By: Eirin Helgaset (297188), Idun Kjoberg (278684), Lauren Scudder (312582) & Susan Stobbe (304906)
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What is happening to our mangroves?

Essay on the negative natural and social effects of the deforestation of mangroves

Introduction

A recent study from the University of Singapore has concluded that more than 60 percent of Myanmar's mangroves has been deforested in the last twenty years (De Alban et al., 2020). Although mangroves only account for 0.7 percent of the worlds tropical forests, they inhibit extremely important ecosystems (De Alban et al., 2020). For example, mangroves are able to store carbon, they serve as a habitat for various species and they offer protection against natural disasters (De Alban et al., 2020). According to the World Wildlife Organization (2016) mangroves are one of the best natural defences against climate change and the negative effects of climate change.

The ecosystems of these forests are highly vulnerable, facing threats related to shrimp farming, rice paddies, palm oil plantations and other forms of agriculture (AMNH, 2018). Shrimp farming is the biggest threat to mangroves, as large parts have been cleared to make room for artificial shrimp ponds. Shrimp farmers dig canals to supply the artificial ponds with large amounts of freshwater and seawater. These channels disrupt the natural flow of water that maintains the health of surrounding mangroves. Agriculture is also destroying these forests, as chemicals and fertilizers get into the water supply. Mangrove forests have low tolerance for industrial and agricultural pollution, and they will die if this tolerance limit is exceeded. Other factors as tourism, coastal development and the charcoal and lumber industries are also a part of why deforestation of mangroves occur. But what effects does the deforestation of mangroves have on nature and society?

Effects of deforestation on mangroves

Weathering natural disasters

The importance of mangroves is well-documented, with many biological, social, and physical benefits for keeping the ecosystem intact. Mangroves provide a natural barrier for vulnerable coastlines, protecting populations providing refuge particularly within tsunamis and strong weather events (Barbier, 2006; Quarto, 2005). Mangroves and other habitats such as coral reefs can be critical components in the overall coastal resilience of areas threatened by natural disasters (Adger *et al.,* 2005). There is not one singular element of mangrove forests that provide protection - trees shield land from wind, trapping sediment in the roots and maintaining a shallow sloped seabed to absorb tidal surge energy. This reduces the height and velocity of incoming waves, and distributes water along the coastal area, preventing further flooding (EJF, 2006). As well as offering protection to the biosphere, mangrove wetlands have been identified as essential in minimising property damage and human fatalities (Mazda *et al.*, 1997; Massel *et al.,* 1999; Chong, 2005).

An EJF report regarding the impact of mangrove loss and shrimp farm development on coastal development (2006) identifies that the deforestation of these mangrove areas causes great intensification of the impacts of natural disasters. A key example of the disastrous effects of natural disasters is the cyclone of 1999 in the Indian state of Orissa, where much of the mangrove coast had been cleared for the development of shrimp aquaculture. This natural disaster killed approximately 10,000 people and destroyed the homes of 7.5 million people (Pearce, 1999). Most noticeably in the aftermath of this disaster it was only within an 100km exposed stretch that was so intensely affected, with the greater area of intact mangrove forests unaffected (Unnikrishnan, 2012; Tynkkyen, 2000). Leading to the conclusion that the destruction of mangrove forests for shrimp farms exacerbated the impact of natural disasters and cyclones. (Pearce, 1999). Without the protection of mangrove forests, there is weakened socio-ecological resilience (Adger *et al.,* 2005) to natural disasters within the community, particularly with the loss of human life, property and destruction of infrastructure associated with economic and social development. The restoration of mangrove forests is challenging, particularly after land conversion to shrimp farming, which provides many difficulties in replanting the trees, which are exacerbated by the disastrous aftermath of natural disasters (Lewis, 2000).

Losing mangrove forest species

Mangroves support rich biodiversity and are among the most productive ecosystems on the planet (Carugati *et al.*, 2018). The partially submerged roots form a tangled web, creating a unique and complex habitat for all kinds of life. Mangroves provide food, breeding grounds and nursery sites for a wide variety of both marine and terrestrial species (Blum and Herr, 2017; Carugati *et al.*, 2018). Habitat loss is normally associated with a loss of biodiversity, which in turn can result in a reduction of the ecosystem's capacity to provide goods and services to humans (Carugati *et al.*, 2018). Many marine species use mangroves as nurseries during early life stages, with roots providing shelter from predators and plenty of food (Blum and Herr, 2017). When the shelter of the mangroves is no longer needed, the animals venture out into the open ocean, making the mangroves a critical source for replenishing fish stock.

