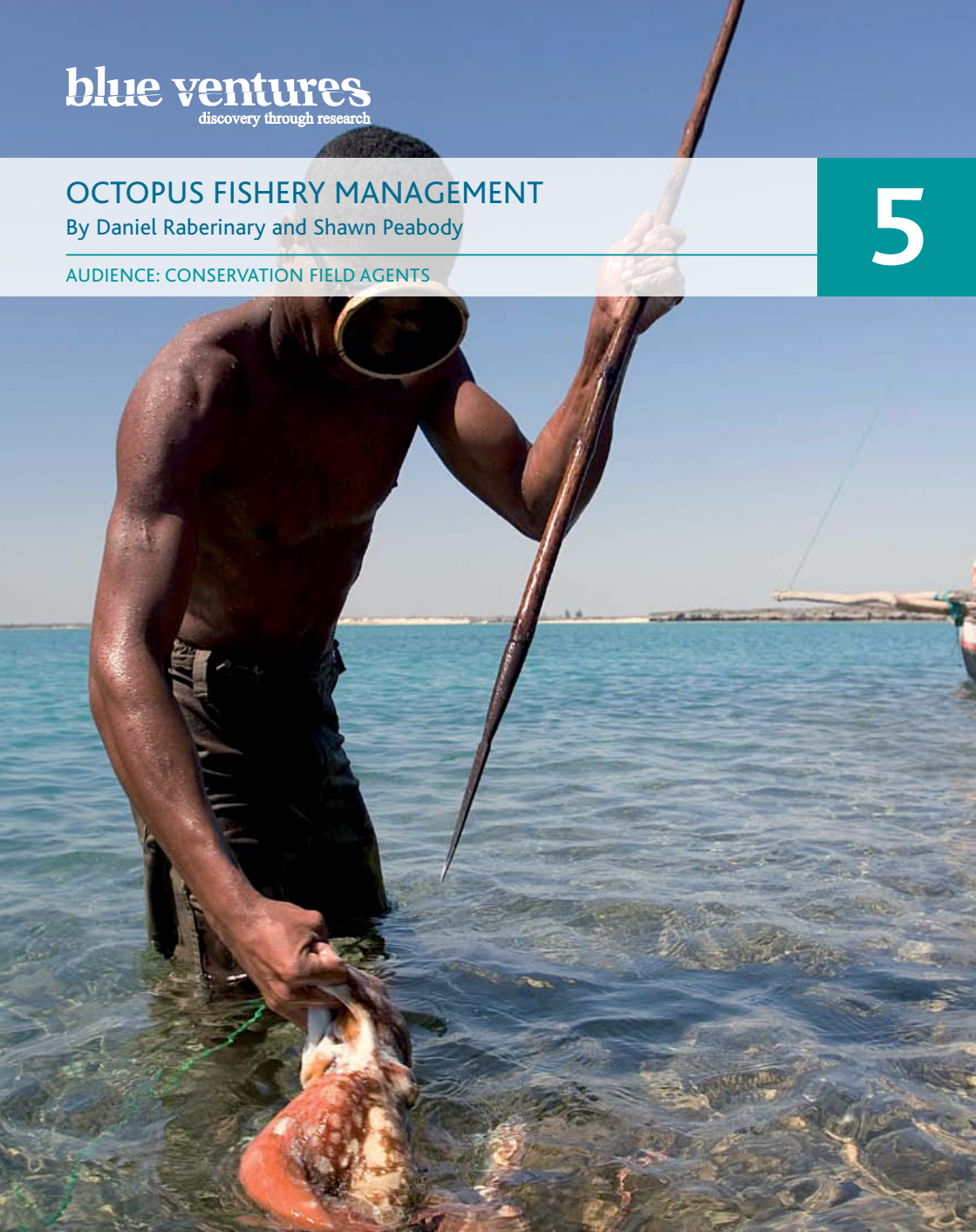


OCTOPUS FISHERY MANAGEMENT

By Daniel Raberinary and Shawn Peabody

AUDIENCE: CONSERVATION FIELD AGENTS

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Introduction

There are three species of octopus found in the Western Indian Ocean region *Octopus cyanea*, *Octopus aeginae* and *Octopus macropus*. In the southwest of Madagascar *O. cyanea* is the most abundant species and the only species that is commonly exported by fisheries companies. *O. cyanea* lives exclusively in areas with coral reef substrate, and is predominantly fished on areas of reef flat during low spring tides. Octopus spend most of their lives in holes in the reef where they lay eggs and hide during the night. During the day, they come out from their holes to hunt but do not usually stray far.

Male and female octopus differ in several important ways. To ensure long term sustainability of octopus stocks we need to focus on the conservation of female individuals. A population that has many

females and a few males will not necessarily reduce in size because one male can mate with several females. However, many males and a few females will result in a dramatic decline in the size of the stock, as females are responsible for laying eggs and caring for them until they hatch. A reduction in the number of females, usually as a result of overfishing, will lead to a decline in octopus. Male and female octopus can be distinguished by studying the 'third right arm', the third tentacle from the front on the right hand side. In males this tentacle is adapted for reproduction and is generally slightly shorter and thicker than on female individuals (see figure 1).

O. cyanea spends most of its life in shallow reef areas, but move to deeper zones of the edge of the reef when they are ready to spawn and lay their eggs. Octopus are one of the fastest growing marine animals. Females reach maturity at around 1.8 kg at approximately 10 months after hatching, though mature females have been found at weights as little as 500 g. Males mature much faster than females, potentially reaching maturity at as little as 350 g. Female octopus lay eggs only once before dying and neither males nor females live more than two years. Due to their fast growth, successful management efforts can achieve short-term increases in catches in as little as three months. Protection of egg-laying females and juveniles during periods of high growth will result in more and larger octopus catches.



