Envirotalk

GOVERNMENT OF BERMUDA
Ministry of Environment and Planning

FALL 2013
VOLUME 81 No. 3

PROMOTING APPRECIATION, ENHANCEMENT AND CONSERVATION OF BERMUDA'S ENVIRONMENT

WELCOME

to our Fall edition of Envirotalk.

In this issue –

- **Dr. Robbie Smith**, Curator of the Museum of Natural History, talks about the future of mangroves in Bermuda.
- Entomologist, **Claire Jessey**, updates us on the status of the Bermuda honey bee situation.
- See the planting calendar to get a head start on what to plant this Fall.

Please contact:
Envirotalk mailing list: envirotalk@gov.bm to be placed on the mailing list or for suggestions for future articles.

Editors note

September is green and clean month with the 21st and 22nd being 'Clean Up the World' weekend (www.cleanuptheworld.org/en) and Green Consumer Day will be held on the 28th. Other important environmental dates to remember are: 20 November for Geographic Information Science Day (GIS) held for Geography Awareness week which is the third week in November (www.gisday.com/about/index.html) and 21 November for World Fisheries Day.

Kimberly Burch – *Editor*

THE FUTURE OF MANGROVES IN BERMUDA?

Mangroves are a globally significant ecosystem, distinctive because they lie between land and sea, acting as a buffer and as a habitat for many species. A "mangrove" is the collective term for all the trees that make up an inter-tidal forest, the largest of which is in Hungry Bay. Much of the coastal "mangrove" you see around Bermuda are just scattered trees, remnants of larger forests that have been reduced dramatically since the time of colonization, primarily as the result of our intensive development of the coastal zone.

Only two mangrove tree species are found in Bermuda, the red mangrove (*Rhizophora mangal*) and the black mangrove (*Avicennia germinans*), where the red mangrove occupies the seaward edge of a forest because the extensive "prop" roots of the tree can support it during intense storms and hurricanes. The black mangrove lacks these prop roots and resides behind the protective red mangroves at the back of the forest. Mangroves cannot endure direct exposure to storm waves, hence are absent from our south shore, and require some degree of sheltering by land. Our protected bays and harbours are the locations where sediment has accumulated since sea level stabilized about 3000 years ago. This is where mangroves thrive in the inter-tidal zone, because they can tolerate the salt water and there is shallow sediment available so they can establish their roots.

What has occurred over the past 3000 years is that the coastal mangroves have trapped sediment moving from land towards the sea and are also able to trap their old leaves, because the dense network of prop roots greatly reduces the energy of tides and storm. This allows mangrove crabs to bury the leaves in their burrows in the forest floor. The accumulation of these old leaves and the very extensive fine mangrove roots form a peat material that does not decay. These twin processes of sediment accumulation and peat formation have allowed the mangrove togrow and extend seaward over the past 3000 years. The critical element here is that the sediment level in the mangrove remains shallow and this is essential for the establishment of the seedlings of the red mangrove at the seaward edge. The presence of the seedlings is necessary so that new trees can grow up if storms destroy existing mature trees on the vulnerable seaward edge.

About 500 years ago sea level began to rise at a higher rate and appears to be accelerating in this era of climate change, driven by rising atmospheric carbon dioxide levels created by our intensive use of fossil fuels since the mid 1800s. These conditions have significantly affected the mangrove in Hungry Bay, where the combination of rising sea level and intense destruction caused by hurricanes has resulted in massive loss of mangroves. This is

dramatically clear in the comparison from our earliest aerial photographs from 1940 to 2010. Nearly one third of the mangrove has been lost in just 70 years (Figure 1).

