WELCOME

to our spring edition of Envirotalk.

In this issue –

- Roma Hayward tells us about the recent stranding of a grey seal
- Dr. Robbie Smith reveals that an endemic micro-snail hasn't gone extinct after all
- Dr. Mark Outerbridge provides an update on the recovery efforts for Bermuda's endemic *Poecilozonites* land snails
- Dan Dickinson describes the results of the latest mangrove spatial study
- Indigenous plant spotlight is on the sea lavender (*Limonium carolinianum*)

  Also See:
  - Our **News & Notices** for reminders and upcoming events
  - The **Planting Calendar** to get a head start on what to plant this spring

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

A RARE SIGHT ON OUR BEACHES

Bermuda has had seals show up on its shores in the past but they are not regular visitors. We only have six recorded over the past 120 years. They are lost and have somehow gotten off course. When they reach us they are often dehydrated, emaciated, and suffering from heat exhaustion. We have seen harbour seals, monk seals, and grey seals.

On February 18, 2023 the Bermuda Aquarium Museum and Zoo (BAMZ) was called mid-morning by a member of the public who had seen a seal pup on her morning walk at Clearwater beach. A picture and video were shared and BAMZ Curator, Patrick Talbot, was dispatched. The call came in a few hours after the sighting, so we were not too surprised to find that the seal was no longer there when we arrived. However, we received another call later in the afternoon detailing its new location and with aquarists quickly responding, we were able to corral the seal pup into a crate to be transported back to BAMZ. It was subsequently confirmed to be a male northeast grey seal about 5 weeks of age.

The northeast grey seal has a cold temperate to subarctic distribution in North Atlantic waters over the continental shelf[1] and range from Massachusetts up the east coast to Canada. Grey seals tend to wean their pups between 16-21 days of age[2]. We suspected that this guy had recently been weaned and was making his way in the ocean, learning how to hunt fish on his own. Never knowing what infections or diseases a wild animal may be carrying when we initially receive them makes it imperative that we keep these animals, and the animal care staff working with them, separate from the rest of the animals in our care. There is always a risk of passing on contagions to other animals if the proper protocols and standards are not maintained. As with all other animals we receive in our rehabilitation program, there is a small team of staff dedicated to feeding and treating the seal while it is quarantined at BAMZ. This involves first teaching him how to eat fish and gradually increasing meal frequency to three feeds per day, regularly weighing him and collecting blood samples to make sure he is making good progress.

Veterinarian and Curator Dr. Ian Walker and the animal care team at BAMZ has years of experience with marine animals and strandings. This little guy is in good hands, eating six pounds of fish a day, gaining weight, and generally doing well. Dr. Walker has reached out to our neighbours on the east coast of the U.S. to see if there would be anyone that could take the seal through the next stage of his recovery and later on to release him (Bermuda's water is too warm and does not have adequate food sources to support him in the wild). Mystic Aquarium graciously accepted that challenge again, as they had done in 2019 when we sent 'Lou-Seal' (another locally stranded grey seal) their way.

BAMZ is grateful for the support from our local community in this venture and is hopeful that his long journey will culminate with his return to the ocean. We would like to thank our volunteers who have assisted with the seal feeds and tank cleaning, Laquita Minors from the Queen's Club has provided several meals for the seal, AirCargo, and various government agencies have assisted in the process of getting this little seal back to where he belongs. This includes the US Counsel General, United States Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA). We would like to remind people that if you come across a seal on a beach or shoreline to keep your distance. It is important to remember that even a resting seal is a wild animal.

Roma Hayward Bsc. RVT
Animal Care and Quarantine Officer
Bermuda Aquarium Museum and Zoo

Mystic Aquarium Animal Rescue Program

Since 1975, Mystic Aquarium's Animal Rescue Program (ARP) has been rescuing, rehabilitating and releasing sick, injured and stranded marine animals along 1,000 miles of the Northeastern coastline throughout Connecticut, Rhode Island and Fishers Island, New York. As a founding member of the Greater Atlantic Region, the ARP cares for sick, stranded or injured marine animals while learning more about why they came to shore. Working closely with the National Oceanic and Atmospheric Administration (NOAA) Fisheries and other government agencies, the Animal Rescue Team responds to an average of 150 hotline calls each year while also providing support to other stranding facilities in New England and beyond. To learn more please visit http://www.mysticaquarium.org/animal-rescue-clinic

References:

[1]Hall, A. 2002. Gray seal *Halichoerus grypus*. In W.F. Perrin, B. Würsig and J.G.M. Thiewissen, eds. Encyclopedia of marine mammals. Academic Press. pp. 522-524.

