surface trolling with feathers, plastic lures or natural bait is a common and simple method for FAD fishing. The gear is inexpensive and can be fished from a small boat. Larger craft can also carry out sub-surface and deep-trolling around FADs, using diving boards, downriggers or cannonballs in order to target the larger fish normally found at greater depths. Trolling under a variety of different conditions is described in detail in SPC Handbook No. 28, ‘Trolling Techniques for the Pacific Islands: A Manual for Fishermen’. Section 3E of the present manual summarises those elements that relate specifically to trolling around FADs.
As well as aggregating tunas and other large pelagic fish, FADs also attract schools of smaller types, including bait fish. These can be caught using traps, jigs, nets or other fishing methods, and then used as bait for vertical longlining or mid-water handlining. Bait catching around FADs is described in section 3F.

**TUNA FISHING METHODS NOT COVERED IN THIS MANUAL**

**Pole-and-line fishing.**

Pole-and-line fishing is a surface fishing method used by both artisanal and industrial fishing vessels. Unbaited, barbless hooks tied on a fixed length of line attached to a fishing pole are jigged in an actively feeding surface school of yellowfin or skipjack tuna. In the industrial version of this method, as well as in certain small-scale pole-and-line fisheries, the fish are encouraged to bite by bringing them into a feeding frenzy using live bait cast into the water from the fishing boat. On industrial vessels, water sprays around the boat are used to imitate the movement of baitfish and to hide the fishermen from the tuna.

**Ring-netting and purse-seining.**

Ring-netting is a FAD fishing method commonly used in the Philippines. Schools of bait-fish or smaller pelagic species aggregated around a FAD are drawn to the fishing-boat by the use of lights. A ring-net is set around the school and is closed in around the fish. A lampara net uses the same principle, but is hung specially to form a floor which will stop the fish escaping downwards when the net is hauled. The same technique is carried out on a larger scale by purse-seiners, whose nets are fitted with a purse-line to close the net under the fish, and which may take many tons of tuna in a single set.

**Horizontal longlining.**

Horizontal longlining has been practised in the Pacific by Asian fishing fleets for over 100 years, and more recently has been adopted by the region’s local fishing vessels, which have been able to take advantage of gear improvements and better technology to carry out longlining with smaller boats and fewer crew. The principles of small- to medium-scale horizontal longlining will be covered in detail in a forthcoming SPC manual.

**Others.**

Many other commercial and sport-fishing methods can also be productively used around FADs, including jigging, spin-casting and even spear-fishing.
FADs are normally thought of as improving the safety of fishing operations. If for some reason a fishing boat operating around a FAD suffers a breakdown, it is more likely to be found because the searchers will know where to start looking for it. On the other hand, fishing around FADs may present fishermen with challenges and dangers that they are not familiar with, especially if they are used to operating only in areas close to shore or to other boats. FADs are usually several miles off the coast, so fishermen working around FADs in small boats must make sure they are properly prepared and equipped for offshore operation.

**Compass**

The most essential piece of equipment for FAD-fishing is a compass. Normally a hand-bearing compass, designed to allow bearings to be taken from prominent objects, is the most useful for a small vessel. The fisherman must know how to use the compass properly—that is, he must be able to take a bearing, follow a course, and work out the reciprocal (opposite direction) of a heading. Ideally he should also be able to plot bearings on a chart and perform elementary coastal navigation. Correct use of a compass will help the fisherman to find his way to the FAD and, more importantly, to find his way home again afterwards. **No fisherman should ever go FAD-fishing unless he has a compass on board and knows how to use it.**

**Using bearings**

Normally the organisation which set the FAD—usually the local Fisheries Department or a fishing company—will publicise the FAD’s position, either so that fishermen can find it, or so that local shipping can avoid running into it. If the position is known, then a fisherman equipped with a compass and marine chart can calculate the bearing and distance of the FAD from his fishing base, and use this information to navigate to and from it. Alternatively the agency responsible for setting the FAD may also publicise compass bearings and distances relative to prominent local features such as reef passages, marker buoys, or objects on the shore. Again, the fisherman can use his compass to follow the bearings and locate the FAD.
A transit bearing is an imaginary line created when two prominent landmarks or other features are in alignment. Examples might include lining up two mountain peaks, one in front of the other, or a navigation beacon on the reef with a church steeple on the shore. The best transit bearings are taken on objects which are clearly visible and far apart; objects that are close together will not give an accurate transit bearing.

