BIO NEWS

Quarterly e-newsletter of the Institute of Biology, Sri Lanka

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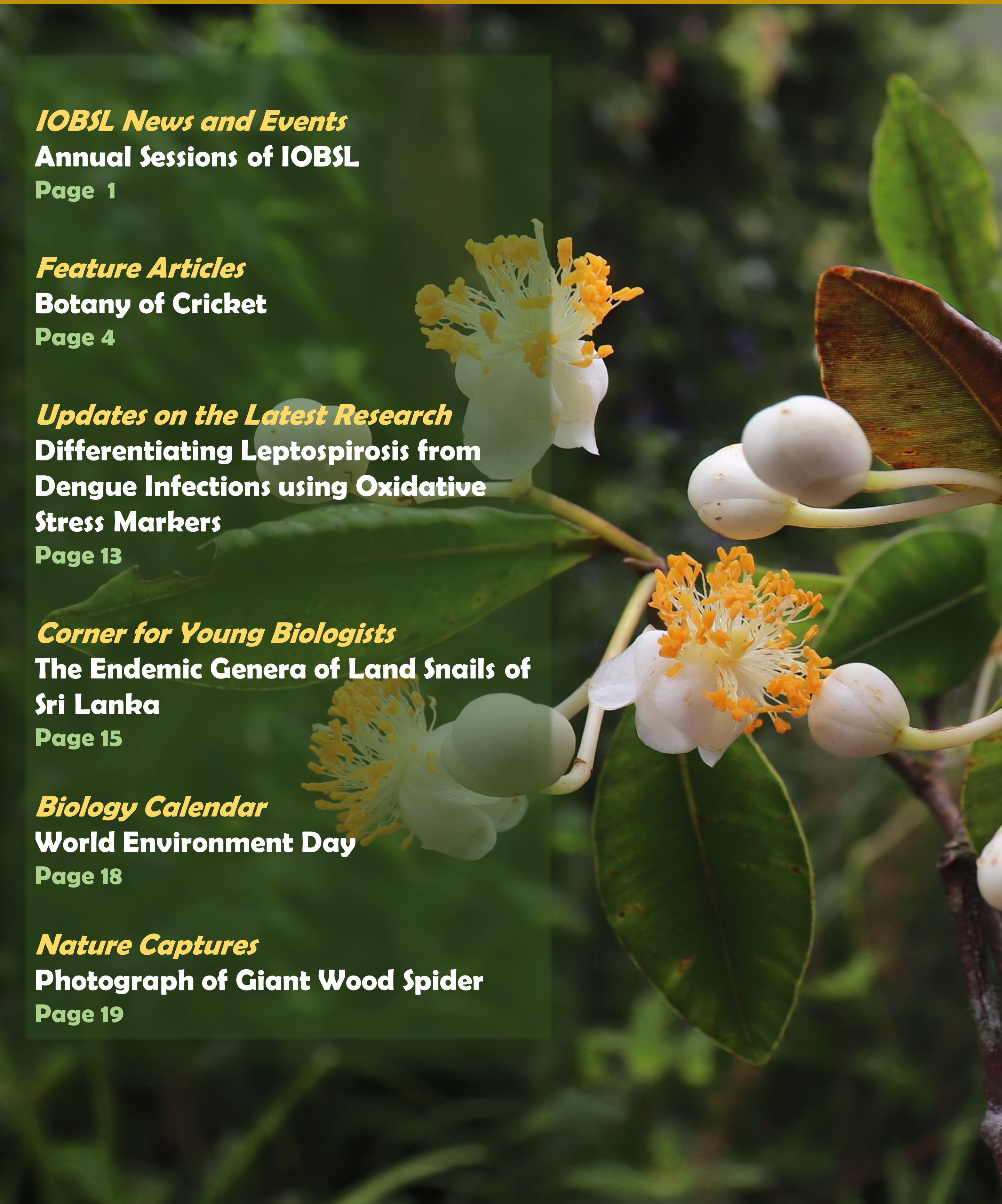

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COVER PHOTOGRAPH
Ms. Kasuni Tharushika Rankoth (Associate member, IOBSL)

COVER STORY

Our cover page depicts a photograph of *Calophyllum trapezifolium* Thwaites. It is commonly known as Keena (S) an endemic plant to Sri Lanka.
This photograph was captured at Morningside, Suriyakanda (Sinharaja Forest Reserve).

CONTENTS

Annual Sessions of IOBSL

The inauguration of the 42nd Annual Sessions of IOBSL will be held on 30th September 2022 at the Marino Beach Hotel, Colombo 03. This year's theme '***A paradigm Shift in Biology***' will explore the recent discoveries, advances and applications of biology while focusing on how they can be integrated to improve the Sri Lankan economy.

Prof. Buddhi Marambe has been invited to deliver the keynote speech at the inauguration. Mr. Rohan Pethiyagoda will be felicitated by the IOBSL this year in recognition of his outstanding achievements. He is a world-renowned conservationist, naturalist, taxonomist of freshwater fish, and an author who was awarded the prestigious Linnean Medal recently.

This year, IOBSL received 50 abstracts for the technical sessions and these abstracts are currently under review by a panel of experts under the four tracks: Zoological Sciences, Plant & Environmental Sciences, Molecular Biology & Biotechnology and Microbiology & Chemical Biology. During the sessions, a panel of judges consisting of renowned researchers will assess each presentation. The best presenter of each track will be recognized with the Best Presenter Award at the closing ceremony that will be held at the end of the Annual Sessions. Registration for the Annual Sessions 2022 is now open and more details are available at http://www.iobsl.org/sessions/iobsl-2022-42nd-annual-sessions

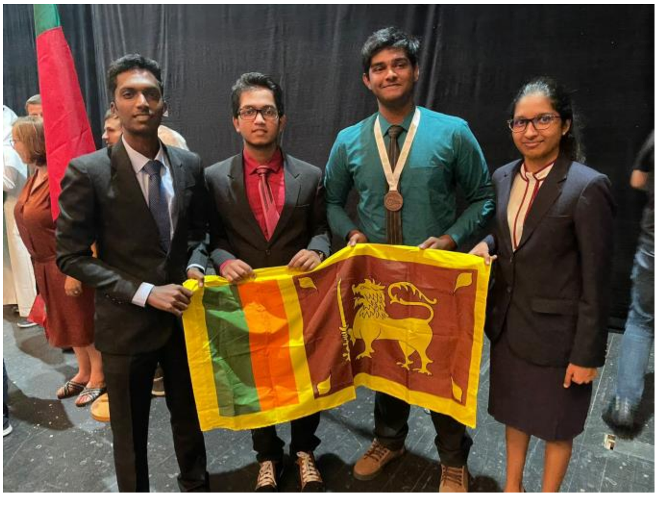
International Biology Olympiad

The International Biology Olympiad (IBO) is an annual event where students from all over the world compete on their knowledge in Biology. As the coordinating body of the Sri Lankan Biology Olympiad, the Institute of Biology, Sri Lanka has been involved since 2009 in selecting students to take part in the IBO with the assistance of the Ministry of Education.