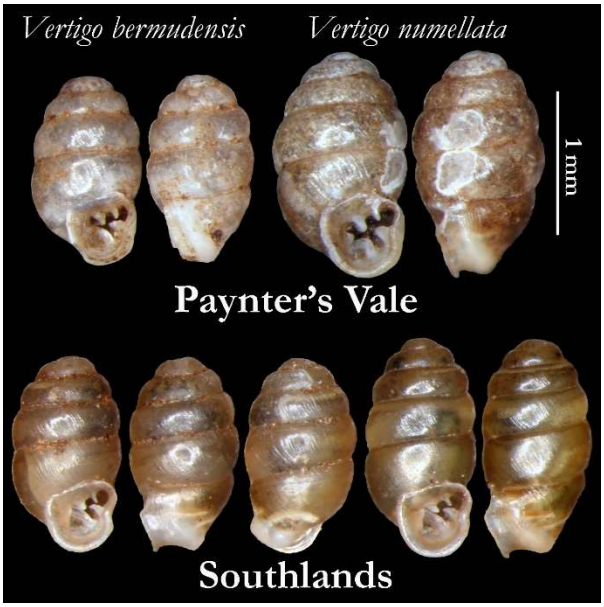
[2]Geraci, JR and Lounsbury, V. 1993. *Marine Mammals Ashore*. Texas Sea Grant College program. pp.282.

RE-DISCOVERY OF THE PRESUMED EXTINCT BERMUDA LAND SNAIL, *VERTIGO BERMUDENSIS*

About one-half of the native Bermudian land snail fauna are tiny shells, about the same size as the snout of the hog on the Bermuda penny (no more than 2.5 mm). Four species of these micro-snails were thought to be endemic to the island, with two (*Vertigo bermudensis* and *Vertigo marki*) being feared extinct. However, this aspect of our island's biodiversity had not been thoroughly surveyed in almost a century. With a grant of the Bermuda Zoological Society, Dr Jeff Nekola of Masaryk University in the Czech Republic visited the island for almost two weeks in January to search for them. Dr. Mark Outerbridge and I guided Jeff around and assisted with the sampling. Jeff has a deep experience studying these types of snails across North America and brought with him critical sampling tools: a set of sieves, designed to separate the very tiny snails from soil and leaf litter.

Jeff was able to re-visit Paynter's Vale, Walsingham Nature Preserve and the protected Church Cave, where all of the native micro-snails had been seen as recently-dead shells in the 1920s. Initial sampling efforts in Walsingham and Admiral's Cave produced nothing. However, Church Cave and Paynter's Vale

contained other dead endemic micro-snail shells (*Vertigo numellata, Carychium bermudensis*), but none of which had been alive within the last 20 years. Robbie and Mark helped Jeff understand the dramatic transformation which had occurred in our forests in the 20th century, following the loss of cedars in the 1940s, and their replacement by invasive species such as the Brazil pepper, Surinam cherry and Allspice. Cedar leaf litter forms soil that supports some of the largest micro-snail populations in North America. Jeff deduced that the loss of high quality cedar leaf litter and its replacement by the leaves of the invasive trees- which possess potentially toxic chemicals that deter herbivorous insects - may have contributed to a wholesale collapse of the Bermuda land snail fauna in the last half-century – larger taxa included.