It may not be possible to use transit bearings when far offshore from low islands or atolls, because the land is not high enough to allow landmarks to be seen. In this case the fisherman will be much more reliant on the use of his compass. However, when FADs are deployed around high islands it is usually possible to find a couple of transit bearings which intersect at the location of the FAD. These can be identified during the first fishing trip and, once noted, make it a lot easier to find the FAD or to come back to it after moving away (for instance when chasing tuna schools).

Using transit bearings

A low-cost hand-held GPS unit

Global positioning system (GPS) receivers

GPS receivers are electronic positioning devices which assist navigation by reference to satellites, and which allow FADs (or any other marine feature) to be located quickly and easily. The position of the FAD is entered into the unit which then guides the fisherman to the correct spot by providing information on course to be followed and distance to be covered. In the past GPS units have been expensive and limited in their availability in the Pacific Islands, but have been gradually getting cheaper and more widespread. In recent times the first hand-held GPS units costing less than US$ 100—cheaper than the cost of a good hand-bearing compass—became available. As GPS units continue to fall in price and become more widely available they will be increasingly used by FAD fishermen.

Despite its usefulness, a GPS unit is a supplement for a compass, not a substitute. All electronic devices can develop flat batteries, break down or malfunction, especially if dropped in sea water. A compass should always be carried even if a GPS is used.
CHAPTER 1: Basic information and techniques

SECTION 1D: AVOIDING ACCIDENTS AND INJURIES

PLANNING

Many accidents at sea are caused by carelessness or lack of preparation. Vessels go adrift for simple and easily avoidable reasons, such as running out of fuel, or minor engine breakdowns. In many cases these incidents could easily have been avoided, but instead they cause great suffering, enormous search and rescue costs, and even loss of life. All boat owners have a responsibility to themselves and their crew to ensure that they have done their best to avoid accidents, and are in a position to cope with them if they do happen. Because they are usually far offshore, FADs can be traps for careless or ill-prepared fishermen.

Before heading to the FAD...

Tell someone who cares where you are going and when you plan to return

Check the weather forecast

Make sure your engine is working well

Make sure all safety equipment is on board

Safety equipment

The type of safety equipment and supplies carried will depend on the type of vessel, the duration and distance of the fishing trip, and local regulations. Even small boats should have a minimum of equipment and supplies, including:

- a compass;
- tools and spare parts for engine repair;
- an anchor and anchor rope;
- a bailer which will float if dropped over the side;
- food, and plenty of drinking water or coconuts;
- spare fuel;
- knives.

Other equipment should include some or all of the following:

- alternative means of propulsion: oars, emergency sail rig, or spare outboard motor;
- a sea anchor (parachute);
- flotation devices: life-jackets, life-raft, longline floats, plastic containers
- signalling devices: a heliograph (signalling mirror), waterproof torch, flares, air horn, VHF radio, EPIRB (emergency position-indicating radio beacon).

For a fisherman whose boat sinks, clinging to a fishing float or a 20-litre plastic container may mean the difference between life and death.

Pre-departure check-list

Before setting off to sea, every fisherman should do the following:

- check the weather forecast. If in doubt be prepared to cancel the trip or cut it short;
- tell someone who cares (family or friends) where he is going and when he plans to return, so that the alarm can quickly be given if he does not come back on time;
- check that the engine is in good condition and running well;
- check that all safety equipment and supplies are on board.

Safety and life-saving equipment

Compass Water Food Spare fuel Knife

Engine tools and spares Bailers

Anchor and rope First aid kit Flotation aids

Signalling devices Alternative propulsion

Shade Sea anchor (parachute)
Fishing boats are places where sharp hooks, gaffs and knives are being used to catch and subdue lively and often powerful fish. This is particularly true when fishing around FADs, where the fish caught are likely to be large and energetic. Minor injuries such as cuts and bruises are almost a certainty, and there is great potential for more serious accidents. The sensible fisherman will take all reasonable precautions to reduce the chances of accidents to a minimum and be ready to cope with them if they do occur.

**Avoid accidents**

The boat’s skipper should ensure that all his crew adopt safe working practices and avoid injury to themselves and other crewmen. In particular, gloves should always be worn to protect the hands from lines, hooks, fish spines and teeth, and knives. When not in use, fishing gear and knives should be stowed safely where they will not slide around or be stepped on.

