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Vezo Fishing: An Introduction to the Methods Used by Fishers in Andavadoaka Southwest Madagascar

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Front page: Spectral bathymetry of the Velondriake network, southwest Madagascar, derived from DigitalGlobe QuickBird imagery. Shallow marine areas are red and yellow, and deeper marine areas are black and green.

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Background

It has been widely recognised that marine resources cannot be managed solely from a biophysical stance, that there needs to be incorporation of anthropogenic factors, including an understanding of traditional resource use and how methods and demands have grown and evolved. There is a close link between how people use coral reefs and their socioeconomic background (Bunce *et al.* 2000). Recognising this link and the importance of understanding the people who use and depend on coral reefs, the ways in which the resources are exploited and the driving forces associated with reef use is of the highest importance.

Overfishing is a primary threat to coral reef ecosystems around the world, having both direct and indirect effects on marine community structure and reducing a reefs ability to recover from destructive natural phenomenon, such as bleaching events and cyclones (Roberts 1995).

Conservation organisations that focus on fisheries management often make promises of social and economic advancement as a result of conservation efforts, however this is rarely born to fruition as there is little direct compensation or alternative livelihoods offered to fishing communities. Conservation organisations need to understand the methods and techniques that local communities employ and the environmental impacts that they have before introducing new techniques and management plans.

Madagascar

Madagascar is one of the largest islands in the Southwest Indian Ocean and has a distinct history and culture as well as one of the richest assemblages of marine resources including coral reefs and mangroves. Madagascar coral reefs are probably the richest and most diverse of these ecosystems with an estimated 6000 reef-associated species, including 752 fish species and 340 coral species (McKenna and Allen 2003).

This diverse assemblage of marine species is at risk not only from being exploited by both industrial and artisanal fisheries but is also threatened by global warming and excessive sedimentation (Nadon 2005).

In recent years Madagascar's smaller artisanal and traditional fisheries have been subject to rapid development increasing their production in response to demand form overseas and through the introduction of improved materials and techniques (Iida 2005). Studies have shown that levels of exploitation of marine resources in the south west are similar to those observed in countries, such as Mauritius that are believed to be over-fished(Laroche and Ramananarivo 1995).

Andavadoaka

Andavadoaka is a small, remote village, in the Tulear province of south west Madagascar. Its rich marine ecosystem is critical to the livelihood and culture of the local Vezo community, whose principal source of income is the pirogue-based traditional fishery (lakana) (Langley 2006).

The pressure exerted on the local reefs as a primary producer of food and money shows little sign of reducing as local populations appear to be growing as much through migration from inland villages as from natural increase (Epps 2008).

Blue Ventures, an international NGO, was established in Andavadoaka in 2003 with the intention of improving the quality of life of the local community who depend on these marine resources, while maintaining the biological diversity, sustainability and productivity of the coral reefs.

Introduction

Although there have been a number of studies that have looked at the traditional fisheries of south west Madagascar, (Astuti 1995; Xirou 2004; Iida 2005) none have provided a detailed description of the fishing techniques that are used by the Vezo people.

The gear and fishing methods used within Velondriake show great variety, like any fishery which targets a range of different species. The majority of fisheries techniques used within Velondriake are traditional including harpoons, hand lines and nets, with the evolution of these and introduction of more commercial methods being introduced throughout the years (Iida 2005). For this report Informal interviews were conducted with local '*nahoda*' (elders) and fishermen during 2008 to gain knowledge of the different methods used within this region.

In order to understand anthropogenic impacts on the marine environment it is important to understand the methods and techniques that the local fishing communities employ. This report aims to provide information, on local fisheries techniques, that can then be drawn on to develop effective management regimes and alternative fishing practises.

Laka (Pirogue)

Vezo is derived from the word '*ivezo*' meaning 'to paddle' and it is often quoted that the Vezo are people that by their nature 'struggle with the sea' (Astuti 1995). The Vezo use canoes known as '*laka*' (pirogues) for transporting goods and people, and as a floating platform for fishing on the barrier reef and the seaward slope, as well as for fishing in the calmer waters between the reef and the shore. Pirogue hulls are made from a single tree '*farafatse*' (*Givotia madagascariensis*) and then hollowed out. Once a hull has been roughly shaped to remove extra weight before transport, it is then sold to the fisherman who will then modify the canoe by adding seats and rails. In order to waterproof the boat the base is painted with tar and the top half using commercial oil-based paint (Figure 1). The canoe is then fitted with an outrigger and mast and is then ready to sail (Astuti 1995). Outboard motors are not currently in common use within the Velondriake region.

Figure 1 The final stages of pirogue construction

Mihake (gleaning)

Mihake is the term applied to walking the reef at spring low tide in order to collect marine organisms. This includes gleaning for octopus (*horita*), using a harpoon/spear to catch the octopus that hide within holes or 'dens' in the floor of the reef flat (see *mila horita*), as well as collection of sea cucumber (see *mila zanga*), and shells (see *mila bozike*).

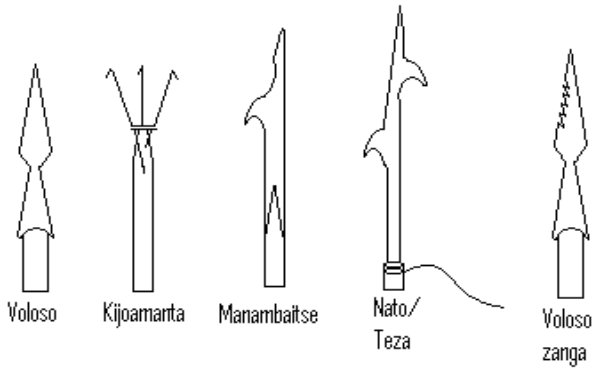

Figure 2 *Voloso, Kijoamanta, Manambaitse, Nato/Teza, and Voloso Zanga* - Spear heads (Left to right)

There are a number of different harpoon types (Figure 2 ***Voloso, Kijoamanta, Manambaitse, Nato/Teza, and Voloso Zanga* - Spear heads (Left to right)**, which vary according to function.

Voloso

Voloso in malagasy means 'Spear' and this is a single pointed spear head with no hooks (Figure 3). This spear often used for octopus gleaning, or sometimes when free-diving

Figure 3 *Voloso* - Traditional spear

Manambaitse

This spear has a flattened head with a point and a single hook (Figure 4) that prevents the fish from coming off the spear once hooked.

Figure 4 *Manambaitse* - Single hook spear

Kijoamanta

This is a spear specifically designed for catching squid (*angisy*) and has 3 or 4 prongs with hooks on the end (Figure 5). This spear type is now rarely used since the introduction of the squid lure '*turlutte*'.

Figure 5 *Kijoamanta* **-** Pronged spear for catching squid

Teza or Nato

This spear is specifically designed for catching turtle. The spear head is particularly sharp, with two large hooks, and the head detaches from the shaft (Figure 6).

Figure 6 *Teza - Detachable* spear head designed for catching Turtle *(Fano)*

Maminta (Line fishing);

Line fishing is practised by both male and female fishers (although predominantly male) depending on environmental conditions and the fishers target species. The line (of different force strength) (Figure 7) is weighted with lead/metal blocks (Figure 11) and usually has a single baited hook (Table 14).

Talirano

Nylon (monofilament nylon line) introduced in 1954 (Langley 2006).

Foly

Cotton cord introduced in 1951 (Langley 2006).

Hooks

Different hook sizes are chosen depending on the conditions and the target species (Figure 8).

Figure 7 *Talirano* - Monofilament Nylon fishing line

Figure 8 *Vinta* – Hooks of different sizes, chosen depending on target species

Tsopoke

Tsopoke is carried out in the deep sea at sites ranging from 30-200m depth. This method usually involves 2 or 3 people on a pirogue, with one person paddling the pirogue whilst the others manage the line(s). A particularly strong line (force #39 or #50) is used especially when targeting larger fish. The line is hooked and weighted, but the hook in this instance is placed above the weight (Figure 9), in order that it does not catch on the reef (if this were to happen the fishers would not be able to dive to retrieve the hook). The hook is usually large (size #5 or #8) and baited depending on the species that the fisherman is targeting (see table). This system is only used in good weather when the currents are not strong, and is particularly used to target Emperor (*fiam-poty*), Snapper (*amporama or sorognale*) and Grouper (*lovo*).

