

# Effects of Coral Bleaching on Reef Fish Fisheries at Sabang

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**Abstract.** Mass coral bleaching was observed at Sabang, Aceh in early 2010, and approximately 60% of hard coral in waters surrounding Sabang died post-event. Coral mortality was expected to affect the composition of reef fish due to elimination of a number of coral functional roles, such as providing a home, a place to eat, shelter and as breeding grounds for fish and other marine organisms. The objective of this research was to compare the coral reef fish catches in Sabang waters before and after the coral bleaching. The data were collected before (in 2008) and after (in 2010) the mass coral bleaching event in Acehnese waters by using a photographic method. Analysis of data on the average catch of fishermen was calculated in units of catch per fishing effort (kg/hour). The results showed that 259 species of coral reef fishes were caught by fishermen in 2008 and 2010. There was no significantly difference between the fish catches before and after the 2010 mass coral bleaching. However, species richness decreased by around 50% after the mass coral bleaching. The knowledge of fishermen and how they might adapt to climate change was very low. Consequently, there is a need to educate the fishermen in Sabang Aceh about climate change issues in order to build their capacity to adapt.

**Key words:** coral bleaching, reef fish, photography methods, CPUE, Sabang.

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## Introduction

Aceh province has larger potency on coastal resources both biological and non biological resources. The province is surrounded by approximately 1,865 km of coastline and has 180 large and small islands. Marine resources are very important for the Acehnese since more than 25% of total population depends on the coastal ecosystems mainly from the fisheries sector.

Sabang and its surrounding waters have good coral reef ecosystems, especially in areas that are managed by local fishermen organization called "Panglima Laot", a traditional organization for fishermen in a certain fishing ground that shares a strict set of rules and regulations (Baird et al. 2005; Brown 2005; Campbell et al. 2007; Hagan et al. 2007). In addition, Sabang is also rich in reef fishes biodiversity and abundance (Rudi et al. 2009). For example, Allen & Adrim (2003) reported six endemic fish species from Sabang waters. Nevertheless, coral bleaching as the effects of climate change was happened in Aceh water from March - May 2010 as predicted by NOAA (2010). The results from a rapid survey in late May 2010 showed that approximately 60-80% of coral reefs in the Sabang waters dead following the high sea surface temperature during the period.

Coral mortality is predicted to affect the composition of reef fish as it may eliminate the function of coral reefs as breeding, nursery and

feeding grounds for fishes and other marine organisms. According to Hourigan et al (1988), the presences of reef fish were highly influenced by the condition of coral reefs, mainly by the percentage of live coral cover. Coral bleaching happen due to the release of zooxanthellae in coral tissue permanently (Marshall and Baird 2000; Ateweberhan and McClanahan 2010).

Climate change has devastating effects in coral reef ecosystems due to extreme environmental sensitivities and consequent bleaching of reef building corals. In early 2010, the reefs of much of Aceh, in particular Sabang, were struck by mass coral bleaching caused by high sea-water temperature throughout the Andaman Sea. The damage to the reefs was extensive, with close to 80% mortality of susceptible species at many sites around P. Weh. This was expected to have an effect on the catches of fishermen in Sabang. However, how much this phenomenon influences the catches of Sabang fishermen is still unknown. Therefore, there is very crucial to evaluate the impact of coral bleaching on commercial coral reef fish fisheries at Sabang focused on the species composition and fishermen catch per unit effort (CPUE). This study can be used as a basis for disaster management due to climate change in particular coral bleaching.

### Material and Methods

The study was conducted on December 2010 to January 2011. The data collection was conducted in five fish landing sites in Sabang, namely Lhok Ie Meulee, Lhok Laot Pria, Lhok Anoi Itam, Lhok Keunekai and Lhok Pasiran. The five sites were chosen in order to compare fish catches before (in 2008) and after (in 2010) the mass coral bleaching in Acehese waters. Data of fishermen catch of hand line fishing method was used in the study. WCS Indonesian Program has already collected these data before the bleaching which will be combined with post-bleaching data.

The data was collected from fisherman who just landed at each site. Photographic method was used to estimate fish biomass (Figure 1), while fish identification refers to Carpenter and Niem (1998a, 1998b, 1998c, 1998d, 1998e), Allen (2000), Kuitert & Tonozuka (2001), and Kimura et al. (2009). The UTHSCSA Image Tool 2.0 software was used to measure the fish size. The parameters used include the total length, fork length and standard length. The fish weight was predicted using following equation proposed by King (1997):  $W = a L^b$ , where: W = fish weight (kg), a = statistical constants (index), L = Fish length (cm), b = statistical constants (index), a and b of each fishes were taken from www.fishbase.org. Data analysis for catch of fishermen was calculated in catch per unit effort (kg/hour) and student t-test was used to compare data fish catches before and after mass coral bleaching.



Figure 1. Photography method to estimate fisherman catch: a photo of some fishes (left) and numbered fishes (right)

Data analysis for catch of fishermen was calculated in catch per unit effort (kg/hour) and student t-test was used to compare data fish catches before and after mass coral bleaching. Interview for each fisherman was conducted to get information of fishing gear, fishing ground, cost and time consumes for fishing activity. Information related to fishermen knowledge about climate change and coral bleaching were also collected using questionnaires methods.

