Blast Fishing in Southwest Sulawesi, Indonesia

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Abstract

Blast fishing has been a widespread and accepted fishing technique in Indonesia for over 50 years. The largest coral reef fishery in Indonesia is around the Spermonde archipelago in southwest Sulawesi. With the expanding population and the increasing demand for fish for export, fishing has intensified and fish catches per unit of effort are stable or declining. The use of bombs made with a mixture of kerosene and fertilizer is widely prevalent. In the market of the city of Ujung Pendang, an estimated 10-40% of the fish from capture fisheries are caught through blast fishing. This is destroying the hard corals. Blast fishing is seen by the fishers as being much easier and results in higher catches than with other traditional methods. They believe that the only way to limit this practice is with stricter policing and higher fines. An effective management option could be to establish national marine reserves within the archipelago, supported by other income-generating activities.

Introduction

Although it is now illegal, blast fishing has been such a widespread and accepted fishing technique in Indonesia for over 50 years that it might in some respects be considered a "traditional" fishing method. Many older Indonesian fishers were first taught the technique by Japanese soldiers during World War II and were impressed by the relative ease and low investment in equipment needed to catch fish in large numbers by simply "bombing" the reef with dynamite. While the type of explosive used has now evolved from dynamite to homemade fertilizer/kerosene bombs, blast fishing is still one of the primary "gears" of choice for many fishers in Indonesia, particularly the Makassarese fishers of southwest Sulawesi.

During the past few years of living among these fishers, the authors have been able to observe blast fishing firsthand, and have been afforded a rare opportunity to speak candidly with many of the fishers who use this technique about their trade, and even examine and measure their catches. While a number of previous researches have detailed the extremely damaging effects of this technique on the coral reefs where this is often practiced (Alcala and Gomez 1987), few have examined in detail the rationale and economics which drive blast fishing. Furthermore, the majority of published studies have focused on the Philippine model of blast fishing, which is slightly different from that found in the Indonesian Archipelago.

This article describes blast fishing as practiced by the Makassarese fishers of southwest Sulawesi, Indonesia with an account of the techniques used, the scope and economics of bombing operations, typical catches, and the fishers' rationale for continuing such an extremely unsustainable technique. We include a summary of how fishers perceive the effects of blasting on fish stocks, as well as their own suggestions for enforcement and control of the fishery. We believe that only with a proper understanding of blast fishing from the fishers' perspective can this fishery be effectively managed.

Background

The focus of this study is the 16 000 km^2 Spermonde archipelago in southwest Sulawesi. Widely considered the largest coral reef fishery in Indonesia, this archipelago boasts up to 200–300 fisherfolk households per kilometer of coastline. Although this area has supported fishing activity since the 14th century, many of the islands have only been inhabited since World War II.

As the human populations on these islands and in the nearby city of Ujung Pandang have grown tremendously, so has there been a great increase in the demand for fish. Interviews with older fishers reveal that the characteristics of the fishery have changed dramatically. Only 40 years ago there was 'no price' for specific fish, as most species were equally appreciated. With increasing exports and the expansion of hotels and restaurants in the area, reef fish such as groupers (*Epinephelus*, *Plectropomus* and *Cephalopholus* spp.), snappers (*Lutjanus* spp.), and rabbitfish (*Siganus* spp.) and reef associates such as fuseliers (*Caesio* spp. and *Pterocaesio* spp.) have become the main target species. Blast fishing is often the favored technique for catching these species, especially the latter three schooling groups.

As might be expected with the rapid development of this fishery, catches per unit of effort have stabilized or are declining rapidly throughout the Spermonde archipelago (Pet-Soede et al., in press). This is the background for the younger fishers who typically form part of a crew of a medium- or large-scale blast fishing operation. They have had either no opportunity yet to invest in their own gear and boat or they have been disappointed by declining catches and/or income. Not surprisingly, their ranks are slowly increasing.

Blast Fishing Methods

The older fishers recall that 40 years ago, blast fishing generally involved the use of actual dynamite that was in abundant supply after World War II. Later, explosive charges were obtained from illegal sales of surplus explosives from international development agency civil engineering projects and even by diving on old war wrecks for still-intact munitions.

