Attachment 1

Mangroves and Its Importance to the Environment and Ecosystem.

What is a mangrove?

Mangrove is a specialized marine ecosystem consisting of a group of plants growing in muddy, loose and wet soils in tropical and sub-tropical areas, comprising of shallow, coastal waters, deltas and estuaries or lagoons. The specific regions where these plants occur are termed as 'mangrove ecosystem'. These are highly productive but extremely sensitive and fragile.

Common mangrove species:

Red mangroves (*Rhizophora mangle*) characterized by aerial roots concealed props roots which provide support for soft mud and stabilize elements.

Black mangroves (*Avicenia germinans*) occurs shoreward to the red mangrove and is characterized by the presence of small pencil-like vertical root shots call pneumatophores. These root shots stand in dense arrays near the high-tide line, enabling the mangrove to obtain oxygen directly from the air.

White mangroves (*Laguncularia racemosa*) grow on elevated grounds above the high-tide mark and behind the red and black mangroves. The leaves are thick and succulent, rounded at both ends, and the same color on both sides. The root system resembles that of most terrestrial trees and seldom show breathing roots.

Fishes, shellfishes and crustaceans:

Major constituents of this group in the mangrove environment are 105 species of fishes, 20 species of shellfishes and more than 225 species of crustaceans. Among these, commercially important are *Meretrix*sp., *Crassostrea* sp., *Penaeus* sp., *Scylla serrata and Mugil cephalis*. Scylla serrata,the large edible swimming crab, inhabits the muddy bottom of mangrove estuaries, as well as coastal brackish water. *Thalassina anomala*, the mud lobster is also found along estuaries and tidal rivers. Mud skippers are one of the fish which live on the mud flats associated with mangroves shores.

Birds are a prominent part of most mangrove forests and they are often present in large numbers.

Fauna:

There are different types of faunal communities in mangrove waters which are dependent on the water component in one way or the other. The planktonic and benthic animal communities also play a very important role in the mangrove ecosystem just like the terrestrial animals. There are different species of crustaceans like *Penaeus indicus, P. merguiensis and P. monodon*, while the crabs are represented by *Uca* sp., *Scylla serrata,*

Thalassina, etc. The fishes are represented by several species like the mud skippers, carangids, clupeids, serranids, mullets, hilsa, seabass, milkfish etc.

Pelagic community:

The mangrove water, usually rich in detritus are highly suitable for fishing. The major fishery resources found in these waters are detritivorous species of fishes, crabs, crustaceans and molluscs. Roughly about 60% of coastal marine fish species is dependent on the mangrove estuarine complex. Prawns are represented by the species of *Penaeus* and *Metapenaeus* while the crabs are represented mainly by *Scylla serrata*. The molluscans of mangrove waters are mainly represented by *Crassostrea* spp., *Mytilus* and clams. In the upstream regions, giant prawns like *Macrobrachium rosenbergii* are also found in large quantities.

Commercial exploration:

Mangrove trees are used for house building, furniture and certain household items. Mangrove trees have been the source of firewood since ancient time. Tannin is extracted from the bark of some mangrove species like *Rhizophora mucronata, Bruguiera gymnorrhiza and Ceriops tagal*. Mangrove trees have 35% tannin in their bark which is higher compared to other countries. Extracts from mangrove bark are used by fishermen to dye their fishing net and enhance its durability. Honey collection from the mangrove forest is a promising business. Bark and roots of *Aegicera corniculatum and Derris heterophylla* are used as mild fish poison. *Avicennia* spp; *Phoenix paludosa and Sonneratia caseolaris* are used for human consumption and as cattle feed. *Nypa fruticans* is tapped for an alcoholic drink.

Importance:

Mangroves shed and drop about seven and a half tons of leaf litter per acre per year. The constantly-shed leaves are quickly broken down by bacteria and fungi and released into the water, providing food for sea-life. Mangroves are the nesting grounds for mammals, amphibians, reptiles, countless unique plants, juvenile fish and invertebrates, sponges, barnacles, oysters, mussels, crabs, shrimps, oysters and many water birds such as the great white heron, reddish egrets, roseate spoonbills, etc.. Mangroves are also recharge underground water supplies by collecting rainwater and slowly releasing it.

The fishes lay their eggs in tangled roots of mangrove trees and later hatch and grow with needed nutrients available. Thus mangroves act as natural nursery grounds. Mangroves offer shelter to the juveniles of a wide variety of marine organisms, notable among them being certain species of penaeid shrimps. A linear relationship exists between shrimp production and the size of the mangrove forest area. Mangroves give recreation to hunters, fishermen, bird-watchers, photographers and others who treasure natural areas.

