

Envirotalk



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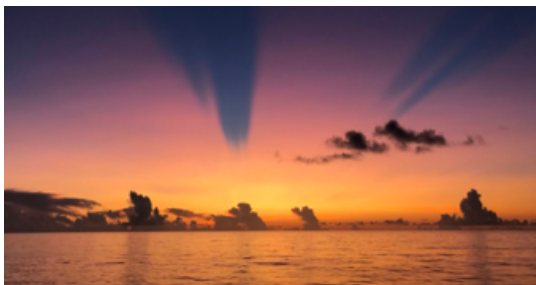
TO PROTECT BERMUDA'S ENVIRONMENT AND RESPONSIBLY MANAGE ITS NATURAL RESOURCES

WELCOME

to our autumn edition of Envirotalk.

In this issue –

- Learn about the science and luck involved in conserving two species of very rare **endemic snails**.
- Read about Bermudian graduate student Shane Antonition's **voyage to the Sargasso Sea onboard Greenpeace's M/V Esperanza**, in search of marine plastics.
- Read about the factors involved in considering **pet importations** under unusual circumstances, such as **following natural disasters**.
- Also see:
 - Our **News & Notices** for reminders and upcoming events.
 - The **Environmental Calendar** to see what events are happening at this autumn.
 - The **Planting Calendar** to get a head start on what to plant this autumn.



Sunset over the Sargasso Sea
(Photo: Shane Antonition)

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BERMUDA'S ENDEMIC LAND SNAILS; ONE MILLION YEARS OLD AND COUNTING!

I have had the privilege of being involved with one of the most gratifying stories of conservation in Bermuda's history. It includes drama, serendipitous discovery, international collaboration, hard work and no small amount of luck.

The story begins approximately one million years ago¹ when a presumed rafting event, facilitated by the Gulf Stream, brought some land snails from the USA to Bermuda's shores. The descendants of those remarkably lucky snails then spent hundreds of thousands of years living here and, because of the selective pressures imposed by changes in sea level and predation from large vertebrates (specifically birds and a land tortoise, all now extinct)^{2,3}, they evolved into at least 12 different species¹ within a single genus known as *Poecilozonites* (pronounced *po-sill-oh-zone-eye-tees*). This genus is entirely unique to Bermuda and each species exhibited its own particular size, shape and colouration - all of which is richly described in our fossil record. The largest species was reported to reach 46 mm in shell diameter; the smallest only 5 mm⁴.



Recent P. circumfirmatus (top left),
recent P. bermudensis (top right),
fossil P. bermudensis (bottom right),
fossil P. nelsoni (bottom left)
(Photo: Mark Outerbridge).

This diverse fossil record caught the attention of numerous prominent biologists during the 19th and 20th centuries including Stephen J. Gould, the late Harvard paleontologist and evolutionary biologist. Gould's doctoral dissertation on fossilized *Poecilozonites* shells during the 1960s later helped him develop, with a colleague, the concept of punctuated equilibrium (long periods of evolutionary stability which are infrequently punctuated by short bursts of branching speciation events). More recent research, however, has suggested that the evolution of *Poecilozonites* on Bermuda was an anagenetic (linear) event during which gave rise to

very different, but sequential, shell morphologies¹. Continuing research on fossilized *Poecilozonites* shells not only sheds light on their paleoecology but it also helps us to understand Bermuda's paleontological past.

We know from historical writings that three species of *Poecilozonites* snails were still alive during the early 20th century; *Poecilozonites bermudensis*

(greater Bermuda land snail), *Poecilozonites circumfirmatus* (lesser Bermuda land snail), and *Poecilozonites reinianus*. The latter was described as being a small snail (ca 9-10 mm) with a restricted distribution on Bermuda (from Bailey's Bay to Shark Hole, Harrington Sound). It was last reported alive in 1924⁵ but the reason for its demise is unclear (very likely through human agency). By contrast, the lesser Bermuda land snail (11 mm diameter) and the greater Bermuda land snail (23 mm diameter) were so abundant throughout Bermuda that they could be collected by the barrel full during the late 19th century⁴. It was not to remain this way for long. Between 1958 and 1968, three different species of carnivorous snails were intentionally introduced by the Department of Agriculture in an effort to control other snails deemed agricultural pests (who were themselves introductions to Bermuda). While the endemic *Poecilozonites* snails were never reported as being pests, they still fell victim to the biocontrol programme. Just ten years after the programme began live greater Bermuda land snails were only known from two locations in St. George's Parish and two locations in Hamilton Parish⁴; by the early 1990s the species was believed to be extinct⁶.



