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REEF ENCOUNTER



LIFE ACCOUNTS – Bob Ginsburg, Charlie Veron,
Rod Salm, Wes Tunnell

Society Honors, Prizes and Awards

New Topic Chapter – The Coral Restoration Consortium

CONFERENCES – Mexico, Florida Keys, Bremen, Oxford

Graduate Fellowship Reports – corals, algae and fish

The News Journal of the
International Society for Reef Studies



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REEF ENCOUNTER

The News Journal of the International Society for Reef Studies
ISRS Information



REEF ENCOUNTER

Reef Encounter is the Newsletter and Magazine Style Journal of the International Society for Reef Studies. It was first published in 1983. Following a short break in production it was re-launched in electronic (pdf) form. Contributions are welcome, especially from members. Please submit items directly to the relevant editor (see the back cover for author's instructions).

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INTERNATIONAL SOCIETY FOR REEF STUDIES

The International Society for Reef Studies was founded in 1980 at a meeting in Cambridge, UK. Its aim under the constitution is to promote, for the benefit of the public, the production and dissemination of scientific knowledge and understanding concerning coral reefs, both living and fossil.

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CORAL REEFS - THE JOURNAL

The International Society for Reef Studies also publishes through Springer's its premier scientific journal entitled "CORAL REEFS". The Journal publishes high quality scientific papers concerning the broad range of fields relevant to both modern and ancient reefs (see <http://www.springer.com/life+sciences/ecology/journal/338>).

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COVER PICTURE: Herbivore biomass is a measure of reef resilience, but, as here, high coral cover may mean fewer herbivores as there is less space for algae to grow (see article by Rod Salm page 18; photo by Rod Salm).



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EDITOR'S REMARKS



I must again apologise that we have only managed one edition of Reef Encounter this year, but at last my two terms as Corresponding Secretary of the Society are coming to an end, so with luck I may now have time and energy to publish twice yearly. So, general articles and short research reports and book reviews will be even more welcome, as well as aspiring candidates willing to take on both my officer role and the six or more council places that will be up for election in December.

Meanwhile one of the pleasures of editing Reef Encounter is being assured through personal contact with authors of the extent of enthusiasm for and commitment to coral reef conservation and research. In this issue there are heart-warming accounts of the contributions of two of our most eminent members, Bob Ginsburg (sadly no longer with us – page 27) and Rod Salm (winner of the Society's Conservation prize – page 18), and of four recent recipients of the Society's graduate fellowships (note Sofia Rivera's article on page 32). There are also some quite delightful accounts of the experiences of three of the travel grant recipients at ECRS2017. I do urge members to glance at all these!

Rupert Ormond

TREASURER'S REPORT



I am happy to report that since the last edition of Reef Encounter, the Society's financial situation has continued to improve. We now have approximately US\$ 225,000 in our accounts, and are expecting to receive our share of the surplus income from the European Coral Reef Symposium (ECRS) shortly. At the same time we have during the last year provided ten student travel grants and four student best paper / presentation awards for ECRS, and donated funds in support of the upcoming Reef Futures Conference being organised in Miami in December by the Reef Restoration Consortium, and the Mexican Coral Reef Society (SOMAC) Meeting being held in Colima, Mexico in April, 2019 (see the announcements below). In addition, we have again during the year awarded six ISRS graduate fellowships and made an Inaugural Reef Conservation Prize award that will result in a series of internship places with the Nature Conservancy. Currently we are finalising support for the next International Coral Reef Symposium (ICRS 2020) to be held in Bremen and looking to invest part of our funds to provide reserves that will ensure the future of the Society.

Erinn Muller

ANNOUNCEMENTS

The Coral Restoration Consortium “the first ISRS Topic Chapter”

We are pleased to announce the formalization of the **Coral Restoration Consortium (CRC)** as the first Topic Chapter of the ISRS. The CRC’s letter of interest was received by Ruth Gates, ISRS President, on June 14, and the ISRS Officers and Councilors approved the letter at the council meeting on July 5, 2018. In their letter, the CRC co-chairs stated their desire to be associated with ISRS because:

“...the ISRS is the principal learned society to which reef scientists and managers from across the world belong and has as its principal objective the promotion of the production and dissemination of scientific knowledge and understanding of coral reefs. We seek to ground the mission of the CRC through increased collaboration with the world’s leading scientists and managers, and join ISRS as a Topic Chapter, to henceforth work together toward solving the coral-reef crisis of the 21st century.”

The CRC is a community of practice that comprises scientists, managers, coral restoration practitioners, and educators dedicated to enabling coral reef ecosystems to adapt and survive the 21st century and beyond. The CRC’s mission is to foster collaboration and technology transfer among participants, and to facilitate scientific and practical ingenuity to demonstrate that restoration can achieve meaningful results at scales relevant to reefs in their roles of protecting coastlines, supporting fisheries, and serving as economic engines for coastal communities.



Three-year-old *Acropora palmata* out-plant colony on Great St. James Island, St. Thomas, U.S. Virgin Islands. Photo credit: Sean Griffin, NOAA Restoration Center.

The CRC was formed with full recognition that saving the world’s coral reefs will be difficult and requires a multi-pronged approach. Immediate and aggressive action on climate change is paramount for the long-term survival of reefs; however, carbon already committed to the atmosphere will continue to warm ocean waters to a level inhospitable to corals for decades to come. Thus, the problem needs to be simultaneously addressed at multiple scales. Globally, aggressive action is required to reverse climate change; regionally, integrated networks of protected reef ecosystems are needed to ensure that corals can survive and adapt; and locally, as threats such as overfishing and pollution are managed, we need to repopulate target reefs with resilient, genetically diverse and reproductively viable corals. This active and targeted coral repopulation using novel ecological interventions is one way we may buy tropical reefs time to adapt to changing ocean conditions so that they may thrive in the future.

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The Coral Restoration Consortium is also excited to announce that [registration is open](#) for the first global conference dedicated to coral reef restoration and interventions. **“Reef Futures 2018: A Coral Restoration and Intervention-Science Symposium” will be held December 10-14, 2018 in Key Largo, Florida, USA at the Ocean Reef Club.** The deadline for discounted registration is September 30.

To get involved with the CRC and receive e-mail updates on the CRC’s development, newsletters with scholarly information on restoration, quarterly webinar announcements, and information on how to join Working Groups [CLICK HERE](#).

For more information, please see the [CRC website](#). For general inquiries on the CRC please email coral.restoration@noaa.gov or contact the coordinator, Tali Vardi, or the co-chairs, Scott Winters or Tom Moore.

