APICULTURE IN OR NEAR MANGROVES:
a natural winner for communities & mangroves

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Introduction

Mangroves are essential habitats that provide support for flora and fauna, including humans. In relation to humans, mangroves have provided communities with: coastal defense from storms and waves, medicine, termite and rot-resistant wood, and food for thousands of years. From an ecological perspective mangroves are part of a linked ecosystem that includes seagrasses and coral reefs. Acting as nurseries for many essential reef species, including the black tip reef shark; and, by up-taking the nutrients from land-based run off, mangroves play an integral role in the balance of a healthy reef ecosystem. Ecosystems which today have become a central part of many island economies, whether from a fishing or tourism perspective.

Bee hives in mangrove forest at Ban Pred Nai, Thailand.

Protecting mangroves, and restoring them appears a huge task, given the distribution and often remoteness of mangrove forests. Community initiatives, often starting small, have had great successes, and are in fact often noted as the most effective preservation technique. Throughout the world there are many initiatives which aim to preserve and enhance the ecosystem services provided by mangroves as an incentive to preserve the ecosystem. The most sustainable of these initiatives is the management or implementation of apiculture.

Apiculture Ecology in Asia

Mangroves naturally provide a safe habitat for bees primarily due to three consistent factors:

- Mangroves provide a year round supply of nectar and pollen for bees;
- Mangroves provide an unlimited water source;
- The stability of mangroves provides protection from storms.

Also affecting the relationship between mangroves and bees are the facts that mangroves have a natural resilience against forest fires; and they naturally deter termites and ants, natural competitors for bees in savannahs, meadows, orchards and other locations where bees are raised for honey production. The 'Black Mangrove' or 'Honey Mangrove' (*Avicennia germinans*) is even believed to rely on bee pollination for reproduction. The links between bees and mangroves are inextricable and have been exploited by humans for thousands of years.

For the implementation of mangrove apiculture projects, there are three common methodologies:

1. Collection of honey from native wild bees in forest habitat including mangroves;
2. Setting-up hives out of natural materials, which wild bees populate the hive and produce honey which can be extracted;
3. Set up commercial hive boxes with native or imported domesticated bees

Beehive at Nai Nang Village, near the mangrove in Krabi Province, Southern Thailand

The first two methodologies are the most commonly practiced in Asia, from the Sundarban mangrove forest in India and Bangladesh to the coastal mangrove forests throughout the Philippines. This is because there are now three major honey bees native to Asia:

- *Apis dorsata* (the Giant Honey Bee);
- *Apis florea* (the Little Honey Bee);
- *Apis mellifera* (the European Hive Honey Bee) along with subspecies *Apis mellifera indica.*

The most common and naturally occurring of the three is *Apis dorsata,* used for the honey industry in:

- Myanmar (Supplemented by *Apis cerana indica)*; India; Bangladesh; Vietnam; The Philippines;

Apis cerana, a bee species that originates from tropical countries such as Indonesia, Malaysia, Thailand and Borneo, is known to be an excellent pollinator of many crops including: spice crops, fruits, nuts, oilseeds, cauliflower, okra, and onion. Several factors make *Apis cerana*, also known as the *Asian Honey Bee*, efficient pollinators, the first being their shorter foraging range. A shorter range means that each worker spends more time with the same plants and has higher floral fidelity. In addition, *Apis cerana* is wild and naturally in balance with a vast array of predators, pests and parasites, meaning they are robust and disease resistant. These characteristics allow them to be used to produce organic honey.

Apis cerena (Source: www.beeworldproject.org)

A typical *Apis dorsata* hive can produce up to 50kg of honey annually, it cannot however inhabit box hives like the European *Apis mellifera*. This had led to a diversification in the honey collection techniques throughout Asia, some past techniques being very destructive, as seen in the Sundarbans. In the 1983/4 honey collecting season 9,300 trees were felled in order to collect 233 tonnes of honey. The same amount of honey could have been collected from 1550 sustainably managed hives. Today in the Sundarbans production has dropped as a result of mangrove loss to facilitate urban expansion alongside mismanaged swathes of forest. Production estimates vary between 100 (Food and Agriculture Organisation) and 200 tons (The Bangladesh Forest Department) of honey collected from wild bee hives, which makes up approximately 50% of the country’s demand for honey.