Size comparison between an adult and hatchling lesser Bermuda land snail (Poecilozonites circumfirmatus) and the tip of a pencil.

The lesser Bermuda land snail appeared to have fared slightly better; a summer student for the Department of Conservation Services (Alex Lines) confirmed live snails at four coastal locations in Smith's, Devonshire and Paget Parishes in 2002. Wolfgang Sterrer (Curator of the Natural History Museum at the time) very wisely collected specimens and sent them to the London Zoo for safekeeping. Since then we fear that this species quietly went extinct in the wild. Numerous surveys have failed to find live snails at any of their former sites (or anywhere else for that matter despite many hours of searching), but thankfully they are still being well cared for in captivity at the London Zoo and the Chester Zoo (the latter joined in with the breeding effort).

We don't know with certainty that the carnivorous snails are solely responsible for the tragic decline of Bermuda's endemic land snails. The wild hogs that once roamed Bermuda may have played a part and rats are known predators of land snails in other countries. Both mammals were brought to Bermuda in the 16th and 17th centuries. Some species of terrestrial flatworms and ribbon worms are also bad news to snails. Bermuda has at least three different non-native species that are known to eat snails^{7,8}. It is also possible that changing

agricultural practices during the first half of the 20th century (i.e. increased availability and usage of pesticides) may have been a contributing factor in their demise.

In the summer of 2014 I received an unexpected visit from a man who introduced himself as Bruce Lines, the father of Alex, and he told me that he had found a live snail which he thought could be one of our vanished endemic land snails. It turned out he was absolutely right! The Lines family had recently established a business in Hamilton and one morning Bruce happened to notice a snail in his shop that looked remarkably like the snails he helped Alex look for 12 years earlier, only much larger. This was an extraordinary moment for two reasons; not only was Bruce one of the few people on Bermuda at the time who knew what *Poecilozonites* looked like but he had also fortuitously moved into one of the last remaining refuges of the greater Bermuda land snail (a second subpopulation was later discovered in 2017 on an island in the Great Sound - by another summer intern!) It just so happened that a small but thriving colony was inhabiting a narrow, dank alley behind Bruce's shop. The concrete jungle of Hamilton had kept the snails isolated from their main predators and allowed them to find a way to survive.



(Left) Mature greater Bermuda land snail (Poecilozonites bermudensis); (Right) Empty shell of a greater Bermuda land snail showing the distinctive variegated-banded pattern for which the genus Poecilozonites is named

The rediscovery of this Lazarus species (in other words one that has come back from the dead) meant that the greater Bermuda land snail could be given a second chance. Following in the footsteps of Dr Sterrer, I collected 166 snails from the alley and sent them to the staff at the London Zoo who had been taking such great care of our captive lesser Bermuda land snails. They were graciously received and subsequently shared with the Chester Zoo for propagation. Thankfully both the greater and lesser Bermuda land snails responded well to life in captivity and appeared quite content to live in climate controlled rooms eating fresh vegetables.

The dedicated breeding efforts in the UK produced thousands of snails over the next four years which allowed for the repatriation and release of more than 18,000 greater Bermuda land snails on five different islands (all are nature reserves) across Bermuda by 2019. These islands had suitable environments to support the snails and appeared to be free of the major predators. The relatively large size of the greater Bermuda land snail (in comparison to the lesser Bermuda land snail) meant that the research team was able to apply tags to the shells of adults and study their survival in the wild after being

released. So far, research conducted on Nonsuch Island (the first island to receive the captive bred snails) has shown that they are not only surviving but reproducing and expanding beyond the areas where they were originally released⁹. Plans are currently underway to reintroduce the lesser Bermuda land snail in early 2020.