Endemic Bermuda micro-snails
Photo: J. Nekola

Jeff, myself and Dr. Kristiina Ovaska (another visiting snail biologist working with Mark on the larger re-introduced Bermuda land snails, *Poecilozonites bermudensis* and *P. circumfirmatus*) explored other nature reserves around Bermuda. It was a great surprise to find a healthy living *Vertigo bermudensis* population in deep leaf litter under the massive banyan trees at the entrance to Southlands! Preliminary molecular genetic analyses confirmed that *V. bermudensis* is a long isolated endemic sister species to *Vertigo milium* of the southeastern U.S. coastal region. The discovery of this population provides some hope that other living populations, and perhaps the other "missing" species, exist elsewhere. Later, Jeff found a dead *Vertigo* shell in some banyan leaf litter at Spittal Pond, and under a surviving old cedar at Deep Blue Pool at Walsingham.

I was able to take Jeff to Nonsuch Island where he had a glimpse of what the endemic Bermuda forest would have looked like. Unlike most areas on the main island, the cedar-dominated leaf litter there harbored a vibrant living micro-snail fauna. While no *Vertigo* were seen in the field, he hopes that careful analysis of this litter in the laboratory might locate something. Mark and Kristiina have had great success with introducing *Poecilozonites* to Nonsuch and so, at a minimum, the stage is set to repeat this with *Vertigo*. This nearly invisible part of Bermuda's unique biodiversity deserves attention and protection and we are indebted to Jeff for his effort and expertise. He is happy to add our snails to the story of the complex evolution of *Vertigo* in North America and the Caribbean.

Dr. Robbie Smith
Curator, Natural History Museum

SAVING BERMUDA'S ENDEMIC *POECILOZONITES* LAND SNAILS

The story concerning the interesting work leading to conservation and recovery efforts for the greater and lesser Bermuda land snails (*Poecilozonites bermudensis* and *P. circumfirmatus* respectively) was published in the 2019 Autumn edition of Envirotalk (vol. 83 no. 3). In this article we will briefly summarize what has occurred since then. Both species are all that remain of a unique genus that has been living on Bermuda for approx. one million years[1]. In fact, the greater Bermuda land snail was considered extinct for the past 30 years, until the serendipitous discovery of a fragile colony in 2014. Live individuals of the lesser Bermuda land snail have not been found in the wild since 2004 despite repeated searches, but recently dead specimens suggest that some cryptic colonies may still survive in isolated habitat pockets. As a safeguard against looming extinction, both species have been reared in captivity since 2016 at the Chester Zoo in the north of England. In addition to their primary function, the captive colonies provide opportunities for research on life history, physiology, and other aspects of the species' biology, as well as on conservation techniques. For example, an English student obtained an MSc degree investigating marking techniques to monitor reintroduced snails[2]. Reintroduction of the greater Bermuda land snail into the wild began in 2016 from the remnant colony and has continued since 2019 using captive-reared snails. So far over 100,000 snails have been released at 27 different locations across Bermuda, of which one third are small, woodland island nature reserves where predators are either absent or controlled. Since 2020 nearly 9,000 lesser Bermuda land snails have been released at four locations deemed suitable for long-term survival. Mark-recapture sampling is being conducted on the larger species at the first and primary release site (Nonsuch Island) to obtain detailed information on movements, survivorship, and population growth.

Captive-bred lesser Bermuda land snails.
Photo: K. Ovaska.

Preparing a shipment of Bermuda land snails for repatriation.
Photo: G. Garcia

Re-introducing and releasing the snails under palmetto trees.
Photo: K. Ovaska

To date, reintroductions of greater Bermuda land snails have proved successful on four small islands with range expansion and recruitment observed in subsequent years[3,4]. At the site of the first introduction (Nonsuch Island), the snails have steadily increased their area of occupancy from 95 m^2 after one year to over 7000 m^2, with maximum straight-line displacement of nearly 100 meters (a relatively large distance for a species that only grows to an inch in size). In 2022, the mean density within the core area was estimated as high as 35 mature and maturing snails/m^2. At two other sites on the same island, populations have failed to establish for reasons that are not fully understood. Additional surveys have shown that these snails inhabit both native and invasive-dominated woodlands and aggregate around limestone features such as overhangs and damp crevices[5]. So far we have been unable to confirm the success of introductions to the main island sites, where predators and habitat disturbance are extensive, but the releases were relatively recent.