The inaugural Coral Restoration Consortium steering committee membership is:

Tom Moore, NOAA Restoration Center (Co-Chair); Scott Winters, Coral Restoration Foundation (Co-Chair); Tali Vardi, NOAA Fisheries Office of Science and Technology (Coordinator); Ileana Lopez, UN Environment-Caribbean Environment Programme; Les Kaufman, Boston University; Ilsa Kuffner, U.S. Geological Survey; Diego Lirman, University of Miami; Phanor Montoya, Corales de Paz, Colombia; Gabriela Nava, Oceanus AC, México; Dirk Petersen, SECORE International; Andrew Ross, Seascope Caribbean, Jamaica; Luis Solorzano, The Nature Conservancy; Dave Vaughan, Mote Marine Laboratories.

Ilsa B. Kuffner



The 2018 Reef Futures Symposium, organised by the **Coral Restoration Consortium** is taking place, in Key Largo, Florida, USA, from December 10th to 14th. The meeting will bring together experts from around the world to share the latest science and techniques for coral reef restoration, while kicking off a global effort to dramatically scale-up the impact and reach of restoration as a major tool for coral reef conservation and management. Abstract Submission is now closed, but delegates can still register via the Reef Futures website, where information is available on the program and potential accommodations: <https://reeffutures2018.com/en/>.



10th Mexican Coral Reef Congress

The Mexican Coral Reef Society (SOMAC), and the University of Colima (UCol), invite readers to the Xth Mexican Coral Reefs Congress, to be held between the **2nd and 5th April, 2019**, at the Educational Technology Center of the University of Colima, Manzanillo, Mexico. The Congress has the support of the International Society for Reef Studies (ISRS).

Under the theme "*Reefs for the Future*" we seek to deepen our understanding of the state of the reefs in times of strong anthropogenic pressures and rapidly changing environmental conditions, and to discuss strategies for ensuring the permanent survival of reefs. In recent years the Congress has been attended by many participants from other parts of the American continent, and delegates from other parts of Latin America are especially welcome. Submissions are accepted in either Spanish or English.

The call for abstracts closes on October 15th, 2018. Abstracts can be submitted on-line via the Congress webpage: <http://www.somac.org.mx/10CMAC>

X Congreso Mexicano de Arrecifes Coralinos

La Sociedad Mexicana de Arrecifes Coralinos (SOMAC), y la Universidad de Colima (UCol) invitan al X Congreso Mexicano de Arrecifes Coralinos, que se llevara a cabo entre el **2 y 5 de abril de 2019** en el Centro de Tecnología Educativa del Campus Manzanillo de la Universidad de Colima, México. El congreso cuenta con el apoyo de la International Society for Reef Studies (ISRS).

Bajo el tema general "*Arrecifes para el futuro*" se busca profundizar nuestra comprensión del estado de los arrecifes en tiempos de fuertes presiones antropogénicas y condiciones ambientales cambiantes, para así discutir las estrategias para garantizar su permanencia. Se invita a la participación de colaboradores de otros países del continente americano. Se aceptan ponencias en español e inglés.

La recepción de resúmenes cerrara el 15 de Octubre de 2018, y se puede hacer en línea en la pagina web del Congreso: <http://www.somac.org.mx/10CMAC>

14th International Coral Reef Symposium



CALL FOR SESSIONS AND WORKSHOPS

We are now over half way between the most recent International Coral Reef Symposium, held in Honolulu, Hawaii, and the next one, to be held in Bremen, in northern Germany. Further the first key date is approaching. **The ICRS 2020 Call for Sessions and Workshops will open on November 1st this year (2018), and close on January 31st, early next year (2019).** Please see the dedicated conference website for further details: <http://www.icrs2020.de/>



Welcome to Bremen, Germany's 11th biggest city (560,000 inhabitants), and its fifth largest business location, where everything is just around the corner. As the symposium website demonstrates (and the Reef Encounter editor discovered during a recent visit to attend an organizing committee meeting), Bremen is, especially in mid-summer, a delightful place to explore – a human scale, historic city – home to fascinating medieval streets and buildings – but with a large wooded park at its heart, and a vibrant University and technological businesses nearby. In short, a most attractive city to spend time in during a conference, or to take one's family to visit (<http://www.icrs2020.de/services/bremen/>).

As an indication of the city's user friendliness, the pleasant international airport, offering direct flight connections to all major European hubs, is serviced by an enjoyable tram which gets one to the city centre in little more than 10 minutes! In 2005, Bremen was named Germany's first 'City of Science'. The University of Bremen with its strong marine science focus is among Germany's leading academic institutions, while the Bremen Exhibition & Conference Center is located in the heart of the city. A wide choice of accommodations and the historic city centre, with its ancient city hall and traditional coffee and tea houses, are within walking distance.



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As reported in the previous Reef Encounter, preparations for ICRS 2020 are being supported by a large international organising committee chaired by Prof. Christian Wild (christian.wild@uni-bremen.de), and coordinated by the ICRS 2020 Conference Secretariat headed by Dr. Malik Naumann (office@icrs2020.de).

Under the overarching symposium theme “Tackling the Challenging Future of Coral Reefs” ICRS 2020 will aim to:

- Showcase significant work, latest findings and new ideas from all disciplines
- Provide a platform for the international ocean community to build bridges among science, conservation, politics, management and public awareness
- Review existing knowledge for a comprehensive outlook on the future distribution and function of coral reef ecosystems
- Explore new insights and technologies to develop science-based and sustainable solutions to tackle the global coral reef crisis
- Promote public and political outreach, in order to disseminate the key symposium outcomes at the local and international level
- Create awareness by involving the public through accompanying lectures and exhibitions
- Minimize and compensate all local and global environmental impacts by the symposium

At the same time the symposium will be open to consideration of a wide range of subject areas and disciplines concerning coral reefs of the past, the present, and the future. The Organising Committee welcomes proposals for sessions and workshops on topics ranging from geological, paleontological, and geobiological subjects to contemporary descriptions of reef status, processes and changes, including mechanisms of coral bleaching and disease. Please give thought now to what sessions you and your colleagues would wish to see included in the program. Then check the symposium website on November the 1st for information on how to proceed.



REEF CONSERVATION UK 2018

RCUK didn't stop with the ISRS European Symposium in Oxford!

Registration is NOW OPEN for RCUK 2018

Saturday 1st December 2018 at the Zoological Society of London

Reef Conservation UK is a networking group that promotes collaboration on issues related to coral reef conservation and research. It holds annual one day conferences at the London Zoo, which are usually attended by both professional and amateur reef workers, many from Europe and beyond, as well as the rest of the UK. As attendees at ECRS 2017 will have discovered, RCUK meetings are characterised by a welcoming atmosphere and some great traditions - most notably Guylian chocolate bars and (warm) beers in the aquarium!