IOBSL selected students for the international competition based on the Sri Lankan Biology Olympiad competition held in January 2022 as an online examination conducted in Sinhala. Tamil and English mediums, proctored by seven universities in Sri Lanka, viz., Universities of Colombo, Sri Jayewardenepura, Ruhuna, Peradeniya, Jaffna, Rajarata and Eastern.

This year, the IBO 2022 was held at Yerevan State University in Armenia from 10th to 18th July 2022. Siluni Wickramathilake from Mahamaya Girls' College, Kandy, Harshan Arumoli from Jaffna Hindu College, Praveen Thennakoon from Ananda Maithreya College Balangoda and Karthik Pravin from D.S.Senanayake College, Colombo participated as competitors. Prof. Hiran Amarasekera from the University of Sri Jayewardenepura and Emeritus Prof. M.J.S. Wijerathne, University of Kelaniya participated as Jury members.

Harshan Arulmoli of Jaffna Hindu College won a Bronze Medal at this year's International Biology Olympiad. 600 High School students and Jury members from 66 countries participated at this competition which consisted of Theory and Practical Examinations.



IOBSL Inter-University Biology Quiz Competition

The Institute of Biology, Sri Lanka (IOBSL), aims to promote education in Biology at all levels. In keeping with this mandate, IOBSL introduced an annual national-level Inter-University Biology Quiz Competition for undergraduates of state universities a few years ago. The competition aims at providing undergraduates with a novel educational experience and enhancing their interest in Biology. The competition will also provide an ideal opportunity for collaboration and inspiration among students, academics and universities across the country. The competition consists of two stages. Around 100 applicants took part in the stage I examination of the IOB Quiz which was held on 18th June on a virtual platform. The top 15 students were selected for stage II and it will be conducted as a live quiz competition.

Top 15 students

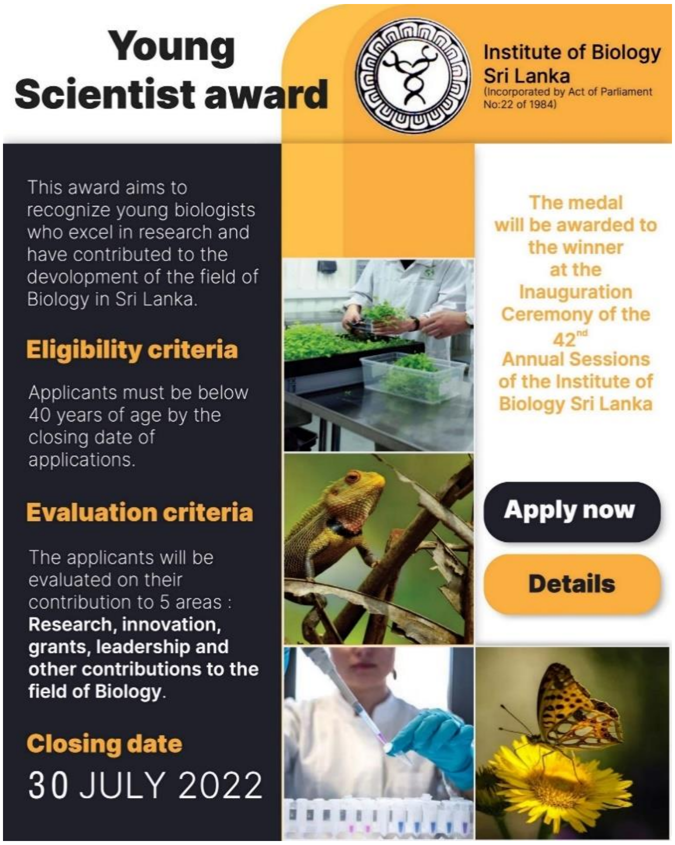
S. Adsaya	University of Peradeniya
B. A. H. Madushika	University of Colombo
M. Pirunthini	University of Jaffna
N. M. V. Silva	University of Colombo
M. H. F. Rihana	University of Sri Jayewardenepura
T. M. S. Thennakoon	University of Colombo
P. C. Weraharage	University of Colombo
W. G. M. L. W.Bandara	University of Peradeniya
I. S. S. C. Uyangoda	University of Sri Jayewardenepura
R. K. S. A. Rathnakumari	University of Ruhuna
Y. B. Dias	University of Colombo
P. V. S. Iresha	University of Colombo
M. S. Sheriffdeen	University of Peradeniya
S. Niroji	University of Jaffna
K. M. Hettige	Open University of Sri Lanka

Institute of Biology Photography Competition

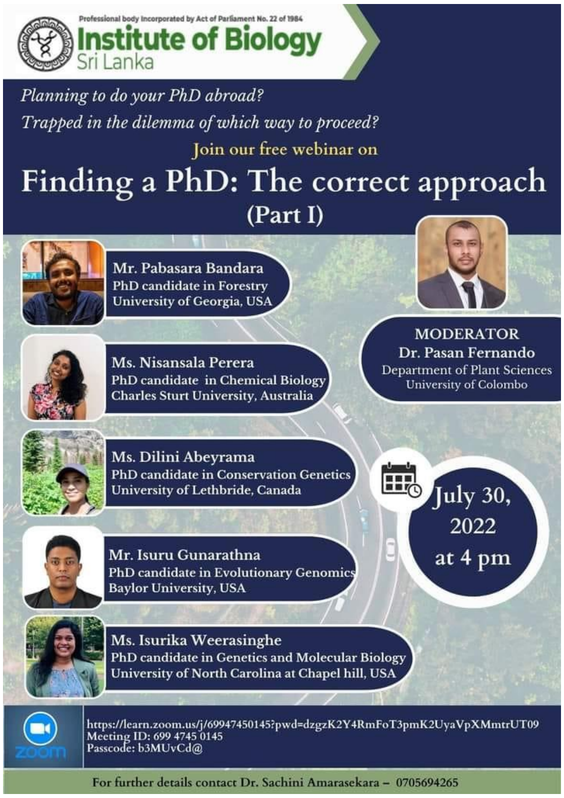
IOBSL organized a national competition on Biology photography on the theme of ***'Nature's battle: A struggle to thrive in a polluted world'***. The competition was open to professional, amateur and youth photographers in Sri Lanka. IOB received 84 photographs, and the best 25 photographs were selected by a panel of experts in photography, publishing, education and conservation aspects. The shortlisted photographs will be posted on the IOB official Facebook page (https://www.facebook.com/iobsrilanka) by the end of July. The most popular photograph will be selected based on the public votes and the Best Photograph and photographs for consolation certificates will be selected by a panel of judges and announced at the IOB Annual Sessions.