A couple of gaffs and a fish club or bat are essential equipment when fishing around a FAD. A large fish should be gaffed through the head and then stunned with a fish club as soon as it has been brought on board. This not only stops the fish from causing injuries, but also prevents damage to the fish flesh which could reduce its value.

When trolling or vertical longlining using a wooden handreel (see section 2F), a common cause of injury is from the reel’s spinning handle. The reel should be fitted with a simple braking system, such as a loop of inner-tube rubber to prevent it from spinning free, as described in section 2F. Always keep well out of the way of the reel handle when a large fish is making its initial run.

**First-aid kit**

In many countries, the law requires boat owners to carry a basic first-aid kit. Even where this is not mandatory, fishing boats should have some first-aid supplies on board. These should include aspirin or panadol (for pain), sticking plasters, a couple of small bandages and some antiseptic liquid and ointment.
MEASURING OUT

Many of the fishing techniques described in this manual require ropes and lines to be measured out so that, when finished, the gear will be fishing at a known or pre-determined depth. The easiest way to measure out the length of a piece of rope or line is for the person doing the job to first measure his arm-span, then count out the correct number of spans that will give the required length of rope. A typical adult male arm-span is 1.5–1.8 m.

SEALING ROPE ENDS

The ends of most types of rope will quickly begin to fray or unravel once they are cut, making handling difficult, so it is necessary to seal them. There are various ways of doing this, depending on the material from which the rope is made.

Melting

The ends of many synthetic ropes can be quickly melted into a solid plug by using a match or cigarette lighter to heat them for a few moments. Some ropes will begin to burn during the process, and give off noxious fumes, so this job should be done outside, or in a well-ventilated place. Once the rope is hot and visibly melting, a damp cloth is used to twist the rope ends together and extinguish any burning parts. The result is a fused rope-end which will not fray.

Whipping

Another method, suitable for natural fibre ropes which do not melt, is to whip the rope ends. This is done using light twine or dental floss as shown in the diagram below.

END SPLICING

Another way to seal rope ends is to make an end splice. There are several types of end splice, a couple of which are shown on the next page.

To make a splice, the strands at the end of a piece of rope are unlaid and then passed back between the strands in the body, or standing part, of the rope. With soft ropes the strands of the standing part can be separated by hand, but for a hard or stiff rope a tool may be needed to do this. A fid is a tool specially made for separating rope strands while splicing, but a screwdriver can also be used.
Before starting a splice it is usually necessary to seal the ends of the individual rope strands so that they do not fray during the splicing process. This can be done using tape or rubber bands, which will normally stay in place long enough to allow completion of the splice, or by melting or whipping as already shown.

**Crown knot**

The method for making a crown knot is as follows:

- unlay the end of the rope for 15–20 centimetres;
- form a loop in the lower strand;
- pass the middle strand over the lower strand and down through the loop;
- repeat the procedure, passing the upper strand over the middle strand and down through its loop;
- pass the lower strand over the upper strand and down through its loop;
- pull tight.

In practice a crown knot is rarely used on its own except as a temporary means of preventing a rope from fraying while tying other knots and splices. The most common use of a crown knot is in preparation for a back splice, as shown below.

**Back splice**

Commence with a crown knot, then:

- using a spike, loosen the first strand below the crown knot;
- taking the adjacent left-hand strand, pass it under the loosened strand against the lay;
- turn the rope to the right and repeat the process with each of the other strands. Pull each strand end tight until they fit snugly into the laid strands of the standing part of the rope;
- continue the splice, passing each strand end over and under a strand in the laid part of the rope. Pull each strand end tight as the work progresses;
- when sufficient splicing has been done, taper the splice by taking more tucks with only two of the strand ends, and then only one;
- trim off the strand ends and roll the splice between your hands to smooth it into shape.
SECTION 1F: ROPE SPICING

SPICING TYPES

When three-strand ropes are to be joined permanently, this should be done using splices rather than knots. Although splices take more time and skill to make, they are stronger than knots and will reduce the chance of the line snagging or causing tangles.

