World Bank. Indonesian Government support would be essential to legitimise the agency's activities. This support would not only acknowledge internationally the importance of such a programme in Indonesia, but also help to fulfil its financial needs to make the agency capable of working independently.

By proposing that international organisations help establish such an agency, I do not mean that I do not believe in the Indonesian Government's ability to act constructively in fisheries matters. The trawler ban in 1980 is undeniable proof of the Government's successful intervention in fisheries (without the involvement of any outside agency; see Bailey, 1997).

However, the cost, of establishing the agency proposed above, if borne by the Government, would be considered prohibitive in present economic conditions. But if we wait until the Government develops the ability to manage these fisheries effectively, I am afraid that destructive fishing practices such as cyanide fishing will have already ruined Indonesia's nearshore marine resources, and further impoverished its many fishing communities.

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# Combating destructive fishing practices in Komodo National Park: Ban the hookah compressor!


*by Jos S. Pet* [1] *& Rili H. Djohani* [1]
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*In efforts to quantify and combat destructive fishing practices in Komodo National Park (KNP), The Nature Conservancy has learned that patterns of marine resource use are complex. While patrols have successfully decreased the incidence of large-scale dynamite and cyanide fishing, considerable further protection is needed before the park is truly a Marine Reserve. Currently, live reef fish have priority for places on the airplane out of Labuan Bajo, while visitors who come to see the Komodo dragon and the world's richest coral and fish life must take a 12-hour ferry! The demersal fish stocks and coral reefs, which have suffered considerable damage already, continue to be threatened by a variety of destructive methods, including the use of hookah compressors, reef gleaning, fish traps, gillnets and bottom lines. In particular, banning the use of hookah compressors, which are used in both dynamite and cyanide fishing, is recommended. On paper, legislation protects all animals, plants and habitats within the National Park, yet park authorities and police officers are not aware of the destructive impact of commonly-practised fishing methods like compressor (hookah) fishing.*


## 1. Komodo National Park

Komodo National Park (see Figure 1 on next page) is located between the islands of Sumbawa and Flores in Indonesia. The park was established in 1980, and has a management unit with 88 staff. The park was declared a Man and Biosphere Reserve and a World Heritage Site in 1986. KNP includes three major islands, Komodo, Rinca and Padar, and numerous smaller islands, together totalling 41 000 ha of land. KNP is famous as the habitat of


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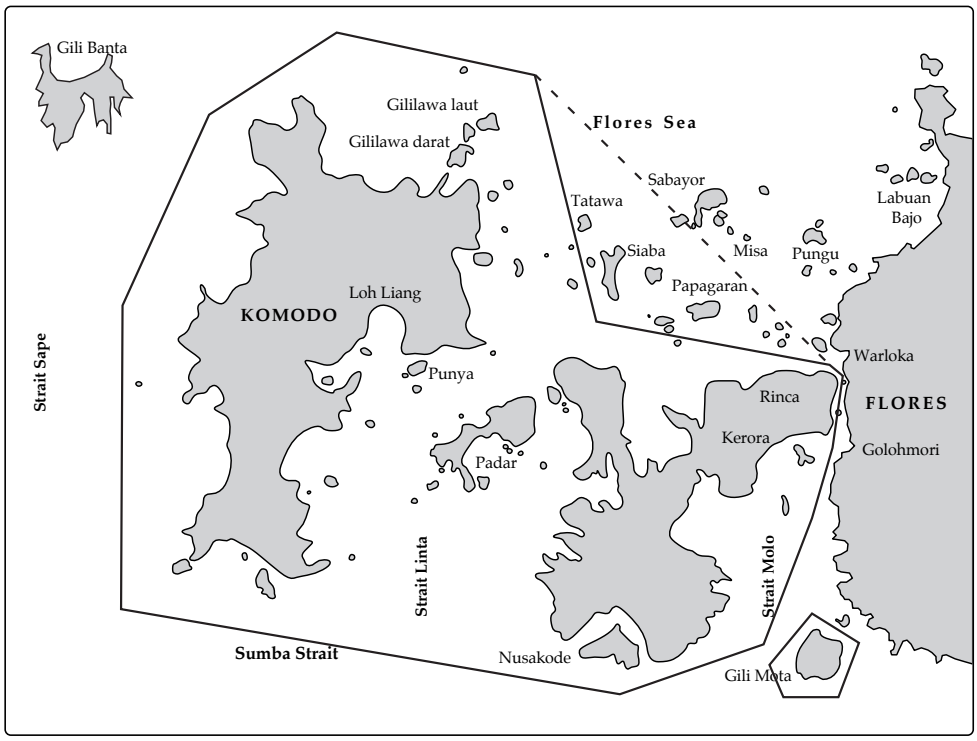



**Figure 1:** **Komodo National Park (KNP)**

the Komodo dragon, *Varanus komodoensis*, but it is also one of the richest areas for coral biodiversity in Indonesia, and has one of the richest fish faunas in the world with an estimated 1000 species. The park contains 132 000 ha of marine waters, with a high diversity of habitats including coral reefs, rocky shores, sea grass beds, sandy bays and mangroves.

There are presently some 2300 inhabitants living within the park, spread out over three settlements (Komodo, Rinca and Kerora). An estimated 15 000 people live in fishing villages directly surrounding the park. Park inhabitants mainly derive their income from a pelagic lift net ('bagan') fishery (95% of their yield comes from this gear type) which is targeting squid and small schooling pelagic fish.

Additional income and food is derived from 'meting', a method whereby corals are destroyed in search of marine invertebrates. This method includes practices ranging from walking and searching with a stick on the reef flats at low tide, to diving with compressors or dive tanks, using steel bars to break the corals. In our experience, all of these methods are quite destructive. In its simplest version, 'meting' results in the trampling of live corals and other organisms and the breaking of corals with sticks and other tools in search of a variety of invertebrates (abalone has been the prime target in recent years). The reef flats are cleaned out and coral rubble remains.

Non-inhabitant fishermen use pelagic lift nets and a variety of other gear types in KNP waters. Although the pelagic lift net forms the most important gear type in KNP in terms of yield, other fishing methods form a major threat to the Park's marine resources. Destructive fishing practices such as dynamite and cyanide fishing (with the use of hookah compressors), reef gleaning and local overfishing destroy both the habitat and the targeted resource itself (fish and invertebrate stocks).