It is still too early to tell whether the releases of the lesser Bermuda land snails have been successful, but we remain cautiously optimistic as some individuals have been detected one year after introduction at an intensively monitored site. Both of these snail species have been designated as Critically Endangered by the International Union for Conservation of Nature and have national legal protection under the Protected Species Act (2003). We remain profoundly grateful to Dr Gerardo Garcia and the invertebrate team at the Chester Zoo for their dedication to the continued care, breeding, and repatriation of these rare snails. A recovery plan, which describes threats and outlines conservation actions, was created in 2018 and can be read by visiting https://environment.bm/news-hot-topics//recovery-plan-for-the-endemic-land-snails-of-bermuda.

References:

[1]Hearty, P.J. & Olson, S.L. 2010. Geochronology, biostratigraphy, and changing shell morphology in the land snail subgenus *Poecilozonites* during the Quaternary of Bermuda. *Palaeogeography, Palaeoclimatology, Palaeoecology* 293: 9–29.

[2]Flewitt, A. 2020. Tag Retention and Location Preferences of *ex-situ* Greater Bermuda Land Snail *Poecilozonites bermudensis*: An assessment pre-reintroduction into the wild. Unpublished MSc dissertation, Manchester Metropolitan University, UK.

[3]Outerbridge, M., Ovaska, K., & Garcia, G. 2019. Back from the brink – Recovery efforts for endemic land snails of Bermuda. Tentacle 27: 16-18.

[4]Outerbridge, M., Ovaska, K., & Garcia, G. 2021. Recovery efforts for endemic Bermuda land snails continue. Tentacle 29: 9-12.

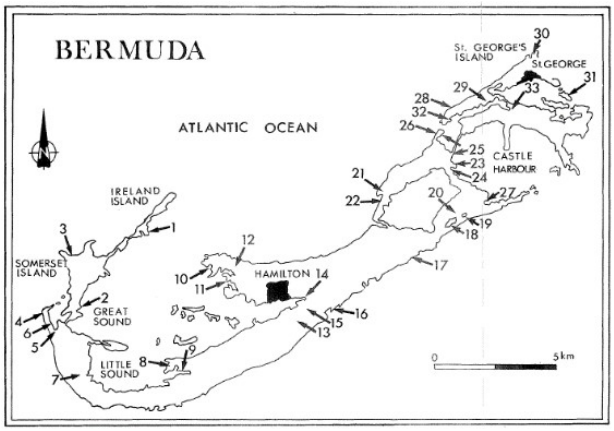
[5]Copeland, A. & Hasselberg, T. 2022. Habitat preferences of the Critically Endangered Greater Bermuda land snail *Poecilozonites bermudensis* in the wild. *Oryx* 56: 34-37.

Dr Mark Outerbridge
Senior Biodiversity Officer

Dr Kristiina Ovaska
Biolinx Environmental Research Ltd.

A MEASURE OF UNIQUENESS – THE MANGROVE SPATIAL STUDY

Bermuda is unique! This statement can be applied to many aspects of the history, culture, traditions and general ecology of our isolated archipelago. Uniqueness holds true as reflected in our designation as stewards to the most northern collection of mangrove forests situated in the northern hemisphere[1]. Specifically, Coots Pond St. George's (32°23'25'' N) is 95 nautical miles further north of the second most recognized assemblage located in Tanegashima Mangrove Park (30°47'40" N) on Tanegashima Island, Japan. This specific uniqueness has drawn some interest over the years as a few different studies have endeavored to understand the spatial extent of the two species of mangroves found in our marine environment; the red (*Rhizophora mangle*) and the black (*Avicennia germinans*). A mapping survey was completed in the early 1980s by Wolfgang Sterrer and David Wingate[2] to measure change to the mangrove communities over a 75 year period. Using the cartographic technology of the day, a desk study was applied to both an historical map (1900) and a Department of Survey topographical map (1975) which produced an in-depth estimate of established mangrove locations. Following this study, Thomas[3] took interest in our unique populations and focused on local mangrove swamps both measuring acreage and studying physical aspects of growth, sedimentation and succession. Differing from Sterrer and Wingate, Thomas used extensive field studies but only surveyed areas where mangroves were found in abundance.