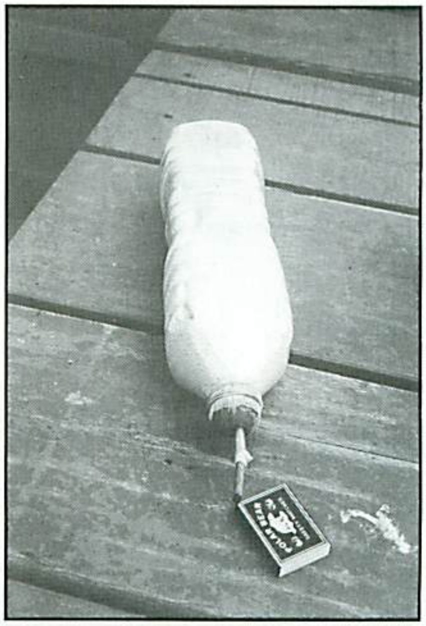
Today, most fishers use explosives of a much less exotic (and less expensive) nature: homemade bombs are manufactured using glass or plastic bottles filled with a 3:1 mixture of agricultural fertilizer (locally known as "urea") and kerosene. Stones or a strip of lead are added to make the bottles sink faster, and a waterproof wick is pierced through the piece of plastic that closes the bottle. The length of the wick is specific to the desired depth of the explosion, and bomb sizes vary between 1 and 5 kg.

The use of this fertilizer-kerosene mixture is fairly recent. Although the fishers interviewed do not remember who introduced this, it has simply spread by word of mouth. It is popular among the fishers due to the widespread availability of the major components; only the waterproof wicks are difficult to obtain because their sale is illegal in Indonesia. Wicks are typically bought on the islands from middlemen.

Regardless of the type of explosive used, the fishing scenario is generally the same: fishers look for a school of fish from their canoes with goggles or a mask. Most sites are on shallow coral reefs, although fishing with bombs for open water pelagics such as scads (*Seiaroides* spp., *Decapterus* spp.), Indian mackerels (*Rastrelliger kanagurta*), sardines (*Sardinella* spp.) and anchovies (*Stolephorus* spp.) has become more important lately. When a school is spotted, the fishers move their boat at least 5 m from the estimated place of impact and light the wick with a smoldering mosquito-coil, which helps control the burning speed of the wick. The bomb generally explodes in about 5 seconds or so, depending on the length of the wick.

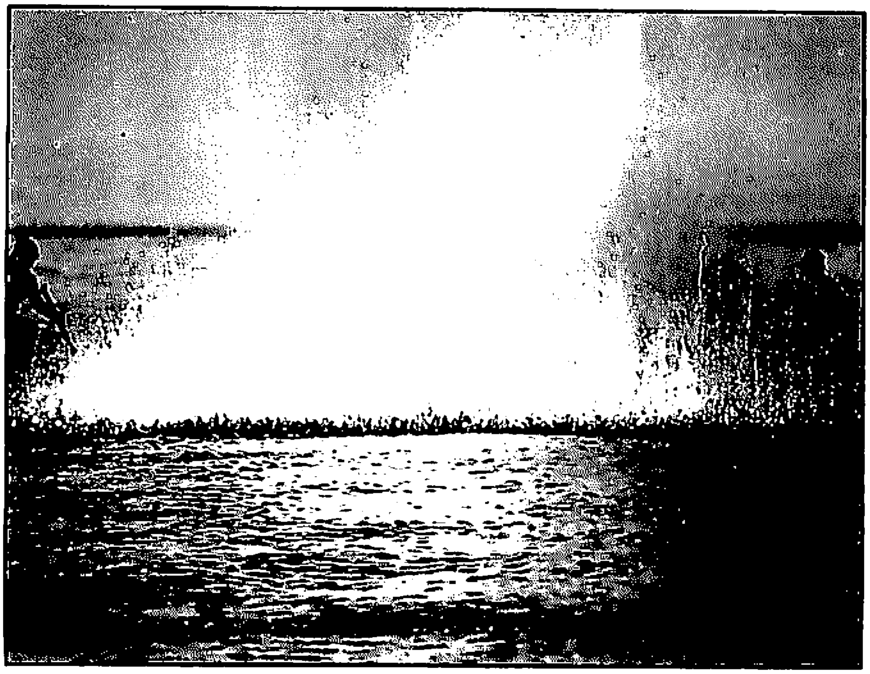
After the charge is exploded, fishers enter the water to collect the fish which have been killed or stunned by the shock wave from the explosion. Fishermen have traditionally used free-diving methods to collect fish after a blast, but they have recently taken advantage of the widespread availability of hookah compressors, which are used for collection of sea cucumber (*trepang*) and for cyanide-fishing for live groupers (Erdmann and Pet-Soede 1996).