The main types of splice used in making up FAD fishing gear are:
- the **eye splice**, used to make a loop which can serve as an attachment point for another piece of line;
- the **fisherman's** or **double splice**, which is used to quickly join two ropes, leaving a loop between them;
- the **short splice**, which is used to join two lengths of rope end-to-end.

**Eye Splice**

Eye splices are a good way to end a rope as they provide an attachment point which is useful in vertical longlining and in many other fishing methods.

To make an eye splice, if necessary first tape or seal the end of each strand of the rope. (This is not needed when using tarred kuralon, the type of rope most commonly used in vertical longlining). It may be helpful to number the ends, or to mark them with different colours. Unlay the ends until you have enough length to work with—about 20–25 cm is enough for 10–12 mm diameter rope. With some ropes, it may be necessary to tie or tape the strands together to prevent them unlaying too far.

Double the rope back so that the finished eye will be the size that you want. Form the eye and spread the strands fanwise, placing them against the rope where it is to be entered. Untwist the body of the rope a little and pass the centre end under the centre strand. Then, pass the left end under the next rope strand to the left and the right end under the next strand to the right. If the rope is hard-laid, you may need a spike or fid to separate the strands widely enough.

If this has been done correctly all three ends should be sticking out at the same level, evenly spaced around the main body of the rope. If they are not like this, pull them out and start again.

Continuing the splice is easier than starting it. Pull the first tucks tight, then take any end and pass it over the next strand and under the one after. Repeat for the other two ends, so that each shows two tucks in the main body of the rope. The ends should still be even and regular.

Repeat this procedure until each strand has 3 or 4 tucks, then cut off the ends close to the body of the rope. To make a tapered splice, make additional tucks with two of the ends so that all three finish at different places, then cut off. With slippery ropes, or those which fray badly, it is worth whipping the splice to ensure that the ends never slip back through the strands.
CHAPTER 1: Basic information and techniques

**Fisherman’s or double splice**

Unlay the two rope ends and position them as shown.

Pass the strand ends from one rope through the body of the other, exactly as for an eye splice.

Complete the tucks and taper as for the eye splice.

Repeat with the other set of rope strands.

**Fisherman’s splice**

The procedure for making this splice is similar to making two eye splices. However instead of splicing the end of a rope back into itself, two ropes are used, with the end of each one being spliced into the standing part of the other.

**Short splice**

To make a short splice:

- unlay the ends of the two ropes to be spliced, and if necessary tape or seal them;
- ‘marry’ the two ends so that the strands are inter-leaved with each other;
- tightly whip or otherwise secure one set of ends around the standing part of the other rope;
- take any one of the unsecured strands and, using a spike, tuck it under a strand of the other rope, against the lay;
- repeat the procedure with all three unsecured strands;
- continue the splice with over and under tucks, then taper it as described for the eye splice;
- remove the whipping and repeat the procedure with the other set of strands;
- when finished, cut off the loose ends of the strands and roll the splice between your hands to finish it.

Once enough tucks have been made, undo the whipping and repeat the process with the other set of strands.

When finished, cut off the tag ends and roll the splice in your hands to smooth it out.
CHAPTER 1: Basic information and techniques

SECTION 1G: JOINING LINES USING KNOTS AND CRIMPS

The following diagrams illustrate some of the knots that will be useful to a fisherman carrying out vertical longlining and other FAD fishing methods.

JOINING ROPEs

Bowline knot

The bowline is good for making a temporary attachment loop in ropes. It is strong, will not slip, and is fairly easy to undo. However it is not good for slippery lines and will not hold in nylon monofilament.

Sheet bend

This is a quick and simple knot, easy to undo, for attaching one rope to a loop (an eye splice or bowline) in another.

JOINING LINES

Crimps

If they are available, crimps (also called sleeves or swages) can be a good way to join monofilament lines together, or to attach hooks and swivels to monofilament and other fishing lines. Crimps are tubular lengths of brass, aluminium, or other suitable metal which are slid over the line and then pressed onto it using a special crimping tool. The crimp may be circular, oval or figure-8 shaped in cross-section, and when squeezed shut, grips hard on the line to prevent it from slipping.
Using crimps can be a lot faster than tying knots, but there are some disadvantages. Apart from the fact that they add extra cost to the gear, crimps may lead to extra wear and tear on the line. High-quality crimps are bevelled on the inner edge, but cheaper ones have a sharp corner which can bite into the line and weaken it through gradual cutting. Aluminium crimps will oxidise, and the rough oxidised edges can again cause wear close to the crimp. The best crimps, which are made of brass and have bevelled inner edges, are also the most expensive.