Young Scientist Award

The Institute of Biology Sri Lanka is introducing an award to recognize Young Scientists who have excelled and contributed to the field of Biology in five key areas, namely, research, innovation, grants and leadership as well as other contributions to the field. The winner will be awarded a medal at the Inauguration Ceremony of the 42nd Annual Sessions of the Institute of Biology Sri Lanka.



Free webinar- ‘Finding a PhD: The correct approach’



IOBSL is hosting a free webinar for undergraduate students on ‘Finding a PhD opportunity’. The resource persons will be individuals who are pursuing or have recently completed their PhDs in US, Canadian, and Australian universities. Both students who are now enrolled in universities and those who have recently graduated will benefit from this event. The programme will be conducted as a two-hour session on 30th July 2022.

Botany of Cricket

Dr. Dilantha Gunawardana (Ph.D., Melbourne, M. I. Biol.)

On the 17th of March 1996, Sri Lanka emerged as the World Champions of Cricket, beating a then formidable Australian team led by Mark Taylor, where a little maestro named Aravinda De Silva scored a century and took 3 wickets. This was the first time that Sri Lanka had won the World Cup of Cricket, climbing on the pedestal to be in the exclusive company of India (1983) and Pakistan (1992), who reached this podium before Sri Lanka. While cricket has its roots in England, the fanatical bases of the sport are found in Asia, where it has attained cult status, proliferating into newer forms (20-20) and breeding new tournaments such as the Indian Premier League.

Although cricket is a game, there is a strong and unbreakable bond between cricket and botany, since whether it is cricket bats and balls, or the outfield or even pitch characteristics (what defines pace or turn), plants play an important role in perpetuating cricket in this field of dreams. It should be remembered that from balsa surf boards to bamboo or maple baseball bats, there is a dependency of sports on botany, which makes the study of botanical cricket a truly memorable foray into journalistic research. In fact, there is a Bradmanesque relationship between cricket and the study of plants; 99.94% of cricketing goods originate from the unparalleled world of botany that provides us giants such as sequoias, baobabs, and bamboo, as well as the pint sized, such as mosses, ferns, and lawns of grass.

First cricket, like baseball is largely defined by the impact of bat on ball, where strikes of a piece of wood, are considered to be the heartbeat of the game. A cricket bat is finely carved and produced from a tough but light consistency of wood from a deciduous tree called the cricket willow. Cricket willow which has a botanical name of *Salix alba* var. *caerulea*, is a type of willow that is grown in Britain for the harvesting of the wood to furnish cricket bats – what is colloquially named as 'willows'. The cricket willow tree has a strong straight woody trunk and is also identified by large leaves which are painted by a bluish green tone. This tree is considered the true origins of the classic bat that is used by both former and current crop of cricketers, from William Grace to Donald Bradman to Sachin Tendulkar to Steve Smith. Although the weight and dimensions of the cricketing bat have evolved, in large, cricketing bats have maintained their dependency on willow wood and even the infusion of carbon-fiber polymers to the backbone of the bat has failed to establish itself as a mainstay of the game of cricket.

A second presence of botany in cricketing arenas is found in the form of cricketing wickets/stumps that are 6 in number and are dug into the ground on the two ends of the pitch, in clusters of three. Bails, which are wooden bridges, are supported on the grooves on the apexes of stumps, numbering to four, two at each end. The ash tree (Genus *Fraxinus*) is the most popular tree for the manufacturing of wickets and bails that are used in a cricket match. Sometimes due to the need to accommodate heavy bails, stemming from the presence of strong winds, there is a special type of wood called Lignum vitae (common name) used to make cricket bails. Lignum vitae is known for its heaviness, density, and strength. Lignum vitae, is the wood of the genus *Guaiacum*, that is native to the New World, especially the Caribbean nations who lit up the early Cricketing World Cups (1975-1983) with flamboyance, flair and brute pace.

Sadly, *Guaiacum sanctum* is now listed as endangered by the International Union for the Conservation of Nature, just like the game cricket in the West Indies, where it is dwindling in popularity. Another area where cricket and botany are interwoven, is the grass meadow on which the game of cricket is played. Grasses belong to the family Poaceae and are a ubiquitous sight on the cricketing field. While the outfield grass is trimmed and cropped to suit the running (and diving) outfielder, the cricket pitch is largely given a total shave – mowed and rolled –; yet with minuscule stubs, to ensure that there is adequate green to keep the fast bowlers (and swing) interested. Therefore, the more grass there is in the bowling area of a cricketing pitch, the merrier for the bowlers, in particular the tearaways or the crafty swing bowlers. Therefore, whether it is a crafty Tim Southee or a fast and furious Mitchell Starc, grass is friend and not foe to the trade of pace bowling.

Asia is universally known for its fanatical followers of the game cricket. Cricket in Asia is not just an adrenaline-charged game, but a religion where people build shrines of cricketing deity, hold effigies (even burn them in despair), follow sermons of the bat and the ball and take to the streets for the celebration of holy days of nail-biting victories and days of holding aloft a gold-plated chalice. What we should not forget, even for a fleeting second, is that the cricketing outfield is a lawn of grass that can be easily be fed with the associative-symbiotic nitrogen-fixing (converting nitrogen gas into ammonia) genus *Azospirillum* to replenish its nitrogen needs. *Azospirillum* is environmentally friendly, economically-sustainable, and unlike its chemical surrogate, urea, will not contribute towards global warming through the release of greenhouse gases such as nitrous oxide.

The name *Azospirillum* stems from the fusion of the terms, *'azo'* pertaining to nitrogen and *'spirilla'* defining a small spiral or twist (although not strictly in the case of *Azospirillum*), and together they form this genus which contains six species of nitrogen fixers. *Azospirillum* was first isolated and identified by the father of nitrogen fixation, Martinus Beijerinck, as early as 1922. Therefore, in all, the future is rosy for *Azospirillum*, a true wonder of the rhizosphere that will forever be an accomplice to the cricketing lawn (as a bosom nutritional friend) and not staunch foe to the future well-being of the climate-change threatened environment.

It is noteworthy that many genomes (total compliment of genes and non-gene DNA of a species) of strains of *Azospirillum* have been sequenced and the data sets have unveiled a strong ancestral contingent of genes and a near 25% non-ancestral component of the genome, where genes encoding for plant root colonization, plant growth promotion and rhizosphere adaptation are strictly strain-specific hinting at nice-specific adaptability. Therefore, it appears that *Azospirillum* does not simply grow in a narrow range of environments but is driven by evolution to adapt/ acclimatize to a wide variety of niches.

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Another inevitability in cricket, is the cricket ball which is made up of cork in the center with a spherical leather cover on the exterior. In the interior of a cricket ball, two halves of cork are rolled together by strong reels of string. Cork is found in the outer rings of trees, is elastic and impermeable to water and is crafted by the division of a tissue called the cork cambium.