Blast fishing operations in the Spermonde can be classified as small, medium or large-scale. The latter operate inboard powered boats of about 10-15 m, which can hold ice for 7-10 days. These large-scale operations have crews of 15-20, and often range up to several hundred kilometers from their home islands. Bombs are thrown from 3-4 small canoes which are launched from the mother ship. Divers use hookah lines from compressors on the large ships to collect fish to a maximum depth of 40 m. The medium-scale operations work similarly, but only operate for day-long trips with smaller boats and a maximum of 5-6 crew. The small-scale, single blast fisher uses a 4m long wooden canoe with one outrigger and a 4-hp outboard engine. These fishers retrieve fish by free-diving with mask or goggles and are hence restricted to blasting on sites which are less than 8-10 m deep.



The bomb, a bottle filled with the highly explosive mixture of artificial fertilizer and kerosene.

A more recent development in south Sulawesi is the use of bombs in the purse seine and *bagan* (liftnet) fisheries. For example, *bagan* fishers throw a bomb just before lifting their nets in order to ensure that no fish escapes. Although this practice, and the bombing in open water for pelagics, does not have the same harmful effects on habitat as blast fishing over the reefs, there is a strong potential for growth overfishing as the gear becomes less selective. The smaller, juvenile individuals of a school are indiscriminately killed in the blast.



The explosion.

The Catch

The catch composition of several blast fishers was sampled monthly at sea between January 1996 and January 1997 (Table 1). It should be noted that the smallest fish are underestimated, for fishers do not usually collect these.

Fuseliers dominate reef catches, and scads and sardines are most important in the open water catches. The larger emperors (*Lethrinidae*), groupers and snappers are highly valued but more difficult to catch in large numbers in the reef operations. Surgeonfish (*Acanthurus* spp.), groupers, snappers, rabbitfish and parrotfish (*Scarus* spp.) are the main reef fish caught.

Overall yields for blast operations are highly variable. Small-scale fishers catch between 1 and 15 kg per trip, with occasional catches of around 25 kg. The medium-scale fishers catch between 5 and 200 kg per boat per day, and large boats may catch up to 2 tons per trip of 7-10 days.

The proportion of fish caught through blasting in the capture fisheries of the Spermonde is difficult to estimate especially because of the efforts of fish sellers to keep this information under wraps. The unsuspecting researcher visiting the fish market in Ujung Pandang is told that all observed reef fish are caught with hook and line (solitary species) or gillnets (schooling species). However, it was not difficult to ascertain eventually that there are no gillnet operations on the Spermonde reefs and that the hook and line fishers operating on these reefs catch mainly groupers which they sell live to the live fish traders.

After an examination of several blast catches, we came to recognize the typical signs of fish caught by this method. Shattered skeletons and soft, mushy flesh are sure indications of blasted fish, and many of the fusiliers and snappers show exterior signs of blast damage in the form of reddish eyes and skin from ruptured capillaries. Based upon these types of cues, when examining daily landings at the major fish market in Ujung Pandang we estimate that 10-40% of the fish from capture fisheries are caught as a result of blast fishing.