Both the crimping tool and the crimps can be costly or hard to obtain in many Pacific Island countries. Some fishermen have been tempted to cut costs by using pliers or a vice instead of buying the proper tool, but this is a false economy. The crimping tool is shaped to fit the crimps and will make a proper joint. Other tools will squash it out of shape and crush the line inside the crimp, weakening it and making it more likely to break under stress. Crimps should never be used unless the proper crimping tool is available.

**Knots**

Fishing is often carried out using monofilament or other light lines which cannot be spliced and which may slip unless special knots are used. All knots will weaken a line, sometimes reducing its breaking strain by more than half. The two knots shown below are recommended as being the strongest methods for joining monofilament and other fishing lines, and least likely to slip.
CHAPTER 1: Basic information and techniques

SECTION 1H: KNOTS FOR ATTACHING HOOKS AND SIVELVES

All forms of fishing around FADs require that hooks, swivels and other items of fishing tackle be attached at various places on the fishing line. In many cases the line is made of nylon monofilament which is slippery and does not grip well when tied. Many knots will come undone under tension, even if they appear secure when tied. Some knots which will hold, and which can be used for attaching tackle to monofilament lines, are shown below.

**Palomar knot**

The palomar knot is popular among Hawaiian fishermen, who claim it is easier to tie and less likely to slip than other knots. To tie the palomar knot, double the end of the line over in a loop. Pass the loop through the eye of the hook or swivel and tie it loosely in an ordinary overhand knot. Pass the eye of the loop over the body of the hook or swivel. Pull gently on the standing part of the line and the tag end together to close the knot. Tighten it up by pulling hard on the mainline, then cut off the tag end close to the knot.

**Clinch knot**

This is a good knot for light monofilament. To make it, pass the end of the line through the eye of the hook or swivel and double it back. Rotate the hook or swivel four or five times, twisting the tag end around the standing part. Lubricate the lines with saliva to make it slip more easily. Pass the tag end back through the loop at the end of the twist and pull gently so that the knot starts to close up. Pass the tag end back under itself. Hold the hook or swivel with pliers and pull hard on the mainline so that the knot pulls tight. Pull the tag end tight and cut off close to the knot, then flatten it with pliers or your teeth so that it cannot slip or be pushed back through.

**Trilene knot**

The trilene knot is recommended by a manufacturer of nylon monofilament. It resembles the clinch knot in some ways, but to start it the line is passed through the eye of the hook twice instead of just once. The hook is then twisted around 4 or 5 times as with the clinch knot, and the tag end passed through the double loop of line where the hook is attached prior to pulling tight.
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Slip knot

As well as being good for heavy monofilament, this knot can also be used for braided lines like super-toto, dacron, etc., whose rough surface prevents slipping and makes the clinch knot (above) hard to pull tight.

To make the slip knot:

- thread the line through the eye of the hook or swivel, leaving about 30 cm of line to work with;
- run the line down the inside of your forefinger, around your fingertip, and up the back of the finger, leaving the hook eye pulled against the fingertip;
- take four or five loose turns with the tag end around the finger, working back towards the fingertip;
- pass the tag end back along the finger inside the loose turns;
- remove the finger, holding the turns in place with the other hand, and pull gently on the tag end.

This will tighten the knot around the main line, leaving a long loop which can be pulled tight by holding the hook with pliers and pulling hard on the mainline.

Types of line protector

- Clear plastic tube
- Coiled plastic ‘spring’
- Nylon thimbles
- Nylon eyes

LINE PROTECTORS

When a hook or swivel is attached to the line using a crimp (see section 1G), the result is that the hook or swivel is free to swing on the loop that has been created, and this can cause wear on the line. To prevent excessive chafing, there are various types of line protector which can be slipped over the line before the hook or swivels is fitted. These include plastic tubes, coils of plastic or metal wound into tiny ‘springs’, and miniature thimbles. Some fishermen believe these items prevent gear loss, while others think they are a waste of money and a nuisance to use.