Cork is obtained from a tree identified by its botanical name *Quercus suber* and although once native to the Mediterranean region is now predominantly grown in Portugal, which is the largest exporter of cork in the world. It is in woodland plantations called 'Montados' that cork is harvested and manufactured in Portugal. Therefore, the cricket ball and not Moises Henriques is the biggest cricketing export from this beautiful country which is known for her vineyards, universities, soccer, and pioneering explorers of the new world.

Therefore, it appears that botany and the game of cricket are inseparable akin to conjoint twins. Botany will always serve as a vast reservoir of foods, fibers, spices, industrial resins, commodities, and sporting equipment and can be termed a 'supermarket' of uncountable ingredients that can be used to perpetuate honorary traditions and delightful sports. So, whether we are watching a game of cricket at the MCG on Boxing Day or taking a tour of the International Hall of Fame in Cricket in Bowral, Australia, or playing a game of street cricket in Colombo, Sri Lanka, one should never forget that the bat and ball that is held in hand, was once part of a woody plant.

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Marine Biotechnology: Key Tools and Technologies

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Marine biotechnology (the major focus of the "blue biotechnology") is the application of science and technology to living organisms from marine resources to produce new products, services, and processes that can be used to address the global challenges of food, energy, and health. Furthermore, marine biotechnology is becoming an important component of the global biotechnology sector with potential biotechnological applications related to drug discovery, environmental remediation, increasing seafood supply, natural product development, industrial processes, and bioenergy. The interest in marine biotechnology has been rapidly growing over the years as a result of modern scientific advances. Moreover, it is not a stand-alone field and is expected to contribute in the future to the development of a fully grown bioeconomy (the sustainable production of renewable biological resources and the conversion of these resources into value-added products, such as food, feed, bio-based products, and bioenergy) from a number of marine resources.

Marine biotechnology plays a crucial role in the sustainable exploration and study of numerous marine bioresources. One of it's oldest and most popular applications is aquaculture, i.e. raising finfish or shellfish in controlled conditions for use as food sources. Currently, a broad range of fascinating new developments in marine biotechnology has emerged, as it now comprises of a broad range of fields apart of marine aquaculture. They are, marine bioactive substances, marine biomaterials, marine bioenergy, marine nutraceuticals, and marine bioremediation. More than 30,000 compounds originating from marine bioresources have been described and potential products developed with the use of marine bioresources. These comprise of drugs and pharmaceuticals, food and nutritional supplements, health and beauty supplements, anti-aging creams, biomaterials, textiles, and feed for farm animals. Intensive research efforts are currently under way to better understand the wealth of potential marine biotechnology applications that our marine environments may harbor.

As we know, biotechnology is not a new endeavor. Nevertheless, the modern period of biotechnology began when gene cloning techniques were developed. Since the 1970s, remarkable and rapidly developing laboratory techniques in genetic engineering and recombinant DNA technology have changed and advanced marine biotechnological research significantly. A wide range of techniques and tools are employed in modern biotechnological approaches. The following section provides a summary of those tools and technologies which have made the greatest impact on marine biotechnology.

Bioprocess Engineering

Bioprocessing is the use of biological systems or organisms to manufacture a product. Bioprocess engineering deals with the design and development of equipment and processes for the manufacturing of products such as chemicals, food, feed, nutraceuticals, pharmaceuticals, and polymers from biological materials. Marine bioprocess engineering focuses on the design and analysis of processes that manufacture valuable compounds from marine organisms within an enclosed and controlled environment. Marine biologists are exploring how marine organisms may be used to synthesize proteins and other biomaterials, which may be used for industrial manufacturing processes. Microalgae may potentially be very valuable for expressing recombinant proteins such as antibodies. They can be easily grown in contained bioreactors, minimizing the risk of airborne contaminants, and protecting the environment from any potential flow of transgenes into the surroundings.

Researchers have also found that they can make large quantities of proteins in marine algae because they can be grown on a very large scale.

Bioprospecting

Bioprospecting (or biodiversity prospecting) is the systematic search for biochemical and genetic information in nature to develop commercially valuable products for pharmaceutical, agricultural, cosmetic, and other applications. Marine bioprospecting is a process that lies at the forefront of industrial production and efforts are ongoing worldwide to identify remarkable marine organisms with novel properties that may be exploited for commercial purposes. Marine bioprospecting provides opportunities to utilize genetic material from the sea in a sustainable manner. There is an extensive range of applications in marine bioprospecting and relevant areas of application may include medicine and processing industries, including oil and gas, food, feed, and biofuels. For example, certain species of marine plankton and snails have been found to be an abundant source of anticancer and antitumor chemicals. Moreover, there are many exciting potential ongoing research to identify previously undiscovered marine organisms that may have commercial value. For instance, major bioprospecting efforts are ongoing around the world to identify bacteria and algae that produce useful enzymes that could help to process biomass into fuel. The process of commercialization from research results based on marine bioprospecting is often a long-term, multidisciplinary activity, and it depends on business expertise.

Bioinformatics and Omics-Driven Technologies

Genomics is the study of the structure, function, and diversity of genomes, while bioinformatics is an interdisciplinary science that involves developing and applying information technology for analyzing biological data such as DNA and protein sequences. Bioinformatics also includes the utilization of computers for the analysis of molecular structures and creating databases for storing and sharing biological data. Genomics approaches are being used to analyze the genomes of numerous marine species. Furthermore, bioinformatic approaches and other omics-driven technologies such as proteomics, metabolomics, metagenomics, and transcriptomics are currently being used to exploit the enormous phylogenetic diversity of marine organisms to explore the evolution of developmental processes, characterizing the marine ecosystems, searching for novel biomolecules, and understanding ecological interactions within prominent marine ecosystems.

Proteomic tools, mainly polyacrylamide gel electrophoresis and mass spectrometry, represent a strong analytical strategy for the phenotypical study of marine organisms of industrial interest. These tools play a vital role in marine biotechnology and offer specific information about expression patterns, post-translational modifications, or protein interaction mechanisms of marine organisms. High-throughput proteomics tools and techniques have recently been coupled with newer bioinformatic tools, thus affording more robust and powerful approaches for both protein identification and characterization purposes.

Transgenic Technology

Marine organisms into which a foreign gene or a gene of interest is artificially introduced using a suitable vector and stably integrated into their genomes are termed transgenic marine organisms. The suitable transformation technique used for the foreign DNA delivery to the target genome greatly influences transformation efficiency and expression. These techniques include both long-established and recently developed approaches: particle bombardment, electroporation, and *Agrobacterium tumefaciens* mediated transformation, glass beads method, and silicon carbide whisker method

The glass beads and silicon carbide whisker methods are specially utilized for microalgal transformation. In addition, many species have been genetically modified for potential applications in the aquaculture industry. Marine biologists are interested in using recombinant DNA technologies to create genetically engineered fish to grow faster and healthier. These transgenic marine organisms are used in a variety of applications; enhancement of disease resistance and somatic growth, development of body color variation in ornamental fish, models for studying human diseases, and transgenic fish as environmental biomonitors. For instance, transgenic salmon, which overexpress growth hormone genes, demonstrate greatly accelerated rates of growth compared with wild strains and nontransgenic domestic strains of salmon. On average, these transgenic strains of salmon weigh nearly 10 times more than nontransgenic native salmon. Furthermore, genetically engineered marine algae have the ability to produce specific high value-added biomolecules and therapeutic proteins and optimize the production of bioenergy.