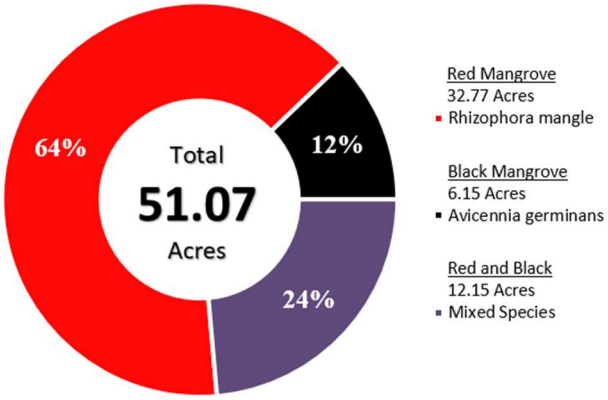
Locations of significant mangrove populations published by M. Thomas in 1993.

These prior efforts laid the foundation for a recent Department of Environment and Natural Resources (DENR) project which used modern geographical information systems (GIS) coupled with field surveys to calculate the present total mangrove coverage and gather information on their habitats. Evidence from historical studies, aerial/satellite imagery, personal knowledge as well as significant input from departmental colleagues was used to create an extensive list of areas to scrutinize for the presence of mangroves. These areas along with any viable coastal habitats were visited by me in 2022 to validate the presence of mangroves occupying areas of 1m² or larger. Field surveys recorded the species type, habitat composition, growing substrate and basic land ownership while also highlighting any significant threats that could affect their health and development. A handheld Garmin Global Position System (GPS) unit was used to pinpoint minor clusters of patchy trees and was crucial to define the transition zones where mangroves stopped and different vegetative areas began. In locations that were unreachable, drone footage was used to help determine presence/absence as well as map the physical scope.

Following the field data collection, the areas verified to be mangrove were digitized using a network of GPS locations and visual analysis of current and historical aerial photography. A high resolution orthomosaic image (2019) was used as the base layer and vector polygons were created as individual entities for each cluster of like-species. A category for mixed species was created as the discrepancy between red and black mangroves was problematic in some areas. After digitizing the extent of each individual polygon they were then populated with the field data and joined spatially.

Before and after depiction of the initial stages of mapping using ground GPS points to define transitional areas.

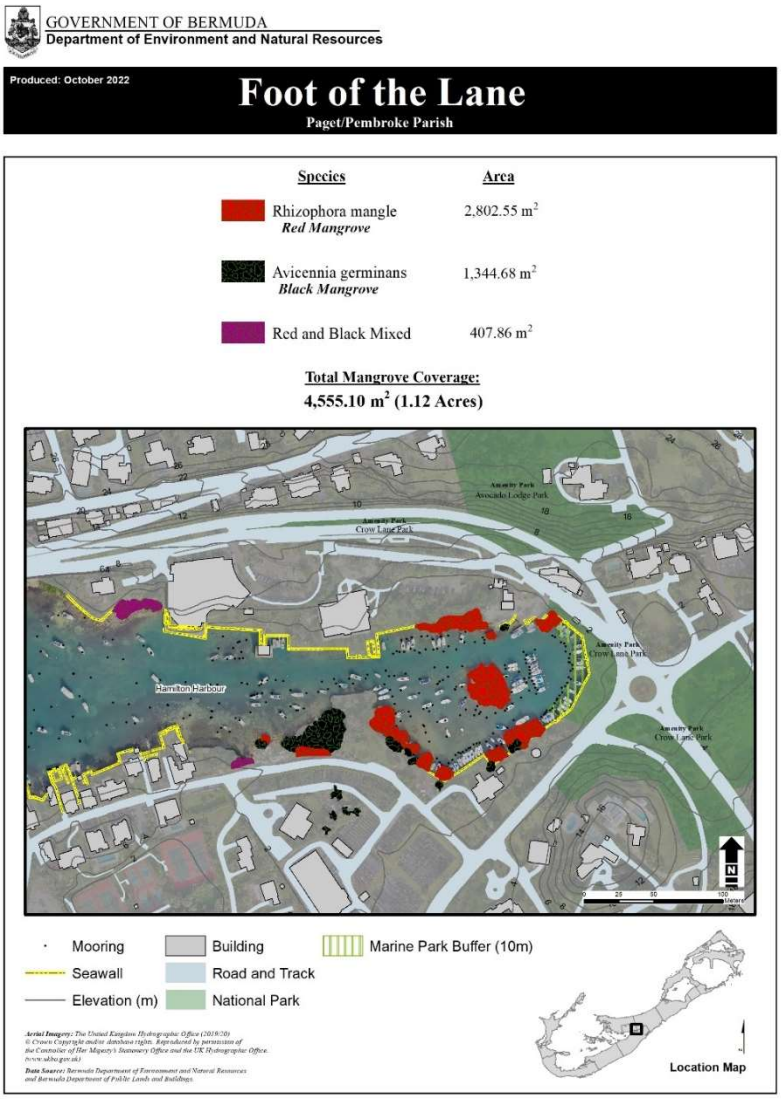
The 2022 spatial statistics are encouraging and show Bermuda has a combined mangrove acreage of 51.1, of which 16.3 acres are located on Government (and Quango) owned land and 34.8 acres are on privately owned land. Red mangrove are the dominant species, making up 64% of the populations while black mangroves only constitute 12%. The remaining 24% consists of mixed stands. A total of 17.9 acres are designated Government nature reserves and 5.7 acres as private nature reserves.