## 2. A management plan for the marine component of Komodo National Park

Upon request from the Ministry of Forestry, The Nature Conservancy (TNC) is assisting the National Park's authority with the management of the marine component of the park. In October 1996, a draft management plan was completed for the marine component of KNP. The objective of the park management is 'To protect the demersal and sedentary marine life forms of Komodo National Park, their ecosystems and their habitats, and to maintain the natural population and community structures of these life forms'. Key modules in the management plan are:

I. Designation of a marine park zonation plan and specification of regulations.
II. Implementation of a cross-sectoral enforcement programme with park authorities, police,

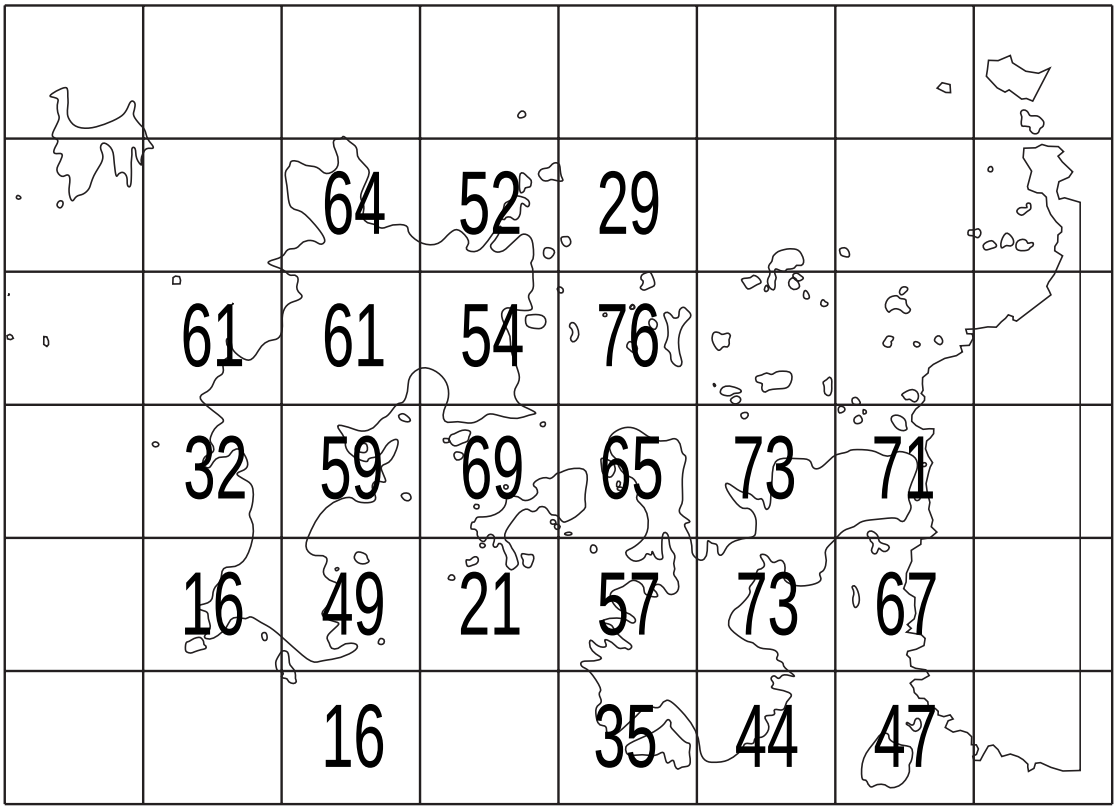



**Figure 2:** **Results of coral reef monitoring, 1996**

army, fisheries service, local government and communities.

III. Involvement of local communities through: (1) community awareness programmes, (2) participatory planning, and (3) establishment of a local NGO.

IV. Building of partnerships with private enterprise to develop alternative livelihoods in a variety of compatible enterprises such as: ecotourism, mariculture and fisheries for large coastal pelagic species.

V. Implementation of an environmental mooring buoy programme to prevent anchor damage from boats bringing tourists to popular snorkelling and diving sites.

VI. Implementation of a comprehensive monitoring and research programme to evaluate management measures and suggest the most desirable and effective interventions. The monitoring and research programme includes the following sub-modules:
   a. monitoring of the status of the coral reefs,
   b. monitoring of the status of commercially-targeted fish populations and their spawning aggregation sites,
   c. monitoring of fisheries resource utilisation patterns,
   d. applied research and monitoring of the sustainability of proposed compatible enterprises (alternative livelihoods), and
   e. applied research and monitoring of the effectiveness of different methods to enhance coral reef rehabilitation.

The present paper focuses on the results from monitoring programmes and on the need for effective law enforcement. This focus does not imply that other programme modules are less important, on the contrary, it is our strong belief that the park management will only achieve their goals by implementing a comprehensive programme in which community involvement and alternative livelihood strategies are very important modules. These other two modules will therefore be discussed in separate papers.

## 3. Present status of the resource and patterns in resource utilisation

### *3.1 The coral reefs*

The coral reef monitoring programme covers 185 sites, which are all surveyed every two years and at three different depths. Averages over 25 square mile areas of the park are used to estimate the overall status of the coral reefs (Figure 2).