Chromosome Manipulation Techniques: Polyploidy Induction

Even though transgenic species are the most common type of genetically modified marine species, a number of polyploid species have been developed. Polyploid marine species may possess excellent traits of economic interest including rapid growth, extensive adaptability, and disease resistance. Hence, several species of artificially induced polyploids are used in marine aquaculture. Artificial induction of triploidy is the most popular ploidy manipulation in marine species such as salmon and shellfish. Triploid organisms comprise three sets of chromosomes (3n) and several different techniques can be used to make triploids. Triploids are usually derived by subjecting fish eggs to a temperature change or chemical treatment to interfere with egg cell division. Several chemicals, such as caffeine, colchicine cytochalasin B, polyethylene glycol, and 6-dimethylaminopurine (6-DMAP) are used in artificial polyploidy induction, but they are generally of limited use due to their chemical toxicity. Fish eggs treated in this way mature with an extra set of chromosomes (polyploid).

Modern biotechnological and genetic engineering tools have contributed immensely toward the development of marine biotechnology with a wide range of potential applications.

In addition, apart from those mentioned above, newly emerging tools and technologies will also play a significant role in the marine biotechnological field in the future.

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Is Sri Lankan Aquatic Wildlife Safe with the Emerging Threat of Engineered Nanomaterials?

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Nanotechnology is a rapidly expanding and advancing field of science which offers enormous benefits to humans. Even though nanomaterials (NMs) have existed naturally from the beginning of the Earth, the scientific community are just beginning to understand the potential risks, unintended effects, inputs, and fate of engineered nanomaterials (ENMs) in the environment. Increased production of ENMs and a variety of commercial-scale applications may increase the possibility of environmental exposure to ENMs in foreseen future. Aquatic environments are the most sensitive and vulnerable ecosystems affected by any manufactured pollutant, including ENMs. A limited number of studies have addressed the impact of ENMs on aquatic wildlife in Sri Lanka. This article's main objective is to reveal the vulnerability of aquatic wildlife of Sri Lanka as the primary target group for the exposure of ENMs and discuss the consequences of ENM exposure using available toxicological data.

Nanomaterials and their applications

Nanomaterials are defined as particle matter with at least one dimension on the nanometer scale, i.e., 1 to 100 nm. However, in ecotoxicological studies, primary particles larger than 100 nm or larger nanoparticle aggregates are sometimes also considered as NMs. Currently, many types of ENMs have been produced, including carbon nanotubes, fullerenes (C60), quantum dots, metal nanoparticles (Au, Ag, Co, Ni etc.) and nano metal oxides (CuO, ZnO, SnO_2, Al_2O_3, MgO, ZrO_2, AgO, TiO_2, CeO_2, SiO_2, $V2O_5$, In_2O_3, Fe_2O_3 etc.).

There is a wide range of applications of ENMs in different fields such as textile, biomedical science, health care, food, agriculture, electronics, environment, renewable energy, and wastewater treatment. Sri Lanka is working towards research and innovation in nanotechnology-based agriculture, water purification, apparel, health care and mineral production, which may have possible ENM inputs into aquatic systems.

What are the possible routes that ENMs enter into the environment?

Different kinds of ENMs can be released from production facilities, wastewater treatment plants and after disposal of ENM associated products. Sometimes intentional, accidental, or unintentional release can occur during production, transport and commercial usage. Irrespective of the method, those ENMs finally end up in aquatic environments through natural precipitation and leakage through soil particles. These particles may exist in particle form, or there is a high possibility of forming aggregations by combining several particles. They can be eliminated or trapped through sedimentation, while some filter-feeding animals and sediment-dwelling animals' uptake these ENPs during feeding. Aquatic plants may absorb the ENMs into tissue systems through active and passive transport mechanisms.

Why is aquatic wildlife vulnerable to ENMs?

Aquatic wildlife includes unique life forms (both plant and animal) that complete their life cycle within or in association of aquatic habitats. Exposure through dietary sources for these organisms depends on the food items, diet composition, and trophic position. They may interact with each other through feeding relationships in food chains and food webs. Primary producers are aquatic unicellular plants, algae and macrophytes. In contrast, primary consumers would be small crustaceans, insect larvae, dragonflies, flies, mosquitos, moths, grasshoppers, spiders, millipedes, earthworms, small fish and fish larvae, amphibians and their larvae, small reptiles, and small mammals.

Secondary and tertiary consumers are adult and juvenile fish, amphibians, reptiles, birds, and mammals including humans. Suspended and soluble metal and metal oxide ENMs tend to accumulate and magnify along food webs. Trophic transfer of nano quantum dots, nano Au and Ag, nano metal oxide TiO_2, ZnO, SnO_2, CeO_2, Fe_3O_4, and SiO_2 particles from algae and phytoplankton to fish and aquatic invertebrates has proven the possibility of transfer of ENMs from one trophic level to another.

Aquatic organisms are susceptible to significant exposure to environmental contaminants through the external covering or integument. For example, an aquatic amphibian's skin is naked, highly permeable, and moist due to mucus secretions. The ENM contaminant has a supportive condition on the body surface to penetrate the skin and enter the body. Meanwhile, many aquatic species have external or internal gills at least in certain stages of their life cycle, which serve as a direct passage to uptake contaminants.

Some aquatic organisms may have a terrestrial stage in their life cycle which may have direct contact with soil or sediment for a significant period during one period of their life cycle. Therefore, contaminants are directly and quickly in contact with the whole organism or body part at least in one of their life cycles stages (shell-less eggs, delicate larvae, adult animals, seeds, plant roots, submerged structures, immature leaves etc.). Although ENMs have low hydrophilicity and instability in the aqueous medium, organic solvents used to increase their hydrophilicity will lead them to become more toxic than the original compound. Although plenty of applications are available, the unique physical and chemical properties of NMs and their behaviour in environmental media are more complex than known chemicals, and this complexity has not been well understood yet. Moreover, the effect of ENMs in mixtures and interaction with other organic and inorganic pollutants are not well studied up to date.

Potential harmful effects on aquatic wildlife

A plethora of studies has been conducted to demonstrate the effect of ENMs in recent decades. Aquatic invertebrates, fish amphibians, aquatic reptiles, birds and mammal models have been used to demonstrate the possible impacts of ENMs under controlled conditions. Different ENMs are severely impacted on developing embryo of fishes and amphibians, induce morphological abnormalities, biochemical, histological, genetical and behavioral changes, genotoxic effect etc. In Sri Lanka, one fish species *(Oreochromis niloticus)* and amphibian species *(Duttaphrynus melanostictus)* were tested with TiO_2 nanoparticles using a static renewal system under tropical conditions.

