FAUNAL CONNECTIVITY FOR ISLAND WETLAND CONSERVATION

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The vast majority of tropical wetland ecosystems are intricately connected by ecological processes acting across landscapes and seascapes. Conservation management within a wetland ecosystem category (e.g. freshwater, estuary, reef, open sea) rather than across systems is the common practice of most agents in government, NGO's and communities. This approach is proving to be generally unsuccessful and few ecosystems, despite funding and action over several decades, can be seriously deemed sustainable in the long term. A fundamental problem is the poor recognition of the processes that link the highest headwaters of streams and rivers, through estuaries, mangroves, seagrass beds and out to the coral reefs. Our research in the Melanesian region (Papua New Guinea, Fiji and Solomon Islands) is building a picture of how these systems are connected in terms of fauna and water quality and what the implications are for conservation management.

There has been a lot of emphasis in recent years on the establishment of marine protected areas (MPA's) for biodiversity and, more often, fish stock enhancement purposes. While this is certainly a positive development, many near shore MPA's are not achieving the desired results of increased numbers of food fishes for harvest and therefore are abandoned or become "paper" parks.

Above: New species of gobby, Tetepare Island (Solomon Islands). Starting above right, *Anguilla marmorata*, Trevally (*Caranx papuensis*), Snapper (*Lutjanus* spp), *Stiphodon semoni*, *Stiphodon rutilaureus*.

We are particularly interested in the aquatic fauna that use all or several of these wetland ecosystem types during different life stages, and are really the living connections between the land and the sea. We aim to provide this connectivity information to help communities and decision makers in the region make better management decisions across whole land and sea systems. Management must occur at the scale at which ecological processes operate or we cannot expect to have a positive effect or to minimize damage to these important ecosystems over the long run.

There has been a lot of emphasis in recent years on the establishment of marine protected areas (MPA's) for biodiversity and, more often, fish stock enhancement purposes. While this is certainly a positive development, many near shore MPA's are not achieving the desired results of increased numbers of food fishes for harvest and therefore are abandoned or become "paper" parks. Our research in the region is showing that for a significant number of so-called "marine" species, the juvenile or sub-adult stages of life are spent in pure freshwater or upper-estuarine low-saline environments. This is true for many species of Snapper (*Lutjanus* spp.), Trevally (Caranx spp.), Grouper (*Epinephelus* spp.), Grunter (*Haemulidae*), Mullet (*Mullidae*) and even some Requiem and Hammerhead sharks (*Carcharhinus leucus*, *Sphyrna* sp.). These are all species favored as food fishes from the

Indo-Pacific reef environment. The implications of this are that communities cannot expect to see population increases or stock maintenance within these preferred food fishes by setting up only management strategies in these marine areas. The freshwater and estuarine habitats of these fishes favored as juveniles and sub-adults must also be managed for maintenance of water quality and reduced fishing pressure if the adult reef stocks are to be maintained or to increase.

This food fish connection with the sea is only a small part of the faunal connectivity story. A vast majority of species in the tropical Pacific freshwaters and estuaries move between the freshwater and the sea or exhibit some form of 'diadromy'. The ever-present eels of the family Anguillidae are catadromous, which means reproduction and early development occurs in the sea. Juveniles migrate back to freshwater and most feeding and growth occurs in freshwater, then the adults migrate back to the sea to reproduce where they complete their lives. However, the major form of diadromous life cycle in the region is called 'amphidromy'. Amphidromy consists of the following stages: 1. Spawning and egg development in freshwater; 2. Larvae hatch and migrate to the sea; 3. Larvae feed and grow at sea; 4. Juveniles return in large numbers to freshwater bodies; 5. Feeding and growth to maturity in freshwater, and adults never return to the sea where they were spawned.

The major freshwater faunal components of Pacific Island streams and rivers are amphidromous species including gobioid fishes of the genera Sicyopterus, Sicyopus, Stiphodon, Lentipes, Cotylopus, Awaous,

The land sea interface, an important link for many species, showing connectivity of the terrestrial and marine environment. Photograph of weather coast of Tetepare Island.

Stenogobius, Schismatogobius, Rhinogobius, Glossogobius, Dormitator, Eleotris and Gobiomorphus, atyid shrimps of the genera Caradina, Atya, Atyopsis, Atyoida, Paratya and Macrobrachium, crabs of the genus Varuna and gastropod molluscs (snails) of the genus Neritina, to name a few. The return of juveniles in huge numbers to estuaries and freshwater bodies has created a widespread seasonal culture of harvesting in the Pacific, and should be managed as a crucial stage in the migratory process. So, when you reach the very highest mountain of a high island in the region, most of the life that you see in the headwaters of a river are generally connected to the ocean in some way and have migrated up the waterfalls and rapids to be there. Common inhabitants of headwaters are eels of the genus Anguilla, gobies of the genera Lentipes, Sicyopus and Sicyopterus, Macrobrachium shrimps, Varuna crabs and Neritina snails all of which are connected to the sea at various stages in their lives.