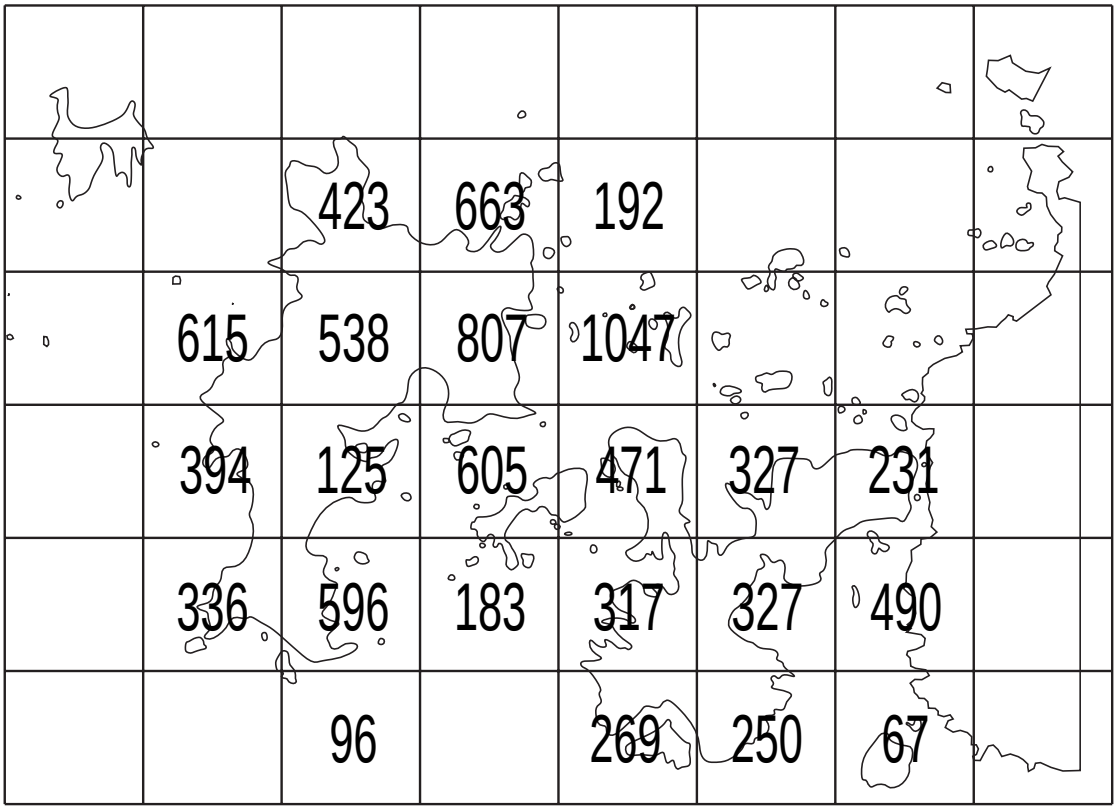



**Figure 3:** **Results of resource utilisation monitoring, 1997**

Results of the 1996 monitoring round show that serious damage has occurred in most areas inside and outside the park. The most heavily affected areas inside the park are found in areas bordering the buffer zone in the north-eastern region of the park, namely the reefs off north-east Komodo, north Padar and north and east Rinca. In all these areas 65 per cent or more of the hard coral was dead in 1996. The least damage (less than 45% mortality) occurs in the south-western and southern areas of the park, with some healthy (hard coral) reefs found especially in the south Komodo and south Padar regions. A few locations in the far north-east of Komodo also remain in good condition. The amount of damage generally increases from south to north and from west to east. Most fishing communities have their settlements on the north-eastern side of the park, except for Sape which is on the west side of the park.

### *3.2 Fish spawning aggregation sites*

By monitoring the size frequencies of a number of commercially-targeted fish species on a number of known aggregation sites, it will be possible to evaluate developments in the fish populations in a cost-effective manner. By identifying mass spawning sites for important fish species it will be possible to select areas which need special protection. A number of aggregation and spawning sites have been positively identified in the north-eastern and south-eastern areas of Komodo. Spawning aggregations of four species of grouper and of Napoleon wrasse were observed to occur in these areas around the month of October. The sites contain concentrations of these species during all months of the year. Many more fish spawning aggregation sites are thought to exist within the borders of Komodo National Park, and additional site surveys will be conducted in October 1998.

### *3.3 Patterns in marine resource utilisation*

A routine patrolling and enforcement programme started on 28 May 1996, with the intention to have two-day patrols covering the entire park area on a weekly basis, and to investigate all capture fisheries activities encountered. The number of incidents of dynamite and cyanide fishing dropped significantly during the first period of intensive patrolling. A reduction of more than 75 per cent was recorded for dynamite incidents, and several arrests were made of fishermen using destructive fishing methods in and around the park.

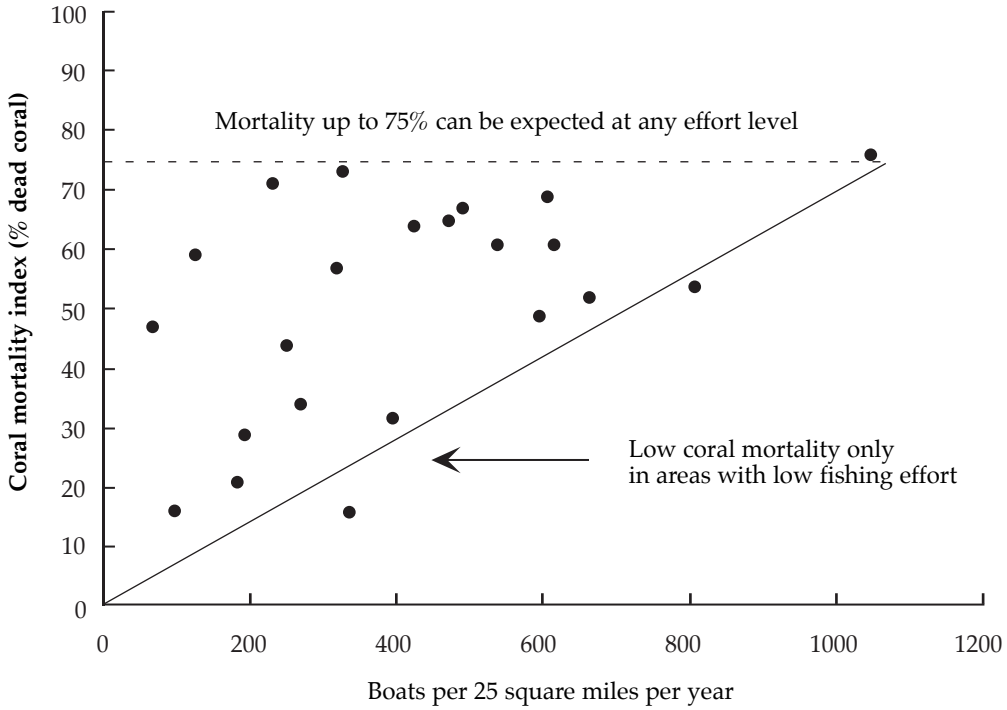



**Figure 4:** **Coral mortality versus total non-bagan fishing effort**

Members of the enforcement team have been trained to record data on resource utilisation patterns during routine patrols in the KNP area. This data includes number, type and origin of fishing crafts, their catches and their distribution in space and time. Each non-bagan (non lift-net) fishing vessel or fishing group encountered during the routine patrols is investigated. Bagan are excluded, since they form a separate type of pelagic fishery which is not considered a threat to the demersal and sedentary marine resources of Komodo National Park. Bagan boats are investigated when they engage in non-bagan activities.