Our long term goal is to have self-sustaining subpopulations of snails, each numbering several thousand mature individuals, on at least ten islands throughout Bermuda. One study¹⁰ has already shown that the snails don't seem to be too picky in choosing the leaf litter they live in, except for areas dominated by casuarina trees; they had significantly fewer snails than did places growing mixed deciduous trees. Rocky limestone outcroppings were particularly popular with the snails, presumably because they are good places to retreat into (and under) when the weather gets too hot and dry.

Thanks to the care and dedicated efforts of so many different people, Bermuda's *Poecilozonites* snails are still among the land of the living. The greater and lesser Bermuda land snails are all that are left of a once mighty clan that has had a very long and fascinating history. The loss of these snails would not only mean that their respective species would go extinct but the planet would actually lose an entire genus.

I am profoundly grateful to Bruce Lines for rediscovering the greater Bermuda land snail in Hamilton and to Miguel Mejias for reporting the presence of the greater Bermuda land snail on Port's Island to me. The hard work of Paul Pearce-Kelly, Dave Clarke, Craig Walker, Ben Tapley and the rest of the invertebrate team at the Zoological Society of London for their pioneering efforts in successfully breeding both species in captivity is gratefully acknowledged. Gerardo Garcia, Heather Prince and the invertebrate team at the Chester Zoo have continued these vital works. In Bermuda, Robin Marirea has been responsible for the captive husbandry. Kristiina Ovaska, with assistance from Alison Copeland and Heather Prince, are responsible for undertaking field research on Nonsuch Island and they have provided many life history observations. Finally I would like to thank the Bermuda Zoological Society and the Bermuda National Trust for allowing the release of captive bred snails on Trunk and Morgan's Islands.

Literature cited:

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- ⁵ Pilsbury, H.A. 1924. Recent and fossil snails of the Bermudan genus *Poecilozonites*. *Proceedings of the Academy of Natural Sciences of Philadelphia* 76:1-9.
- ⁶ Gould, S.J. 1993. *Eight little piggies: reflections in natural history*. W.W. Norton & Co. 479 pp.
- ⁷ Jones, H. and Sterrer, W.E. 2005. New species and records of terrestrial flatworms (Platyhelminthes with three new species) and nemertines of Bermuda. *Zootaxa* 1001:31-58.
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- ⁹ Ovaska, K. 2018. Reintroduction of the endemic Bermuda snail *Poecilozonites bermudensis* to Nonsuch Island. Unpublished report. Department of Environment & Natural Resources, Bermuda.
- ¹⁰ Copeland, A. 2018. Determining the habitat preferences of the Bermuda land snail *Poecilozonites bermudensis* on Port's Island, Bermuda. Department of Environment & Natural Resources, Government of Bermuda, Hamilton.

Mark Outerbridge
Wildlife Ecologist

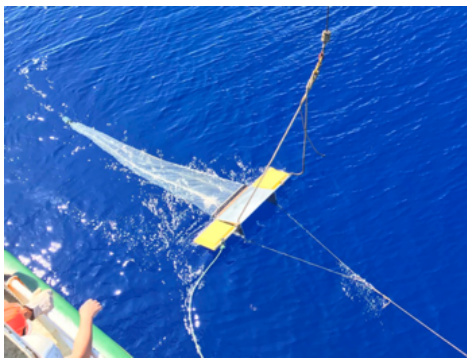
A SEA OF PLASTIC: A REFLECTION ON GREENPEACE'S JOURNEY TO THE SARGASSO SEA

Our oceans face an immense legal challenge. At present, Bermuda or any other country, is free to exploit or protect the areas of ocean in their EEZs (Exclusive Economic Zones) as they see fit. However, the ability to legally protect important areas of our oceans, beyond national jurisdiction, is not in place. This includes most of the Sargasso Sea in the North Atlantic, which is a vital nursery ground for juvenile turtles, eels and many fish species.

Enter Greenpeace's Protect the Oceans Campaign, which has two important aims. The first is to lobby in support of a proposed UN Global Ocean Treaty, which is currently under negotiations, and could be agreed upon as early as April 2020. This treaty would provide the legal framework for the designation of ocean sanctuaries in international waters including the monitoring and enforcement of these areas. The second aim is to use the Global Ocean Treaty to protect 30% of our oceans by 2030, which is needed to safeguard threatened wildlife and mitigate the more severe effects of climate change. Considering that only ~1% of our oceans are

protected, the initiative is wildly ambitious, but greatly needed. In support of the campaign, Greenpeace has undertaken an extensive Pole-to-Pole expedition, going to remote locations and highlighting various key threats. Two legs have been completed in the Arctic and the Lost City Hydrothermal Field in the Mid-Atlantic ridge, focusing on climate change and deep sea mining respectively. Bermuda was the start of the third leg.