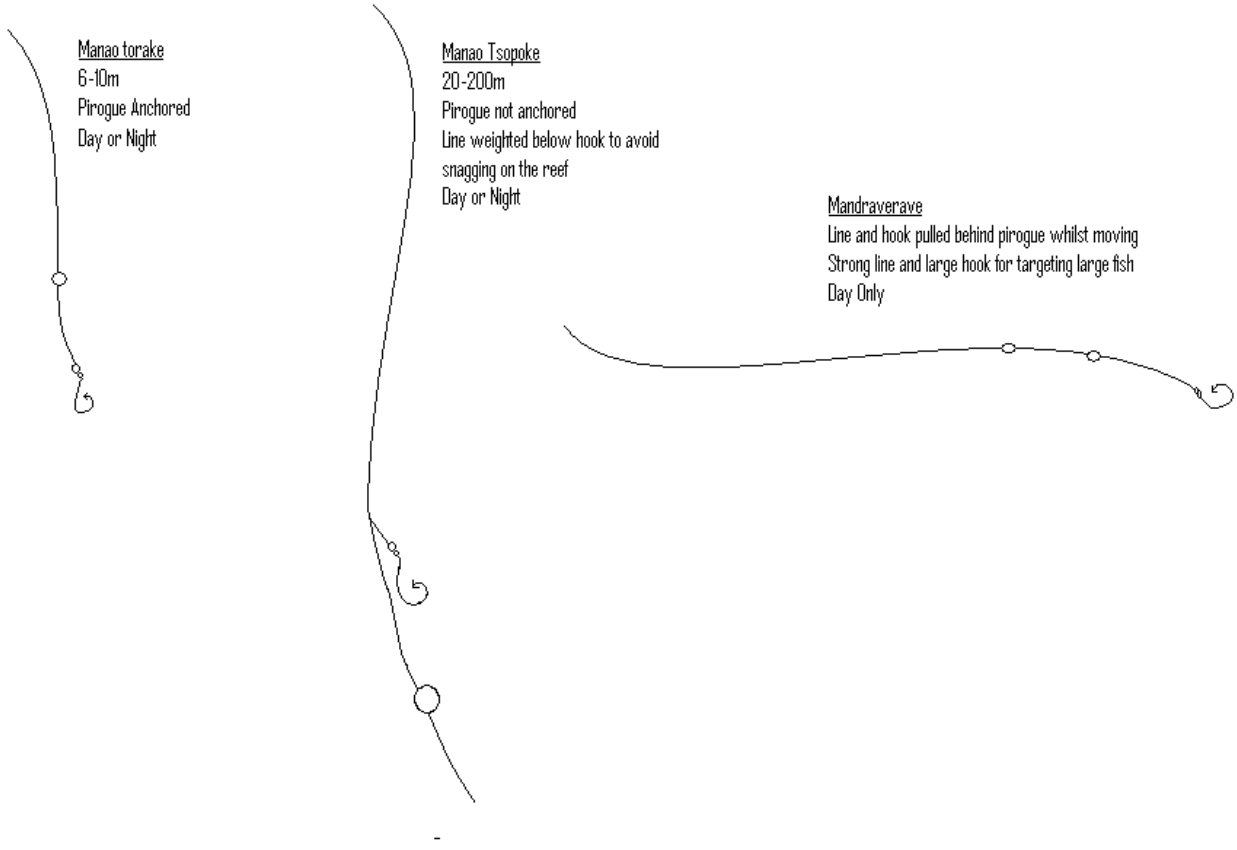

Figure 9 *Maminta* - Line fishing. *Torake, Tsopoke and Mandraverave* (Left to right)

Mandraverave

This is a type of 'trolling' (pulling the line behind a moving pirogue). This system uses a strong line similar to that of *tsopoke* (#29 - #50 force). The line is attached to a wire or cable by a swivel link known as a '*koro*' (Figure 10) and a large hook (size #8) is attached on the end of the cable. The line is not weighted, and the bait is chosen to have little floatability (Figure 9). The steel trace means that the fish, usually large pelagics, such as Tuna (*darapy*), Mackeral (*lamatra*), and Barracuda (*alo alo*) do not cut the line with their teeth or break the line when they struggle.

Figure 10 *Koro* - A barrel swivel link to prevent the line from twisting

Torake

This system is used in shallow water, between 2 and 10m depth. The pirogue is normally paddled by a single person whilst the other stands up and repeatedly throws the line (*manao torake*) into the sea. The line used is between force #6 and #8 and is constructed, with a small weight and hook (size 14 or 15) (Figure 9). Unlike *tsopoke* the hook is placed on the line after the weight (Figure 11) as if the hook gets caught on the reef the water is shallow enough that the fishermen can dive to retrieve it. This method is often used to target rabbitfish (*amboromasake*) snappers (*amporama or sorognale*) and emperors (*fiam-poty*).

Figure 11 *Fitoke* – Weights (metal) attached when line fishing to allow hook and bait to sink

Turlutte

This is also known as '*maminta angisy*' which means 'fishing for squid'. This is usually carried out during the day,but also at night when there is a full moon. There are usually two people on the pirogue although sometimes there may only be one. Turlutte is the lure used (Figure 12), often made from wood and brightly painted to attract the squid, it has many backward facing metal prongs which hook the squid as it attempts to attack the lure (Figure 13). The line attached to the lure is pulled behind the pirogue with the fisherman that is paddling also guarding the line; the second fisherman is free to continuously throw a second line, as described in *tsorake*.