Effects on the Reef

The most obvious damage is to the framework builders themselves, the hard corals. Explosive blasts typically shatter the more delicate corals, and can leave characteristic craters in the substrate. The size and nature of these craters vary considerably with the size of the charge and the distance from the substrate when exploded (obviously, blasts aimed at catching pelagics over deep water or over sand flats cause little physical damage). On a reef flat, when an average-sized bomb explodes close to the substrate, an area with a diameter of 1-1.5 m is often completely destroyed. Branching and foliose corals are blown into rubble, tabulate acroporids break and fall over, and larger massive corals are often cracked. If a bomb is thrown on a reef slope, the damaged area has a different shape and is usually somewhat larger due to breakage from coral fragments rolling or sliding down the slope. Reefs which are subject to repeated blasting are often reduced to rubble fields punctuated by an occasional massive coral head. The length of time necessary for recovery of such a reef may be several decades, due to the unsuitable nature of unconsolidated coral rubble as a recruitment substrate for coral larvae.

In addition to destroying the reef framework, blast fishing results in extensive side-kills of non-target and juvenile fish and invertebrates. Furthermore, those organisms which survive do so in a habitat with a greatly reduced three-dimensional structure; such reduced habitat complexity is detrimental to most reef organisms for feeding, escaping predators, and for further recruitment (Carpenter et al. 1981).

Distribution and Scale of Blast Fishing Operations

It is difficult to estimate the actual number of blast fishers operating in the Spermonde. Within the Spermonde, most blast fishers were from the islands of Barrang Lompo, Kudingareng Lompo and Lumu-

Lumu. During the course of this study, we followed a small-scale fisher operating on a daily basis from Barrang Lompo. From interviews with him and other fishers, we estimated at least 12-15 small-scale blast fishers from the island (population of ± 3 000). In addition, approximately 10-15 medium-scale crews operated and at least 10 large-scale boats used blast fishing exclusively from the same island. The total number of blast operations in the Spermonde was estimated to be 150-200, many of which are medium-scale. Overall, roughly 15% of the fishers on the island of Barrang Lompo derive the majority of their income from blast fishing. This is about the same as the 17% which Galvez and Sadorra (1988) estimate for the Filipino village of San Roque, where blast fishing was practiced on the small and medium scale and by the large *taksay* operations that employed over 30 fishers and used up to 40 sticks of dynamite per day. It is difficult to imagine that such a large number of fishers will continue for long in this extremely unsustainable fishery. Indeed, the Spermonde fishers may soon face a situation similar to that in the Kepulauan Seribu Archipelago off Jakarta, where blast fishing has all but ceased due to a complete collapse of the reefs (Erdmann, in press). At least one explosion could be heard during a one hour dive at any of the 160 reefs in the Spermonde. This is perhaps not surprising, as the small-scale fishers alone light at least 3 bombs per day.

Rationale for Blast Fishing

The most common justification given by the blast fishers interviewed was simply that blast fishing is much easier than using other gears. This was the very premise on which the Japanese first introduced blasting to these fishers, and can be applied to Filipino fishers as well (Galvez and Sadorra 1988). Fishers feel they can catch many more fish per day (higher CPUE) by blasting than by more traditional means, while at the same time avoiding the constant repair of nets and lines that become tangled and torn on the reefs. With the adoption of hookah compressors and manufactured dive masks, the operations are even more efficient. Even the ever-present danger of explosion accidents has been greatly reduced with increasing sophistication in making bombs.