Regular entry £40 (UK); students and concessions £30. For more details see that RCUK website at: <https://www.reefconservationuk.co.uk/>



SOCIETY AWARDS AND HONORS 2018

The Society announced in May the award of its 2018 honors to the following members:

Eminence in Research Award: **Professor Rolf P. M. Bak** (Netherlands Institute for Sea Research, Den Burg, Netherlands); **Dr. James W. Porter** (Odum School of Ecology, University of Georgia, Athens, Georgia, USA)

Mid-Career Award: **Professor Joshua E. Cinner** (ARC Centre of Excellence in Coral Reef Studies, James Cook University, Townsville, Queensland, Australia)

World Reef Award: **Dr. Ranjeet Bhagooli** (Faculty of Ocean Studies, University of Mauritius, Mauritius)

Elected to ISRS Fellows Status: **Philip Munday** (ARC Centre of Excellence in Coral Reef Studies, James Cook University, Townsville, Queensland, Australia), **Andrew Hoey** (ARC Centre of Excellence in Coral Reef Studies, James Cook University, Townsville, Queensland, Australia), **Sue Wells** (Cambridge, England, UK)

Congratulations to the successful candidates and thanks to all members who participated.

Society Elections, December 2018 FIRST CALL FOR CANDIDATES

Two of the Society's officers and half of the current Council members will be completing their current 4-year terms of office at the end of this year. This is a preliminary call for nominations for candidates for the available vacancies which will be filled as a result of elections to take place in December (2018). Officers and Council Members are allowed to seek re-selection for a second term, but those who have completed two consecutive terms are not permitted to stand again until they have completed at least one term out-of-office.

The officer posts up for election are as follows:

VICE-PRESIDENT: **Dr. Yim Golbuu** (Palau) is eligible to stand for a second term.

CORRESPONDING SECRETARY: **Prof. Rupert Ormond** (UK) has completed two terms and so is not eligible to stand for a further term. Nominations are sought for this key post.

In addition, there will be **EIGHT COUNCIL POSITIONS** to be filled by election or re-election, as a result of **SIX** Council Members completing their 4-year terms, and **TWO** other members retiring early.

PLEASE CONSIDER WHETHER YOU MAY BE ABLE TO SERVE THE SOCIETY BY STANDING FOR ELECTION AS A COUNCIL MEMBER OR OFFICER. Serving as a council member or officer is an excellent way to get to know a cross-section of fellow coral reef researchers and conservationists. **Candidates from different global regions are especially welcome.** For information on the role and work load of respective positions, please contact any existing officer or council member you may know, or email the present Corresponding Secretary. Nominations will open officially on November 1st.



ISRS Graduate Fellowships / Research Grants

The Society has announced the award of its 2018 Graduate Fellowships to the following student members:

Alexander Fordyce (UK) University of Newcastle, Callaghan, New South Wales, Australia, for research entitled: "The use of Computer Tomography to investigate fine scale structure, density and porosity of coral skeletons following thermal stress and resulting chemical dissolution by microbial endoliths".

Remi Ketchum (US) University of North Carolina, Charlotte, North Carolina, USA, for research entitled: "Molecular and microbial mechanisms of thermal adaptation in the keystone urchin, *Echinometra mathaei*, along the Arabian Peninsula".

Athira Prasad (India) Kerala Agricultural University, Thrissur, Kerala, India, for research entitled: "Climate Change and Population Connectivity of Lakshadweep Atolls".

Amanda Ramos (Cuba) University of Havana, Playa, La Habana, Cuba, for research entitled: "Influence of benthic algae on larval behavior and settlement of the coral *Acropora palmata*".

Maria Santos (Brazil) University of Ryukyus, Okinawa, Japan, for research entitled "Sibling zoantharian species: connectivity and associated zooxanthellae".

Karine Scavo (US) Boston University, Boston, Massachusetts, USA, for research entitled "Evaluating the role of mangroves as refugia for the branching reef coral, *Porites divaricata*".

Congratulations to the successful applicants and thanks also to the other ISRS members who submitted research proposals. 28 applications were received, with three fellowships reserved for the best applications from candidates from developing countries.

ISRS CORAL REEF CONSERVATION AWARD 2018

Earlier this year the Society agreed to offer a new CORAL REEF CONSERVATION AWARD to include a \$2,500 cash prize in support of personal research or conservation activities.

In May the Council of the Society was pleased to announce that the inaugural ISRS Coral Reef Conservation Award has been awarded to: **Dr. Rodney (Rod) V. Salm** (Senior Advisor Emeritus, The Nature Conservancy, Kailua, Hawaii, USA), in recognition of a career-long record of achievements in tropical marine conservation.

Thanks to all members who nominated candidates or were themselves nominated. [Nominations for the 2019 Award will open in the new year, with re-nomination of past candidates welcome.](#)



Winners of the Best Paper Award: Coral Reefs volume 36 (2017)

The editorial board of *Coral Reefs* collectively nominated 24 papers as candidates for the “*Coral Reefs*” Best Paper Award for Volume 36 (2017). The panel then agreed on a short-list of three publications comprised (in alphabetical order) of the following papers:

De Bakker, Didier M., Fleur C. Van Duyl, Rolf PM Bak, Maggy M. Nugues, Gerard Nieuwland, and Erik H. Meesters. "40 Years of benthic community change on the Caribbean reefs of Curaçao and Bonaire: the rise of slimy cyanobacterial mats." *Coral Reefs* 36, no. 2 (2017): 355-367.

Poland, D. Á. and M. A. Coffroth. "Trans-generational specificity within a cnidarian–algal symbiosis." *Coral Reefs* 36, no. 1 (2017): 119-129.

Tanner, Jason E. "Multi-decadal analysis reveals contrasting patterns of resilience and decline in coral assemblages." *Coral Reefs* 36, no. 4 (2017): 1225-1233.

In the final deliberation all three papers received multiple votes, but there was a clear winner: the paper by Didier de Bakker and colleagues (see abstract to right). One member of the Editorial Board was moved to express her admiration in the following terms: “The de Bakker et al. paper just perfectly captures the changes in the Caribbean in a really detailed way... the major phase shifts are all beautifully articulated in the data and figures, and the paper is extremely well-written..... I am a huge fan of the de Bakker paper - I think it is an instant classic that is going to be the benchmark study for Caribbean reef trajectories.”

Congratulations to Didier, Fleur, Rolf, Maggy, Gerard and Erik. They will receive the plaque and the monetary award donated by Springer, publishers of *Coral Reefs*.