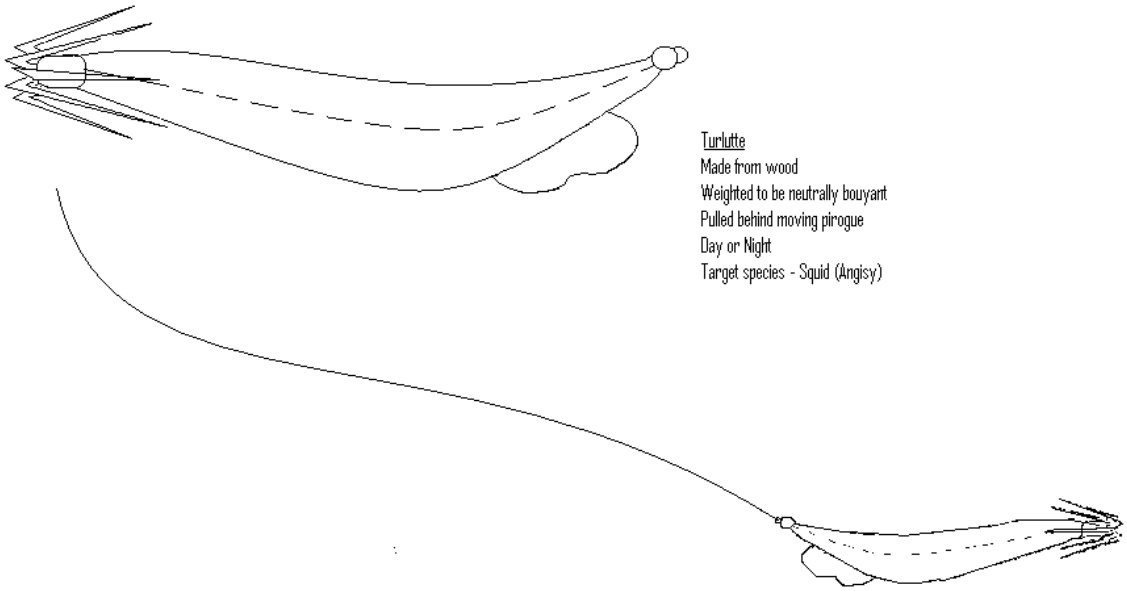

Figure 12 *Turlutte* - Squid Lure

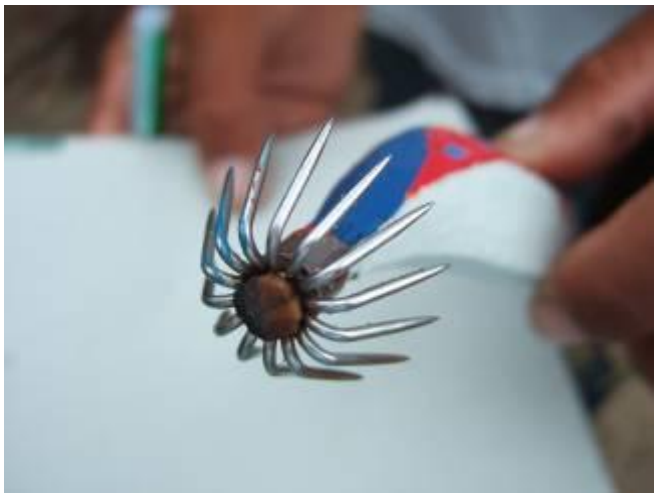

Figure 13 *Turlutte* - The pronged head of the lure designed for catching squid. These lures were introduced by AO/MAG/97/008 project.

Palangre

Palangre is a method similar to long lining, using *talirano* line and rope, the line that is used has a much higher force than used in normal fishing. There are two types of *palangre* (Figure 15); the first is anchored at either end, with line and hooks held in mid-water, and floats marking both ends and the centre. The second is only anchored at one end and has a series of smaller floats attached to hooks and lines. The size of the line and the number of hooks on the line is dependant upon the materials available but lines can reach up to 100 m in length.

Aofa (Bait)

The Vezo use different bait (*aofa*) attached to the appropriate lines or nets used to target different species (Table 14).

Table 14 *Aofa* – Bait is different depending on the target family

Target Family	Bait
Serranidae (Grouper)	Small fish and squid
Lutjanidae (Snapper)	Small fish and squid
Sparidae (Bream)	Small fish
Belonidae (Needlefish)	Small fish (trolling)
Siganidae (Rabbitfish)	Octopus ink (dried)
Carangidae (Jack/trevally)	Squid, small fish and sardines
Scombridae (Tuna and Mackeral)	Small fish, squid and 'milkfish'
Lethrinidae (Emperor)	Meat fish, octopus and squid
Sphyraenidae (Barracuda)	Small fish, squid and 'milkfish'
Chondricthyes (Shark, Guitarfish and Ray)	Fish

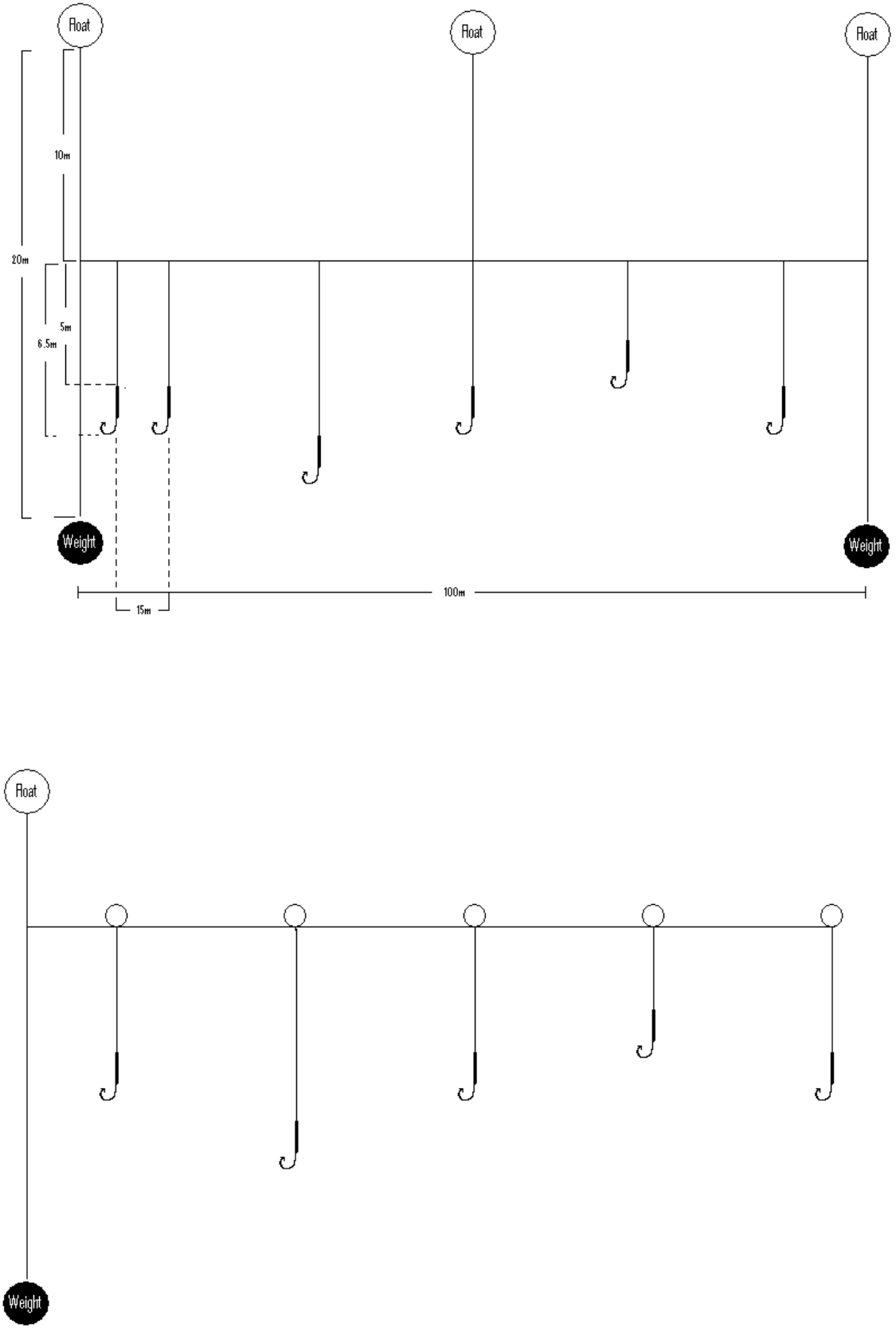

Figure 15 *Palangre* - Long Line for targeting large pelagic fish including sharks

Mihaza (Net fishing);

Mihaza is the Malagasy word for 'net fishing'. Before the introduction of nylon/man made/synthetic line in 1963 (Langley 2006) nets (*harata*) were made from vegetable fibres/cotton (*foly*) but today most nets are made of nylon (*talirano*) and are bought ready-made although some nets are still made locally.

Nets can be deployed and used by an individual or by a group, and fishers use different nets and different methods of deployment according to the depth of the fishing site, the target species, and the local environmental conditions. Most nets however are structured in the same way (Figure 16) with a line of ballast weights (lead, cement or shells) at the base and a line of floats (rubber, plastic) at the top of the net so that the net holds its position in the water.