Figure 1:
The difference between the 'third right arm' of a male octopus (top) and female octopus (bottom).

Protection of octopus habitat will also lead to increases in other marine animals, including corals, in those areas.

This handbook aims to help field technicians teach fishing communities about octopus management techniques, especially temporary octopus reserves. The text below has been designed to give technicians a solid, yet simplified scientific background from which they can teach and encourage local communities to implement seasonal closures. In addition to this text, a colour comic has been included to help present much of this information to communities and school children.

Octopus fishing techniques

Fishing materials

Spears and harpoons are the most common gear used to hunt octopus. Both tools are used to pry the octopus out of its hole. Once freed from the hole, the octopus is killed with a quick strike to the head with a wooden club. Local sailing canoes (pirogues) are often used to transport people to reef areas, but fishing is usually done by divers or fishers that walk along the reef flat.

Method of capture

Octopus are hunted in three different ways in southwest Madagascar.

Gleaning: Women and children, and sometimes men, will walk along reef flats with a spear at low tide searching for octopus holes.

Diving: Men dive deeper areas of reef flats or hunt for octopus at high tide using a mask and snorkel and a spear or harpoon.

Cruising: During times when the water is exceptionally clear, octopus can be sighted from a pirogue as it moves slowly over areas of reef flat. When an octopus is spotted, men will dive into the water with a spear to harvest it.

Fishers look for octopus dens in the reef flat. Holes of a suitable size are often marked by middens near the entrance (small piles of stones and discarded bi-valve shells). All of the fishing methods listed above for finding octopus then employ the following technique to harvest the octopus. The holes are prodded with a spear to see if there is an octopus present. If there is an octopus present it will generally wrap its tentacles around the spear or otherwise try to push the spear out. The octopus can then usually be dug out of the hole by slowly twisting the spear until the tentacles become entangled or until the body of the octopus is pierced. The spear can then be removed from the hole with the octopus attached. If the octopus has dug deep into the hole and cannot be dug out, fishers will often use a second spear or a pick to break up the coral around the hole to release the octopus.

The introduction of new octopus fishing techniques

Traditional fishing techniques for octopus, especially gleaning, are very destructive to coral reef habitats as people crush coral under their feet as they walk over the reef. The method for capturing the octopus using a pick or spear to break apart octopus holes destroys



future octopus habitat and also kills corals that may be adjacent to octopus holes.

Alternative fishing techniques do exist in other parts of the world for different octopus species, including octopus lures and octopus traps or pots. Lures and pots allow for the capture of octopus without the collateral damage to habitat. These techniques have been widely adopted for *Octopus vulgaris* in the Mediterranean Sea, but are still under trial for *O. cyanea*. The benefit of pots and traps is that the reef is not disturbed by fishers walking on the reef, but has the potential to over-stress the fishery because a greater proportion of mature females may be caught in pots at depth. Free diving and gleaning are likely to have a much smaller impact on mature females because octopus brooding dens are usually located at depths inaccessible to these fishers. Therefore the introduction of new harvesting methods should be done with great care for brooding populations and will probably only be beneficial to the ecosystem in places where coral cover in the octopus habitats is high and so threatened by gleaning.

Habitat destruction

Picks

Picks are used by fishers to extract octopus that will not easily come out of their holes. This is more common when female octopus are brooding and have eggs to protect. It is best not to harvest brooding females because they are so important to the regeneration

of stocks. The use of picks not only destroys habitat, but also enables the hunting of brooding females. It is therefore a good idea from a management perspective to ban the use of picks in octopus fishing.

Gleaning

Divers can hunt octopus without walking on coral, but gleaning fishers can not help the destruction caused by their feet. Fragile branching corals and soft corals are most affected by gleaning but other hard corals can also be severely damaged. It should be noted however, that octopus are most frequently hunted on reef flats that have already been damaged by years of gleaning on foot. In these areas, gleaning may not cause much additional damage. The wide scale adoption of new fishing techniques that eliminate gleaning, or large, permanent marine reserves will allow reef flats to recover. However, degraded reef flats that are often fished for octopus are not degraded further by gleaning provided fishers do not destroy coral deliberately to catch octopus which are hiding.

Octopus biology

The life cycle of octopus

Eggs and hatching

Octopus lay eggs in long strings which are suspended from the roofs of their octopus hole. For two weeks after they are laid until hatching, they are cleaned by the mother octopus, who will not leave the hole during this two week period. After hatching, the tiny pin-head sized octopus are dispersed over





a wide area of potentially several hundred kilometres, as they float through the water and are carried by currents. For four to eight weeks, the juvenile octopus remain dispersed throughout the water column before returning to coral reef areas. When they return to the reef they are still very small, weighing 70 –100 g.

Maturation

After arriving on the reef flat, juvenile octopus tend to seek out small holes in the shallowest areas of the reef flat where the water is warm. These areas provide protection from pelagic predators such as sharks, marine mammals and large fish which cannot readily live in shallow areas, and also have an abundance of food such as reef crustaceans and molluscs.

As the octopus get larger (>300 g), they begin to move to deeper, cooler areas of the reef flat where their rate of growth dramatically increases.

Reproduction

Female octopus reach maturity at between 1,000 and 1,800 g. This weight is variable, and female maturity is linked to ecological conditions rather than a desired weight. When a female matures she will retreat to a hole at deeper parts of the reef, seal the hole with small stones and lay eggs. The number of eggs laid is dependent on the size of the octopus (which depends on its health, age, food acquired) but normally range from 200,000 to 500,000.