Habitat characteristics show clear trends indicating 80% of our populations are found in and around coastal bays and anchialine ponds. The majority of those are growing in mud and muddy sand within in the eastern and central parishes of the island, specifically Hamilton, St. George's and Paget. A major challenge faced by these low lying coastal areas is their susceptibility to sea level rise and storm damage. In fact, an estimated 20 acres of mangrove forests could be lost in future decades as ocean levels rise and fixed obstacles (e.g. buildings, sea walls, roads) prevent their natural migration landward (a process called 'coastal squeeze'). More abrupt changes will affect 10 acres which have been identified as being highly vulnerable to storm erosion, especially during the hurricane season. Marine traffic, vessel beaching, and the use of mangrove habitat as dinghy storage has the potential to negatively affect up to 16 acres.

Another threat impacting 20 acres of Bermuda's mangroves are the effects of surface runoff from adjacent lands. Trace metals, polycyclic aromatic hydrocarbons (PAHs), and chemicals wash in from neighbouring roadways, agricultural fields and golf courses affecting the flora and fauna living within these wetlands.

The following is an example of a final mapping product for one location illustrating species composition, extent of mangrove coverage, and proximity to other local features. *The full PDFs are expected to be available at https://environment.bm/habitats in the near future.*



References:

[1]Bunting, P.; Rosenqvist, A.; Hilarides, L.; Lucas, R.M.; Thomas, T.; Tadono, T.; Worthington, T.A.; Spalding, M.; Murray, N.J.; Rebelo, L-M. 2022. Global Mangrove Extent Change 1996 – 2020: Global Mangrove Watch Version 3.0. Remote Sensing.

[2]Sterrer W, Wingate DB. 1981. Bermuda's wetlands and marine environments. In: Hayward SJ, Gomez VH, Sterrer W. Bermuda's Delicate Balance: People and the Environment. pp 402.

[3]Thomas MLH. 1993. Mangrove Swamps in Bermuda. Atoll Research Bulletin 386:1-17.