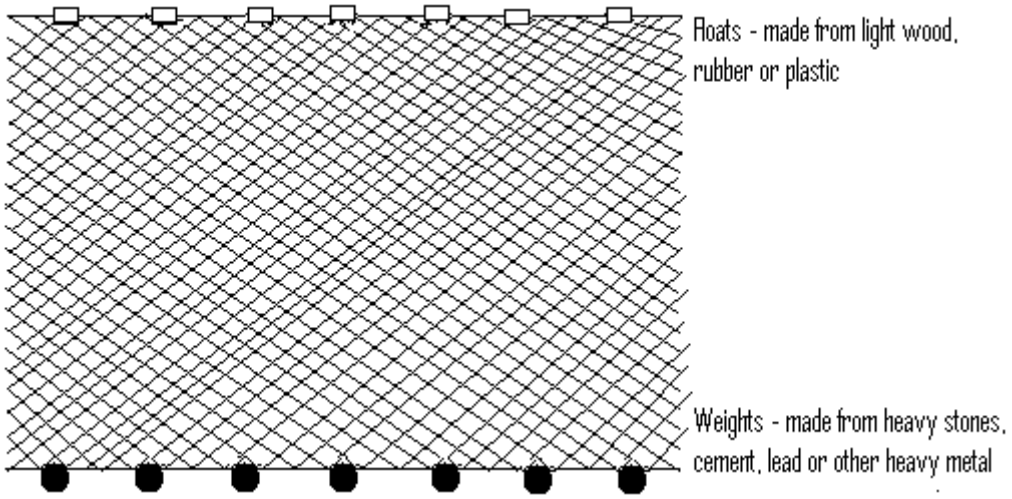

Figure 16 *Harata - Nets generally have floats along the top and weights along the base to make the net 'stand' in the water*

Harata (Net)

There are different types of net, the majority will act as a gill net (entangling fish that are too large to pass through the mesh as they struggle to back out of the net) although they may also be employed in different fishing systems such as set netting and seine netting.

L'electronique

L'electronique (also referred to as simply *talirano*) nets are produced locally from nylon line (Figure 17). The mesh is usually 2 or 3 fingers width and each net has a wire/cord running through the top/bottom. The ballast is either heavy sea shells (*Turbo cornatus*) or cement blocks, spaced roughly at 30 cm intervals along the foot rope, and the floats are often light wooden blocks roughly spaced every 40cm along the top rope. The *l'ectronique* net is used particularly when targeting Rabbitfish (*amboromasake*). The typical *l'electronique* net is between 1 and 2 m width with a 100-200 m length.

Janoky

Janoky is a type of gill net that similarly to *l'electronique* is made from nylon line (*talirano*) and can be made locally within the village or can be brought ready made, and usually has a mesh between 2 and 4 fingers width.

Figure 17 *Talirano/ l'electronique* - Locally produced nylon gill net

Jahoto

The *jahoto* net was introduced in 1989 (Langley 2006) is between 300-800 m in length and has a fall length of 1-2m made from thicker nylon than most other nets (force #3) and has a small mesh size around 1 finger/ 1 thumb width (Figure 18). It is designed for catching small shoaling fish close to the shore and for this reason it is often used with a mosquito net (*makarakara*) pocket in the centre to retain the smallest of the fish and often when seine netting.

Figure 18 *Jahoto* - small mesh gill net introduced in 1989

Zdzd

The *zdzd* net is a large gill net that was popularised by the German development company GTZ in 1992 in order to reduce the effects of fishing on nearshore reefs through the development of offshore fishing (Langley, 2006). The *zdzd* can be up to 150 m in length with a fall length of 6-8 m, it has a large mesh size of 8-10 cm and is designed to target larger pelagic fish species and sharks (Figure 19).

Figure 19 *Zdzd* - Larger mesh net used for deep sea fishing

Jarifa

This is another large gill net used in the deep sea that was also introduced to Andavadoaka in the 1990's. It is generally around 100-200 m long with a fall length of around 5 m, and a mesh size between 12 and 25 cm. It is used when targeting large pelagic fish and sharks (*akio*) (Figure 20).

Figure 20 *Jarifa* - Large mesh gill net, used to target large pelagic fish including shark

Makarakara

This is mosquito net (Figure 21) that is used as fishing net in order to catch the smallest fish and shrimp. The *makarakara* is often attached in the centre of another net such as *jahoto* when seine netting so that as the fish are herded into the net they are all trapped in this central pocket section.

Figure 21 *Makarakara* - Mosquito net, often used as a pocket in the back of another net such as jahoto/ janoky

Feripe

This nylon net has a mesh size about the width of a little finger, it is brought ready to use with a fall of 6 m and length of 100 m (Figure 22), however due to the decreasing catches the Vezo more recently join four (or more depending on what they can afford) nets together to make a net that is about 200 m in length and has a fall of 12 m.

Figure 22 *Feripe* - A small mesh net often joined together to make large nets over 200m long

Fishing Systems

Mandroake

Mandroake is a simple gill net method, usually employing 2-4 people in a single pirogue that can be applied at anytime. The *talirano* net is set out from the pirogue, with one person driving the pirogue, another deploying the net and a third person in the water diving on the net to make sure that it doesn't catch on the reef; positions are changed when people start to tire. The net is laid out coiling in at the end (Figure 23). After the net has been set the fishers in the pirogue start to hit the water with a stick (*mamofondrano*). Beginning at the open end of the net and chasing the fish down the net and trapping them in the coiled end. They then retrieve the net pulling it up into the pirogue coiled end first, and retrieving the fish from the net.

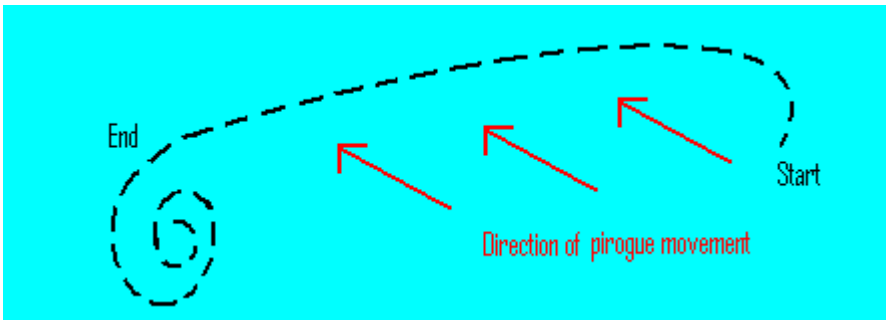

Figure 23 *Mandroake* - fishing system usually employing 2- 4 people in a single pirogue

Tarikake

This is a simple beach seine system usually using *feripe, jahoto* and *makarakara* nets. The net is deployed very close to shore in the shallows, and usually employs between 4 and 10 people, some on the pirogue laying the net whilst others make sure that the net does not snag on the reef. A *jahoto* or *feripe* net will often have a mosquito net cod end at the back where the fish will collect as the net is pulled towards the shore. Ropes are attached to both ends of the net and the fishermen pull the net in towards the beach (Figure 24). The first pirogue collects up the net whilst the second collects the fish caught in the net.

Jahoto nets are also often used close to mangroves and on seagrass beds in order to target Mojarra (*Tampininy*), however this net has a small mesh size which is relatively indiscriminate of which fish it ensnares.

Mananjake or Molialy

The *mananjak*e or *molialy* systems also use *feripe* and *jahoto* often with a mosquito net pocket. This method is relatively labour intensive, involving 3 boats and between 6 and 10 fishers. One boat runs the net out whilst the others run out the rope. The net is deployed at night in shallow water (5-20 m) during the high tide, so that the fish are trapped as they follow the tide out off of the reef. The net is left over night and the fishers return to the net in the morning when the tide is at its lowest. Divers in the water make sure that the net does not 'snag' on the reef, as well as beating the net as the fishers on the beach haul the net in towards the shallow reef. The pirogues then collect

up the net and the catch which usually consists of fusiliers (*fitse*), snappers (*amporama, sorognaly*) and emperor (*fiam-poty*).