Male octopus reach maturity at approximately 500 g. Males can mate with more than one

female and continue to search for mates until they reach an age of 12-15 months when they eventually stop eating and die. Most octopus reach a size of 5-6 kg before death but some have been recorded as large as 9 kg. For a summary of the lifecycle presented in this section, refer to the associated comic which shows the life stages of the octopus with time periods and weights.

Reserves

Marine reserves are areas of the sea which are closed to fishing on either a temporary or permanent basis. Alternatively a marine reserve may just impose gear, size or quota restrictions on fishers. Octopus reserves are usually temporary, lasting three to six months, but longer reserves, or permanent reserves are also possible. Due to the quick life cycle of octopus, short reserves still result in substantial benefits to the long-term sustainability of stocks and in the productivity of the fishery. Reserves may be closed to octopus fishing only, or as is common in the southwest of Madagascar, closed to all fishing activities.

Closures should be managed by local communities where everyone has a say in the choice of reserve sites, the length of closure, and the methods of enforcement and fines. Communities may post a guardian at the site or simply keep an eye on each other.

There are two distinct periods when temporary octopus reserves can be implemented to improve octopus catch and the long-term

sustainability of the fishery. These periods correlate to the periods when most female octopus are brooding and then several months later, when small octopus have returned to the reef flat and are rapidly increasing in size towards sexual maturity.

Brooding reserves

Closures during the period when large numbers of female octopus are brooding ensure sustainability of the fishery by increasing the number of juveniles that hatch and are spread throughout the region. As stated earlier, a single female octopus can produce up to 500,000 eggs. Protecting brooding octopus therefore has the potential to increase the production of juveniles dependent on subsequent natural losses from predation and strong currents, which carry larvae too far away from reef areas. Additionally, due to the wide dispersal of juveniles, it is unlikely that juveniles return to the reef flat where they hatched. To maximise benefits, brooding reserves should be repeated each year and should be as large as possible. For long-term regional stock management, these closures are probably more important than closures during the rapid growth and maturation season.

While the main purpose of these reserves is to protect the long-term sustainability of the stock, the closures also result in substantial increases in production. Not all octopus brood at the same time so while protecting brooding females, the reserve will also allow for non-brooding females and males to

grow to a larger size. It should also be noted that when reserves are closed to all kinds of fishing, they will also protect other species including fish and squid, potentially helping to increase their stocks too.

In the southwest of Madagascar, the primary brooding period is thought to be between mid-October and mid-February. The community often decides to hold reserves for only a part of this period (often November to mid-February) preferring to reduce the benefits of the reserve in order to have a longer fishing season before the closures begin. Studies into the reproductive cycle of the local octopus populations are vital before selection of the closure period as timing of spawning and recruitment peaks is known to vary throughout the Western Indian Ocean region.

The National Closure for octopus in west Madagascar is December 1st – February 1st. This short closure will likely produce benefits to the long-term sustainability of the fishery, though is unlikely to be as effective as longer closures. The law came into effect in 2006 and may be revised in the coming years to encompass a greater proportion of the main brooding season.

Recruitment reserves

Reserves held for three to four months and start when large numbers of juveniles appear on the reefs (June in southwest Madagascar), can greatly boost octopus catch for fishers. By protecting juveniles as they return to the reefs, until they grow into mature adults, greater numbers and larger octopus



are captured by fishers. Without reserves, juveniles are often killed or scared into deeper waters by fishers. The reserves prevent this from happening resulting in more juveniles developing into large octopus and staying on the reef top where fishers can easily capture them.

Reserve management

Reserve committee

After a community agrees to implement an octopus reserve, they should elect a reserve committee. This committee should include representatives from the major groups or families in the village and should also include women. The committee will be responsible for investigating claims of poaching, spreading messages to the community related to the reserve and assist with organising the opening day ceremonies (speeches by elders and NGO technicians, traditional ceremony or prayer, opening whistle). The committees also promote participation by giving each group a voice in the running of the reserve. The buy-in of elders will promote compliance with the rules by the larger community.

Prevention of theft

The community is responsible for ensuring the security of reserves from poachers. Traditional conflict resolution methods can generally be adapted for use in settling disputes between members of the same community, or from outside. The reserve committees should be trained to investigate reports of theft and to lead conflict resolution efforts in cases of theft. In some instances, communities

have decided to appoint some people as guardians and give them a small wage. This can be helpful in situations where community members are reluctant to report poaching because of close family ties or an aversion to open conflict.

Marking the reserve area

It is important to delimitate the reserve area either with buoys or flags and signs. Marking the area will help enforcement and also prevent theft as it improves the certainty of the witness that someone is in the reserve area. Clear reserve delimitation also provides a visible reminder to the would-be poacher that they are breaking the law; poachers cannot claim that they "didn't hear" about the reserve or that they "didn't know where the boundaries were."

Enforcing the rules

Reserves should increase community cooperation and unity, not cause conflict. Inevitably however, there will be conflicts as some people break the rules, poach from reserves and get caught. It is important that these conflicts are resolved quickly and to the satisfaction of everyone in the community. Long standing disputes between families or individuals caused by reserves should not be allowed to continue. Community elders, sometimes under the guidance of NGO technicians, should work to resolve conflicts whenever they occur.

Before bringing the issue to a community meeting or meeting of the community elders, a few leaders of the village should

approach the accused and listen to his story. False accusations are not impossible and it is important to give the accused the impression of a fair and honest investigation. After the accused and accuser have been interviewed and other witnesses consulted, the reserve committee should either bring the issue to the village council or let the issue go (if the accusation is found to be baseless).