The amphidromous gobies of the region are incredibly beautiful and unique animals deserving of a special mention. Firstly, they are the major component of Indo-Pacific Island aquatic fauna forming the most numerous, species-rich and conspicuous fish assemblages. Secondly, from a conservation point of view, they contain the highest proportion of island or archipelagic group endemics of any freshwater fish fauna in the region. Also, there is the widespread culture of harvesting the larvae in huge numbers as an important source of protein during the migration period. Often the small island endemic members of this group are among the first to disappear if water quality declines due to logging, agriculture or other land development. So there seems to be potential in using this very "connected" group as an indicator for river basin health in the Indo-Pacific.

As an anecdote, the Kubuna River on Viti Levu, Fiji, has experienced decades of catchment alteration including clear-fell logging of the entire upper and middle catchment areas for planting of pine plantations and lower catchment areas for sugarcane plantations, resulting in erosion, siltation increases and water flow reduction. Elders in the villages adjacent to the river and near shore marine areas claim that the migration of goby larvae (cigana) from sea to the river and up-river stopped entirely over 15 years ago after a gradual decline of several years from the time of clearing the land. Recent conservation work in the catchment and foreshore areas by the Fiji Locally Managed Marine Area Network, World Wildlife Fund – Fiji and Wetlands International-Oceania have assisted villages to establish a managed near-shore reef protected area, river mouth/mangrove protected area and a series of several forested tributary no-take zones within the last few years. Albeit in small numbers (10s instead of 1000s), gobies (*Sicyopterus lagocephalus* and *Sicyopus zosterophorum*) have last year (2005) begun a sea to river migration for the first time in over 15 years. It is suggested that by establishing a landscape-seascape corridor of managed areas that incorporate near shore marine, mangrove/estuary and managed river habitats, crucial elements of the amphidromous life cycle can be managed to protect or restore natural populations. It is likely that further ongoing work to re-establish riparian buffer zones will greatly assist in restoring the numerical abundance of this group of fishes and the overall ecological integrity of the watershed and near-shore marine areas.

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ENVIRONMENTAL HAZARDS, SOLOMON ISLANDS

MAN-MADE LAKE MAY BE HAZARDOUS

Could cyanide contaminated lake burst its banks?

Residual water from the mining site of the Gold Ridge Mining company now forms a lake, in a valley that previously had no water.

The Global Village News Team was able to collect this story that was rather strange and interesting, which may not have been brought to the attention of many readers.

The Gold Ridge mining uses a Cyanide Process to extract gold from fine-gold bearing rocks. Sodium cyanide solution is mixed with finely ground rock that is proven to contain gold, and is then separated from the ground rock as gold cyanide solution.

Zinc is added to the solution, precipitating out residual zinc, as well as the desirable gold metals. The zinc is removed with sulphuric acid, leaving a gold sludge that is generally smelted into an ore that is shipped to a metals refinery for final processing into 99.99% pure metal.

The cyanide technique is very simple and straightforward to apply, and a popular method for low-grade gold ore processing. Like most industrial chemical processes, there are potential environmental hazards presented with this extraction method, in addition to the high toxicity presented by the cyanide itself.

This was seen in the environmental disaster in Central-Eastern Europe in year 2000, when during the night on the 30th of January, a dam at a goldmine reprocessing facility in Romania released approximately 100, 000m³ of wastewater contaminated with heavy metal sludge and up to 120 tonnes of cyanide into the rivers of Tisza and Danube.

Experts were flown into Honiara recently to investigate the possibility to drain out the water and determine its possible impact to the environment. Eye witnesses said that the lake is reaching its brim and may overflow soon with continuous inflow from nearby small streams and rain. It was reported that the villagers below the lake will have to be evacuated to a new site to prevent fatalities due to the expected water-outbreak.

"There is nothing else we can do but the water has to be drained" said one expert.

It was reported that they are planning to drain this lake via a nearby stream but the impact this will have on fish and other living animals in the river or the sea is unknown.

What will happen to the plants, the animals, the fish in the river and sea, and the soil?

If Gold ridge continues to operate using this technique in the years to come, what are the likely future impacts this will have on the environment?

- Compiled by Marlon Houkarawa