Exposed fish exhibited immuno-haematological changes, leading to physiological stress and regressive histological changes in the intestine, gill and liver, while amphibians showed significant mortality, delayed development, and physical blockage alimentary canal, morphological abnormalities, delayed development and histological alterations in the intestine and liver.

Intensive research has been carried out to investigate the proper use of ENMs in agriculture in nanosized fertilizers, pesticides, herbicides, sensors, and innovative delivery systems at low cost and using little energy. However, some studies revealed that these ENMs negatively impact plant growth performance and, physiology by altering the reactive oxygen species (ROS), antioxidant metabolism, and change plant photosynthesis by affecting pigments, photosystems, and leaf protein contents. Although positive impacts of nano incorporated fertilizers on Oryza sativa have been investigated by several researchers in Sri Lanka, the possible adverse effects of ENMs on aquatic plants have had limited attention.

Future perspectives and research needs in Sri Lanka

Sri Lanka has initiated nanotechnology-based research and commercialization of the nano-based products in the last decade with the collaboration of government and private companies. They have introduced commercialized products such as nanoparticle incorporated fertilizers, textile and healthcare products.

Unfortunately, limited attention has been given to understand the environmental health and safety issues based on nanotechnology and to assess the possible impacts of ENMs on biota, including aquatic wildlife. The scientific community must pay attention to the main three problems that should be solved in the near future. First, to determine types of ENMs to use in biological test protocols and characterization tests (analysis of physical, chemical properties, aggregation, sedimentation) before, during and after those experiments. Secondly, to determine the route of uptake of ENMs by organisms in different environments and finally to determine the organism and endpoints of measurements. At present Sri Lanka has carried out limited research on understanding ENMs behaviour under tropical conditions, possible exposure routes and assessing the risk of ENMs to tropical biota.

Inadequacy of data regarding the risk of ENMs may also be the major obstacle to implementing regulatory actions. Some developed countries, including those in the European Union, the United States, and Australia attempted to introduce development-description-and usage associated standards for ENMs. These standards consider the potential hazards and protection of the environment and human health. Central Environmental Authority (CEA) Sri Lanka has introduced several tolerance limits for industrial waste, drinking and irrigation water, air pollutants and monitor aquatic systems' pollution levels. However, measures have not been taken to check ENM levels in aquatic media s or introduce tolerance limits for ENM or nano incorporated wastewater. Evaluation of ENM exposure to aquatic wildlife is an essential step in conserving aquatic wildlife in Sri Lanka from this prospective threat. The responsible production of ENMs, regular monitoring of waste treatments, introducing ENM associated legal framework or policy documents, and continuous risk assessment while ensuring human health and environmental safety are mandatory steps to solve this matter. As responsible scientists and environmentalists, raising public awareness and generating scientific knowledge related to the potential risk of ENMs is a timely requirement. The scientific community must ensure that ENMs are safe and that adequate precautions are taken before spreading them into the aquatic environment.

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Differentiating Leptospirosis from Dengue Infections using Oxidative Stress Markers

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Clinical diagnosis of leptospirosis and dengue is challenging due to non-specific presentation of symptoms in the early phases. Misdiagnosis of leptospirosis as dengue, increases the mortality risk of patients with leptospirosis as prompt antimicrobial administration is essential in treating leptospirosis. Identifying reliable markers and their potential in differentiating these two diseases is a critical need in a country like Sri Lanka where annual incidence continues to be high in both diseases. This article describes the updates of a recent research conducted to identify the potential markers which can be useful to differentiate the two diseases.

Leptospirosis and dengue are two of the most common infectious diseases endemic in Sri Lanka. Leptospirosis is a zoonotic infection caused by *Leptospira* bacteria which enters into the human host through recently injured skin or through the mucous membrane. Dengue is caused by the dengue virus which is an RNA virus transmitted by mosquitoes. The highest burden of the diseases in concern is carried by the tropical countries. However, due to the similar, non-specific presentation of symptoms in early states of illness, the clinical diagnosis of both diseases is challenging. Laboratory diagnosis of dengue is widely available islandwide whereas laboratory facility for diagnosis of leptospirosis is confined to a few central laboratories in the country.

In the year 2021, around 7000 and more than 25,000 of patients were reported with leptospirosis and dengue infections respectively islandwide. Although the magnitudes are greatly varied, patients with leptospirosis are often misdiagnosed as dengue especially during the dengue epidemics. Similar observations have been reported elsewhere including India and Bangladesh.

Innate immune components initiate the battle against infectious agents to protect the body through the production of many pro-oxidants. Antioxidants such as glutathione, uric acid, bilirubin, detoxify pro-oxidants to protect the body from the harmful effects of excess pro-oxidants accumulated in the body. The subtle balance between pro-oxidants and antioxidants is affected during infections due to the massive production of pro-oxidants. This leads to the diminished antioxidant capacity (AOC) resulting in oxidative stress. Elevated pro-oxidants are potent in attacking all four major types of biomolecules (protein, lipid, carbohydrates and nucleic acids). Oxidative damage to proteins and lipids is commonly measured by quantifying the protein carbonyl (PC) content and lipid hydroperoxide (LP) content respectively.

A study conducted at the Institute of Biochemistry, Molecular Biology and Biotechnology (IBMBB), University of Colombo revealed that patients with leptospirosis (n=110) in Sri Lanka have significantly elevated levels of PC, LP and significantly low levels of AOC compared to those of the age and gender-matched healthy controls (n=60). The above-mentioned laboratory confirmed leptospirosis patients were clinically characterized as severe and mild according to previously published criteria. Interestingly, PC and LP levels detected in the patients with severe leptospirosis (n=60) were significantly higher compared to the critical phase dengue patients (n=30).

Subsequent Receiver operating characteristic curve analysis has indicated that the cut-off value of 13 μmol/mg protein of PC is potent in identifying a case of severe leptospirosis over critical phase dengue with 100% specificity and 82% sensitivity.

Serum uric acid (UA) levels and total bilirubin (TB) levels were also significantly high in the patients with severe leptospirosis compared to those of the critical phase dengue despite the similar AOCs detected. Elevated levels of UA and TB in severe leptospirosis patients could possibly be due to the renal and hepatic involvement in disease pathogenesis. However, both UA and TB showed moderate sensitivities (63% and 50% respectively) in detecting a severe leptospirosis case over critical phase dengue despite high specificities (90.5% in both). Accordingly, the findings of this study show that serum protein carbonyl may be a reliable marker in differentiating severe leptospirosis from critical phase dengue in Sri Lanka.