Flemish eye

An alternative system, which provides line protection at no extra cost, is to make a Flemish eye in the line when fitting the hook or swivel. This is simply a double overhand knot which is tied loosely in the line through the hook or swivel eye. Making a Flemish eye will prevent the hook or swivel chafing through the line over time.
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SECTION 1F: BAIT

One of the most important factors in vertical longlining, and in most other mid-water fishing techniques, is good bait. The type and quality of the bait affects not only the amount of fish caught, but also the economics of the fishing operation. Vertical longlining uses a lot of bait—10 to 20 pieces for every set, depending on the number of hooks—so it is important to use the most effective and affordable bait if the fishing operation is to make a profit.

TYPES OF BAIT

Some of the more common bait types used for vertical longlining and other types of mid-water line fishing are as follows:

- **mackerel scad**, an oceanic fish which is seasonally abundant in many Pacific Island countries. Large schools may form around FADs or in other areas outside the reef, and can often be caught by jigging with small feathered hooks, netting, or trapping (see section 3F for more information about catching bait). Catching the fish around the FAD immediately before fishing may allow them to be used as live bait;

- **big-eye scad**, a semi-coastal species found in many reef and lagoon areas. Again it can be captured by jigging or netting. Where there are industrial pole-and-line fisheries this species often figures in the catch from night-time bait-fishing using dip-nets. Since it is generally too big for tuna pole-and-line bait, it may be available to FAD fishermen;

- other locally-available **small pelagic species** including flying fish, Indian mackerel, garfish, hardyheads, sardines and pilchards, which can often be caught, or purchased on the local market. In some countries juvenile milkfish are available from fish farms. These have been tested as bait by industrial longliners with generally good results, especially when used live.

- **small tunas** such as skipjack, mackerel and frigate tunas. These are often captured during trolling operations around FADs. Although small individuals can be used whole, they are mostly too large for this purpose and have to be used as cut bait;

- **squid**. Various types are available, usually frozen and imported, although at least one species (the big-fin reef squid) occurs in Pacific Island lagoons and can be caught using special multi-hook squid jigs (see section 3G);

- **commercial longline bait**, which may be available in countries where there are industrial longline fisheries. Bait is generally sold frozen in large (10 or 25 kg) boxes and may include saury, pilchards, sardines, mackerels and squid.

There does not seem to have been much use of prawns, worms or other invertebrate baits for longlining, even though these are favoured for other types of fishing.
There are various ways of cutting and rigging cut baits. A good method is to take a 2 cm thick fillet of the bait fish with the skin still on, and cut this into triangular or rectangular pieces 8–10 cm long and 2–3 cm wide. One piece is enough for each hook, and is rigged by rotating the hook through the skin side first and then back out again. Care should be taken to ensure the bait is not too thick or rigged in such a way that it ‘chokes’ the hook, i.e. hides the point and reduces the chances of a hook-up.

Depending on its size and condition, bait may be used whole or cut into pieces. In most cases whole baits are better than cut baits, and live bait generally results in the best catches, although catching bait and keeping it alive may be difficult. Some fishing tackle stores sell small battery-operated air pumps which are specifically made for keeping bait alive in a bucket or ice chest filled with sea water. By aerating the water and changing it regularly, it may be possible to keep the bait alive for several hours or a day.

Bait rigging

The best method to rig fresh mackerel scad or bigeye scad is shown in the diagram opposite. To rig a bait in this manner hold the body of the bait in one hand, and take the hook in the other. Run the hook vertically downwards into the back of the bait just behind the first rays of the front dorsal fin. Then rotate the hook until the point exits the bait’s body just behind the head. A similar method is used to rig live baits, but with the hook being placed a little further back along the body to avoid killing the bait.

Small baits or those which have been frozen may not hold on the hook when rigged in this way. In this case they can be rigged by hooking through the eyes or head. Whole squid should be rigged by passing the hook through the mantle, not through the head.