At the end of July I boarded Greenpeace's research vessel M/V Esperanza for a two week journey into the Sargasso Sea. I found the onboard experience was quite unique from anything I had done before. To be out there in the open ocean was, at a minimum, quite awe-inspiring and humbling. To be so far from land, with other ships a rare sight, makes you feel very isolated and really puts into perspective how small we are in the vast ocean. At the same time, it is also beautiful. The sunsets were amazing and the water was this deep pristine blue. However, this initial impression is deceptive, for what hides out here is microplastic pollution, and this was the reason for the voyage.



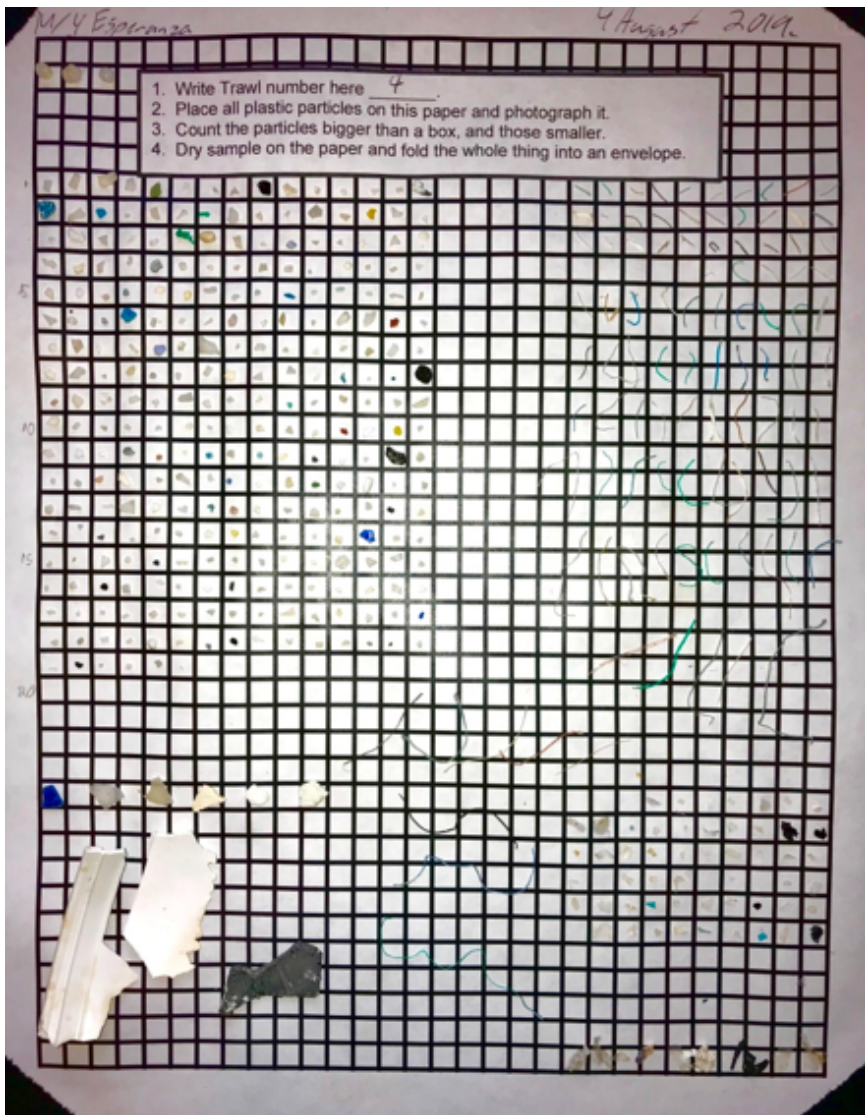
Manta trawl from the side of the *Esperanza*
(Photo: Shane Antonition)



Sieve of microplastics collected from the Sargasso Sea (Photo: Shane Antonition)