Stable ecosystems develop when the species population density moves towards equilibrium after a disturbance, and no one species becomes dominant (Malik *et al.*, 2015). However, a study from Indonesia by Malik *et al*. (2015) found that disturbed mangrove areas had generally low numbers of mangrove species, and also a clear dominance of one or two mangrove species, indicating an unstable ecosystem. The coverage of mangroves in the area was below 50%, indicating large open areas of forest, and that the rate of biodiversity of species is declining. The area was also dominated by saplings and seedlings, with few trees having a diameter larger than 15 cm, and mature mangrove being difficult to find.

The nutrient-rich waters of mangrove channels, filled with algae, crustaceans, molluscs and juvenile fish form tight links in the marine food chain (Quarto, 2005). Exploitation such as deforestation often changes the biodiversity of the remaining mangrove forests (Malik *et al.*, 2015). By reducing the number and abundance of species, the composition and structure of ecosystems also changes. A study by Carugati *et al.* (2018) found that a disturbed mangrove area showed a loss of 20% of benthic biodiversity, and a loss of 80% of microbial-mediated decomposition rates. In

addition, since benthic fauna are the main target of the abundant feeding juvenile reef fishes, mangrove deforestation could have important consequences on neighbouring ecosystems.

Concrete action plan / restoration success story

Until now, the paper has mainly focused on the consequences and major disadvantages of cutting down mangroves. But it is possible to successfully restore mangroves. Unfortunately, to date there has been more destruction than restoration, and it is not easy to find a good restoration success story. It is nevertheless entirely possible to achieve this by performing five steps.

These five steps were presented in a report written by Roy R. Lewis III, and are necessary to achieve successful mangrove restoration:

1. Understand the autecology (individual species ecology) of the mangrove species at the site, in particular the patterns of reproduction, propagule distribution and successful seedling establishment
2. Understand the normal hydrologic patterns that control the distribution and successful establishment and growth of targeted mangrove species
3. Assess the modifications of the previous mangrove environment that occurred that currently prevents natural secondary succession
4. Design the restoration program to initially restore the appropriate hydrology and utilize natural volunteer mangrove propagule recruitment for plant establishment
5. Only utilize actual planting of propagules, collected seedlings or cultivated seedlings after determining through Steps 1-4 that natural recruitment will not provide the quantity of successfully established seedlings, rate of stabilization, or rate of growth of saplings established as goals for the restoration project.

These steps are often overlooked and ignored when we are trying to achieve successful mangrove restoration. And failure in restoration can often be traced back to poor or no execution of steps 1-4, ie that one has gone directly to step 5. Its therefore crucial to implement all 5 steps when one wants to successfully restore our mangroves. Prevention of deforestation is besides the restoration of mangrove forests also very important. Policymakers should design conservation programs and provide funding for initiatives that conserve mangroves. Heightened awareness and educational programs for communities that live close to mangroves can also help prevent further loss. It should be discussed with communities how they can sustainably use and live with the mangroves.

Conclusion

In conclusion, the world’s mangroves are experiencing extreme threats from deforestation and need to be both restored and preserved. The ecosystems of mangrove forests are highly vulnerable and threatened by agriculture and aquaculture. Mangroves inhibit important functions for both human and animal life, such as carbon storage, a habitat for various species and offering protection against natural disasters. With climate change, natural disasters will be more common and mangrove forests provide a natural barrier for vulnerable coastlines. The mangrove trees shield the land

from wind, offer protection to the biosphere and reduces the height and velocity of incoming waves. Therefore, mangrove forests are essential for minimising property damage and human fatalities. Ecosystems of mangroves are one of the most productive ecosystems of the planet. Yet the disturbance of these ecosystems by deforestation is causing the loss of various mangrove species. As restoration of these ecosystems is essential, five steps for future restoration are outlined in the paper. These steps are, to: understand the autecology, understand the normal hydrologic patterns, asses the modification of the previous environment, design a restoration program and use the information of the previous steps for planting. Restoration actions in combination with limiting deforestation is thus essential for the future.

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