The objective of this monitoring programme is to determine who is doing what, where and when in the park. The database on resource utilisation patterns shows park managers which community groups are involved in which fishing activities, where they fish, and when they fish.

Over time this data will also show any changes in the behaviour of fishermen due to management measures, and it will indicate which groups of fishermen or areas in the park may need extra attention.

Non-bagan fishing effort in the park ranges from less than 300 boats per 25 square miles per year in the south to more than 1000 boats per 25 square miles per year off the coast of north-east Komodo (Figure 3). The area with the highest fishing effort is also the area with the highest coral mortality.

Areas with low coral mortality are typically those areas where fishing effort is low (Figure 4), although high coral mortality is also found in a few areas where fishing effort is relatively low. There are no areas where fishing effort is high and coral mortality low. It is also clear that fishing effort is relatively high in areas where fish spawning aggregation sites are located, and fishing therefore forms a direct threat to the fish species aggregating at these sites.

Communities in the park, the villages of Komodo, Rinca and Kerora, represent only 21 per cent of the non-bagan fishing effort in the park. Communities directly surrounding the park (Mesa, Papagarang, Labuan Bajo and Warloka) represent 36 per cent, communities from Sape (east Sumbawa) represent 29 per cent. Outsiders from further away represent 14 per cent of the effort. Fishermen from Komodo and Rinca are involved in reef gleaning (see Figure 5 on next page), those from outside the park mainly in bottom hook-and-line fishing, gillnetting, compressor and 'bubu' trap fishing.