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The Endemic Genera of Land Snails of Sri Lanka

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Sri Lanka is a country with a high density of biodiversity and a high endemism. When considering the endemic species of Sri Lanka, limited attention has been given to endemic land snails. However, the endemism of land snails of Sri Lanka has a high value especially compared to the other animal groups. There are 253 species of land snails, of which 205 species are endemic. According to these values an endemism of 81% can be seen. There are 5 genera that is only found in Sri Lanka. These genera are *Acavus*, *Aulopoma*, *Oligospira*, *Ratnadvipia* and *Ravana*. The members of these five genera and their characteristics are described below. The members of the genus

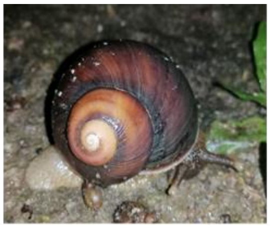

Figure 1: – *Acavus phoenix*

Figure 2: *Acavus phoenix*

Acavus are known as "Wedagolla" in the Sinhalese language as they are used for medicinal purposes in indigenous medicine according to folklore.

This is a genus belonging to the Acavidae family and all the members of this genus exhibit a complete snail body. The genus *Acavus* has three species (*A. phoenix, A. superbus* and *A. haemastoma*) and eight subspecies (*Acavus phoenix phoenix, A. phoenix castaneus, A. superbus superbus, A. superbus greville, A. superbus roseolabiatus, A. haemastoma haemastoma, A. haemastoma fastuosa* and *A. haemastoma melanotragus*).

The classification of this genus is based on the colour and the colour patterns of the shell/body, colour of the lip of the shell etc. All the members are arboreal during the day and usually moves on the ground at night. They feed on fungi, algae, lichens and rotting fruits. Their distribution is restricted to the wet zone and wet microhabitats of the intermediate zone.

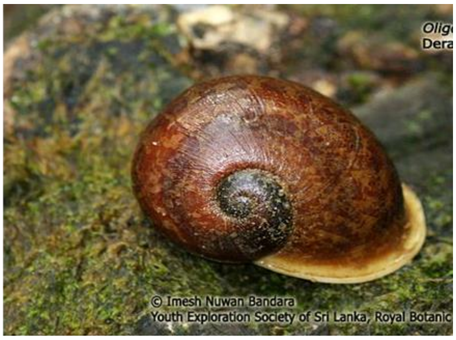

Figure 3: *Oligospira polei* in Deraniyagala. From "Endemic Land Snails of Sri Lanka," by Slendemics, 2011 (https://slendemics.net/easl/invertibrates/snails/landsnails.html)

The genus *Oligospira* also belongs to the Acavidae family. The shell is somewhat similar to *Acavus* but it is less conical with a flat top. Based on the colour and colour patterns of the body and shell they are classified in to three species, which are *O. polei, O. skinneri* and *O. waltoni.* The colour of the shell takes a white, rose and dark brown respectively for *O. polei, O. skinneri* and *O. waltoni.* Some species of this genus are arboreal while some are ground dwelling.

The snails belonging to genus Aulopoma have an operculum which is used to cover the entire body within the shell and are known as Aulopom's operculate snails.

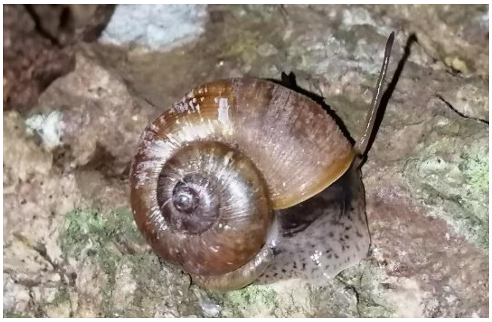

Figure 4: ***Aulopoma itieri***

The operculum is ornamented with some concentric rings as well. The classification of the members of this genus is based on the umbilicating pattern of the shell, shape of the shell, colour and diameter of the shells. This genus includes the four species; *A. grande*, *A. sphaeroideum*, *A. itieri* and *A. helicinum*. The largest member of this genus is *A. grande*, where the diameter of the shell can be 25 mm. *A. itieri* is a species that can be commonly found in home gardens, and it is the smallest member of this genus where the diameter of the shell is approximately 13 mm. The members of this genus are ground dwelling and lives in groups.

Figure 5 :The shell of an ***Aulopoma*** **sp. showing the operculum**

The *Ratnadvipia* genus includes the three species; *R. irradianus*, *R. karui*, and *R. edgariana*. These snails show semi slug characteristics since the mantle covers the shell and as they have an incomplete shell. *R. irradianus* is a common species in the wet zone and the intermediate zone of Sri Lanka. *R. karui* is only present in the wet zone but not common as R. *irradianus.* The other species, *R. edgariana* is very rare and the present records are low.

A red to brown to black brown colour can be taken by the shell of *R. irradianus* while, it is bright yellow to orange-brown in *R. karui*. These two species can also be easily identified separately based on the shell coverage by the mantle. The shell of *R. karui* is covered broader anteriorly and less broad posteriorly by the mantle. However, the shell of *R. irradianus* is covered similarly in both anterior and posterior sides by the mantle. The members of this family are generally herbivores but there are some carnivore records too.

Figure 6 – ***Ratnadvipia irradianus***

The genus *Ravana* is named after an ancient king of Sri Lanka. This is a monotypic genus with *R. politissima* (Sri Lanka Ravana Snail) as the only species. This species was first described by H. Colonel and F.R.S. Godwin in 1901 using a specimen from Watavala area. However, this species was not found again until the start of the upper Kotmale project in the 1990s. There are also some records from the Knuckles region. According to the first description of this species it is a similar in structure to the invasive species *Macrochlamys* sp. but the shell has an extra number of whorls.

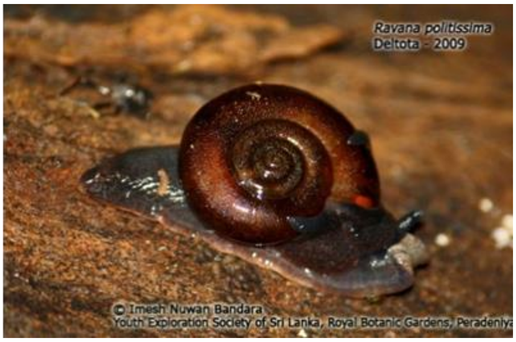

Figure 7: ***Ravana politissima*** **in Deltota. From "Endemic Land Snails of Sri Lanka," by Slendemics, 2011 (https://slendemics.net/easl/invertibrates/snails/landsnails.html)**

Some of the above described genera including *Acavus, Aulopoma* and *Oligospira* have been found from prehistoric human settlements of Kuruvita Batadombalena, Kitulgala Belilena, Alawala, Bellanbadipalassa, Seegiriya Pothana like places.