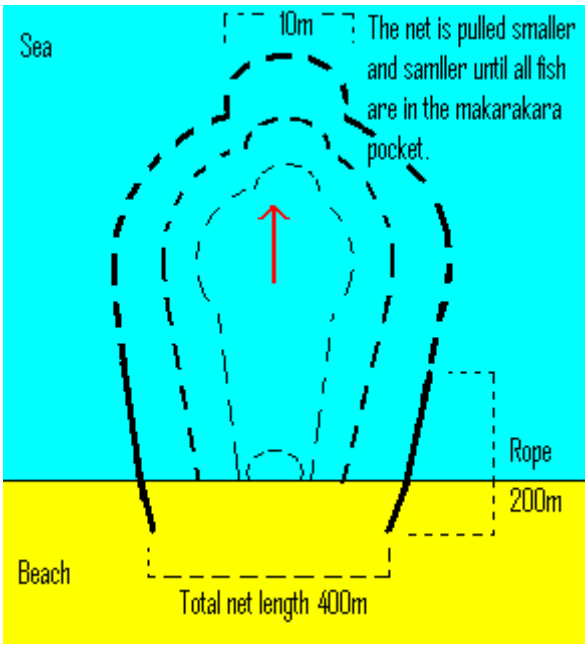

Figure 24 *Tarikake* - Simple beach seine system, highly destructive when using smaller mesh nets

Saro-an-davaky

The *saro-an-davaky* system is often performed using l'electronique or talirano nets and is used to target shoals of reef fish such as Snapper (*amporama, sorognaly*), Rabbitfish (amboromasake), and Parrotfish (*trabeake*). Fishermen will wait until they see a shoal of fish on the reef before they deploy the net. Once they have identified a shoal one person will stay (in the water) with the end of the net whilst two others in the pirogue will follow a course around the reef deploying the rest of the net (Figure 25). Another diver will also make sure that the net does not catch on the reef, as well as acting to chase the fish into the net. The pirogue pulls the net inwards in a decreasing circle, until it is quite small; they then start to collect up the net and the fish. Divers will also carry spears with which they will catch cryptic or territorial fish that are hiding in the reef.

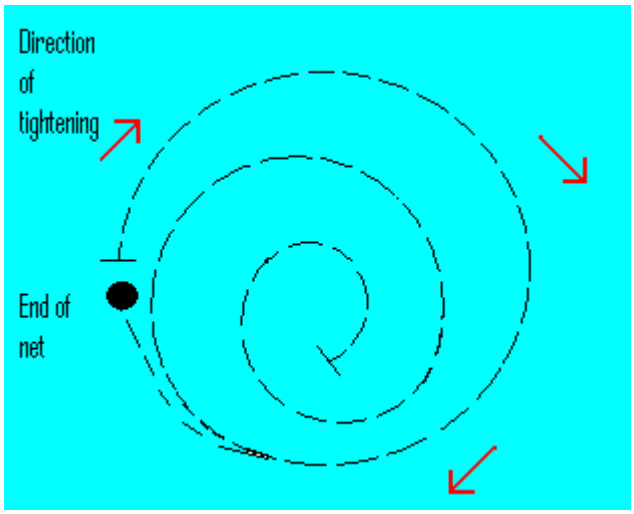

Figure 25 *Saro-an-davaky* - Gill net system used to target a large shoal of fish

Valaritse

When using the *valaritse* system fishers often use *talirano* nets, with a mesh size of between 1 and 3 fingers width. This system is only used in good weather on the spring tides to reduce damage to the nets and to allow easy access for the pirogue. The net is laid out on the flat reef at high tide just behind the breaking waves (Figure 26). It is laid on the flat with a diver checking that the net is not caught on the reef and that there are no holes at the base of the net through which fish might escape. As the tide ebbs the fish start to head out to deeper water and become entrapped in the net. At low tide the fishermen return to collect the net and their catch, slowly moving one end of the net towards the other.

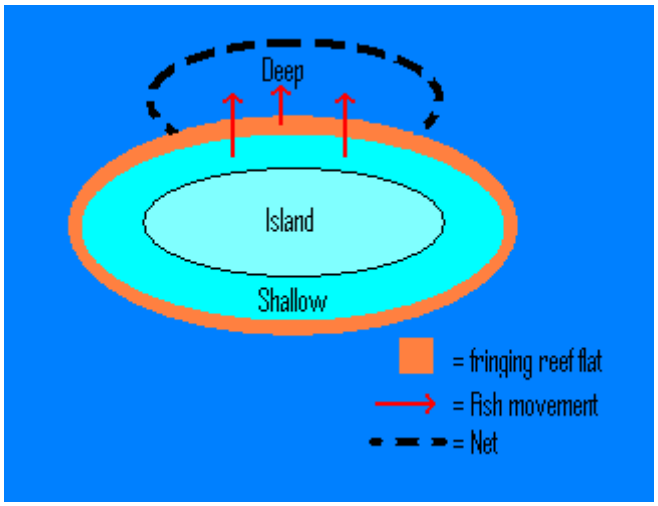

Figure 26 *Valaritse* - Set gill net, targeting fish as they escape the out-going tide.

Manao Jarifa or Manao Zdzd (Shark)

For targeting shark and other large pelagic fish the fishermen will set their nets during the day out usually past the barrier reef at sites between 50 and 200m deep.

They will either use *jarifa* or *zdzd* nets that have a large mesh size. If using *jarifa* nets they will bait the net, often using ray (*fay*), moray eel (*murene*) or other baitfish (Figure 1). They do not bait the *zdzd* nets as these will quickly catch large pelagic fish such as Tuna (*darapy*) which will then act as bait for the shark (*akio*). The net is anchored at one end, the length of the anchor line is set longer than the depth of the sea bed, after checking the depth using a small 5 kg weight. The anchor line forks approximately 10 m from the net so that it is attached to the net at both the top and bottom. The long length of this anchor line allows the net to move around with the prevailing current. Also from this end of the net is a second rope (250-300 m), which comes to the surface where it is marked with two buoys and a flag (Figure 27).

The net is weighted so that it sinks, but has floats along the top of the net to allow it to 'stand-up' in the water. The far end of the net has another small weight (2-5 kg) and is also attached to buoys at the surface by a third line (250-300 m), which also helps the net to stand-up in the water. The buoys also mark the position of the net, having two buoyed lines reduces the risk of losing the net.

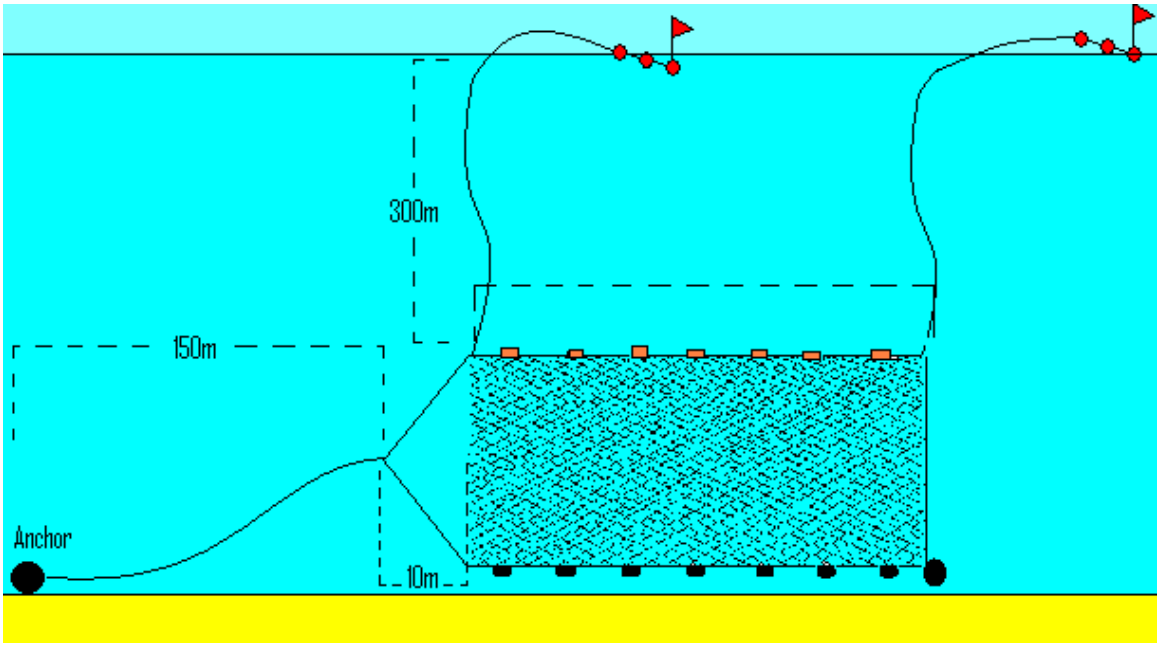

Figure 27 *Manao Jarifa/Zdzd* - Deep sea fishing system using larger mesh gill nets for targeting pelagic species

Shark fin (*akio vombotse*), driven by the growing demand of Asian markets, is one of the most lucrative of marine products for Vezo fishermen (Table 28).