I started a long-term study in the Hungry Bay mangrove in 1992 at the same time a visiting graduate student, Joanna Ellison, began her work on studying the peat deposits and eventually determining the rate of sea level rise in Bermuda over the past 5000 years. We worked together to set up a set of four study plots from the outer western seaward edge to the very eastern landward side (Figure 2). In each plot we measured the tree density, the number of seedlings and began monthly measurements of the amount of litter fall (dead leaves, twigs, seeds, etc.) that drop from the trees in each plot. Joanna also measured how much of the litter fall material was removed by tidal action. We determine that our mangroves were very seasonal, replacing most of their leaves in the summer and fall but a significantly large quantity of this material was not being trapped but removed by each tide, particularly because of the number of boat channels cut into the forest and maintained by local residents over the past two centuries. The loss of leaf material has reduced peat formation in the forest and the outer part of the mangrove was now too deep for seedlings to become established. These conditions have not allowed the forest to regenerate after storms and so it has "retreated" after each major storm.

I saw this directly in 1995 when Hurricane Felix destroyed the outer edge of the forest and eliminated my outermost study plot 1, which extended over 10 metres in from the edge into the forest. I was astounded to see such extensive damage. I continued working in the remaining plots until 2002 when I left Bermuda to teach and conduct research in the US. I returned to Bermuda in 2009 and in August 2010 I found the time to revisit my study sites. I was not prepared for the destruction that Hurricane Fabian had wrought (Figure 3) and within a month after this visit Hurricane Igor imposed another harsh blow, establishing the new edge seen in Figure 1. I re-started my study including the monitoring of the litter fall in 2011, as the production of new leaves is a good measure of stress and I hoped that I could assess how well or poorly the mangrove was doing, given a perspective from my measurements in the early 1990s. One significant concern I had was for Plot 2 because the recent hurricanes had deposited an immense amount of sand and rubble on top of the peat, upwards to 1.5 metres thick, pushed in from offshore (Figure 3).

The mangrove trees in Plots 3 and 4 appear to be as productive now as they were back in the early 1990s but Plot 2 may be more productive, which is a counter-intuitive result, given the amount of material that has buried

their roots. I can't easily understand why Plot 2 is doing well but there might be some benefit of extra nutrients associated with the storm material. I am also waiting to see if new mangrove seedlings can re-established in Plot 2 now that is much shallower in some places.

The future of mangroves in Bermuda is tied to sea level rise, which may be as much as 50 cm in the next century, according to conservative climate change models. Thus we expect Hungry Bay to continue to contract in size to the "bottleneck" near Plot 3 (Figure 3), as the higher land mass will protect it well from storms. In other places you would predict mangroves to expand in a landward direction but with the level of intense development we have along our valuable coastline (roads, docks and seawalls), as well as invasive plant species such as Brazil pepper (*Schinus terebinthifolius*) and casuarina (*Casuarina equisetifolia*), it is hard to see where the mangroves can expand.

Mangroves are protected under the Protected Species Act 2003 due to their value for habitat and ability to mitigate coastal erosion and Hungry Bay is a designated RAMSAR site, a "Wetland of International Importance". As a priority the Department of Conservation Services will be undertaking an island-wide assessment of mangrove areas this year. The survey will map established mangrove areas, assess their health, determine areas at risk, as well as potential areas for restoration. To this end the Department of Conservation Services has begun planning a major mangrove restoration project on Cooper's Island Nature Reserve, to mitigate some of the large losses of mangroves lost in the construction of the airbase in 1940–41.

We need to continue to study our mangroves and their response to sea level rise as they are an important coastal buffer and essential wetland habitat for many of our rare species, such as the giant land crab (*Cardisoma guanhumi*) and as roosting sites for migratory birds.