There are human-made perforations in the shells of *Acavus* and *Oligospira* found from these prehistoric sites in Sri Lanka, and it is possible to assume that these perforations were made either to make jewelry or to eat the fleshy contents within the shells. Hence, these species have a historical value too.

Considering the threats faced by these endemic genera, deforestation is chief amongst them. Deforestation leads to habitat loss due to the destruction of the suitable microhabitat of these snails. Another problem is the alien invasive snail species. These invasive snails consume the food of the endemic genera and there by decreasing the available resources for them. Sometimes the invasive species tend to hunt and eat the endemic snails too. Bio-piracy and wild-life trading are the other threats that are present. However, due to the historical and genetic value of these endemic snails, it is everyone’s duty to protect them.

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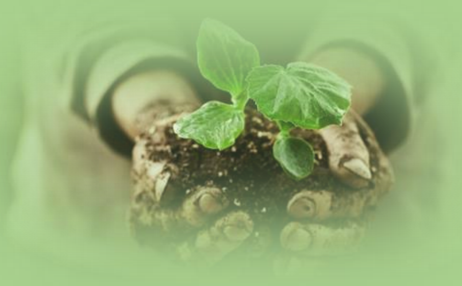
International Day of Plant Health

May 12

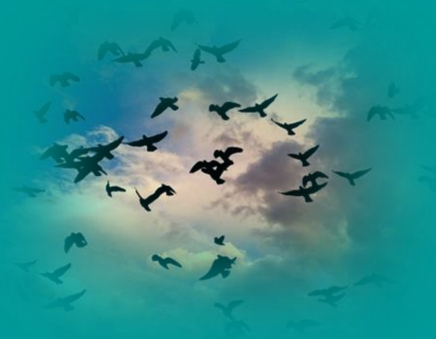
The International Day of Plant Health is dedicated to raising global awareness of the importance of protecting plant health. Healthy plants create the foundation for all life on Earth, biodiversity and ecosystems. Plant health is also important for the sustainable development of agriculture and for achieving food security.



World Migratory Bird Day

May 14

World Migratory Bird Day highlights the need for the conservation of migratory birds and their habitats. This day raises global awareness of the ecological importance of bird migration, threats faced by migratory birds and the need for conservation.



International Day for Biological Diversity

May 22

The United Nations has proclaimed May 22 as the International Day for Biological Diversity to increase global awareness and education of biodiversity issues and conservation.

World Environment Day

June 5

World Environment Day is the largest global platform for environmental conservation and it is celebrated by millions of people across the world. Since 1974, it has been celebrated every year on 5th June and encourages actions.

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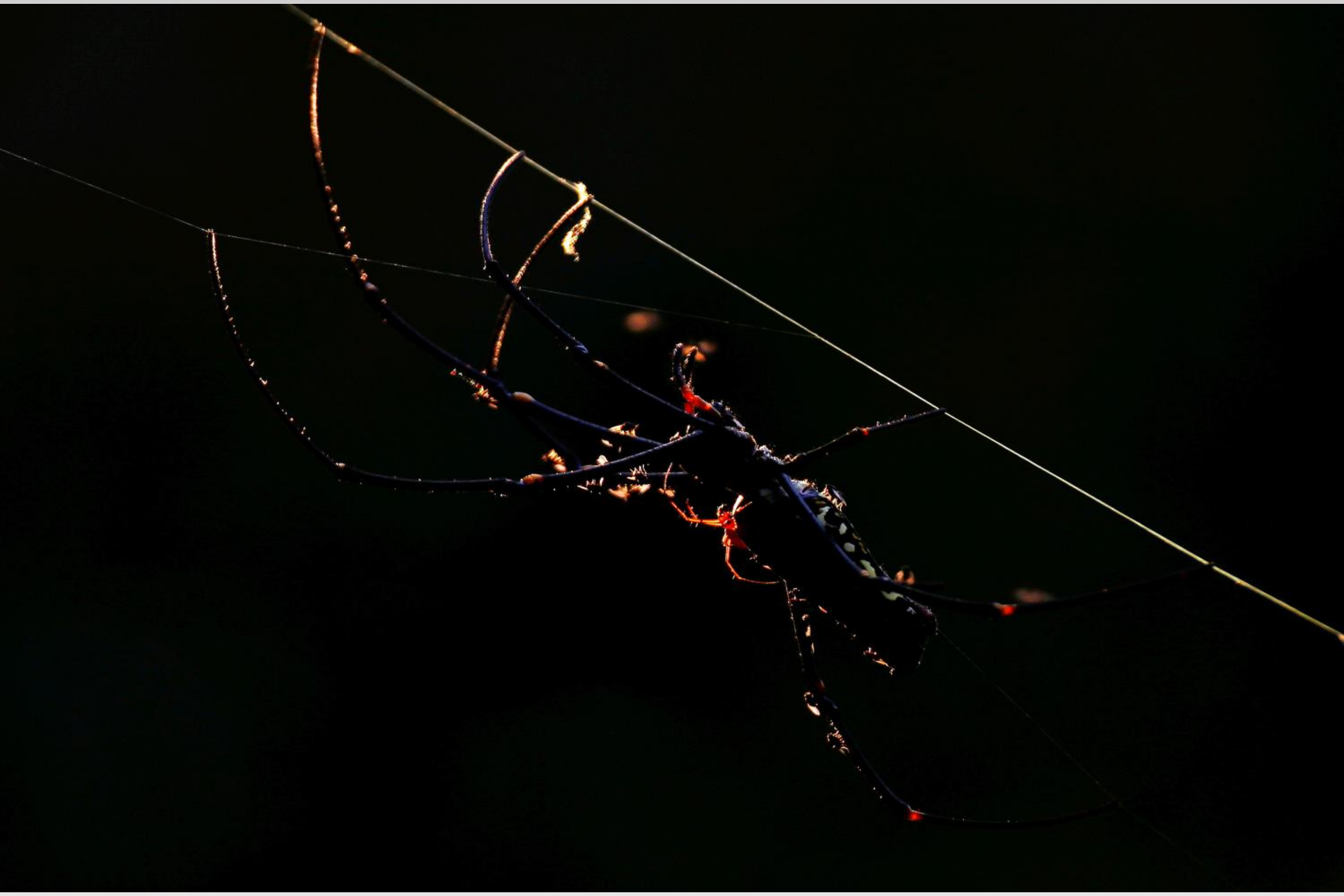
Nature Captures

Giant Wood Spider (Giant Golden Orb-weaver) – *Nephila pilipes*



The giant wood spider (Araneae; Araneidae) is the largest orb-weaver species in Sri Lanka, commonly inhabiting moist habitats including primary and secondary forests and rural home gardens. *Nephila pilipes*, shows sexual size dimorphism- female gigantism and male dwarfism. Their vertical web is asymmetrical, and the silk appears golden-yellow in color. The photograph was taken in a home garden in Bulathkohupitiya, Kegalle District, Sri Lanka.

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