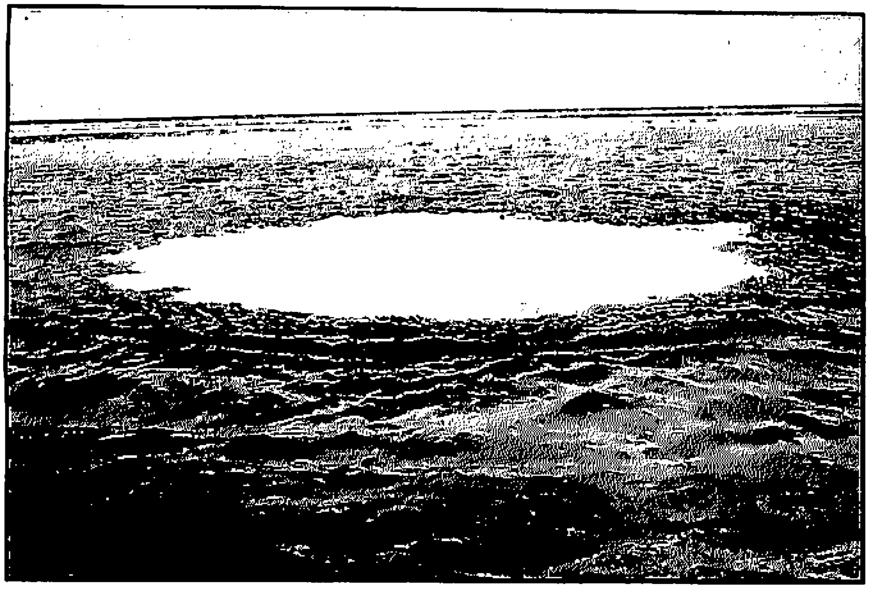
The financial rewards of blast fishing are often attractive as well, though these vary greatly with the size of the operation. Small-scale blast fishers see small profits, while crews on the larger boats can earn more than many government officials. For the small-scale fishers, the bomb components (fertilizer, kerosene and fuse) cost roughly US$1 per bomb. The typical individual blast fisher uses 2-3 bombs per day and averages a 5 kg fish yield, which can be sold for US$5. The $2-3 earned per day is roughly the same as the $3 per day a traditional handline fisher might make. The medium- and large-scale blast fishery is substantially more profitable. Divers working with such operations earn US$50-150 per week (this despite the frequent US$100-150 "fines" which boat owners typically pay to the marine police). These salaries far exceed those in any other fishery in the Spermonde, save those of the divers working in the live reef food fish trade (Erdmann and Pet-Soede 1996). A final reason given for participating in blast fishing was simply "tradition". A number of the fishers interviewed had never used any other type of fishing gear and showed no inclination to learn more traditional techniques or invest in other gear types. Sadly, the only fishers who seem interested in switching gears are those who forego handlining and liftnet fisheries to join the growing number of dynamite and cyanide fishers.

What is the fishers' perception of the future of blast fishing? Despite educational efforts by the local University (Hasanuddin) and international NGOs such as the World Wildlife Fund (WWF) and

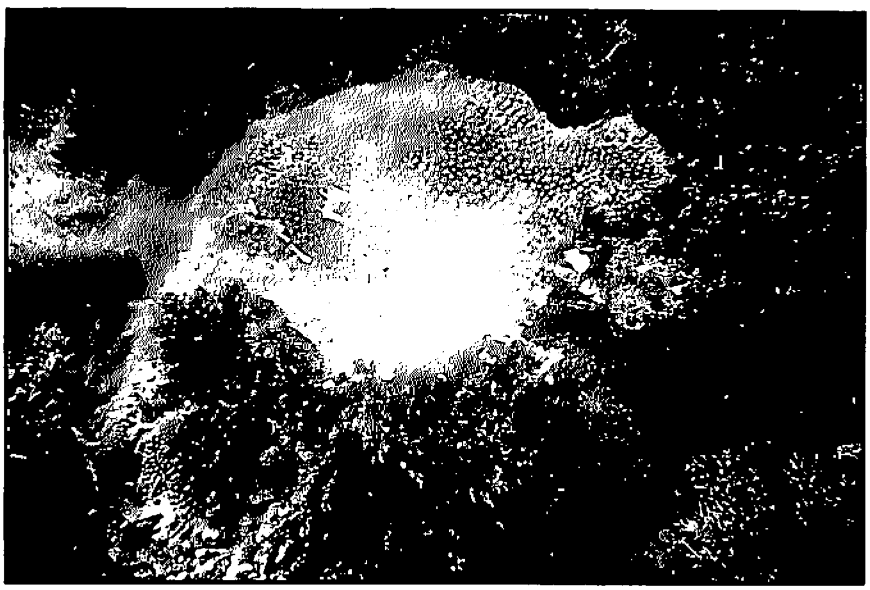
Table 1. Fish categories found in a sample[1] of 50 blast catches with a total biomass of 1 200 kg, measured at sea and the relative importance of each category in the catch biomass, Spermonde, southwest Sulawesi.