Mangrove swamps and other low-lying areas along the estuaries are generally preferred for brackishwater fish farming. The species cultivated are *Liza parsia, L. tade, Mugil cephalus, Chanos chanos, Penaeus monodon* and *Fenneropenaeus indicus*. Mangroves trap debris and silt, stabilizing the near shore environment and clarifying adjacent open water, which facilitates photosynthesis in marine plants. The fringing network on mangrove buffers natural forces such as hurricanes, wave action, tidal change and run-off, preventing soil loss with its firm, flexible barrier. Beyond serving as a refuge for juvenile marine organisms, mangroves filter sediment and buffer coastlines against erosion and storm surge. The major ecological

role of mangroves is the stabilization of the shoreline and prevention of shore erosion. The dense network of prop roots, pneumatophores and stilt roots not only give mechanical support to the plant, but also trap the sediments. The important ecological role of the mangroves is the detritus, which help in feeding and provides breeding and nursery grounds for the juveniles of many commercially important shrimps and fishes.

Threats to mangroves:

Shoreline development has replaced mangroves with marinas, dredged channels, airports, seawalls and other commercial and residential construction. Other threats are illegal dumping, beach renourishment, and oil spill, agricultural run-off that contains herbicides, pesticides and sugarcane wastes. Globally mangrove forests are disappearing at a rate of 1-2 percent per year, a pace that surpasses the destruction of adjacent ecosystems, coral reefs and tropical rainforests. The U.N. Food and Agriculture Organization estimates that mangroves are critically endangered or approaching extinction in 26 out of the 120 countries in which they are found. Mangroves have been deforested and reclaimed to such an extent that the mangroves along the Suva area coasts are very much degraded. This has not only affected the coastline but also the fisheries to a large extent.

Conclusions:

Mangroves serve as a critical nursery for young marine life and therefore play an important role in the health of fisheries and the economic well-being of fishermen and the traditional fisheries or qoliqoli owners. The ecosystem is also considered as most productive and biodiversity providing significant functions in the coastal zones as buffer against erosion, storm surge and tsunamis. Afforestation of mangrove areas on a large scale and prevention of further mangrove loss is the most urgent need of today, if the coastal environment is to be brought back again to its earlier pristine glory.

Other additional notes:

Mangroves provide energy for their respective ecosystems. The organic material in freshly fallen mangrove leaves can be utilized by other organisms. So can the organically rich sediments around the tree roots, which support a number of crustaceans and mollusks. Mangroves also provide shelter for organisms, both above ground and underwater. The thick tree roots provide a surface for attachment of sessile marine invertebrates, and the nooks and crannies provide hiding for fish and smaller organisms. The tree canopies support a diverse insect fauna as well as roosts and nest sites for insectivorous and piscivorous birds. Larger mammals and crocodiles are a feature at some mangrove forests, particularly in the Indo-Pacific region. Mangroves provide nurseries for juvenile fish as well, because of their high biomass of available food and the refuge the roots offer from predators. Mangroves prevent erosion with their thick, extensive root systems, by holding sediments together. Such an extensive an tangled root system that the world record for the 100 yard dash through a mangrove forest is said to be 22 minutes and 30 seconds. The thick tangles of vegetation also protect the inland from tropical storms by dampening the power of waves and blocking wind. Although they are battered and damaged by such storms, they always grow back. No man-made

coastal barrier is capable of self repair as is the mangrove.
In the last 50 years, mangroves have been in decline across the globe. Their uses to humans are numerous. Hundreds of products are derived from mangrove trees, from charcoal, to construction materials, to incense, to hair oils and honey. From them come many goods. There is even an alcohol derived from the Nypa palm mangrove associate that can be turned into transport fuel. The interesting flora and fauna associated with mangroves provide opportunities for scientific study, tourism, and education, such as in this class. Mangroves are important in the maintenance of commercial offshore stocks of fishes. It has been argued that five of the six most important commercial fishery species in the U.S. may be dependent on intertidal zones, such as mangrove habitats. Unfortunately, it is human exploitation that is leading to the demise of the mangrove. In Thailand, more than 70% of mangroves have been destroyed. Destroying factors, which mostly take place in third world countries looking to make quick profits, include several forms of pollution and aqua-culture development, such as clearing the mangroves for agriculture, mariculture ponds, and salt production, and the over exploitation of mangroves for building materials and for fuel. The future of mangroves is questionable. Many believe that through research we will find better ways to manage these unique mangrove aqua-culture systems. Others believe that what needs to be given to third world countries is the money, the technology, and the education necessary for people to achieve sustainable-yield practices. In some mud flats, degraded forests, and shrimp culture areas, mangrove replanting has been initiated. Mangrove rehabilitation around the globe is also being undertaken by government agencies, backed by the research of private sectors. Local communities have even taken steps in conserving mangrove forests, as we finally begin to realize the importance of this unique ecosystem to the global web of life. These environmentally friendly practices and attitudes are ultimately what is necessary if we are to preserve mangroves for future generations.