Table 28 *Akio vombotse* - Price of shark fins (2008)

Quality/Size	Price Ar/Kg
1st	120,000
2nd	60,000
3rd	30,000
4th	15,000

Target Fishing Methods

Basim-pia

Spear guns are used when free-diving (*manirike*) often for fish or lobster (see *manirike tsitsike*). The gun itself, including the trigger, is wooden (Figure 29), and the spear is metal re-bar sharpened into a point and fitted with a metal barb (Figure 30).

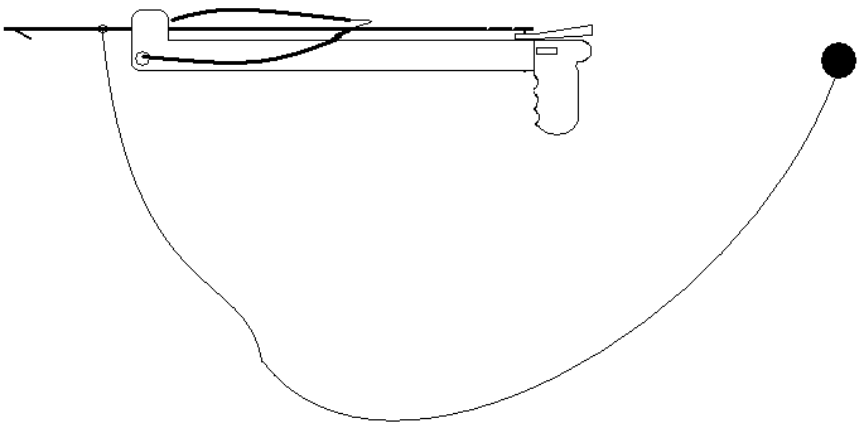

Figure 29 *Basim-pia* - Spear Gun usually a wooden frame, with metal spear

Figure 30 *Basim-pia* - Metal Barb fixed to metal spear, and Spear Gun

Mihaza Varilava (Sardine)

For targeting sardine the Vezo use a fishing system known as *mihaza varilava* (net fishing sardine). The mosquito net (*makarakara*) is used for this system of fishing, and the sardines are targeted in the shallows up to about 5 m depth. The fishermen deploy the net around a shoal of sardine that they have seen from the surface. They close the net around the shoal and then bring the net slowly to the centre; the fish will then become trapped in the pocket at the back of the net. Local fishermen say that previously huge schools of sardine would come into the bay of Andavadoaka, but that a few years ago this stopped and now there are only small schools of sardines.

Mihaza holy (Fishing at night)

The Vezo will often fish at night , targeting snapper (*amporama, soronaly*), emperor (*fiam-poty*) and rabbitfish (*amboramasake*), as well as parrotfish (*trabeake*) and sometimes jack (*lagnora*) or mullet (*bika*), using the *mandroake* system. The fishers will mark the net with buoys, which will either have fire on them or a bell so that they do not lose the net during the night.

Mihaza fano (Turtle fishing)

Although fishing for turtle (*fano*) is illegal within Velondriake, and throughout Madagascar, it is still considered very 'Vezo' to catch a turtle. With turtle meat a delicacy selling for 100Ar per piece or 2000 - 3000Ar/Kg and little policing of the law turtles are still regularly targeted within Velondriake.

There are two methods that they use to specifically target turtle: The first is using a *jarifa* net (Figure 20) and deploying it in a fashion similar to *mandroake*, this is referred to as '*mihaza fano'*. The fishermen will be out at high tide and if they see a turtle surface for a breath then they will begin to lay the net. They will set the net on the far side of the reef flat on the outside of the breakers, and then paddle around so the turtle is between the pirogue and the net. They will then start to thump a stick on to the reef in order to scare the turtle towards the net. Once the turtle is caught in the net they place large (25 cm or bigger) hooks into the soft parts of the turtle (around the shoulders) so that as they release it from the net it is not be able to swim away.

Figure 31 *Fano Zaty* - A large Green Turtle (*Chelonia mydas)* is carried in on top of the pirogue

Teza/ Nato (Turtle fishing)

The second method is using a pirogue set up specifically with spears to target turtles, called *nato* or *teza* (see harpoons).This system is set up on a specialised pirogue (Figure 32), and is often used in bad weather or at night on a new moon when there is no wind. The reason for this is that in bad weather the Vezo say that they can 'sneak up' on a resting turtle using the swell to hide themselves, or at night when it is calm and there is no moon the bioluminescence in the water highlights a turtle as it swims through the sea.

The spear has a quick release head attached to a rope, which is coiled up in the pirogue. When a turtle surfaces the fisherman will launch his spear into the carapace of the turtle, the spearhead detaches from its shaft as the turtle swims off. The fishermen swiftly pick up the spear shaft and allow the turtle to pull the pirogue along. As the turtle begins to tire and surfaces again the fisherman will throw a second spear into the turtle's carapace. This ensures that if one of the hooks detaches the turtle will not be lost.

Using either of these systems, once the turtle has been secured the fishermen will haul the turtle into the boat using ropes. If however they catch a particularly large turtle that is difficult to haul into the pirogue then they will start to sink the pirogue filling it with water so that they can then easily lift the turtle inside or on top of the pirogue (Figure 31). Once the turtle is landed then they will bail out water from the bottom of the pirogue making it float once again.

Five turtle species are documented to be found in Madagascar, these include *Chelonia mydas* (*Fano zaty*) (Figure 31), *Eretmochelys imbricata* (*fano hara*), *Caretta caretta* (*apombo*), *Dermochelys coriacea* (*valozoro*), and *Lepidochelys olivacea* (*tsipioke*).

Figure 32 *Teza/Nato* - Pirogue and spear system used to specifically target Marine Turtles.

Mila Zanga or Mihake

Due to the huge demand from the Asian market, sea cucumbers (*zanga*) are of high economic important for the Vezo (McVean *et al.* 2005). There are different methods that are used for targeting the different species of sea cucumber (Table 33).

As described earlier mihake involves walking on the reef, sand or seagrass beds, at spring low tide and collecting the sea cucumber into a bucket.

Mila Zanga haly

The second method is the same as *mila zanga* but is performed at night during the spring low tide and is known as *mila zanga haly*. Both of these 'gleaning' methods are usually carried out by women and children.

Manirike Zanga

The final method targets species that are found in deeper water. This system is used solely by men and only on days where the visibility is particularly good with little swell and wind. Using a 5-6 m long spear, with a slightly serrated edge on the spear head (*voloso zanga*), the fisherman will usually free-dive to within 5 metres of the reef (sometimes up to 30 m). Once they have located the sea cucumber they will stick the spear into it and leave the spear to start their ascent. The spear is attached to floats which bring the spear, along with the sea cucumber, to the surface.