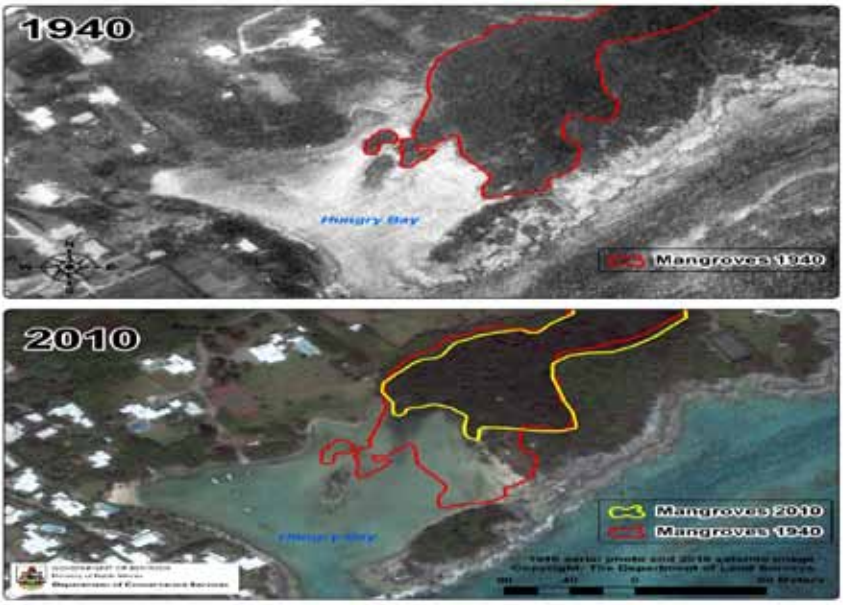

Figure 1. Loss of the mangrove forest in Hungry Bay from 1940 to 2010. Compiled by Mandy Shailer, DCS.

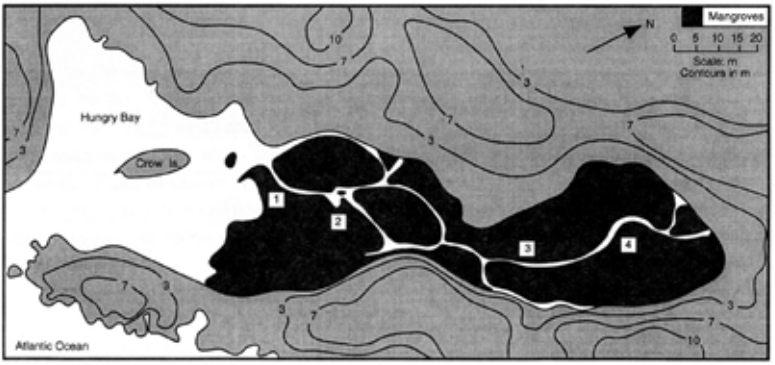

Figure 2. Historic study plots in Hungry Bay and extent of the mangrove forest in 1993. Plot 1 was destroyed in 1995 by Hurricane Felix and Plot 2 was buried by sediment pushed in by hurricane Fabian in 2003 and Igor in 2010.

Figure 3. View to the north of the western seaward edge of Hungry Bay in 2010, prior to Hurricane Igor's impact. Notice the extensive dead mangrove stumps and trunks. All rubble and sand in the foreground was deposited there by Hurricane Fabian and extends off to the northeast about 100 metres into the mangrove, along the shoreline.

Dr. Robbie Smith
Curator, Natural History Museum
Dept of Conservation Services

BERMUDA BEES – AN UPDATE

Bermuda's bee population has had a rough few years and recently experienced another massive die off, the start of which occurred in the fall of 2012. Since this time the Department has been concerned about the rise in symptoms that often indicate a Nosema infection (crawling on the ground, lethargic, lack of honey collection) and the occurrence of a colony with numerous bees displaying the characteristics of Deformed Wing Virus. Beekeepers have reported losses of up to 70% of their colonies during this time and inspections of several bee yards (apiaries) confirmed the substantial losses. During these inspections, several surviving colonies exhibited Nosema symptoms and the presence of Nosema was suspected. Nosema infections are caused by a microsporidian gut parasite called Nosema ceranae, that is easily transmitted from bee to bee. Low levels of this parasite can be tolerated by the bees, but high levels can stress a bee colony, often to the point of collapse. Samples were taken and tests confirmed that the colonies had levels of Nosema high enough to cause concern. Fortunately,

Nosema is bee-specific and is not a risk to humans via the honey, so there is no concern when consuming local honey.