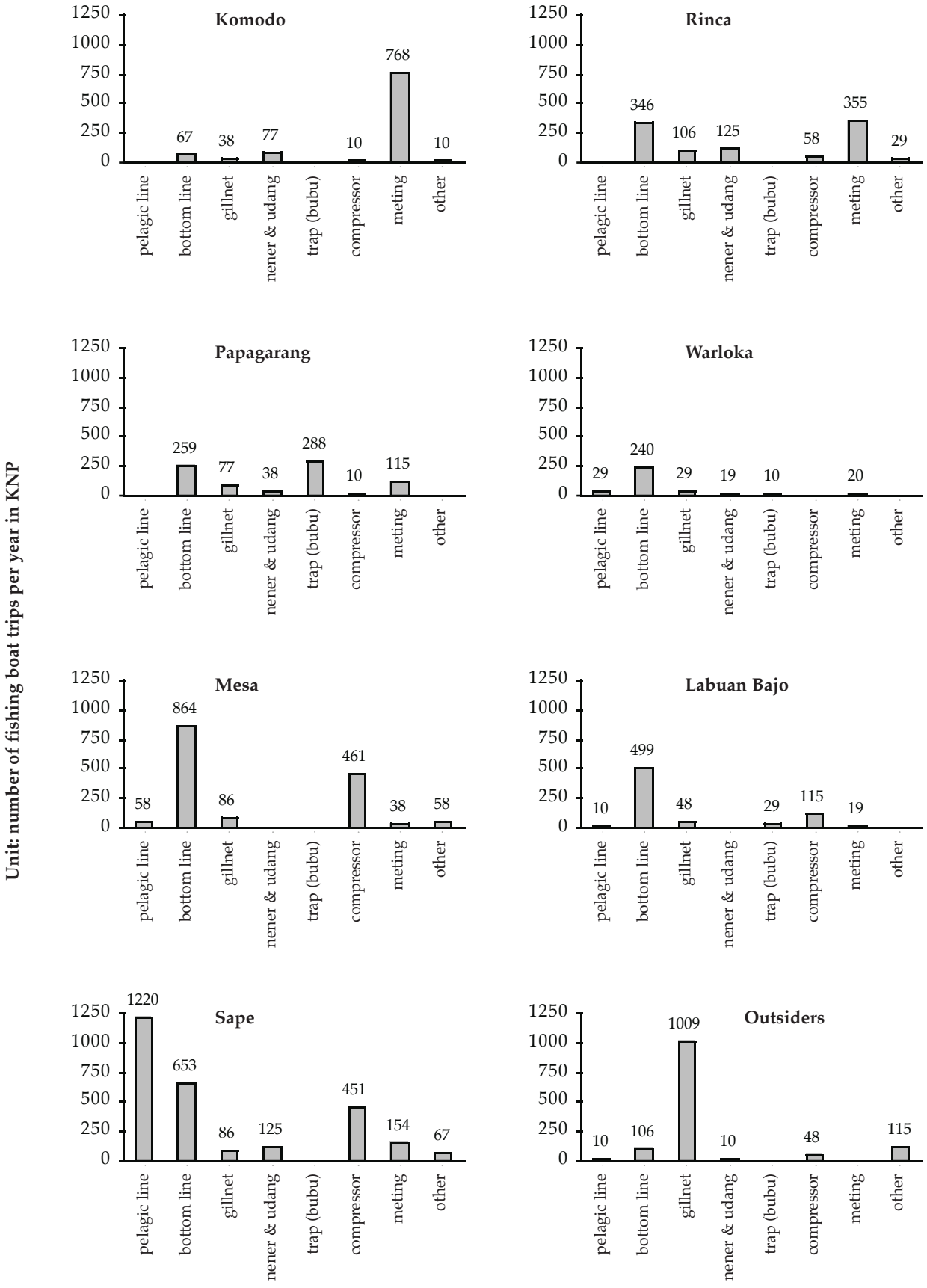



**Figure 5:** **Non-bagan fishing effort per gear type and origin**

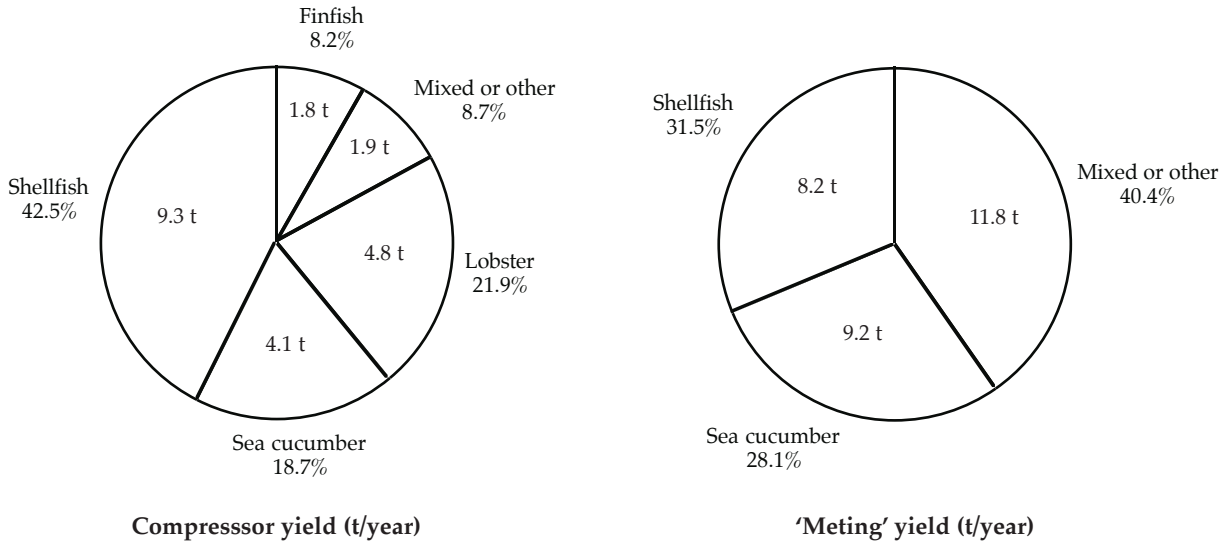



**Figure 6**

**Yield categories per gear type for compressor fishing and 'meting', in KNP, 1997**

Most gear types yield single products except for 'compressor' (hookah) and 'meting' (Figure 6). The latter two gear types typically yield a widely varied catch, ranging from live fish and lobster (often caught with cyanide) to sea cucumber, shellfish (mostly abalone and pearl oyster), coral and seaweed. These two gear types or methods form major threats to the marine ecosystem of Komodo National Park. It should be noted here that dynamite and cyanide fishermen (at least the larger operations) always involve the use of compressors.

Non-destructive and low-impact methods such as pelagic hook-and-line together account for only 18 per cent of the non-bagan catch, whereas the highly destructive methods of 'meting', compressor fishing, trap fishing and 'other methods' (including bomb and cyanide fishing) together account for 34 per cent of the total non-bagan effort. The most common gear types used in the park, are bottom hook-and-line and gillnets. These gear types together account for 48 per cent of total effort in the park, and are direct threats to sedentary fish stocks in the park, especially when they are used in areas where fish are aggregating to spawn. Large amounts of spilled nylon fishing line were encountered at fish spawning aggregation sites, and certain species like square tail coral trout (*Plectropomus aerolatus*), which aggregate on shallow coral reefs, have been decimated on these sites.

The non-bagan yields represent only a small percentage in terms of weight of the total yield (bagan + non-bagan) harvested by inhabitants plus non-inhabitants. It is estimated that around 1000 t of fish, lobster, shrimp, pearl oyster and abalone were harvested from Komodo National Park (by all users combined) in 1997, whereas the yield from bagan was an order of magnitude greater. The exact figure for the total bagan yield from National Park waters is unknown. For park inhabitant alone, non-bagan yields represent only five per cent in terms of weight of the total yield (bagan + non-bagan). Fishermen from Komodo comment that non-bagan activities are disproportionately important to them, however, since the bagan fishery is exploited by middlemen who leave very little of the profits for local fishermen. Freeing the fishermen from the claws of these middlemen, and helping them to gain higher profits from their bagan activities may be an important strategy to keep them from destroying the reefs.

## *4. Destructive fishing methods and law enforcement*

Although the frequency of dynamite fishing in the park has been low during recent years, destructive fishing practices and local overfishing remain a constant threat to the Park's sedentary marine ecosystems. We can not really speak of a 'Marine Reserve' when harvesting, and destruction of marine life is occurring at the present rate in Komodo National Park. We have a long way to go before the KNP waters will be a marine reserve where all living creatures and their habitats are fully protected. The local Fisheries Service, for example, feels that the KNP waters are fishing grounds where yields have to be maximised. Park managers, however, comment that legislation is already in place to protect all animals, plants and their habitats within National Parks in Indonesia. Enforcement of this legislation, however, has not been implemented. Supporting materials from outside sources would help to convince the park authorities of the need of a ban on hookah

compressors. The protection of the marine environment in KNP has to be taken seriously, and the following phases of increasingly strict law enforcement need to be implemented:

I. Remove all large-scale dynamite and cyanide fisheries from within the Park's borders. Large-scale dynamite operations work with big boats and dive crews in canoes with hookah compressors. Large-scale cyanide operations consist of motherships with several work-boats with hookah compressors.
II. Combat large-scale dynamite and cyanide fishing in the buffer zone (north-east of KNP) and further outside the park.
III. Remove small-scale dynamite and cyanide fisheries (with compressors in small boats) from within the Park's borders.
IV. Combat small-scale dynamite and cyanide fishing in the buffer zone and other areas directly adjacent to the park.
V. Prohibit key destructive gear types from within the Park's borders. The most urgent need here is to ban the hookah compressor.
VI. Close the park for demersal gear types like gillnets and bottom hook-and-line. Only by banning the widespread use of gillnets and bottom hook-and-line from the park, starting with a closure of fish-spawning aggregation sites, can sedentary fish stocks truly be protected. Exceptions will have to be made for park inhabitants.
VII. Establish multiple-use zones near settlements in the park, where inhabitant fishermen have exclusive fishing rights to use demersal gear types. The park waters should remain open for pelagic fisheries, preferably with exclusive fishing rights for park inhabitants and neighbouring communities.