Dan Dickinson
GIS Mapping Analyst

INDIGENOUS PLANT SPOTLIGHT: SEA LAVENDER (*LIMONIUM CAROLINIANUM*)

Photo: M. Outerbridge

Sea lavender is a small perennial plant that only grows in Bermuda's salt marsh environment. The leathery, oblong leaves grow in a rosette pattern and typically reach lengths of 4-6 inches. The main stem appears during the summer months, reaching a height of 12-18 inches. It is highly branched, and terminates in numerous small, papery, lavender-coloured flowers. It is unlikely that this salt-tolerant native species was particularly common on Bermuda, even historically. In the 1918 publication 'Flora of Bermuda', Britton commented that sea lavender was found growing in a few places along the shores of Castle Harbour, but that was before the U.S. military began its dredging and land reclamation activities in 1941. Sea lavender has become an exceedingly rare sight these days. In fact it is now known only from one location; the Stocks Harbour nature reserve. This 2.6 acre reserve is a mangrove-dominated wetland containing a tiny relict salt marsh approx. 825 square feet in area. Despite the fact that the marsh has been getting smaller over the past several decades it still has hundreds of sea lavender plants within it. Rising sea level combined with mangrove expansion will eventually cause the marsh to be subsumed into the surrounding mangrove swamp and, without active intervention, lead to the local extirpation of Bermuda's sea lavender.

NEWS & NOTICES

Lobster Statistics Reminder

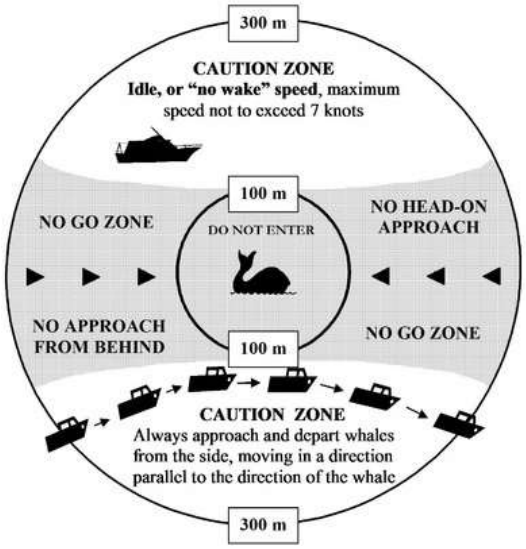
Recreational lobster divers are reminded that their catch statistics for the 2022-2023 season must be submitted online (using the portal at www.fisheries.gov.bm) **by the end of April**. There should be an entry for each date / location that you fished, and a "No fishing" entry for any month in which you did not fish. Anyone failing to submit catch statistics for the season will not be issued a recreational lobster diver license for the upcoming lobster season. Please call 293-5600 or email fisheries@gov.bm if you are having difficulties accessing the portal.

Spearfishing Reminder

Recreational spear fishers are reminded that spearfishing statistics should be submitted **monthly** using the online portal at www.fisheries.gov.bm. Please call 293-5600 or email fisheries@gov.bm if you are having difficulties accessing the portal.

Whale Watching Guidelines

Whale watching can be enjoyed in Bermuda's waters during the winter and spring months. The public are reminded that all whales and dolphins are protected by law. Boaters are requested to follow the whale watching guidance located at https://environment.bm/whale-watching-guidelines