The community rules must be respected. The first person caught may be let go without a fine but thereafter, communities should be pushed to enforce their rules. Even a very small fine sends a message that the community will not tolerate theft. The act of theft should be phrased as much as possible as an act of disrespect toward the entire community and the elders, and therefore the entire community needs to be compensated. At the same time, the poacher should be allowed to save face as much as possible so as not to create a lasting anger toward the community or the NGO. There is a fine line between these two goals and communities will struggle to make the right decisions at first. More important than any single poacher or fine is that the community gain trust in the legitimacy and fairness of the conflict resolution system.

Conditions affecting results of reserves

A number of conditions may affect the outcome of results. Disappointing results with a single opening should not be taken as a sign that octopus reserves will not work in an area. Conversely, good results do not mean that

further improvements cannot be undertaken. The various factors that may affect reserve success are described below. It is important to note however, that there is not one best way to implement a reserve. Many of the factors represent trade-offs between benefits and costs. For example, a longer reserve closure will result in more production, but may make life for octopus fishers harder during the closure period. The best choice is that which balances the needs of fishers during the closure with the medium-term benefit of increased production on opening day, and the long-term benefits that larger reserves have on the regional fishery.

Timing of closure

Timing can have a large effect on the production of reserves. As discussed earlier, brooding closures and recruitment closures produce different benefits of production and long-term fishery sustainability. Reserves during other periods (other than brooding and recruitment) will also produce increases in catch, but not as much as brooding and recruitment reserves. It is possible for badly timed reserves to have negative effects on the fishery. An example of this would be if a reserve opened during the peak brooding season, as large numbers of mature females would be caught which would greatly reduce the number of juveniles released into the area. Openings timed when many juveniles are present on the reefs will also produce negative results in the medium and long-term as many juveniles will be killed or scared



into deeper areas where they are more easily attacked by predators.

Reserve duration

To ensure good results from the reserve, closures should last for a minimum of two months. Conversely, closures lasting more than six months risk losing the support of fishers. Additionally, due to their short life span, closures lasting more than eight months may not produce more octopus as larger octopus will die of natural causes after spawning has occurred. Longer reserves will however boost the numbers of juveniles released into the area and will produce fisheries benefits to other areas.

In the Velondriake Locally-Managed Marine Area (LMMA), southwest Madagascar, closures of 10-12 weeks have been seen to produce dramatic production results and are considered to be a suitable length so that fishers do not see the loss of that site to fishing during the closure period as too much of a sacrifice.

Quality of the reserve site

The potential for octopus production in an area is highly dependent on the reef habitat. Marginal areas that naturally produce only low levels of octopus catch will not dramatically improve due to the implementation of a reserve. Reef and rubble areas that are too deep, too shallow or too sandy will not produce great results from reserves. Areas that are the right depth and have rocky or coralline substrate respond best to octopus reserves because these are

the preferred areas for octopus. While good coral cover is good for octopus populations, it is not a requirement. Many reef flats are already highly degraded and still have high octopus populations. In fact, it may be necessary to consider that reserves should not be implemented on areas with high coral cover because the concentration of fishers on opening day will increase destruction of coral as a result of gleaning. Reserves are more suited to degraded reef flats that already exhibit low levels of coral cover.

Surface area of the reserve

Larger reserves will produce more octopus as there is more undisturbed habitat to provide shelter to the octopus. Larger reserves are better than small reserves because they ensure that more fishers will acquire a good catch. Additionally, a small reserve may intensify destruction of octopus habitat when large numbers of people crush the small area of coral substrate on opening day.

Poaching

Poaching can dramatically decrease the production of reserves on opening day. Poaching concentrates the benefits of the reserves into the hands of a small number of thieves while also scaring octopus out of the reserve and into deeper water. With experience, communities can learn to establish strong social norms against poaching while improving systems of reporting and enforcing fines.

Conclusion

With proper management it is possible to increase the sustainability of the octopus fishery while also increasing production of octopus. Successful reserves can improve the standard of living of communities, improve cooperation and democratic decision making, while fostering leadership among community members. Unsuccessful reserves can also lead to community division and discouragement with natural resource management. In order to encourage the successful implementation of reserves, communities need to understand how reserves work. This handbook is a tool to assist field agents and community leaders in teaching fishers about reserves and their benefits. It is hoped that this guide will be used repeatedly to facilitate discussions and further understanding of the benefits of octopus fishery management. Success can only be achieved when everyone in the community works together, which is only possible when everyone understands what they are working towards and why.

How to use this handbook

This guide is intended as a reference and training guide for conservation field agents and community leaders. The included comic is intended as a tool for explaining to communities and students the scientific knowledge that is needed for octopus management. The comic should be shown to communities to generate interest and spread knowledge about octopus management and prompt discussions about the possibility of trialling temporary octopus reserves in their region.