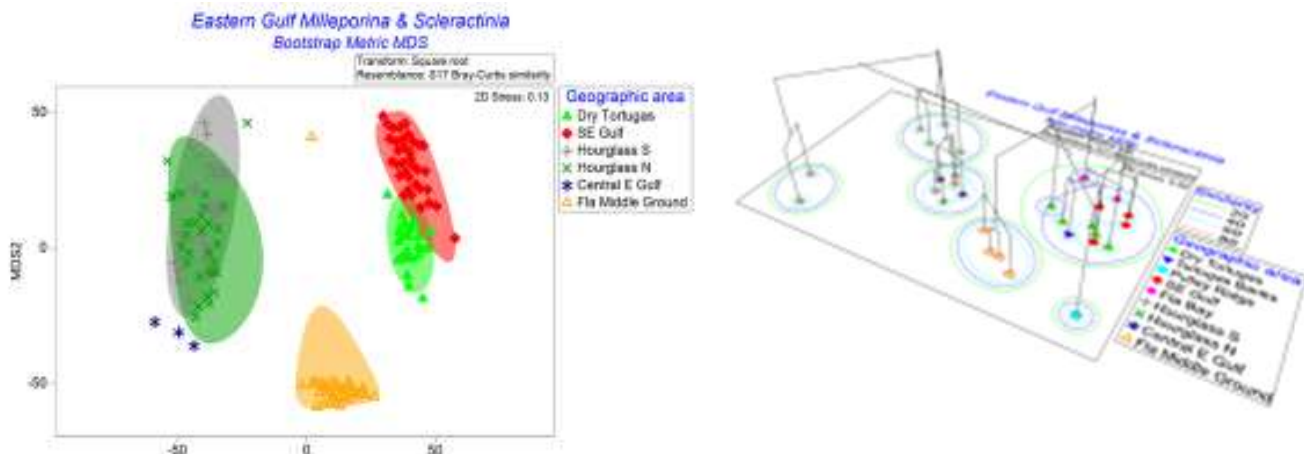
Abstract

Over the past decades numerous studies have reported declines in stony corals and, in many cases, phase shifts to fleshy macroalgae. However, long-term studies documenting changes in other benthic reef organisms are scarce. Here, we studied changes in cover of corals, algal turfs, benthic cyanobacterial mats, macroalgae, sponges and crustose coralline algae at four reef sites of the Caribbean islands of Curaçao and Bonaire over a time span of 40 yr. Permanent 9 m² quadrats at 10, 20, 30 and 40 m depth were photographed at 3- to 6-yr intervals from 1973 to 2013. The temporal and spatial dynamics in the six dominant benthic groups were assessed based on image point-analysis. Our results show consistent patterns of benthic community change with a decrease in the cover of calcifying organisms across all sites and depths from 32.6 (1973) to 9.2% (2013) for corals and from 6.4 to 1% for crustose coralline algae. Initially, coral cover was replaced by algal turfs increasing from 24.5 (1973) to 38% around the early 1990s. Fleshy macroalgae, still absent in 1973, also proliferated covering 12% of the substratum approximately 20 yr later. However, these new dominants largely declined in abundance from 2002 to 2013 (11 and 2%, respectively), marking the rise of benthic cyanobacterial mats. Cyanobacterial mats became the most dominant benthic component increasing from a mere 7.1 (2002) to 22.2% (2013). The observed increase was paralleled by a small but significant increase in sponge cover (0.5 to 2.3%). Strikingly, this pattern of degradation and phase change occurred over the reef slope down to mesophotic depths of 40 m. These findings suggest that reefs dominated by algae may be less stable than previously thought and that the next phase may be the dominance of slimy cyanobacterial mats with some sponges.

Terry Done (chair of the judging panel)

ADVANCED PRIMER 7 / PERMANOVA+ WORKSHOP

St Petersburg, Florida, USA - March 4th-8th, 2019



An advanced workshop on Primer 7 / Permanova+, directed by distinguished Prof. Marti J. Anderson, is being held at Weedon Island Preserve Visitors' Center, St Petersburg, Florida, USA, from March 4th-8th, 2019. Participants will engage in lectures on key topics and computer lab sessions on supplied data, with ample opportunity to discuss and analyze their own data in consultation with Prof. Anderson (dedicated time for this is provided on the final day). Participants should bring their own laptop; software may either be purchased, or participants can make use of a free time-limited, fully functional version that will be made available to registered participants for use during the workshop.

The workshop is for those who have some working experience with PRIMER but are keen to learn about the latest developments in version 7 and PERMANOVA+. New tools include: shade plots with flexible ordering & clustering of axes; coherence plots to show species displaying statistically distinguishable response patterns; unconstrained binary or divisive flat clustering (as in *k*-means) along with SIMPROF tests; metric, threshold metric, non-metric or combined MDS in any dimensions; bootstrap averages to show variation among averages in metric MDS space; new plot types (bar, box, means, line, histogram, scatter, surface, shade) in 2-d or 3-d; animations of ordinations captured to video files; multi-factor and multi-variable segmented bubble plots in 2-d and 3-d; and much more.

Course fees are US\$ 1,000 for those registering before November 30th, \$1,100 afterwards (\$700 and \$800 respectively for students). This covers all course materials, lunches, coffee/tea and snacks during breaks, and free Wi-Fi. The course fee **does not include** other meals, accommodation or transportation.

To express interest in attending, please send an email directly to the PRIMER-e office: primer@primer-e.com. You will be sent a registration form and a detailed schedule. To register, please fill out the **registration form** and return it directly to primer@primer-e.com to secure your place. Places are limited. **Registration and payment must be received by February 8th, 2019.** For further information about the venue please contact Walt Jaap (wjaap@tampabay.rr.com).

COMMITTEE ACTIVITIES

ISRS Conservation Committee

With 2018 designated as the third International Year of the Reef (IYOR), the Conservation Committee has focused on activities in support of this initiative.

We assisted with preparation of the ISRS pledge to raise awareness of 10 things that individuals can do to help save coral reefs (<https://signup.com/client/invitation2/secure/2180229/false#/invitation>). We also co-ordinated the

production of a briefing on the impact of sunscreens on coral reefs, commissioned by the International Coral Reef Initiative (ICRI) and compiled by Elizabeth Wood. It has been published on the ICRI website, as a document representing the first synthesis of available evidence. Any ISRS members with an interest in the subject are urged to look at the ICRI document and send comments and additional material to Liz Wood (ewood@f2s.com). Preliminary feedback on the document has been very positive as this is the first attempt to review the evidence from all angles. The report has not yet a formally endorsed ISRS as a briefing



document, but can be downloaded from the ICRI website at: <https://www.icriforum.org/icri-documents/icri-publications-reports-and-posters/impacts-sunscreens-coral-reefs>

The Conservation Committee also helped to organise the European launch of IYOR at the European Coral Reef Symposium in December 2017. ECRS was hosted in Oxford, UK, by Reef Conservation UK, a founder organisation of the first IYOR in 1997. The launch was a lunchtime event attended by some 50 people. Speakers included Rupert Ormond, Sue Wells and Jessica Bellworthy for ISRS, Heather Koldewey and Dr Dominic Andradi-Brown for RCUK, Elizabeth Wood who introduced the sunscreen briefing and Charles Sheppard who spoke about the urgent need for effective communication during IYOR2018 and the role of journalists and the media. IYOR activities in Germany were described by Goetz Reinicke, and in Belize by Melanie McField. The event ended with a screening of the film **Voices from the Reef**, produced by IUCN-The World Conservation Union and the Great Barrier Reef Marine Park Authority, which summarises the crisis facing reefs today and the urgent action that is needed, using the Great Barrier Reef as an example.