Table 33 *Zanga* - Different species and methods of targeting Sea Cucumber

Species	Malagasy name	Collection method
Actinopyga mauritiana	*Fotsitsetsake*	*'Maloke hariva' (*diving – only targeted in areas of spur and groove reef*)*
Thelenota ananas	*Zanga brosse*	*Manirike zanga*
Holothuria scabra	*Zanga foty or Benono'mpase*	*Manirike zanga, mila zanga*
Holothuria nobilis	*Benono mainty*	*Manirike zanga*
Holothuria fuscogilva	*Benono foty*	*Manirike zanga*
Stichopus chloronotus	*Zanga sogno*	*Manirike zanga* (10m depth – collected by hand)
Bohadschia subrubra, Bohadschia vitiensis	*Mangery foty, Kalalijake*	*Mila zanga*
Actinopyga echinites	*Rorohan-kena (Tronkena)*	*Mila zanga*
Sichopus horrens	*Manmonfo*	*Mila zanga*
Holothuria edulis	*Zanga mainty*	*Mila zanga*
Holothuria atra	*Zanga sitilo*	*Mila zanga*
Holothuria cinerascens	*Zanga fleura*	*Mila zanga* (only during the day – found in groups in the shallows)
Actinopyga miliaris	*Rorohan-kena mainty*	*Mila zanga haly*
Thelenota anax	*Somalypapa*	*Mila zanga haly* (night gleaning)
Stichopus hermanni	*Zanga trachytera*	*Mila zanga/ Mila zanga haly* (both day and night gleaning)

Mila Soky (Sea Urchin)

The Vezo target a single species of urchin (*Tripneustes gratilla*) which they call '*soky*'. They collect the urchins by hand at low tide walking through the Seagrass beds (*orianga*). Using the siphon end of the shell *Pleuropoca trapezium* (*bozike lahy*) they break the urchin teste around the mouth. After washing in sea water they collect the gonads which are pinky orange/yellow. They use this to make urchin cake simply known as '*soky,*' thought to have aphrodisiac and rejuvenating (especially hang-over relief) properties.

Mila Bozike (Shells)

There are a number of shell species that are targeted for food or for sale as tourist trinkets in Toliara and Morondava. Those collected for food include *bozike lahy* (*Pleuropoca trapezium*) and *bozike vavy* or *jonka (Chicoreus ramosus)*. They are collected by men whilst diving or by women gleaning at low tide. They cook the mollusc either by boiling or putting the shells in the fire. They sell the meat for 100Ar per piece and collect the hard operculum cover (*fimpy*) which is sold to a collector in Morombe, who then sells it on for jewellery or to produce incense (Iida 2005). The Vezo will then use the shells for making a kind of traditional cement (sokay) which is used as a mortar on wooden-framed houses. *Donax sp.* (*tek tek*) is also collected for food whilst gleaning on the reef flats, also cockles (*diviky*), oysters (*huitre*) mussels (*moules*), and chitons (*salabato*) (although these are not generally sold). In the mangroves shell species; *Arcidae* and *Terebralia palustris* are collected for local consumption.

Giant Clams (*hema*) are another species collected by fisheries export companies particularly in the northern villages close to Morombe. The dried meat is currently sold at around 6,000Ar/Kg

Other shells, such as cowrie (*Cypraeidae*) (*tsokarike, kokiazy, fela*), triton shell (*Charonia tritonis*) *(antsiva lavavolo),* helmet Shells (*Cassidae*) *beja)* as well as giant clam shells (*Tridacna*) (*hema*) are collected by women and children for sale as tourist trinkets in Tulear or Morombe.

Atrina vexillum (tsilatsilake be), Pinna muricata (tsilatsilake), Pinctada margiritifera (tsilatsilake bato), Isgnomon ephippium (tsilatsilake kely) are collected and sold for pearl shell.

Manirike tsitsike (Lobster)

Lobsters are targeted by men and boys whilst free-diving (*manirike*), usually around 5-20 m depth and using a spear gun (*basim-pia*). The Vezo target a number of different lobster species (Table 34)

Table 34 *Tsitsike* - Lobster species targeted by Vezo fishers

Latin name	**Malagasy name**
Panulinus homanus	*Tsitsike apombo*
Panulirus versicolor	*Tsitsi bola*
Panulirus longipes longipes	*Tsitsi mena or mena mahazo*
Panulirus ornatus	*Gant*
Parribacus antarticus	*Tsitsi bato*

Mila Jakake (Crab)

The Vezo also target the different crab species that live in the mangroves. There are two methods that are used for targeting crab. The first take place at low tide where people walk through the mud in the mangroves spearing crabs (using *voloso*, or *manambaitse*) and collecting them in a bag or bucket (Figure 35).

Figure 35 *Mila Jakake* - A woman targets crab in the mangroves using *manambaitse*

The second method uses small baited lines which have floats on the surface and are laid out using a pirogue. When the fisherman notices that one of his float is being pulled under the water they slowly approach the line and start to pull it in, then using a tennis racket like implement called *kipao* to scoop the crab up so that it doesn't escape. Crabs cannot be caught with hooks, but instead are jerked out of the water while it grasps the bait in its claws.

Mila Horita or Mihake (Octopus)

Octopus (*horita)* are a highly valuable resource, which once collected are then sold to local fisheries export companies such as Copefrito and Murex (Humber *et al.* 2006). With men, women and children alike all gleaning for octopus, either walking on the exposed reef flat during spring low tide or free diving on shallow reefs, numbers were reported to be in decline in the region prior to conservation management intervention by local NGOs (Humber *et al.* 2006, Langley 2006). The Vezo are adept at recognising the mound of stones that signify an octopus den. Once the den of the octopus has been established the fisher will tickle (*mikilikilike*) the octopus using the spear (*voloso*). The octopus grabs hold of the spear and then the fisherman will bring it out slowly. The gleaner will then take hold of the octopus' head and will spear the octopus through the mouth up to 10 times. They will then turn the head inside out to ensure that the octopus is dead before continuing their gleaning (Figure 36) They will collect the ink from the octopus and dry it out to use for bait when line fishing for rabbitfish (*amboromasake*).

There are 3 species of octopus found in this region *Octopus cyanea* (*horitambato*), *Octopus aegina* (*horitanakora*), and *Octopus macropus* (*horitandolo*), with *Octopus cyanea* being the most commercially important of these (Langley, 2006).

Figure 36 *Mihake* - A Vezo woman uses a spear to glean for Octopus on the reef flat

Maminta Angisy (Squid)

(See *Turlutte* - Squid Lure)

Mila Crevette (Prawn)

There are 2 methods employed by the Vezo when targeting prawn/shrimp

Kititse

For large prawns (*kamaron*) fishers use a small hand made wooden bow and arrow (Figure 37). This method is generally used by young boys who will target small fish and prawns.

Makarakara

For small prawns and shrimp. This method uses a small mosquito net (see *makarakara*) which is pulled with the fishermen as they walk, very slowly, down the channel in the mangroves. The base of the net is attached to the fishers' foot and the top of the net is held onto by the fisherman.

Figure 37 *Kititse* - A small bow and arrow used by Vezo children to target prawns or small fish

Mandaro (Cyanide fishing)

Mandaro is an illegal fishing method that uses the poison from the endemic terrestrial plant *Euphorbia famata*. In order to collect the poison the fisherman will firstly dig a hole around the base of the tree, until they reach hard sand or rock. They will then cut the trunk of the tree a number of times allowing the liquid to pool at the base of the tree in the previously dug hole. Whilst performing this task the fisherman will wear a mask to protect his eyes from the poison, if they do not have a mask they will perform this with their eyes closed. Once the liquid has pooled at the base of the tree they will collect it up into buckets. They will take 4-5 buckets of liquid *laro* and mix it with sand (*fasy*) on the beach. They then fill the pirogues with the *fasy/laro* mixture and during the low tide at night they will walk around a designated area that is marked with flaming torches and has already been laid out with a net set to about 2-3 m depth, collecting handfuls of the toxic sand and putting it into the sea. They will wait approximately half an hour for the toxin to take effect, after which they will collect fish that become entangled in the net or float to the surface dead. The fishing group will collect the fish from the area three times, firstly at night when the poison first takes effect. The second time will be during the high tide the following morning, and then finally the women will return at low tide during the day to collect any that are left (*mila bokandaro*).

Destructive Fishing

Destructive fishing is often defined as 'those practices which result in the direct damage to either the fished habitat or primary habitat structuring organisms (such as scleractinian corals)' (Pet-soede and Erdmann 1998). However many methods are not directly destructive in this sense, but have other ecologically detrimental side-effects. Some of the Vezo fishing methods described in the previous chapters are more destructive than others. Here we look at how destructive each method is, and their impacts on the reef ecosystem.