OCTOPUS MANAGEMENT

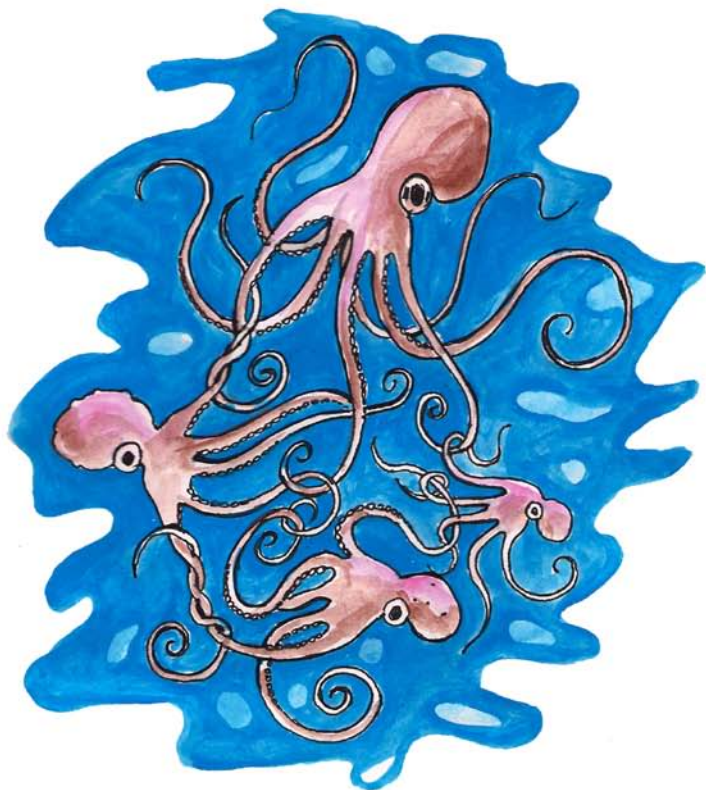
INDIAN OCEAN COMMUNITY CONSERVATION HANDBOOK 5

OCTOPUS FISHERY MANAGEMENT

BY DANIEL RABERINAR

AUDIENCE: STUDENTS, COMMUNITY MEMBERS

TRANSLATOR: SHAWN PEABODY ARTWORK: NADY RATSIMBAZAFY



blue ventures
discovery through research

MacArthur
Foundation

 Sida



OCTOPUS LIFE CYCLE

3. AT 5-6 MONTHS THEY BEGIN TO RETURN TO THE REEFS.

2. YOUNG ARE AS SMALL AS A THUMBNAIL. THEY DRIFT THROUGH THE WATER AS FAR AS A KILOMETRE OUT TO SEA.

4

4. AS JUVENILES THEY LIVE ON THE SHALLOW PARTS OF THE REEF EATING CRUSTACEANS AND HIDING IN THE RUBBLE.

5

5. AFTER 8-10 MONTHS THE FEMALES LAY THEIR EGGS IN HOLES IN DEEPER PARTS OF THE REEF.

1

1. EGGS HATCH IN HOLE WITH MOTHER, YOUNG ARE DISPERSED BY WATER CURRENTS.

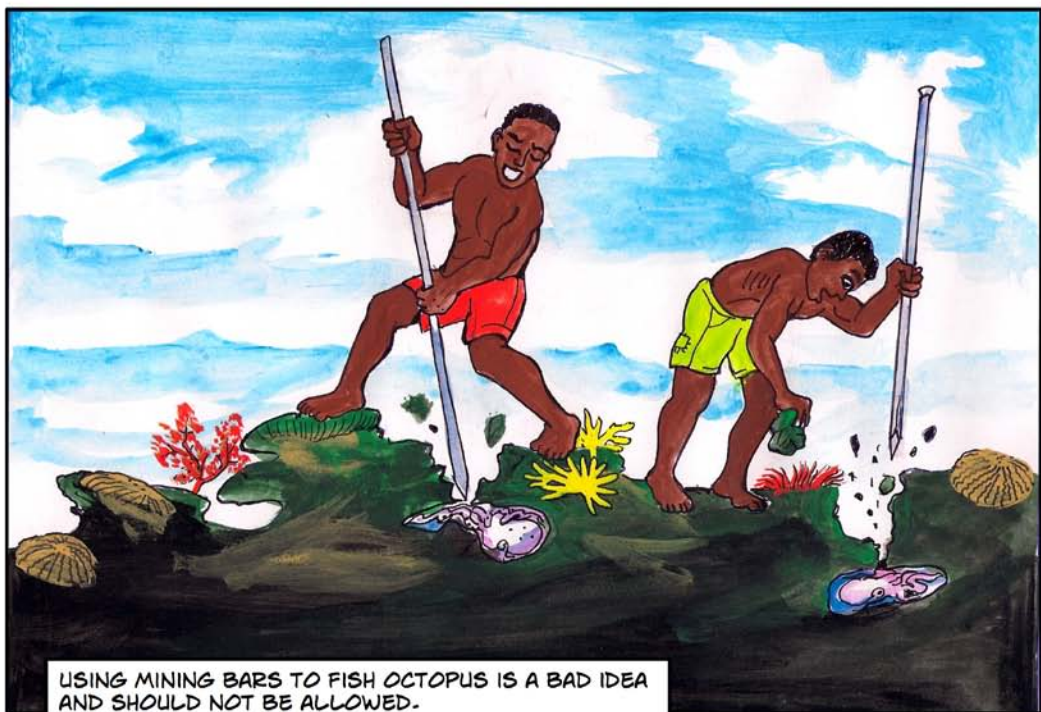
OCTOPUS SPEND ALMOST ALL OF THEIR LIVES ON RUBBLY PARTS OF THE REEF FLAT. THEY HUNT, ESPECIALLY DURING THE DAY, EATING CRUSTACEANS AND SMALL FISH. THEY LIVE ONLY 12- 24 MONTHS AND HAVE MANY YOUNG.

DESPITE HAVING MANY YOUNG, IT IS POSSIBLE FOR OCTOPUS TO BECOME SCARCE AND EVEN EXTINCT IN A REGION.