Additionally, honey collection is a very risky business in the Sundarbans. Indeed, honey gatherers have to travel through the Sundarbans forests which are home to the Royal Bengal Tigers which are the only species of tigers that consume human meat. Honey collectors have elaborated various technics to try and protect themselves. One of these technics suggests that tigers don't attack someone that is looking directly at them. Hence the collectors wear rubber masks, with human faces drawn on them, on the back of their heads. Despite these kind of means, up to 80 people are killed by these predators each year and many more are wounded.

Honey collectors using rubber masks against tigers in the Sundarbans (Source: http://www.independent.co.uk)

The Sundarbans, being one of the largest and most biodiverse mangrove forests in the world, provides a valuable opportunity to understand the ecology of mangrove apiculture. Studies on the forest's ecology, focusing specifically on bees has shown that important mangrove species for apiculture are:

- *Aegicerus corniculatum;*
- *Avicennia officinalis;*
- *Avicennia alba;*
- *Brugiera gymnorrhiz;*
- *Ceriops decandra;*
- *Rhizophora mucronata;*
- *Sonneratia apetala;*
- *Sonneratia caseolaris;*
- *Xylocarpus mekongensis;*
- *Cynometra ramiflora;*
- *Acanthus ilicifolius.*

The Sundarbans however is a relatively unique circumstance as it does show one of the greatest floral biodiversity out of all mangrove forests, therefore initiatives in this area can

benefit from all of these species being present. Under more normal circumstances where forests have significantly less floral biodiversity, the major species identified as important for mangrove apiculture are listed below, alongside alternative uses:

- *Avicennia spp*: pollen produce and used for food, timber, as fodder and as fuel.
- *Nyssa spp*.: used for food and timber
- *Rhizophora mangle*: used as fuel and for timber, land and amenities
- *Serenoa repens*: pollen producer

American Apiculture Initiatives

North and South American apiculture projects typically rely on Black Mangroves (*Avicennia germinans)*, Buttonbush Mangroves (*Conocarpus erectus*), Red Mangroves (*Rhizopora mangle*) and White Mangroves (*Laguncularia racemosa).* Initiatives such as those in Florida and Cuba utilize method #3 with *Apis mellifera* kept in commercial hive boxes. The hives are migrated between citrus farms and black mangrove forests. Looking at one small-scale Floridian business, Keez-Beez, the owner produces 9 tonnes of raw honey from 500 hives, using the byproducts to produce soaps and medicines for extra income. Guyana apiculturists practice a mixture of methodology #1 and #2, taking advantage of the introduced, but now local hybrid, the Africanised Honey Bee, an *Apis mellifera* hybrid. Using this technique, beekeepers in Fort Wellington collect 25-30kgs of honey per hive annually, with more engaged keepers owning up to 100 hives each.

Mangrove honey is a popular product in Florida, USA

Source:https://www.google.co.th/search?q=Florida+black+mangrove+honey&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwjwhqulipjMAhWMGJQKHemcCjUQsAQIPw&biw=1152&bih=586

Apiculture as an Alternative

Mangrove apiculture is the most widely spread alternative use of mangroves in the world, it is not however practiced to its full potential, particularly in Asia. Although practiced in the Philippines, mangrove apiculture only provides approximately 30 tonnes of honey per year. This amount makes up only 25% of the country's 120 tonne demand for honey. There is great potential for growth in the mangrove apiculture industry, theoretically. The major

threat to mangroves in the Philippines comes from development pressure to expand the tourist industry. In areas where tourism has become the major industry, development has overwhelmed planning and environmental legislation, with hectares of mangroves lost to make way for beach front property.

Challenges, Risks and Benefits

Implementing and maintaining mangrove apiculture initiatives comes with challenges. Challenges which can be distinct in each region with drivers rooted in industry, economy, community and politics. A common challenge, or necessity, is to increase the population's perception of importance of mangrove ecosystems. Even in the Sundarbans, which shows a relatively high engagement in mangrove apiculture, there are only approximately 2000 honey collectors. With an area estimated to be in excess of 10,000 km², this is relatively few collectors. The same is true in mangrove forests throughout Southeast Asia. Mangroves are typically lost to destructive uses such as aquaculture pond formation or unsustainable wood extraction. Profitable, yet short-term uses of mangroves which cannot provide sustainable benefit to the community.

Another common challenge faced by mangrove apiculture initiatives is deforestation pressure from economic sources. Access to forests is often hampered by the density of the forest itself, with many uses of large forests existing mainly within the landward fringes. Degrading the forest to facilitate access is often followed by road construction and urban expansion. This loss of mangrove cover constitutes the loss of habitat for bees and therefore a decline in the amount of honey that can be collected. This of course works both ways, with successful apiculture initiatives creating the reverse pressure, a demand for greater mangrove cover to increase the benefits of honey collection.