Gleaning

Mihake is a relatively destructive method due trampling of the reef and a breakdown in the structural complexity through the removal and movement of rocks in the search for target species. However this method can only be employed during the spring low tide, reducing the amount of destruction that occurs on a daily basis.

Line Fishing

Line fishing is one of the least destructive of the fishing methods employed as it allows fishermen to target only a single fish at a time and to also target larger bodied species reducing the number of juveniles caught before they reach maturity.

Line fishing however is not always a non-destructive method, when monofilament fishing line get snagged on the reef, dropped or discarded by fishers they can become entwined around coral structures, it has been shown that this is directly related to the death of these entangled corals (Yoshikawa and Asoh 2004).

In addition to this is the use of multi-hook lines, *palangre* (long-lines), which allow fishermen to target large pelagic species; however the bycatch of seabirds, turtles and marine mammals associated with long-line fisheries mean that this method can be relatively destructive. Large scale use of longlines can dramatically reduce the number of top level predators, such as shark and pelagic piscivores, on the reef resulting in further ecosystem damage through shifting trophic guilds (Scheffer *et al.* 2001).

Net Fishing

Net fishing, particularly the use of bottom set and small mesh gill nets are believed to be highly destructive fishing practises employed by large numbers of fishing populations throughout the world**.**

Bottom nets that are weighted to be set on top of the reef often become tangled with branching hard corals and other complex substrate, causing damage as they are removed or smothering corals if they are irremovable and subsequently discarded.

Lost or discarded fishing gear is the most hazardous types of marine debris pollution for marine life. Lost gillnets and traps can remain intact and catch marine life for well over a decade continuing to remove large amounts of biomass through ghost fishing a process which is estimated to catch amounts between 5% and 30% of the annual landing levels (Laist 1996).

One of the biggest threats comes from the increasing amounts of by catch through the use of small mesh nets to ensnare all sizes and species of fish.

Bycatch is the incidental catch of non-target species, and has a particular impact on those that are long-lived and exhibit low reproductivity, such as sea birds, turtles, sharks and marine mammals. Bycatch has knock on effects on ecosystem functioning through the removal of species or elimination of either predatory or prey species (Alverson *et al.* 1994; Hall *et al.* 2000).

The use of *makarakara* (mosquito nets) for fishing, outside of sardine season, has been made illegal in the region due to its unselective removal of all fisheries resources; however, while in many places such as Velondriake the law is also enforced by a local law called a '*Dina'*, people still employ this technique, particularly when fishing is bad for a longer period than normal.

Small mesh nets although not illegal are also extremely destructive, mainly because they remove large amounts of small juvenile fish, reducing levels of reproductivity, and causing population decline.

Beach seines (*tarikake*) are one of the most destructive fishing practices employed in the region. The use of small mesh nets being dragged through areas of coral reef and seagrass beds undermines the structural dynamics of these habitats and reduces ecosystem quality through the indiscriminate removal of marine species.

Large mesh nets such as *jarifa* and *zdzd* also have detrimental effects. While they are more selective than other small mesh nets they are still relatively destructive due to their removal of key predatory species. Removal of top level carnivores from a system has been shown to affect reef community structure, reduce species diversity and thereby destroy integral ecosystem processes, functions and resilience (Roberts 1995).

Other net fishing methods are also moderately destructive as they deploy nets on the reef, while divers in the water move boulders and chase other fish into the nets increasing the amount of damage to the reef substrate. Structural damage to the reef habitat is believed to have a greater impact on fish populations and reef recovery than disturbances that leave the complexity of the habitat in place (Syms and Jones 2000).

Other fishing methods

Other target fishing methods cause relatively low levels of destruction on the reef, although some such as the use of mosquito nets to collect prawns negatively affect other similarly vulnerable ecosystems such as mangrove forests and seagrass beds.

Spear fishing, due to its high selectivity, is ranked similarly to line fishing (Roberts and Polunin 1991) as it can remove significant numbers of large bodied target species, and has been shown to have a significant effect on the size of target species on a reef (Slyka and Sullivan 1998).

Possibly the most destructive, although uncommon, of fishing methods is the use of *laro* or poison fishing. A completely indiscriminate method, cyanide solutions (naturally occurring in *Euphorbia* sp.) strong enough to stun large reef fish have been shown to be lethal to most reef organisms including smaller fish and both mobile and sessile invertebrates. This practice is noted to be used more extensively, in places such as Indonesia where there is a greater demand from the live fish trade, where it is documented to have wide scale effects on the whole ecosystem (Pet-soede and Erdmann 1998).

Overfishing

The largest threat however does not come simply from the use of these destructive methods but is derived from Malthusian overfishing (McManus *et al.* 1997) where unregulated population growth results in: increased competition between communities, declining marine resources and a subsequent increase in the intensity of fishing and greater use of more destructive methods in order to maintain fisheries landings at previous levels (Roberts 1995).

References

Alverson DL, Freeburg MH, Pope JG, Murawski SA (1994) A global assessment of fisheries bycatch and discards. FAO Fisheries Technical Paper. Rome, FAO. 339: 233

Astuti R (1995) People of the sea: Identity and descent among the Vezo of Madagascar. Cambridge University Press

Bunce L, Townsley P, Pomeroy R, Pollnac R (2000) Socioeconomic Manual for Coral Reef Management. Australian Institute of Marine Science, Townsville, Australia

Epps M (2008) A Socioeconomic Baseline Assessment: Implementing the socioeconomic monitoring guidelines in southwest Madagascar. Blue Ventures Conservation Report.

Hall MA, Alversonb DL, Metuzals KI (2000) By-Catch: Problems and Solutions Marine Pollution Bulletin 41: 204-219

Iida T (2005) The Past and Present of the Coral Reef Fishing Economy in Madagascar: Implications for Self-Determination in Resource Use. Senri Ethnological Studies 67: 237-258

Laist D (1996) Marine debris entanglement and ghost fishing: A cryptic and significant type of bycatch? Alaska Sea Grant College Program, Fairbanks, AK (USA): 33-40

Langley JM (2006) Vezo Knowledge: Traditional Ecological Knowledge in Andavadoaka, southwest Madagascar. Blue Ventures Conservation Report

Laroche J, Ramananarivo N (1995) A preliminary survey of the artisanal fishery on coral reefs of the Tulear Region (southwest Madagascar). Coral Reefs 14: 193-200

McKenna SA, Allen GR (2003) A rapid marine biodiversity assessment of northwest Madagascar. Conservation International, Washington, DC

McManus JW, Reyes RB, Cleto L, Nanola JR (1997) Effects of Some Destructive Fishing Methods on Coral Cover and Potential Rates of Recovery Environmental Management 21: 69-78

Nadon MO, Griffiths, D., and Doherty, E. (2005) The Coral Reefs of Andavadoaka, South West Madagascar. Blue Ventures Conservation

Pet-soede, Erdmann M (1998) An Overview and Comparison of Destrucive Fishing Practices in Indonesia. SPC Live Reef Fish Information Bulletin 4: 28-36

Roberts C (1995) Effects of Fishing on the Ecosystem Structure of Coral Reefs. Conservation biology 9: 988-995

Roberts C, Polunin NVC (1991) Are Marine Reserves Effective in Management of Reef Fisheries? Reviews in Fish Biology and Fisheries 1: 65-91

Scheffer M, Carpenter S, Foley JA, Folke C, Walker B (2001) Catastrophic shifts in ecosystems. Nature 413: 591-596

Slyka SD, Sullivan KM (1998) The Influence of Spear Fishing on Species Composition and Size of Groupers on Patch Reefs in the Upper Florida Keys. Fisheries Bulletin 96: 388-392

Syms C, Jones GP (2000) Disturbance, Habitat Structure, and the Dynamics of a Coral-Reef Fish Community. Ecology 81: 2714–2729

Xirou C (2004) Interaction between Different Enterprises Making Use of Coastal Resources in Andavadoaka

Yoshikawa T, Asoh K (2004) Entanglement of Monofilament Fishing Lines and Coral Death Biological Conservation 117: 557-560