### Results

A total of 259 fish species corresponding to 28 families were recorded during the study (data not published). Species number was varies among the sites, ranging from 73 (Pria Laot) to 133 (Pasiran) in 2008 and from 29 (Pria Laot) to 77 (Pasiran) in 2010 (Figure 2). Species richness at all sites was decreased about 50% in average after coral bleaching phenomenon. However, there were no significantly differences between fishing catches before and after coral bleaching (Table 1). Indicating that, presently, the coral bleaching affect on fish community but not on livelihood of fishermen. This is because the fishermen have been improving their efforts and time to catch more fish, therefore they got fish catches similar to pre coral bleaching, but the species composition was decreased significantly.

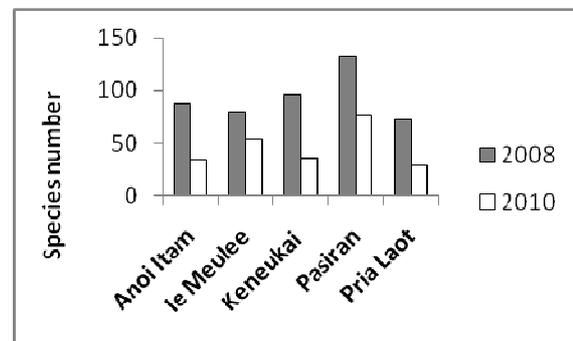


Figure 2. The species number of reef fishes that caught by fishermen in Sabang waters

The average of fishing catches before and after bleaching at five study sites showed there were some different patterns among the sites on the number of fishermen catches. At Anoi Itam and Keneukai sites, there were declined of catches before and after the coral bleaching. While, at Ie Meulee, Pria Laot and Pasiran sites showed the increasing of fishermen catches. However t-test results at each sites showed that there were no significantly differences between fishing catches before and after coral bleaching (Table 1).

Table 1. The catches of fishermen (mean of CPUE ± SE) in five sites and t-test, ns = not significant

Year/test	Sites				
	Ie Meulee	Anoi Itam	Keunekai	Pria Laot	Pasiran
2008	0.22 ± 0.03	0.61 ± 0.2	1.30 ± 0.36	0.28 ± 0.05	0.88 ± 0.13
2010	0.30 ± 0.03	0.58 ± 0.13	0.76 ± 0.13	0.45 ± 0.10	1.56 ± 0.33
t-test	ns	ns	ns	ns	ns

The knowledge of Sabang fishermen on climate change was poor. Around 82% of fishermen of Sabang stated that they do not know what the cause of

the coral bleaching is. Similarly, the question regarding what is climate change, 64% of fishermen claimed they do not know what climate change is. Around 82% of fishermen also claimed they do not know the causes of climate change.

### Discussion

Our finding showed that coral lost because of mass coral bleaching impacted the species richness of reef fishes in Sabang waters as shown by fishermen's catch. Pratchett et al (2008) stated that coral loss may also have longer-term consequences for fishes that require live corals as settlement. Cinner et al (2009) reported that the loss of habitat structure following coral mortality is expected to affect 56% of targeted species.

Based on CPUE data, around six months after mass coral bleaching, the fishermen was still sustain in fishing and the effect of coral bleaching on the abundance of reef fishes was felt. It is estimated that for a longer time, e.g. more than two years after the coral bleaching, the impact is expected to be significant, especially for corallivore fishes that need coral as food source. In future, it is also estimated that the fishermen of Sabang need more effort in order to sustain their fishing because they have to go to farther fishing grounds which will consume time and money. Cinner et al. (2009) stated that coral bleaching can indirectly affect coral reef fishes and fishermen need adaptive fishing gear and management in response to climate change. It is estimated that it needs more than five years for coral reef of Sabang to recover to initial state.

Lack of knowledge of Sabang fishermen about climate change could be one point of vulnerability of Sabang fishermen on disaster preparedness, especially disasters caused by climate change. Wisner et al (2004) stated that disasters are defined as the result of the interaction of vulnerability or powerlessness of humans (vulnerability) to threat from the natural activity of harmful (hazards) such as earthquakes, tsunamis, floods, storms and others at the same time. In other words, if a disaster occurs somewhere or is prone to the dangers of earthquakes, tsunamis, floods, landslides or storms, but humans who live in these places do not have the knowledge and ability to deal with it. For that, it needs a lot of activity to be done about environmental awareness campaigns related to climate change.

The knowledge of Sabang fishermen and how they adaptive to climate change were low. Consequently, there was a need to mitigate the fishermen of Sabang Aceh to face climate change issues. Some recommendations are put forward relating the results of this study. There is a need to support and building the awareness of fishermen and coastal community

from climate change issues. There are some adaptation and mitigation strategies that prepared to face the climate change for example by looking for and create alternative livelihoods for fishermen. Mitigation can be done by maintaining and improving the quality of marine ecosystems, such as accelerating the establishment of marine protected areas, promoting ecotourism and awareness-raising efforts of other communities in the protection and preservation of marine resources in a sustainable manner until the future.

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