The Conservation Committee is currently discussing priorities for future action. We welcome comments and assistance from any ISRS member. Please join us!

Sue Wells (suewells1212@gmail.com)

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ISRS Student Committee

A little over a year ago a handful of enthusiastic young marine scientists formed the ISRS Student Committee. The committee aims to disseminate information, highlight student achievements, and aid career progression. This includes a webinar series hosting career professionals from various sectors and also the new online blog, Reefbites, that allows students to work on their writing as well as editorial skills; we've had a full and exciting year!

Our committee has representatives from all student stages, from high school to early post doc and members from the America's, Asia, Europe, and Australasia. Most of us were able to attend the European Coral Reef Symposium in Oxford in December (photo). We kicked off these brilliant few days with drinks in a local pub; we were overwhelmed by the number of people who attended and did our best to squash into the small, low-ceilinged corner we reserved. Cosy as it was, it allowed everyone to mingle and get to know the committee as well as other students – a great night!

The mentor lunches were also a great success attended by more than 100 students. These were organized lunch breaks with professors to facilitate informal discussion between students, peers, and professors. Twenty-four academics willingly volunteered to provide career advice and relaxed conversation, to which we had some great feedback - thank you to all involved. Due the success in Oxford, a couple of committee members organized another brilliant, fully-packed social event at the International Symbiosis Society Conference in Oregon this summer. We were delighted to see plenty of familiar faces and many new ones.

The committee is not only working on engaging with students during conferences, but also all year around through social media, organized webinars and our very own science blog: Reefbites (see illustration opposite). A core focus of our committee will continue to be involving you – the students – in writing and editing scientific content for Reefbites. We welcome anyone to write a short piece on any reef topic you are passionate about. This can be used to highlight a recent piece of your research, interesting reef observations or community work, and share it with a wide audience around the world. On Twitter and Instagram our committee has been actively sharing news, upcoming conference and webinar events, and highlighting interesting research. Follow us on social media to keep up to date and submit your suggestions to us; we want to hear from you!



The ISRS Student Committee at ECRS 2017

How can we help you best? What kind of events would you like to see us organise? Please join us!

Contact: isrs.students@gmail.com

Blog: <https://reefbites.wordpress.com>

Twitter: @ISRSreefstudent

Instagram: ISRS.students

Jessica Bellworthy & Maha J. Cziesielski

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Reefbites

ISRS Student Blog

[ABOUT US](#) [GET INVOLVED](#) [GALLERY](#) [MEDIA RESOURCES](#)

SEPTEMBER 20, 2018 / REEFBITES / LEAVE A COMMENT

Oysters can build reefs too!

Get involved – go to Reefbites at <https://reefbites.wordpress.com/>

SEPTEMBER 25, 2018 / REEFBITES / LEAVE A COMMENT

Thermally tolerant symbionts: adaptive saviors or opportunists?

WE ARE FIGHTING

SEPTEMBER 21, 2018 / REEFBITES / LEAVE A COMMENT

“We are not drowning, we are fighting”: Pacific Islanders want you to know that they still have hope for their islands

ISRS Education Committee

This has been an exciting year for the Education Committee and its members. A key reason as readers will know is that 2018 is the International Year of the Reef (IYOR 2018), with many innovative events for the public worldwide. The IYOR website <https://www.iyor2018.org/> has an excellent list of news and what has been happening, many of the items involving ISRS members.

The year really kicked off at the European Coral Reef Symposium (ECRS) in Oxford in December 2017, where the Education Committee was well represented. Subsequently, members have been involved in giving lectures and presentations, a couple are mentioned below. The Chairs of both the Education and Student Committees met at ECRS and resolved to work together. Subsequently they had a Skype meeting in June at which they discussed areas of promising collaboration. These included:

1. Student Committee sharing and linking Education Committee materials on the isrs/reefstudents website.
2. Mutual promotion of social media/Committee activities (in particular a possible copy-editing initiative by Education Committee).
3. Mentoring activities, including mentoring for careers outside academia.

We recognise the need to facilitate mentorship for students (and non-students) for reef/science related careers outside of traditional academic pathways, e.g. natural resource management, policy, NGOs, publishing, science communication (journalism) etc. Some ideas for achieving this are:

1. Student blog post: on careers outside of academia including lists of options, tips, links to useful information and resources.
2. Recorded webinar(s) on careers outside of academia (invited webinars by people in different sectors, e.g. Alison Green, TNC; Jon Day, ex-Great Barrier Reef Marine Park Authority; etc) to give an overview of working in that sector, personal experience, tips, list of skills required for entry, etc.
3. Career-focused mentor scheme: invite/list experienced mentors in a range of non-academic sectors willing to volunteer, to i) offer brief bio, top tips, and ii) contact details so that people may contact them for specific advice/brief mentor sessions by email/phone/skype. These people may be then listed on the main ISRS website, complete with photo, brief biography (& CV perhaps?), top 10 tips for getting into/working in their sector, contact details. Both committees may then promote the scheme to the ISRS membership (and beyond).



James Crabbe's Lecture at the Linnean Society, London

It was agreed that activities undertaken should be high reward to membership and the public at low maintenance cost (time and finance) to either committee.

Lectures and presentations given by committee members have included:

- a) A lecture at the Linnean Society, London: <https://www.iyor2018.org/resource/what-hope-for-corals-in-this-international-year-of-the-reef-professor-james-crabbe-fls/>
- b) Coral Reefs in their International Year; the Stanley Gray Lecture given in Trinity House, London: <https://www.youtube.com/watch?v=1UyRgT2ay50>

These presentations can be watched by following the above links.

James Crabbe, Committee Chair

REEF CURRENTS

General articles and overviews of reef science and management

Chasing Coral Reef Conservation: A Lifelong Adventure

Rodney V. Salm¹

Senior Adviser Emeritus, Pacific Division Marine Program, The Nature Conservancy

resilientreefs@gmail.com

August marked the one-year anniversary of my retirement from The Nature Conservancy, or, as I prefer to call it, the onset of my “forever sabbatical.”

It’s been a busy time: getting over biweekly paycheck separation anxiety; getting comfortable living in a world of “rolling Sundays” where each day has both nothing on the agenda and everything imaginable on the agenda; and, with my wife Suze, putting together three diving and snorkeling trips to Indonesia on the liveaboard, Seven Seas. We’ve seen much of interest; but most of all, we’ve seen vibrant and robustly resilient coral communities that are untouched by climate change. Some have centuries old *Porites* colonies and table *Acropora* corals 50, 60, even 70 years old, which is significant for these most stress-susceptible of corals. But we’ve also seen areas where coral communities have bleached, died and largely disappeared; bleached, weakened and succumbed to disease; or bleached, died and come back dominated by different species (e.g., former fields of table *Acropora*, now visible by their pedestals only, are covered by foliose or branching and bushy coral growth forms).