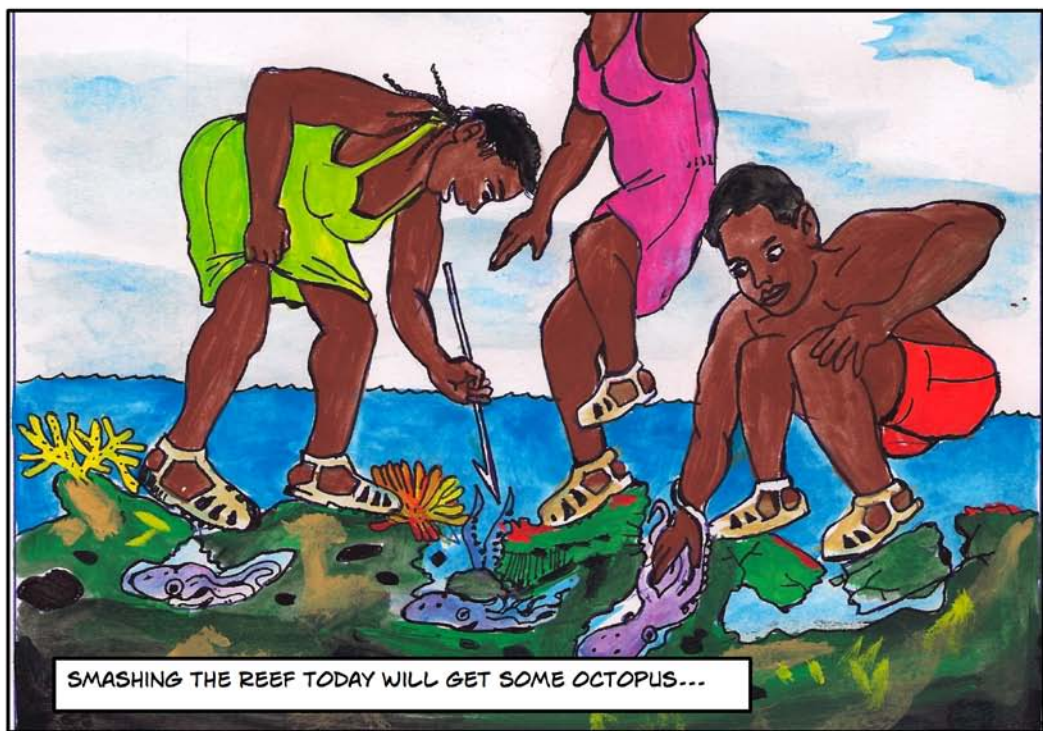


BY UNDERSTANDING THE LIFE CYCLE OF OCTOPUS, WE CAN LEARN HOW TO MANAGE THEM SO THAT THEY DON'T GO EXTINCT AND SO THEY CONTINUE TO PROVIDE INCOME TO FISHERS.

THE FIRST THING TO KNOW ABOUT OCTOPUS MANAGEMENT IS THAT THE REEF IS VERY IMPORTANT TO THEM. A DESTROYED REEF WILL NOT SUPPORT MANY OCTOPUS BECAUSE THERE WON'T BE PLACES TO HIDE OR FOOD TO EAT.




USING MINING BARS TO FISH OCTOPUS IS A BAD IDEA AND SHOULD NOT BE ALLOWED.






ANOTHER THING TO KNOW IS THAT FOR A FEW MONTHS EVERY YEAR, FEMALE OCTOPUS CARE FOR THEIR EGGS IN THEIR HOLES AND DON'T COME OUT.

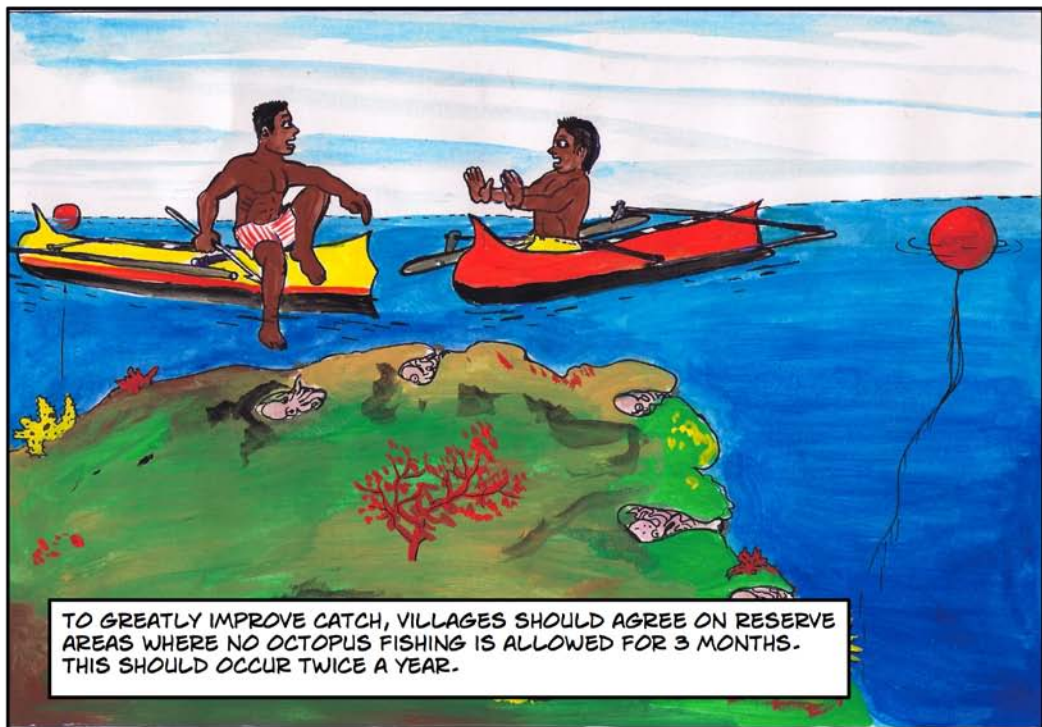


IF LEFT ALONE, THEY WILL PRODUCE MANY OFFSPRING WHICH CAN BE CAUGHT MONTHS LATER WHEN THEY ARE BIG.