In the section below, the different phases are discussed, and examples are given to highlight the specific problems which are encountered while trying to achieve the goals.

### *I. Remove large-scale dynamite and cyanide fisheries from KNP waters*

The first objective is the most easy to achieve once a routine patrolling programme has been installed. Large-scale operations, run by outside fishermen, are simple to identify and have in fact been reduced by more than 80 per cent from Komodo National Park. Serious confrontations took place, especially in 1996. After that, the message had become clear and such operations became rare inside the park. Live-aboard recreational dive vessels still occasionally report bombing in remote corners of the park, and these are sometimes larger operations. If reports come in time, a patrol can be sent out and the bombers can usually be arrested. Large-scale cyanide fishing for aquarium fish is still occasionally encountered, and is difficult to prosecute. Boats from east Java have been chased out of the park on various occasions, but police and park wardens seemed unwilling to make arrests, supposedly since ex-military personnel are present on these boats. *[See Adhuri, p. 12 of this issue, for similar problems elsewhere in Indonesia—Ed.]*

Example from one recent occasion: Our monitoring crew reports two large boats (15 and 20 GT) inside the park, off north-east Komodo. Judging by their design, these boats are from Banyuwangi or Madura (east Java), and they are using hookah compressors, probably fishing for aquarium fish with cyanide. We receive the report at 3 p.m., immediately inform the park authorities and the police and are told to keep one speedboat standing by. We suggest sending two speed boats immediately. The next morning, the KNP authorities and the police send some people to go out after the cyanide boat, using one of our speedboats. The enforcement team reports later that they found the cyanide boats that morning. They were from Banyuwangi and they were fishing with cyanide for aquarium fish. One man is arrested and our speedboat driver finds some eight to 10 litres of cyanide solution, which is taken in as evidence. One person is arrested and placed in the speedboat. According to our boat driver, the police officers wanted to let the boats go right away, but the KNP staff did not agree. After that, the enforcement team orders the cyanide boats to go to Labuan Bajo immediately. They do not put any guards on the boats and they do not follow them either. Instead they go in to a park ranger station on Komodo Island to have their lunch. When they finally go to Labuan Bajo, the cyanide boats are obviously not there. The arrested person, who is still on the speedboat, is ex-Navy, and he would later be released because of 'lack of evidence'.

This is an example where competence and bonafide leadership were clearly lacking in the enforcement team. Since late-1997, TNC has hired a pensioned Chief of Police from the region, who has an excellent patrolling record and who has joined all patrols since early-1988. A successful arrest of a large-scale cyanide operation was made outside the park under the leadership of this ex-policeman.

### *II. Combat the large-scale dynamite and cyanide fisheries in the buffer zone and other areas outside the park*

Our present strategy is to combat the large-scale destructive fisheries as soon as they enter the park buffer zone or other waters in the immediate park surroundings. The minimum objective of this strategy is to make these operations leave the area

before they enter the National Park, the maximum objective is to have these operations prosecuted as an example and warning to other operations. Unfortunately, National Park staff are not allowed to patrol outside the park under their present leadership, but fortunately the local police has recently obtained 'water police' status, which means they can and should react immediately to any report of illegal activity in the waters of Komodo District. In practice this means that any suspected activity outside the park can now be checked by calling the police, who will normally send two constables with us in our speedboat to investigate the activity.

In 1997, this strategy led to violent clashes with outside large-scale dynamite fishermen who tried to throw bombs in the speedboats and were answered with gun fire. Although actual arrests are difficult and dangerous, usually these boats do not return after this type of engagement. In the case of one serious clash, the crew of a dynamite boat was arrested in Maumere Hospital, on the north coast of Flores Island, where they reported in with several gunshot wounds. Fortunately nobody was killed.

Fish bombing on a larger-scale still takes place at Gili Banta, north west of Komodo, by boats from Sape (east Sumbawa). This island is too far for intervention from Labuan Bajo and belongs to the Nusa Tenggara Barat (NTB) Province, where Police from Labuan Bajo have no jurisdiction. Nothing can be done here from our side. In February 1996, Banta Island was recommended for addition to KNP and NTB provincial authorities pledged commitment to protect the Island. Nothing happened after that.

No fewer than seven large cyanide boats (fishing for aquarium fish) from Banyuwangi have been spotted working in and just outside the buffer zone, north of KNP, in December 1997. Most of them were checked by the police and cyanide was found on all occasions. Still, these boats were only chased away and not a single person was apprehended. The district Chief of Police was present when one of these boats was investigated. Most of these boats seemed to have ex-Army or ex-Navy personnel on board. We have to have our own strong leadership on the patrol boats to make sure that arrests are made.

In December 1997, four 'Hong Kong–type' metal dinghies (blue and red) with modern outboard engines, compressors and well-equipped dive crews were working around the north- western tip of Flores Island. We decided that it was most likely a cyanide operation based on a mothership, although we couldn't locate that vessel. This case was reported to the Fisheries Service, who did not react. We decided to see if we could locate the mothership, and found it a few days later (the operation had moved east, away from Labuan Bajo), with the same dinghies working nearby. Again they were diving and we suspected cyanide fishing for live reef food fish. In Labuan Bajo we reported to the police and fisheries and we went out with two speedboats.

We apprehended the mothership and five speedboats equipped with professional gear. The divers were surprised and asked us what was going on since their boss had already 'talked to the authorities'. Four of the dinghies were equipped for diving and working when we arrested them. One dinghy seemed to be on standby. The divers were using Technisub dive suits, modern regulators and well-maintained hookah compressors. All dinghies had brand new Yamaha outboard engines. Each dinghy had two divers and two helpers in the boat. We came in at very high speed to minimise their time for reaction. When we approached the speedboats, the divers were just surfacing and they threw several plastic squirt bottles in the water which we were able to recover. On all speedboats and on the mothership we found many squirt bottles with unknown contents.