Additional surveys were performed to determine varroa mite levels and were found to be high which is consistent with mite levels found in samples taken in the past. Varroa is a parasitic mite that lives on the bees and feeds on their blood. This mite was first discovered to be established in our local bee population in 2009 (see Envirotalk issue Spring 2010, Vol. 78 No. 1). During an apiary inspection, one bee colony showed an unusually high number of bees exhibiting symptoms characteristic of Deformed Wing Virus which is transmitted by varroa mites, the symptoms of which render the bees unable to fly. The presence of these two symptoms in conjunction with the dramatic colony die-offs and poor honey collection may indicate that the bees are suffering from a low immune system which may allow viruses to express themselves and Nosema levels to increase within colonies. Research has indicated that any stressor that the bees encounter, such as Nosema, varroa, viruses, wax-moth or exposure to pesticides may not itself cause the bees to decline, but when several stressors are present they can have a synergistic effect and the immune system is overwhelmed and the colonies may collapse.

An alternative explanation has been offered by an experienced bee scientist from the US who has seen many situations similar to ours. He proposed that the 'crash' and 'recovery' population dynamics of our bee colonies since the varroa mite was established on the island, point to viruses previously unknown to our bees being transmitted by the mite into the population, which then declined and slowly recovered. The population which survived was able to co-exist with these viruses and the population leveled out. The subsequent crash in population, he suspects, was due to the viruses mutating within the varroa mites and 're-infecting' the bees with a new version of the virus, causing the bees to die-off again. Bees from the populations which are able to adapt and cope with the stresses of the viruses, the mites, the gut parasites and Bermuda's unique environmental conditions, will survive. If this is the case local beekeepers may be able to breed new queens from the most vigorous of the remaining colonies to repopulate Bermuda's declining colonies. There are obvious concerns regarding the reduction of genetic diversity that arise as a result of this 'survival of the fittest' exercise.

The Department has also been in discussion with another researcher from the US who is interested in assisting us with an alternative solution to

mite management. This would be in the form of the introduction of a naturally occurring 'varroa detection and removal' trait which will help control the parasite. Bees with this trait detect mites in the cells of developing bees, open the cells and drag out the contents for disposal.
A third option for mite control is to treat the bees periodically with chemicals to kill the mites. This is not something the local beekeepers are in support of as they are looking to keep all pesticides out of their hives as it leads to a multitude of additional problems.

The Department has also been reviewing, for some time, the effect of agricultural and landscape pesticides on local bee populations. One of the concerns is related to the use of neo-nicotinoid insecticides in Bermuda. International research has indicated that these insecticides, and other pesticides, may be negatively affecting immune systems of bees, their behavior, communication and the ability to sustain healthy hives. Some restrictions have already been placed on the use of this group of insecticides on the island and the Department of Environmental Protection is looking at further restrictions. Studies are also underway to determine exactly how much exposure the bees have to these chemicals by examining the pesticide residue in local beeswax and pollen.

Fortunately, there have been a number of reports of bee swarms at this time, which is a good indicator that a population increase is occurring. This is typical for this time of year and allows for swarms to be captured and new colonies started. Uncaptured swarms typically become feral bee colonies which serve as a reservoir for future swarms. The Department is monitoring the bee situation and is asking the public to report swarms a beekeeper or to the Department of Environmental Protection, Plant Protection Lab at 239-2322. The public is encouraged not to spray them as they are a valuable resource which is under threat.

What can you do to help the bees?

1. **Select plants that attract bees**.Bees have a strong preference for purple, white and blue flowers, and some reds and oranges. Try planting bee-favorites such as cuphea (Mexican Heather), pentas, lantana, alyssum and sunflowers in your garden. Herbs such as rosemary, thyme and mint or vegetables such as pumpkins and squashes are also attractive to the bees.

2. **Let your lawn be diverse.** Bees like to feed on clover and matchstick weed in the lawn so don't kill off these 'weeds' with herbicides or over

mowing and let the bees feed as both will die off naturally later in the season. Wild mustard, nasturtium and fennel are other plants that bees enjoy but are sometimes hastily pulled up by over-eager gardeners seeking a manicured lawn or garden.

3. **Provide a water source.** Bees need to drink water so a clean bird bath filled with water or a small pond will ensure they have moisture.