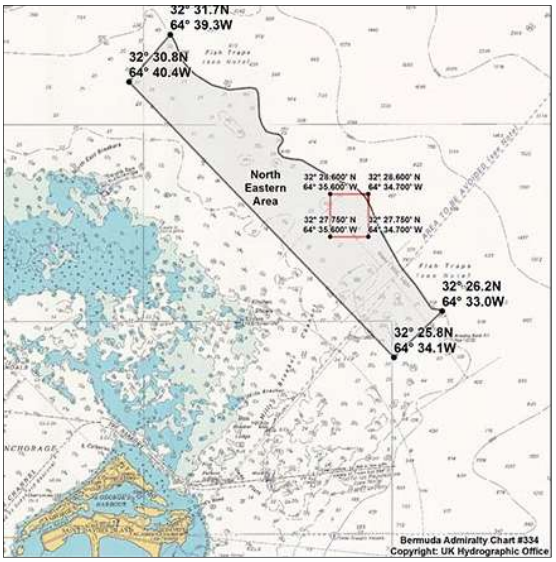


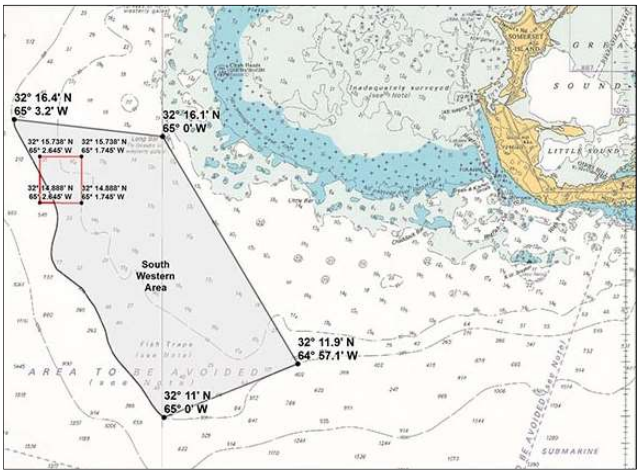
Spring Splash Lionfish Tournament

The spring competition will run from April 21st through 23rd. Enquire at Makin Waves on Church Street in Hamilton for further information. Lionfish culling permits must be active in order to participate in any Bermuda tournament. Anyone wishing to obtain a permit for the first time should email permits@lionfish.bm

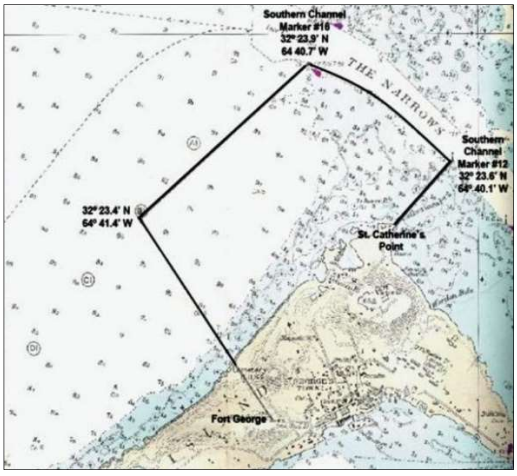
Seasonal Fishing Closures to Protect Spawning Groupers and Grunts

Please remember that fishing is prohibited in the northeastern and southwestern Seasonally Protected Areas (aka the 'Hind Grounds') from **April 15th through August 14th**. Within each of these areas there is an extended closure box (shown red on maps) that aims to protect black groupers, and these two areas are closed to fishing through the end of November.





Fishing is also prohibited in the blue striped grunt aggregation area, off Fort St. Catherine, for the months of **May and June.**



The blue striped grunt seasonally protected area

PLANTING CALENDAR – WHAT TO PLANT IN THE SPRING

VEGETABLES

March & April

Beans, beets, broccoli, cabbage, carrots, cassava, cauliflower, chard, christophine, collards, corn, cucumber, eggplant, kale, leeks, lettuce, muskmelon (Cantaloupe), mustard greens, okra, pepper, potatoes, pumpkin, radish, rutabaga, squash, sweet potato, spinach, tomato, turnip, watermelon

May

Beans, cucumber, okra, pumpkin, radish, squash, sweet potato, tomato

June

Beans, cucumber, squash, tomato




FLOWERS

March & April

Acrolinium, ageratum, alyssum, antirrhinum, aster, aubrietia, baby blue eyes, bachelor's buttons, bird's eyes, blanket flower, begonia, bells of Ireland, calendula, candytuft, carnation, centaurea, chrysanthemum, cineraria, coreopsis, dahlia, African daisy, dianthus, forget-me-not, geranium, gerbera, globe amaranth, globe gilia, godeita, gypsophila, hollyhock, impatiens, larkspur, lathyrus, marigold (African & French), nasturtium, nicotiana, pansy, petunia, phlox, red tassel flower, rose everlasting, rudbeckia, salipiglossis, salvia, scabiosa, statice, snow-on-the-mountain, spider flower (cleome), star-of-the-veldt, stock, sweet pea, sweet William, verbena, viola

May & June

Amaranthus, balsam, calendula, celosia, coreopsis, cosmos, gaillardia, gazania, globe amaranth, hollyhock, marigold, portulaca, rudbeckia, vinca, zinnia