Figure 1. Robustly healthy coral communities among the Islands east of Flores, Indonesia, that have either resisted stress or managed to avoid it, thanks to favorable prevailing oceanography and weather: high coral cover and diversity, good color (left); enormous table *Acropora* with deep color and active growth margin (center); 250-300-year-old boulder *Porites* (right). (Photos by Rod Salm)

All the while, I do what I’ve always done: keep my eyes wide open, try to see, really see, what I’m looking at, think about what I see, and ponder what it means for the future of coral reefs and how we manage them. Keeping hope

¹ Rod Salm was the winner of this year’s ISRS inaugural Coral Reef Conservation Award. The editors invited him to write about his career, reflecting on the challenges of tropical marine conservation.

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alive can be challenging at times. To persevere in a marine conservation career, one needs to be a zealous optimist and able to sustain enthusiasm, eschew cynicism, and celebrate every success no matter how small. While optimism can be a distraction and the equivalent of burying one's head in beach sand (only to drown later as sea levels rise), it can also be the fair wind that keeps us sailing through the doldrums of despair.

This past year has released time to reflect on the evolution of coral reef science and conservation over the past fifty years. The 1960s and 1970s were heady decades. There was a dearth of information, few field guides, but almost limitless opportunity for adventure and discovery. The adventure came from the lack of rules then, or safety standards, the situations in which that placed us, and the keen anticipation and thrill of discovery. Funds were tight; and understanding absent for why a dive buddy was needed for what was perceived as one person's job. This persisted intermittently into the 1980s for me.

David Stoddart's Atoll Research Bulletin reports on the ecology of this or that coral island provided early guides. He and others described the geology, geomorphology, floristics, and ecology of islands and their adjacent reefs. Seminal and enduring guidance for my thinking, action and scientific development came from ecologist Ken Tinley's holistic view of coastal systems and tutelage in Mozambique, Ian McHarg's *Design with Nature* (McHarg, 1969), and Carleton Ray's truly pioneering thinking on marine conservation, particularly his *Critical Marine Habitats* paper (Ray, 1976). I learned from those early leaders to see the big picture, how things fit together, and the dynamics of whole systems. Today, the coral reef research field is more crowded driving scientists to become more specialized. The big picture view is a victim as it is harder to pull together quickly into papers that meet the criteria of many scientific journals. This is a direction that so much science has taken, especially among younger scientists keen to establish themselves, advance their careers, and who suffer the pressure to publish. Yet, there is prodigious opportunity to develop conservation science. It requires that scientists design their science to meet local needs and abilities. Science protocols that are intuitive are more likely to be adopted, applied, and interpreted by local scientists and communities, even if they fall short of requirements for publication in peer-reviewed journals. Clearly a balance is needed between observational science that leads to hypotheses and the hard science that follows to refine these into defensible material. The two are complementary and equally valuable.

My passion for natural history came early on in life. There were "miles and miles of bloody Africa" (as the saying went) to explore, providing me the opportunity to discover birds, snakes, wetlands, hollow trees, dunes, beaches, tidal flats and nearshore reefs in Mozambique, the country of my youth. In 1971, this passion was honed by Sir Peter Scott and Keith Shackleton sailing aboard the natural history tourism ship, the Lindblad Explorer. By then Sir Peter had developed a keen interest in fish watching and got me started on listing fishes at every site we snorkeled or dived. We visited reefs that hitherto had not been dived by others. It was a transformative experience to be likely the first eyes to see a place and marvel at the size, number, and total lack of timidity in fishes there. I had been doing this for years back home, but not appreciating the privilege.

My first recollection of a living coral came 15 years earlier in such a place. In 1955, I was snorkeling as a boy along the Mozambique coast when I came across a slimy looking cauliflower. Eventually, I linked it to the wave-washed, white coral pieces along the beach. To this day I retain the clear image of that *Pocillopora verrucosa* colony and its location. It wasn't until the late 1960s that I was introduced to coral reef research through participation in annual University of Natal field trips to the Estação de Biologia Marítima de Inhaca, Mozambique. I volunteered for other university trips too. Camping out nearby I would provide weird and wonderful specimens they sought, as well as fresh fish and spiny lobsters in return for shared meals and great company. This exposure to field-based marine science set the course for my future focus.

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Figure 2. Hut on Mozambique coast with friends Quappy and Thug; Rod (right)

The rest of my summer holidays was spent in a hut I'd built with friends, separated from an elephant reserve by high dunes. I would spend two months there with an assortment of friends or my brothers taking only 22 liters of water, 20 liters of wine, boxes of matches, and as much rice as our money allowed. We traded fish for other supplies at a fishing village 5 kilometers away and lived well. It was here that I learnt to respect currents, deal with frisky sharks, and live off the sea. The self-sufficiency learnt proved invaluable to my work later.

The early '70s were a time of underwater exploration for me across the tropics of the world, both polar areas, the lakes and rivers of Amazonia and many places in between; and a time of learning about ecotourism done well through the superb practices of naturalists aboard the Lindblad Explorer. It was also a time of immense benefit thanks to the disciplined note taking acquired from Sir Peter, and a baseline from which to contemplate change. There was adventure too, including a significant role in two shipwreck rescues.

In 1973, I returned to Mozambique, spending two months alone with a hammock, mosquito net and tarpaulin, to study the Ponta Torres coral reef off Inhaca Island and its management issues and needs. This southernmost framework coral reef off the Mozambique coast allegedly was under threat from tourists. Each day after drawing water from a deep hole to boil and drink later, I laid my quadrat and mapped the reef. When the sun went down, the lights went out, leaving a lot of time to think about the day's observations. In two months, only four tourists visited: a couple bent on romance who were clearly upset to see me and disappeared into the bush and left an hour later; and an elderly couple who sailed over from the mainland for the weekend. They snorkeled once briefly.

The most frequent visitor was a goatherd who came by every 10 days or so to fish while his goats browsed on dune vegetation. At dawn during one of his visits, I was sitting on a tree branch high up the dune behind my tiny campsite to watch the rising sun bring to alive the colors and patterns in the bay before me. The early light accentuated shadows along fingers of sand coaxed by strong southeasterly winds from the dunes towards the reef. These dunes were sparsely topped by trees perched high on spindly roots. Scrambling up and around them were goats bent on feeding.

To my and eventually many others' surprise, these goats were the greatest threat to the reef. The goats had stripped vegetation from the dunes releasing sand that blew into the sea forming a spit which threatened to smother the corals. This observation turned conservation practitioners' heads away from looking just at coral reefs for management issues. Yet it wasn't until many years later that the link between land and sea was fully considered in conservation planning and management. Today, it is common but still not universal practice.