Unfortunately, an estimated 4-12 million metric tons of plastic waste enters our oceans every year, and is carried by ocean currents into the gyres like the Sargasso Sea. These wastes put this vital nursery ground, which is already facing threats from climate change, over-fishing and vessel traffic, under additional pressure. We need to have a clearer understanding of the extent of microplastic pollution. My role as an assistant scientist was to conduct manta trawls for microplastics, which involves putting a small net in the water for 30-60 minutes and letting it skim the surface of the water to collect the floating plastic debris. In comparison to my previous sampling experience working at the Bermuda Aquarium, Museum and Zoo (BAMZ), I was not prepared for the amount

of plastic we found out there. Every trawl had hundreds of microplastic pieces, comprised of fragments, fibres and films. In one sample, we found 1,299 pieces alone, most between 1 to 5mm in size. These microplastics are often consumed by fishes, as I determined in a project with BAMZ and the Bermuda Institute of Ocean Sciences in 2017. The microplastics compromise fish health and may deliver chemical contaminants that can work their way up the food chain onto our dinner plates.



Datasheet of microplastic particles and fibres from the Sargasso Sea
(Photo: Shane Antoniton).

There were other science projects happening on the Esperanza, too. We had scientists measuring the temperature of Sargassum mats to see if they provide a thermal advantage for the growth of juvenile turtles; environmental DNA (eDNA) sampling to get an indication of species present around Sargassum, but unseen in during snorkel surveys; and specialized sampling for extremely small plastic microfibers.

This wealth of science was complimented by an impressive media team. Photographers and reporters captured the story of what we were finding, which is an important step in informing the decision makers of the need create the Global Oceans Treaty. My time on Esperanza was truly a once in a lifetime experience, to be a part of something much larger than yourself, to help our one planet. I'm immensely grateful for the opportunity.

***Shane Antonition,
Research Assistant, Bermuda Aquarium, Museum and Zoo***



M/V Esperanza docked at Penno's wharf (Photo: Shane Antonition)

ARE WE OUR SISTER'S KEEPER?

We're in hurricane season again; that time of year we find ourselves at the mercy of Mother Nature. Hurricane Dorian has just pummelled The Bahamas, leaving dreadful devastation and fatalities. The WhatsApp chat for the Caribbean Animal Health Network had been very busy with well wishes and expressions of support for the island nation, as well as reports, updates and pictures of the storm and its aftermath. Now it contains pleas for help and wish lists of badly needed items. Even when this article becomes published, the full impact of Dorian will not be known.

Flashback to hurricane season 2017:



Hurricanes Irma, Jose and Maria were major storms that brought horrific destruction to the Caribbean. Thankfully, through the Royal Bermuda Regiment and the private sector, Bermuda provided essential aid to our sister Islands of the Caribbean.

But for Veterinary Services in the Department of Environment and Natural Resources, those storms gave rise to an interesting ethical and legal dilemma. Shortly after Hurricane Irma rendered Barbuda "hardly inhabitable" and tore through the British Virgin Islands and others, Veterinary Services received an inquiry from the local office of an international company. The company's Caribbean office was so severely affected by Irma, the company sought to relocate affected employees, families and their pets to Bermuda. The question was simple: Would we accept the animals? The considerations and ramifications were far from simple.

Each country has legislation designed to prevent or minimize the likelihood of the introduction of certain diseases. These laws are designed to protect the health of their citizenry, their animals, their agriculture and their economy. Bermuda is no different.

Bermuda's import legislation for dogs and cats has requirements that address the threat of rabies, a disease that is present in some Caribbean countries. According to the enquiring company, their people had fled BVI for Puerto Rico. In their haste to escape the catastrophe, they went from a country that claims rabies-free status to an island where rabies is endemic. That's like jumping from the frying pan into the fire. Additionally, our import regulations seek to protect against the importation of ticks, which are also in the Caribbean and carry a myriad of disease-causing organisms.

Given the extensive devastation and the haste of fleeing, we understood that pet owners likely would not be able to document veterinary histories sufficient to demonstrate compliance with our import laws. Should we suspend our import laws in order to receive pets from affected Islands, as Veterinary Services' contribution to assisting affected families? What would this suspension mean to local residents? To what risks would we be exposing Bermuda by suspending our conditions of entry? If we make exceptions for this natural disaster, should we make exceptions for other reasons: missed vaccinations, or failure to vaccinate for any one of a variety of reasons?