Land conversion is the greatest deforestation pressure mangroves face. It is a significant problem in all areas with mangroves, particularly in Southeast Asia - the hub of shrimp aquaculture, providing 50% of the farmed shrimp market. This is a significant challenge to overcome if apiculture is to be highlighted as a sustainable alternative land use in countries such as Indonesia and Vietnam. As a consequence of such large-scale land conversion another challenge has arisen. Social values have begun to change, noticeably in some areas. Where environmental sustainability and connectedness was once an integral part of community, that relationship has begun to disappear. In Indonesia in particular it has been replaced by economy facing society that demands exploitation of ecosystem services, sometimes to the point of complete obliteration.

Challenges are also faced on a local level. The lack of defined terms of ownership of land and borders creates conflict in determining who has the right to use land. This is a problem faced by communities throughout the world. Inter and intracommunity conflicts over the same issue has also created issues. All apiculture initiatives using methodology #1 and #2

indicate ownership by marking trees. Theft of honey from marked trees is a significant issue, as there are very little resources to enforce ownership and protect property. For honey hunters which rely on honey for their livelihood this is a significant problem that demands solution if initiatives are to be marketed as an incentive for conservation to any group of people.

Bees themselves are also under threats which is a serious issue as bees are the main pollinators of our food supply crops. The United States Environmental Protection Agency (EPA) states that the decline in health of honey bees and the increase in death rates are due to multiple factors such as pests, pathogens and viruses, poor nutrition, bee management practices, lack of genetic diversity and last but not least pesticide exposure.

Bees are exposed to pesticides in many ways:

- They may come in direct contact with sprays
- Pollen-collecting hairs can pick up pesticide residues.
- Bees may drink contaminated water or nectar

Since the Green Revolution, the development of chemical-intensive agriculture has contributed to the dreadful decline in bees and other pollinators populations worldwide. Hence, it is essential to raise awareness, on a local and international scale, on the negative effect of pesticides.

The neonicotinoid chemicals, class of neuro-active insecticides causing the most damage to honeybees worldwide. The first neonicotinoid chemical, named Imidacloprid has been widely used as an insecticide since 1994 on all sorts of crops such as corn and vegetables. The US Environmental Protection Agency states that the global production of this substance was 20,000 tonnes in 2010 making it one of the world's most-used pesticides. It has been observed that even low-levels of Imidacloprid (25 parts per billion) cause a decline in the number of bees and the honey they produce as it impairs olfactory learning especially in Asian honey bees (Apis Cerena). (http://www.nature.com/articles/srep10989)
The main manufacturers of neonicotinoid pesticides are Bayer CropScience, Sumitomo Chemical, Syngenta, Nippon Soda and Mitsui Chemicals.

So far, three neonicotinoids, including imidacloprid have been banned in the EU since April 2013 and more recently Montreal, Quebec (Canada) banned all neonicotinoids in December 2015.

Pesticide use is killing bees worldwide (source: http://www.inquisitr.com/)

The benefits of mangrove apiculture are outlined by the FAO as:

- Alleviating rural poverty by creating in-situ income-generating activities through beekeeping
- Improving the potential of beekeeping by planting melliferous mangrove species toward the landward fringe (mangrove afforestation/reforestation)
- Improving equipment and quality through careful management (capacity building)
- Overcoming specific diseases and pesticide misuse

Focusing on case studies and counties in particular however the benefits vary. In the Senemgambie Meridionale benefits include the nutritional benefit of supplementing the typical diet with honey and byproducts. Around the world communities benefit from the enhanced crop pollination that occurs near melliferous mangroves. Initiative in South America have begun to expand the scope of their initiatives with attempts coming from Colombia, Venezuela and Guyana to enter the fair-trade honey market.

Sustainably managed mangrove apiculture initiatives have the potential to be certified as organic and fair-trade products, as is the case with Wayuu (Venezuela/Colombia) honey. This is significant because there has been a steady and noticeable increase in demand for fair-trade honey, particularly in Western Europe where demand has surpassed 1.7 million tonnes. Many of the typical honey producing countries have felt the impacts of climate change and a gap is forming in the market, particularly since Chinese producers have lost significant consumer loyalty after it was found their product was contaminated with Chloramphenicol. This market can be entered by sustainable initiatives, and entrance into such a high demand and high value market provides significant incentive to create sustainable apiculture initiatives. Initiatives which can in turn support mangrove restoration and protection.

General references

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