This discovery and publication of the findings (Salm, 1976) launched me on my marine conservation career with WWF and IUCN. This ushered in a remarkable period of discovery, adventure and pioneering work in coastal and marine conservation that at once initiated IUCN and me into marine conservation. But really gratifying was that the newly independent Frelimo government of Mozambique picked up the report and implemented my recommendations as the first field project for their boy and girl scout equivalents. Seven years later, a government team took me there to view their success: the dunes were heavily covered by plants again and the sand spit had been stopped by currents and turned in on itself like a fish hook.

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Figure 3. Tagging walrus in the Chukchi Sea. Photo by Bill Curtsinger courtesy of National Geographic

The early years of research and conservation assessments (1973 into the late 1980s) required living and diving alone in remote areas of Mauritius, India, Sri Lanka, outer islands of the Seychelles, Indonesia, and Oman; and work along the Venezuelan and Pakistan coasts. The conditions were often difficult and some adventures frankly harrowing. But the rewards in marine conservation progress were gratifying. This early work was very physical, so I leapt at the chance to have a different kind of adventure. Carleton Ray, the father of international marine conservation, provided me the opportunity and I joined him as his graduate student. This was absolutely the right decision. My summers were filled with work in the Caribbean Islands, the coasts of central America, and in Alaska, including swimming among ice floes and tagging walrus.

These opportunities posed a problem to one that suffered a pathological addiction to adventure and couldn't say no. To complete field research I would need to get as far away from temptation as possible. Fortunately, a position with the 1978-79 British Joint Services Chagos Expedition and chief scientist Charles Sheppard provided the solution and a most rewarding experience. The 1980s brought work that is the stuff of dreams for conservation scientists. The early half included a mandate to explore the reefs and coasts of Indonesia starting with the most remote. The goal was to identify and get valuable conservation areas decreed as one or another form of protected area. We hired fishing boats wherever we went and slept on fishy planking for nights on end or camped ashore when possible. Piracy was an issue in some parts then: we had our share of adventure confronted by them or confronted as pirates.

The Government of Indonesia had a most enlightened strategy. Accepting that they had negligible experience in marine conservation, the decision was made to get areas established on paper as a bastion against loss to the emerging oil and gas exploration and production industry. Later, management would be implemented for priority sites as the expertise was developed. Lines on maps is certainly the first step in achieving area protection and the Indonesian authorities wanted a lot of them. They got 180 proposed sites from my counterparts and me. Enforcement and effective management of designated sites has been slow in following. Nevertheless, coral communities and fish stocks in these areas are generally better than those in adjacent undesignated places.

In the mid-1980s, an outstanding opportunity arose to study the entire coastline, nearshore seas and islands of the Sultanate of Oman, a country I'd never heard of. I was to explore the entire coastline above and below water using all

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means possible, document what I found, and assess the conservation value and needs of any special places. The output was a series of coastal zone management plans in which marine protected areas were embedded. Oman remains the highlight of our family life for my wife, two daughters and me. And it thrills me still more than 25 years later to hear from visitors there how that early work persists until today, including signage that I'd placed in protected areas.

1990 introduced me to the challenge of mass coral bleaching. The Musandam Peninsula in Oman is a subsiding mountain range with sheltered fjords bounded by rock mountains that radiate intense heat. The sea surface temperatures rose to 35°C. The corals cooked, paled, bleached and died. That was a wake-up call. I returned to Muscat where colleagues at the Marine Science and Fisheries Center told the story of Cat Island on their doorstep: currents faltered, and water temperature rose by a full 10°C to 39°C. Corals bleached immediately. Within two days the water circulation was restored, the temperature normalized, and the corals slowly began to regain their color. Mortality was 2%, compared to 95% up north. I should have noticed a pattern then and there but didn't.

How could marine conservation practitioners manage the impacts caused by something so large and remote from their areas as global warming and mass coral bleaching? Working in East Africa and the western Indian Ocean for IUCN in 1998, I was in a hotspot again and still fretting over a practical response to manage the impacts of heat stress and coral bleaching. In April that year, while helping my eldest daughter with her field project on reefs at Kiwayu island, we noticed bleaching in progress. Interestingly, it was more pronounced on reefs in the clear, cooler waters off the east side of this high island than on the reef fringing the foot of the western side. Here the water was warmer and more turbid. There was a pattern here again. It was so obvious and literally hiding in plain sight, but I missed it again. That 1998 bleaching event caused a tsunami of global concern: scientists rushed to study the death and dying process, and conservation practitioners threw up their hands despairing of what to do about tackling a threat so vast and so well beyond their bailiwick.

In 1999, I joined The Nature Conservancy to build their Asia Pacific Marine Program, travel took me around Indonesia, Solomon Islands, Papua New Guinea, and Palau. Coral bleaching had been patchy in and among these places. Accordingly, I exhorted our field teams to focus on the coral communities that didn't bleach and die, reasoning that if we could understand why these lived, we would have the key to identify those that were well positioned to survive future heat stress and bleaching. If well managed and connected in mutually replenishing networks of conservation areas, these natural refugia would provide larvae essential to the recovery of more susceptible coral communities. *"Designed to survive, managed to last and connected like strings of pearls across the tropics"* became our rallying cry.

When asked what he was doing to address coral bleaching, Andrew Smith, the director of our TNC Palau program summed it up saying that he pretended warming and bleaching didn't exist because he didn't know what to do about them. Together we spent several days visiting different reefs around Palau to have a close look at how coral bleaching had affected the islands – or not. It was clear that some coral communities had bleached, and others had not, that parts of some communities had bleached but not the rest, that deeper corals sometimes bleached more severely than corals in the shallows, even those that were emergent at lowest tides. Once again, patterns were manifesting themselves and awaiting recognition. Eventually, as my eyes slowly adjusted to the deep shade under a rocky overhang in the mushroom shaped Rock Islands, I realized that the same species of table *Acropora* that was alive below my face mask was dead below my fins: the one in deep shade and the other in bright sunlight less than two meters away.

Suddenly all fell into place and embarrassingly so. It wasn't rocket science. Shaded corals had less light stress and avoided bleaching. Indeed, entire coral communities fringing the shores of shaded bays survived bleaching, the high island effect, as in Palau's now well studied Nikko Bay.

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Figure 3. Diverse, healthy corals in Nikko Bay, Palau. These corals were unaffected by the 1998 bleaching event. (Photo by Rod Salm)

Also, there were sites where water jetting through narrow reef passes or between islands caused mixing and cooling of heated water that helped corals avoid bleaching there. Corals that emerged above water at low tides were already conditioned to stress and survived too. And counterintuitively perhaps, nearshore corals in turbid waters rich with plankton and suspended organic material fared better than those in clear water on the barrier reef.