Reef fish (13%)	Reef associates (29%)	Pelagics/pelagic demersals (58%)
Surgeonfish (24.6%)	Fuseliers (95.6%)	Scads (89.4%)
Groupers (12.7%)	Jacks (2.7%)	Sardines (8%)
Snappers (11.9%)	Goatfish (0.8%)	Anchovies (1.4%)
Rabbitfish (11.4%)	Barracudas (0.6%)	Indian mackerel (1.2%)
Parrotfish (9.8%)	Ponyfish (0.01%)	
Unicornfish (5.9%)	Silverbiddies (0.01%)	
Triggerfish (5.1%)	Halfbeaks (0.01%)	
Sweetlips (5%)		
Treadfin bream (3.9%)		
Wrasses (2.8%)		
Emperors (3%)		
Rudderfish (2.9%)		
Butterflyfish (2%)		
Batfish (0.4%)		
Damselfish (0.4%)		
Angelfish (0.4%)		

[1]This does not include the large-scale blast fishing operations as they fish in other areas far away from the research area of the authors and it does not include the catches from liftnets. If these are included, anchovies would provide a larger part of the pelagic catch biomass.



Sediment floats to the surface right after the explosion.



Damaged coral after the explosion.

The Nature Conservancy, many blast fishers still seem oblivious of the detrimental effects which blasting and consequent reef damage have on future fish stocks. Even those who seem to understand the ecological consequences of blasting are often content to rationalize these away with religious beliefs: "The sea is immense, as is the power of Allah; he will ensure that there are always fish." However, the growing evidence of the collapse of fisheries in the Spermonde indicates otherwise.

Scope for Management

With such perceptions prevalent among the Spermonde fishers, what is the prognosis for effective control of blast fishing? When asked this question, the fishers themselves respond that the only way to cut down on the practice is to increase the probability of detection and capture by increasing the intensity of patrols! Most of them, especially the small fishers, will not be able to endure high fines and this may eventually force them to look for alternate incomes. The marine police of Ujung Pandang announced that they intend to pursue just this route, intensifying patrols from May through July 1997, with the aim of halting all illegal fishing practices.

Nonetheless, in an area as widespread as the Spermonde, patrols require an enormous amount of people and monetary resources. Some have suggested that it would be more cost efficient to survey the landing sites for evidence of fish caught through blasting and prosecute those selling these fish. Unfortunately, under the current system in the Spermonde, fishers sell their catch first to middlemen (*pungawa*) who then sell the fish at the landing site, making this type of enforcement rather difficult. Taking this into account, true enforcement of blast fishing laws in the Spermonde seems only theoretical at this point.

Perhaps the most effective management option in the Spermonde is the creation of a national marine reserve within the archipelago to serve as a sanctuary for the remaining fish stocks. This model has been proved successful in other regions of Indonesia, such as in Northern Sulawesi (Bunaken Marine Reserve) and in Komodo. In both of these reserves, the Indonesian Department of Forestry and Conservation (PHPA), in concerted efforts with the international NGOs, WWF (Bunaken) and The Nature Conservancy (Komodo), has been able to effectively establish legislation and the infrastructure to truly ban all illegal fishing practices such as blast fishing. In the case of Bunaken, this policy has actually helped to generate other sources of income for local communities as the high quality reefs and the abundance of large fish in the reserve lure thousands of divers each year from Europe and Asia. Likewise, the planned development of the Komodo National Park rests largely on ecotourism for the provision of alternative livelihood for local communities (Pet and Djohani 1996).

This approach to management is also currently being adopted in the Spermonde. The South Sulawesi Department of Planning is working to create a 100 ha reserve in the northwestern edge of the coastal shelf, centered around the island of Kapoposang where the local community does not use bombs and fishes strictly with hook and line for small tuna (*Auxis* spp.) and other pelagics. The relatively unspoiled reefs in the area already attract substantial dive tourism.

It is difficult to envision that a 100 ha reserve in the midst of the 240 000 ha Spermonde will be able to generate alternative incomes for the entire population of fishers in the area. It seems likely that the local fertilizer manufacturers will enjoy 'booming' sales in the immediate future.

Acknowledgments

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