4. **Do not use pesticides in the garden unless it is absolutely necessary.** If you do have to use pesticides, chose the least toxic option available. Soap solutions, horticultural oils, diatomaceous earth and home remedies such as hot peppers, garlic and coffee grinds have their place in controlling garden pests.

   See your local plant nursery for advice on less-toxic pesticides and the application of good horticultural practices to garden maintenance will lessen the need for pesticide use.

5. **Remove wild swarms safely — do not destroy them**. Healthy bee colonies increasing in size will swarm, leaving some bees and a queen in the old hive with the old or new queen and some workers leaving to find a new location. A swarm that is still looking for a home may rest on a branch or side of a house temporarily though holes in trees, roofs and buildings may be suitable homes for a swarm. If you find you have a swarm nearby, contact a beekeeper to have it removed professionally. He will take those bees and start a new beehive with them rather than killing them unnecessarily.

6. **Support your local beekeeper.** Buy local honey when available as taking care of bees is an expensive task and time consuming. Selling honey is one way that beekeepers can recover some of the costs of buying and maintaining hives, equipment, etc.

The beekeeping industry is going to need more beekeepers to keep the industry alive. If you are interested in keeping bees or even having bees kept on your property, contact a local beekeeper to express your interest.

Claire Jessey
Entomologist, Plant Protection Officer
Dept of Environmental Protection

PLANTING CALENDAR – WHAT TO PLANT IN THE FALL...

VEGETABLES

September

Beans, Broccoli, Brussels Sprouts, Cabbage, Carrots, Cauliflower, Celery, Chard, Cucumber, Eggplant, Kale, Leeks, Mustard Greens, Parsley, Pepper, Potatoes, Radish, Rutabaga, Tomato, Turnip.

October

Beans, Beets, Broccoli, Brussels Sprouts, Cabbage, Carrots, Cauliflower, Celery, Chard, Chives, Cucumber, Eggplant, Endive, Kale, Leeks, Lettuce, Mustard Greens, Onions, Parsley, Pepper, Potatoes, Radish, Rutabaga, Spinach, Squash, Strawberries, Thyme Tomatoes, Turnip.

November

Beans, Beets, Broccoli, Brussels Sprouts, Cabbage, Carrots, Cauliflower, Celery, Chard, Chives, Kale, Leeks, Mustard Greens, Onions, Parsley, Potatoes, Radish, Rutabaga, Spinach, Squash, Strawberries, Thyme, Tomatoes, Turnip.

FLOWERS

September

Celosia, cosmos, gazania, globe amaranth, impatiens, marigold, salvia, snow-on-the-mountain, vinca and zinnia.

October

Ageratum, antirrhinum, aster, aubrieta, begonia, bells of Ireland, candytuft, carnation, centaurea, chrysanthemum, cineraria, dahlia, dianthus, geranium, gerbera, gypsophila, impatiens, larkspur, lathyrus, nasturtium, nicotiana, pansy, petunia, phlox, rudbeckia, salpiglossis, salvia, statice,

snow-on-the-mountain, spider flower/cleome, star-of-the-veldt, stock, sweet William, verbena and viola.

November

Ageratum, antirrhinum, aster, aubrieta, begonia, bells of Ireland, candy-tuft, carnation, centuarea, chrysanthemum, cineraria, dahlia, dianthus, geranium, gerbera, gypsophila, impatiens, larkspur, lathyrus, nasturtium, nicotiana, pansy, petunia, phlox, rudbeckia, salpiglossis, salvia, statice, snow-on-the-mountain, spider flower/cleome, star-of-the-veldt, stock, sweet William, verbena and viola.

ON HER MAJESTY'S SERVICE

GOVERNMENT OF BERMUDA
Ministry of Environment and Planning

PUBLISHED BY: GOVERNMENT OF BERMUDA • MINISTRY OF ENVIRONMENT AND PLANNING • DAME LOIS BROWNE EVANS BUILDING • 58 COURT STREET • HAMILTON HM 12 • BERMUDA • DESIGN: DEPARTMENT OF COMMUNICATION AND INFORMATION