The divers had caught groupers (flowery cod, *Epinephelus fuscoguttatus*); barramundi cod, *Cromileptes altivelis*; coral trout, *Plectropomus leopardus*; Napoleon wrasse, *Cheilinus undulatus*; and lobsters. One dinghy had caught 13 large flowery cod in a few hours, and from the look of this catch we suspected they were in the process of cleaning out a spawning aggregation. Each dinghy had a small reservoir build next to the live fish well, where they were mixing a solution of sea water with Sunlight soap bars and, we suspected, cyanide. We do not know what the soap is for, but we have thought of a few options:

1. The soap actually increases the effectiveness of the cyanide solution.
2. The soap increases the solubility of the cyanide.
3. The soap forms a white cloud underwater, showing where the solution is and facilitating manipulation.
4. The soap disguises the cyanide.

(If this practice has been observed elsewhere and/or if it is known why the soap is used, we would like to hear the answer to this question.)

On the mothership we found several bottles with a solution containing white powder (but no soap). We suspected this to be cyanide. The concentration in these bottles seemed to be high since the powder was not dissolving. On the mothership there was a large box with sunlight soap bars. In total there were eight hookah compressors (four on the mothership and one in each dinghy). The mothership had a

large, well-maintained inboard engine and two auxiliary Yamaha outboard engines. The mothership could work with eight divers in the water and each dinghy with two divers. It was about 25 metres long and had several large, live fish wells. There were 23 crew in total, and all were brought to Labuan Bajo where they were processed by the police.

The captain showed us some letters, with signatures from the local Fisheries Service and other local government officials which would allow this boat to fish with 'hook-and-line' and 'traps'. No gear of this kind was found on any of the boats, and the letters were not official licences but 'locally-arranged papers'. The crew told us that their boss was called Arifin, from Kendari, Sulawesi, and this person would be staying at the house of Pak Haji Idris (a local live-fish trader) in Labuan Bajo. It is rumoured that the whole operation is actually financed by a Korean person who is using Arifin as a front man. We have agreed with the local head of police that we will supply travel money for one policeman to bring the evidence to the Criminal Laboratory in Jakarta.

We also obtained several bottles (which were not recorded as evidence) which we had analysed separately to enable cross-checking of results. One set of five bottles was sent to the International Marinelife Alliance (IMA) and these samples tested positive for cyanide. A second set was sent to PT Sucofindo in Jakarta, and these also tested positive with reported results for cyanide concentration:

| | | | |
|---|---|---|---|
| 'Sample 1' | : | 762.50 mg/l | |
| 'Sample 2' | : | 1251.00 mg/l | (with soap) |
| 'Sample 3' | : | 2017.50 mg/l | |
| 'Sample 4' | : | 2.30 mg/l | (with soap) |
| 'Sample 5' | : | 1401.00 mg/l | |

'Sample 4' was filled out of the reservoir in the dinghy, into a used squirt bottle. This result suggests that the cyanide was not yet mixed in that reservoir. The low concentration was probably left-over cyanide from the used bottle.

In the meantime the local Fisheries Service has reported to its upper echelons that the arrested fishermen were just using soap to catch fish and that there was no cyanide. The boat is still being held because it didn't have all the right papers, but the rumours are that this will be 'fixed' before the trial starts. The police sent one constable to the criminal laboratory after only three weeks, and when we checked the evidence they were bringing, it was clear that 'unsoaped' cyanide solution had disappeared. Some of the 'soaped' solution was still there, and we still have hope that the manipulation of evidence has been insufficient. We fear, however, that the criminal laboratory will not find any cyanide.

We are confident, however, that our 'minimum objective' will have been achieved, and that this operation will leave the area before ever having entered the waters of Komodo National Park. The fishermen on this operation will hopefully also bring the message back home (if they do not end up in jail).

### *III. Remove small-scale dynamite and cyanide fisheries from the park*

Although the small-scale dynamite fishery is no longer a very large threat inside the park, small-scale cyanide fishing by surrounding communities remains a major problem. Many boats from the Pulau Mesa and Sape communities are fishing with compressors inside the park, and patrol data show that they normally catch lobster and live reef fish (mostly barramundi cod). Many of the compressor fishermen are using cyanide, but this is difficult to prove. They keep their cyanide containers connected to large stones which are dropped overboard as soon as they see the patrol boat. No cyanide is found when these boats are searched, and it is picked up by the divers after the patrol has left. These type of small-scale cyanide operations can only be stopped by banning the use of hookah compressors.

Inspection of holding cages outside the park (where these boats are landing their catch) showed large numbers of Napoleon wrasse, barramundi cod, groupers and coral trout. Fishermen who were interviewed upon landing admitted the use of cyanide in front of police, Fisheries personnel, park authorities and the press, but nothing was done by the authorities. Although the trade in Napoleon wrasse is prohibited without a special licence, this means nothing in practice, since local traders, who do not have any licence, can apparently continue even after serious complaints in the press. Local government officials do not seem to have any incentives to make problems for the live reef-fish trade. (On the contrary, we are forced to conclude.) Live fish fly out of Labuan Bajo to Bali every day, and, in the small plane, take priority over tourists, who are forced to take an old ferry to Sumbawa. The supply of oxygen for these live fish transports is larger than the one that is available for SCUBA-diving emergencies.

### *IV. Combat the small-scale dynamite and cyanide fisheries in the Park's buffer zone and in other areas surrounding the park*

Small-scale bombing and cyanide fishing is still a problem in areas just outside the park, and is very difficult to combat. Our strategy is to invest in intensive interaction with communities. Arrests are made when certain groups are becoming a clear problem.

But, rather than placing of criminal charges, communication is the key after arrests. We try to involve small-scale fish bombers in our community work or in alternative livelihood projects after they have been arrested. Their communities will also receive extra attention in terms of awareness programmes and surveillance. An example of combating small-scale fish bombing is described below.

In October 1997, fish bombing is suspected on reefs north of the Park's buffer zone, by boats of a style like those from Palue Island (north Flores). The boats seem to be based in the area around Labuan Bajo, since this is where they are sailing to and from. Many fishermen with boats of the 'Palue style' are camping at a beach on Bajo Island, near Labuan Bajo. Fishermen from Labuan Bajo complain that these people are bombing the reefs where they normally fish with hand lines. They report that the Palue people are selling fish from fish bombing every day at Pulau Mesa.

In November, bombing fish is observed on a reef not far from Labuan Bajo. We observe a small green boat of the Palue model. Many dead fish are floating around while that boat returns in the direction of Bajo Island near Labuan Bajo.