Veterinary medicine is a helping profession. Naturally, I wanted to contribute to the relief and recovery of our sister Islands and fellow CaribVet and CARICOM members that were in need. I personally knew the veterinary officers of the affected island states. I was sensitive to the fact that Bermuda faces hurricanes, and we could have been the one devastated and calling upon the outside world to assist.

Our Premier, acting in his capacity as president of the United Kingdom Overseas Territories Association, criticized the United Kingdom's response to the Caribbean disaster. Did that mean Bermuda should do all it can to assist? Does that mean suspending our laws to respond to pleas from our sister islands? If we admitted undocumented/poorly documented animals, could we monitor those animals once released into the general population of Bermuda? If not, do we have the human, financial and infrastructure resources to establish and operate a special facility to quarantine these undocumented animals?

And if we suspended our import controls, we would definitely lose our own rabies-free status. How would other countries react? Would animals of Bermuda origin continue to be accepted as freely elsewhere, or would more stringent requirements be placed upon us all?

All of these questions were considered. Answers were not clear.

In the end, exceptions were not made; laws were not suspended. A small number of families did relocate to Bermuda with their pets, all of which were properly documented.

Hurricanes, earthquakes and other natural disasters have given rise to better disaster risk reduction and management planning (which goes beyond the scope of this article). But many difficult questions were raised, including: Could we have done more? Should we have done more? Should we be better prepared to do more... for ourselves, for others? What is our moral obligation? Are we our sister's keeper?

***Jonathan Nisbett, DVM
Veterinary Officer***



NEWS & NOTICES

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.

Lobster Diving Reminder

Now that lobster season is underway, recreational lobster divers are reminded that they should fly a standard red and white dive flag when they are diving for lobsters, and must avoid diving in the vicinity of commercial lobster traps. Catch statistics must be reported using the online portal at www.fisheries.gov.bm.

Keeping lobster catch statistics up to date through the season helps improve accuracy, particularly when it comes to reporting locations, and avoids a rush or complications as the reporting deadline of April 30th approaches. Please call 293-5600 or email fisheries@gov.bm if you are having difficulties accessing the portal.

ENVIRONMENTAL CALENDAR AUTUMN 2019

SEPTEMBER 2019

Saturday September 21st: World Cleanup Day

The 3rd weekend in September is World Cleanup Day. In Bermuda, events on this day are led by KBB, who will host their annual coastal cleanup on September 21st.

Saturday September 28th: Green Consumer Day

Green Consumer Day is observed annually on 28th September to encourage responsible and environmentally friendly purchasing. This day highlights the problems of consumerism and its impact on the environment. Take this opportunity to buy items that are locally produced, can be recycled, and that have little or no packaging.

OCTOBER 2019

Saturday October 12th: World Migratory Bird Day

World Migratory Bird Day celebrates the autumn movement of birds from their summer to winter habitats. This year's theme – "Protect Birds: Be the Solution to Plastic Pollution!" – will highlight the negative impact of plastic pollution on migratory birds and their habitats.

<http://www.worldmigratorybirdday.org/about>



NOVEMBER 2019

Wednesday November 13th: GIS Day

GIS (Geographic Information Systems) Day is the Wednesday of the National Geographic Society's Geography Awareness Week, which is the third week in November.

<https://www.gisday.com/en-us/overview>

Thursday November 21: World Fisheries Day

The origin of World Fisheries Day is linked with the establishment of the World Fisheries Forum (WFF) in 1997. It is a day to highlight the environmental aspects of fishing, as well as social issues such as sustaining fishing communities, social justice, and preserving the cultural history of fisheries workers.

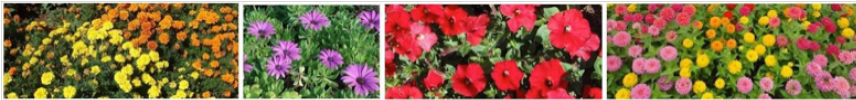
PLANTING CALENDAR – WHAT TO PLANT IN THE AUTUMN...

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, 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.