BUT IF CAUGHT THE EGGS WILL BE DESTROYED AND THERE WILL BE MANY LESS OCTOPUS AVAILABLE TO BE CAUGHT MONTHS LATER.

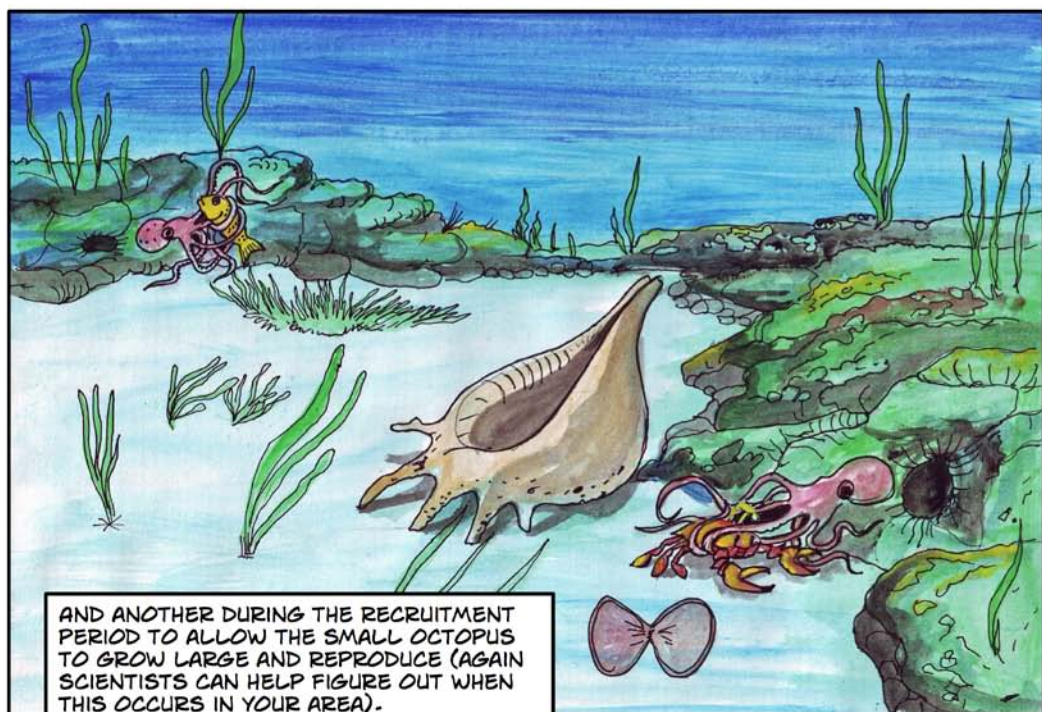
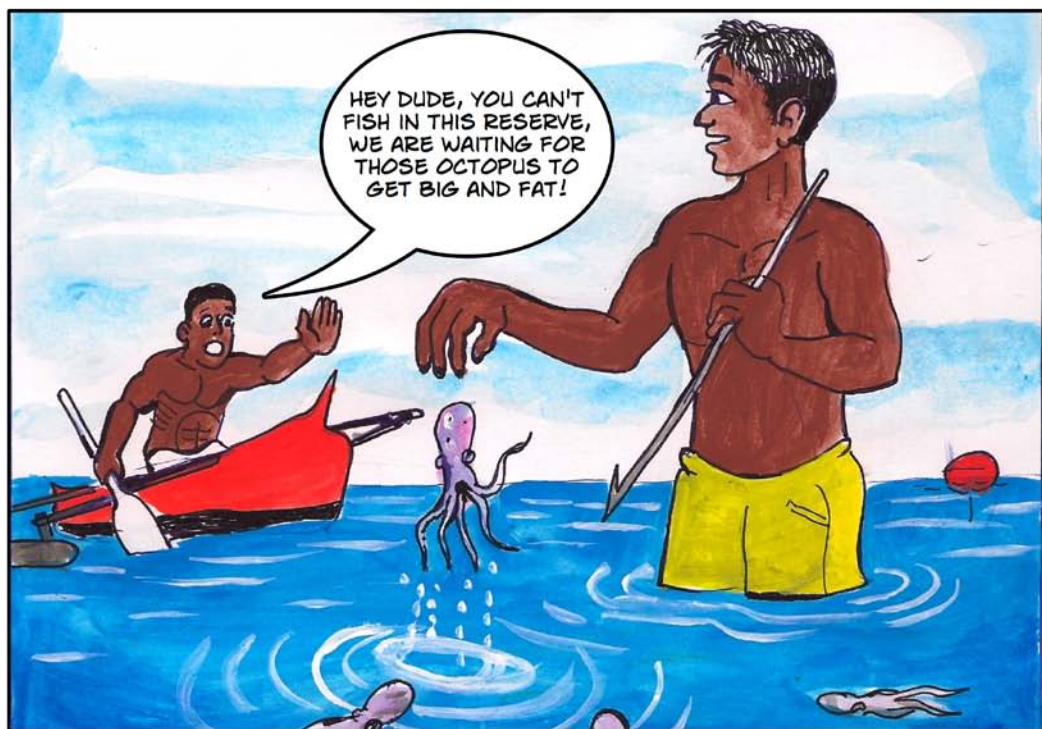