We find out that there is a settlement of Palue origin near Labuan Bajo in an area called 'Nangenae'. These people keep strong connections with their 'home island', work together with fish bombers from that island and are notorious dynamite fishermen themselves. This community has now become the focus of our attention, and the Police are also starting to collect information in their village.

In December, our fish monitoring team reports a dynamite fishing operation at work at Kanawa Island, north of the Park's buffer zone. A small boat of the Palue type is at work, and this boat is probably from the Nangenae settlement. We decide to organise an arrest, and go out in the company of two policemen. A successful arrest is made of a 'Palue' fisherman from Nangenae. The fisherman confesses quickly, and we confiscate around 200 kg of dynamited fish. This fishermen is roughed up a bit by the police, and made to promise he will stop this practice. Our community workers recruit the man for one of their projects, and he is now helping our efforts. Dynamite fishing by 'Palue fishermen' is presently on the decline in areas bordering the park.

### *V. Ban the hookah compressor, the reef gleaning practices and the 'bubu' fish traps from the waters of Komodo National Park*

This is our greatest challenge, and is expected to have the greatest impact given the present situation. The compressor fishermen are fishing out the lobsters and valuable reef fish, whether it be with cyanide or not. They also decimate the valuable shellfish like pearl oysters, abalone, and giant clams, the sea cucumbers, the whip corals and many other life forms, destroying marine habitats in the process (corals are broken in search of the lobsters and shellfish). The Park's authorities are still not doing anything against these practices and the local Fisheries Service is even giving out licences to fish with compressors inside the park. Komodo National Park should not allow compressor fishing to continue in this World Heritage Site and Man and Biosphere Reserve.

### *VI. Ban the widespread use of gillnets and demersal hook-and-line by outsiders from the waters of Komodo National Park, starting with a ban on fishing at the fish spawning aggregation sites*

This will be a difficult task, and can only be achieved when there is true political will to make a marine reserve out of the waters of Komodo National Park. At present the demersal fish stocks are under heavy pressure from these gear types, and population and community structures of these stocks are undoubtedly affected. Although complete closure for gillnets and bottom hook—and-line would be the logical intervention, it cannot be expected that this will happen soon. Much greater chances exist to achieve closure of fish-spawning aggregation sites, since the need for this measure is much easier to communicate to park managers. It is therefore extremely important that as many spawning aggregation sites as possible are identified in the park, and that the need for closure of these sites is urged upon decision-makers.

### *VII. Introduce exclusive fishing rights for park inhabitants to use demersal gear in multiple use zones and for both inhabitants and surrounding communities to use pelagic gear in the National Park waters*

TNC is initiating a legal study to find out what the scope is for a zonation system with exclusive fishing rights for inhabitants of National Parks in Indonesia. Implementation of such a system should coincide with a proper licensing system under the control of National Park authorities. Interventions on this level are only beginning to be discussed on a local level, and will be part of the 'long-term planning' for a few more years.

## 5. Conclusions

I. Eventually, Komodo National Park should be closed for demersal harvesting techniques, except for exclusive fishing rights for park inhabitants in multiple-use zones. The most

urgent intervention is an active ban of hookah compressors for the entire park, for which no new legislation is needed. Compressor fishermen from neighbouring fishing villages should be targeted in alternative livelihood programmes such as the development of a fishery for large coastal pelagics or mariculture initiatives.

II. A second important intervention would be to stop 'meting' by park inhabitants. The latter intervention may be facilitated by freeing local fishermen from the exploitation of middlemen, so they can earn sufficient income from their bagan activities. Park inhabitants should also be directly targeted in alternative livelihood programmes such as eco-tourism and/or extensive mariculture in multiple-use zones.

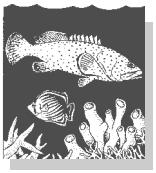
III. The marine resources of Komodo National Park cannot be protected without an effective enforcement programme, including frequent patrols of all the Park's waters. If the park management cannot afford or is not willing to organise these patrols, other institutes, including NGOs, can make sure that law enforcement is indeed implemented.

IV. Corruption and lack of political will at the local level is a major barrier to be overcome before marine reserves can be successfully implemented in Indonesia. Community awareness and education therefore has to be taken to higher levels and should include government awareness and cultivation of political will.

V. The present status of the resource can be described with the following characteristics:
   a. highly damaged and continuously degrading coral reefs,
   b. continuing destructive fishing practices inside the park,
   c. high fishing effort and pressure on demersal stocks like lobsters, shellfish, groupers and Napoleon wrasse,
   d. few economic alternatives available to local communities, and
   e. questions without answers on how to speed up coral reef rehabilitation.

VI. Detailed management objectives should:
   a. stop degradation of the coral reefs and keeping the damage at a level which is not higher than what was recorded in 1996,
   b. stop all destructive fishing practices, including compressor fishing, 'meting' and fishing with 'bubu' traps,
   c. implement full protection of demersal stocks, at least by banning the use of hookah compressors and by closing all known fish-spawning aggregation sites to all types of fisheries,
   d. promote a shift of fishing effort from demersal fishing inside the park area to pelagic fishing inside and outside the park area,
   e. support members of local communities to enter into compatible enterprises like ecotourism, mariculture or pelagic fisheries,
   f. develop a feasible methodology for the enhancement of coral reef rehabilitation.

VII. We need supporting materials from outside sources to convince the park management of the need for a hookah ban!



# An overview and comparison of destructive fishing practices in Indonesia

*by Lida Pet-Soede* [1] *& Mark Erdmann* [2]

## Introduction

Indonesia is richly endowed with marine natural resources, and its people are highly dependent upon them for food, coastline protection, and other ecosystem functions. Despite this strong dependence, and an adequate legal framework to protect them, destructive fishing practices (DFP) continue to pose some of the greatest threats to the sustainability of Indonesia's marine ecosystems, particularly its coral reefs. Here we present an overview of DFP in Indonesia, with detailed descriptions of those fishing techniques most destructive to its coral reefs. For each of these capture methods, we describe the technique as practised in Indonesia (with regional variations noted when applicable), the species most commonly targeted by each capture method, data on typical yields and profitability (when available), as well as a subjective assessment of which of these destructive techniques pre-

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