From National Geographic

Mangroves Are Nurseries for Reef Fish, Study Finds

John Roach
for National Geographic News
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Mangroves—forests of tropical trees and shrubs rooted in saltwater sediments between the coast and the sea—are crucial nurseries for coral reef fish, according to a new study. The finding highlights the importance of the rapidly dwindling habitats to reef communities. "Beyond showing they are important, we showed they are much more important than even assumed," said Peter Mumby, a marine biologist at the University of Exeter, England. Mumby and his colleagues found that mangroves serve as a vital, intermediate nursery as coral reef fish journey from their cribs in seagrass beds to the large coral reef ecosystems that fringe coastal communities.

Coral reef fish were up to twice as abundant on reefs adjacent to mangrove forests compared to reefs that weren't, researchers found. They also learned at least one species, the rainbow parrotfish (*Scarus guacamaia*), depends on mangroves for its very survival. The study will appear in tomorrow's issue of the science journal *Nature* and was supported by a grant from the National Geographic Society's Committee for Research and Exploration.

Mangrove Conservation

Mumby and his colleagues believe that conservation efforts are necessary to protect connected corridors of mangroves, seagrass beds, and coral reefs to maintain the resiliency of coral reef ecosystems—and their productivity for fisheries. Ivan Valiela, a marine biologist with Boston University's Marine Biological Laboratory in Woods Hole, Massachusetts, agrees. He said the research reinforces the concept that individual ecological units—mangroves, reefs, land—are crucially intertwined. "Maintenance of these important environments therefore has to be done from a wider perspective," he said. "This whole set of concepts bears on the issue of setting up coastal reserves, national parks, maintaining commercial stocks, and a host of other management issues."

Nursery School

Mangrove forests are home to an abundance of wildlife. Above water, butterflies, birds, and mosquitoes zip around the canopy. Snakes, crocodiles, and crabs scurry and swim about the forest floor. And in India, Bengal tigers (*Panthera tigris*) laze in forest branches. You tend to find mangroves form this very dense network of channels and creeks that are very, very calm and peaceful but also [teem] with all sorts of life," said Mumby. Researchers have long known that fish often mature in the murky saltwater amid the tangled labyrinths of roots created by mangroves. But according to Mumby, the importance of these nurseries to reef fish communities had never been quantified.

Factors such as fishing pressure and larval supply were thought to be more important to the structure and abundance of reef fish than the presence or absence of mangrove forests. Since juvenile fish are known to hang out in other habitats like seagrass beds and small, protected patch reefs before venturing out to large reefs, researchers sought to answer a key question: In the absence of mangroves, wouldn't these other habitats suffice? To find out, they sought coral reefs so isolated from mangroves that it would be impossible for fish from mangrove habitats to reach them. They found such reefs in Belize. "In Belize, we have the unusual situation of offshore reef atolls with massive amounts of mangroves as well as atolls with nothing at all," said Mumby. The researchers contrasted the populations of 164 fish species in the two different habitats. They found that mangroves serve as an intermediate nursery, making for much healthier and robust coral reef fish communities. Mumby explained that the fish start out in seagrass beds, but once they grow two to three inches (five to eight centimeters) they are too big to hide from predators there. At that point they move into mangroves, which offer murky hiding spots and abundant food. "They survive well in the mangroves until they are a bit larger," said Mumby. "But at some point they need to move to the reef. We are not sure why they move to the reef, but [we] suspect it's a good place to reproduce." Once they grow big enough in the mangrove, the fish swim out to patch reefs in the lagoon. There, they co-exist with thousands of other juvenile fish, packing on girth in order to reach and survive on the larger, fringing reef. In the absence of mangroves, fish swim directly from the seagrass beds to the patch reefs. But because they are smaller, predators catch them more easily, said Mumby.

Mangrove Destruction

Previous research by Valiela indicated mangroves are being destroyed more than twice as quickly as the well-publicized destruction of tropical rain forests. "We, by no means, expected to find the rates we in fact calculated," he said. In the past, mangroves were deemed a mosquito-infested nuisance to waterfront home development and razed. Today, they are mostly cleared to make way for shrimp farms. Mangroves provide important functions, including processing land-derived nutrients, serving as a buffer against pollution runoff, and filtering food for marine mammals. The finding that mangroves serve as crucial nurseries for coral reef fish highlights another reason to conserve these rapidly disappearing habitats. "To really sustain fish, one thing you should aim to do is conserve a certain amount of mangroves," said Mumby.

According to Valiela, this is easier said than done. "We are dealing with Third World, marginal economies. There are few choices for these people. We are sure they do not want to damage the very environment in which they live, but there are few other crops that yield as much [as shrimp farms]," he said. Mumby said he hopes the findings will strengthen the importance of mangroves to fishermen who have a key political voice in many tropical regions. Valiela is calling on the international community to better understand the ecology of these connected ecosystems and pose conservation incentives and sustainable development alternatives for affected local communities.