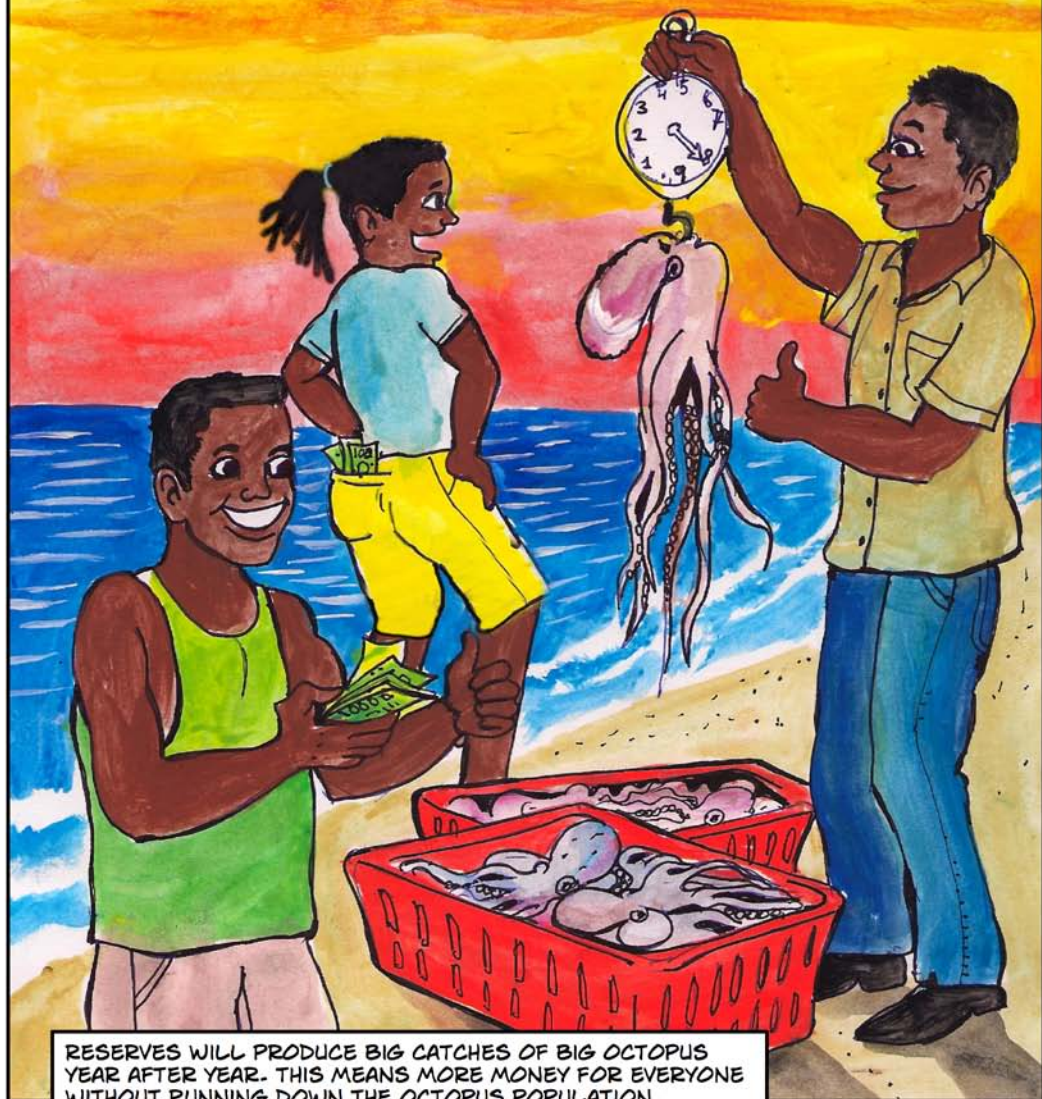
TO GREATLY IMPROVE CATCH, VILLAGES SHOULD AGREE ON RESERVE AREAS WHERE NO OCTOPUS FISHING IS ALLOWED FOR 3 MONTHS. THIS SHOULD OCCUR TWICE A YEAR.



ONCE DURING THE SPAWNING PERIOD TO ENSURE THAT THE EGGS HATCH AND THERE WILL BE LOTS OF OCTOPUS NEXT YEAR (SCIENTISTS SHOULD BE ABLE TO HELP DETERMINE THE RIGHT TIMING IN YOUR AREA).



RESERVE OPENING



RESERVES WILL PRODUCE BIG CATCHES OF BIG OCTOPUS YEAR AFTER YEAR. THIS MEANS MORE MONEY FOR EVERYONE WITHOUT RUNNING DOWN THE OCTOPUS POPULATION.



IF WE PROTECT THE REEFS AND
IMPLEMENT RESERVES TWICE A YEAR
THERE WILL ALWAYS BE OCTOPUS
FOR EVERYONE AND THE FISHERS' WAY
OF LIFE CAN CONTINUE.

END

This work was supported in part by the Western Indian Ocean Marine Science Association (WIOMSA), under Grant No: MASMA/books/05/08. The views expressed herein are those of the author(s) and do not necessarily reflect the views of WIOMSA and Sida. WIOMSA and Sida are authorised to produce and distribute reprints for educational purposes notwithstanding any copyright notation that may appear hereon.

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Level 2 Annex, Omnibus Business Centre
39 - 41 North Road, London N7 9DP, UK
Tel: +44 (0)20 7697 8598
Fax: +44 (0)800 066 4032
Email: info@blueventures.org
www.blueventures.org