There are various ways of cutting and rigging cut baits. A good method is to take a 2 cm thick fillet of the bait fish with the skin still on, and cut this into triangular or rectangular pieces 8–10 cm long and 2–3 cm wide. One piece is enough for each hook, and is rigged by rotating the hook through the skin side first and then back out again. Care should be taken to ensure the bait is not too thick or rigged in such a way that it ‘chokes’ the hook, i.e. hides the point and reduces the chances of a hook-up.
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SECTION 1J: USING A SEA ANCHOR

A sea anchor, or parachute anchor, is a useful aid to vertical longlining and other FAD-fishing methods. The sea anchor will prevent the fishing boat drifting as a result of wind and instead cause the boat to move in the same direction as the current. This is extremely useful when vertical longlines are being allowed to drift (see section 2I), since the sea anchor will cause the vessel to stay relatively close to the gear. This results in less time and fuel wasted in following the gear using the motor, and less chance of losing the lines when they drift out of sight. **Sea anchors also provide a valuable safety function.** If the engine breaks down, the sea anchor will prevent the boat from drifting too far away from its original position, which is a major aid in search and rescue operations. If the boat is caught in a storm, deploying the sea anchor causes the boat to ride with its bow facing the wind, reducing the likelihood of waves broaching the vessel and swamping it, possibly causing it to sink.

**TYPES OF SEA ANCHOR**

Sea anchors can be of various kinds. Purpose-built models are available commercially, and these consist of a cone made from strong synthetic cloth, and fitted with shrouds made from webbing similar to that used in car seat belts. In locations where there are military surplus stores, second-hand cargo parachutes can be purchased. Alternatively, an enterprising fisherman can improvise a sea anchor from a sheet of heavy canvas or tarpaulin and some rope.

**RIGGING THE SEA ANCHOR**

The sea anchor is rigged with several lines, as shown below: the **anchor line**, which takes the weight of the boat once the sea anchor is deployed; the **trip-line**, which is used to haul the sea anchor back on board the vessel; and the **haul-in line** which is used to recover the trip-line. Without a trip-line it is practically impossible to haul the anchor in due to the enormous water resistance the open parachute creates.
The anchor line is a length of strong rope, 20–30 m long, of the same diameter that would be used by the vessel if it were using a normal ground anchor. One end is connected to the shrouds of the sea anchor, the other to the boat.

If possible, a large swivel should be used between the anchor line and the shrouds. The best type to use is a dome swivel, which is specially made for this purpose. The swivel does two jobs: it stops the sea anchor from becoming twisted during use, and it provides a weight to prevent the parachute from being pulled to the surface and collapsing.

The trip-line can be made of lighter rope than the anchor line since it is not intended to take the weight of the boat. The line should be rigged with a small float to keep it at the surface where it will not interfere with the sea anchor. It should also have a sinker at the end which is attached to the parachute’s vent strap, to make sure the parachute stays well below the water surface. If possible a 3-way swivel should be built into the line between the connections to the float, sinker and vent strap in order to minimise tangling. If a 3-way swivel is not available, the float can be connected directly to the vent strap using a length of light chain.

**Setting and Hauling**

The procedure for deploying a sea anchor is as follows:

- check the shrouds are free to run and not tangled;
- connect the anchor line, swivel and shrouds together;
- attach the trip-line to the vent strap, then to the float and sinker ropes;
- attach the float to the trip-line, and then the haul-in line to the float;
- lower the trip-line, float and sinker into the water from the bow of the boat, while the helmsman uses the engine to hold the boat facing into the wind;
- lower the sea anchor into the water, vent section first, then the rest of the parachute, then the shrouds;
- while holding onto the base of the shrouds, have the helmsman reverse the vessel gently away from the parachute to assist in opening it up;
- when the sea anchor has begun to open, carefully lower the dome swivel into the water making sure it does not fall among the shrouds and tangle with them;
- as the sea anchor opens up and the vessel falls away from it, pay out the desired amount of anchor rope and haul-in line, until the vessel is well clear of the sea anchor;
- make sure the weight is being taken by the anchor line and not the haul-in line, then tie them both off.

The following steps are carried out when hauling the sea anchor:

- while using slight forward throttle, recover the haul-in line to reach the trip-line, and pull in the float;
- recover the trip-line and haul it in. This will cause the parachute to invert itself and begin to close up;
- pull in the parachute, release vent first, allowing the water to spill out;
- once the body of the parachute is on board, pull in the shrouds, taking care that they do not get entangled;
- disconnect the sinker, swivel and float in the reverse order to that in which they were deployed;
- haul in the anchor line;
- store inside a canvas bag for future use.

When hauling the sea anchor, make sure the wind does not get hold of it, especially if a real parachute (as opposed to a commercial or home-made sea anchor) is being used. The force of a fully inflated cargo parachute in a strong wind can be very powerful and can cause an accident.
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