Several things converged to help make sense of it all. In 2000, while delivering training on sea level rise impacts on turtle nesting beaches and mangroves in Komodo National Park, we turned to the challenge of coral bleaching. I tentatively raised the possibility that places where corals were naturally protected from heat and light stress by cooling, shading, screening, and stress hardening created climate change refugia. If protected, such places provided opportunities for corals to survive global warming. I made my

case, but not before noticing that Peter Mous, one of TNC's finest marine scientists, took off and didn't return for quite some time. Oh well, I thought, that idea went over like a heavy weight belt.

Peter returned to announce that he had been on the satellite phone with Terry Done sharing the idea and committing me to submit an abstract for the 2000 International Coral Reef Symposium in Bali. The deadline for abstract submissions was past, but the subject was a hot topic, so to speak, Peter was persuasive, and Terry was encouraging. I had until the next day to draft and submit the abstract.

It was done, accepted, and I was at once both committed and terrified. With great trepidation, I stood to present what seemed like such simplistic, obvious ideas to an august group of leading coral reef scientists at the Bali ICRS. The timing was perfect. Folks wanted solutions. These first, simple ideas provided some, even though based only on observations. Corroboration by hard science was yet to come.

Billy Causey, Superintendent of the Florida Keys National Marine Sanctuary commented immediately, saying that the ideas explained an enigma: he had observed how corals along what he called the 18-foot break survived the nearly annual bleaching in the sanctuary, while those in the "gin clear" waters of the outer barrier reef suffered. Until this point he hadn't been able to interpret why. A couple of years later, Billy took me there and we noticed deep color and absence of disease in corals, and numerous recruits on this inshore reef. The coral community on this reef was screened from intense irradiation by suspended organic material and plankton, and was thriving: a resilient refuge among others stressed by heat stress and succumbing to bleaching.

Next, Steve Coles of the Bernice P. Bishop Museum, who with Paul Jokiel had published the results of their research on the role of heat and light in coral bleaching, stood up and endorsed the ideas and offered to help develop them further. Now we required the means to do this. Then Gilly Llewelyn, at the time with WWF, provided catalytic funds to take things forward. In 2001, Gilly, Steve and I convened the "Beach House Meeting" in Hawaii. Included were such leaders of the day in coral reef science and conservation as Billy Causey, Peter Glynn, Paul Jokiel, Terry Done, and Jamie Oliver to provide the cachet of credibility to the outcome. Anticipating long term career opportunities in the discipline, potential leaders of tomorrow were invited too to provide continuity, including David Obura, Jordan West, Will Heyman, and Athline Clark who also facilitated the sessions.

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The meeting achieved its objectives, but follow-up would be critical to give legs to the concept of natural climate change refugia and resilience principles. These needed to be adopted and implemented widely across the tropics. There are lessons here for those concerned with the application of their research. There were five pieces to the outreach strategy: 1) get support early from key leaders within the host organization (TNC in my case) to achieve adoption and enable application of the concept; 2) collate the science and produce a toolkit to get it into the hands of scientists and conservation practitioners, and provide training in its use; 3) develop simple, practical steps for application of the concept together with an early adopter to demonstrate the feasibility of the process to others and catalyze broader adoption; 4) inspire interest among scientists and practitioners to help refine and develop resilience concepts and application mechanisms and handover complete ownership to them of pieces they want; and 5) engage experts in government relations working in high level forums to influence global policies and generate commitments to develop resilient MPA networks.

Professional colleagues credit me as the person who first developed practical resilience principles for coral reef management to address climate change, heat stress and coral bleaching. Yes, I and my direct field observations may have prompted the conversation. But in truth, it is the many discussions, debates and arguments around a concept and its implementation that contribute to development of a good idea that can influence the direction of conservation action. In 2003, the Reef Resilience CD-ROM toolkit was launched at the Durban World Parks Congress. After handing the toolkit on to others to take forward, it has been expanded and improved upon as an online version (<http://www.reefresilience.org/>), and used to provide online and personal training to planners and managers in 75% of the 103 countries with coral reefs.

The Republic of Palau was the first nation to adopt and implement the resilience principles to establish a nationwide protected areas network that was resilient to climate change. This provided a working example that was leveraged across the Micronesia Challenge and the Coral Triangle Initiative where climate change resilience and MPA networks are integrated into their action plans. Many leaders in resilience science and applications have emerged. Their many shoulders are better able to carry the load than few. This released us in TNC to focus on integrating the emerging and cutting-edge science into refinement of the resilience principles for implementation at sites, in countries, and in policy forums.

TNC's committed government relations staff worked effectively with their many partners to incorporate resilience principles, particularly the concept of marine protected area networks, into the language of such international instruments and related action plans as the World Summit on Sustainable Development, World Parks Congresses, Conferences of the Parties of the United Nations Framework Convention on Climate Change, among others.

I was happy to provide support to these initiatives but devoted most of my time to getting out to remote areas and working with local partners and staff. It was more fun: I was underwater, had sand between my toes, great conversations, even better stories, hours to listen and learn, and the opportunity to interpret complex science and make it relevant and applicable in different local contexts.

I learnt from this that sharing ideas freely and openly provides greater value and wider adoption and implementation, which after all is, or should be, the principal goal and ultimate measure of success for any field-based conservation scientist. As we progress in our careers, we need to hand on our ideas and ownership of initiatives unconditionally to younger people to carry forward, and celebrate the change happening through their endeavors. There is value in being an enabler, nurturing creativity, cultivating wonder, and getting out of the way.

Slowly I handed over development and stewardship of innovative science and management strategies for coral reefs and species to others. This released me to play a stronger role in the field training and mentoring of conservation scientists from many countries, assisting them with field applications of science to conservation practice and with their career development. A career that had strong grounding in field science and applications in multicultural contexts and widely differing capacities, and with governance structures at local, national, regional, and global levels provided the grounding for this task. This experience established my commitment to develop science protocols that are designed to meet local needs and abilities, are intuitive, and more likely to be adopted, applied, and interpreted

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by local scientists and communities, even if they fall short of requirements for publication in peer-reviewed journals. In this context, I developed methods and measures for citizen scientists to assess coral reef resilience as a contribution to local conservation efforts. Citizen science has been around for many years, decades even. It is here that I found my calling and gratification over the last seven or so years of my fulltime working life. It took me full circle back to my naturalist beginnings and that big picture approach. It reinforced the value of observational science, of eyes in the water looking for patterns and formulating ideas that otherwise might be overlooked, and of knowing when to pull in the big guns to do the hard science needed to hone those ideas.



Figure 4. A sample of resilience indicators used with citizen scientists: broad size range of table *Acropora* corals, deep coral color, high cover and diversity (left); seamless growth plane reorientation in toppled or overturned coral colonies – in this case a huge table *Acropora* was shaken off its pedestal on the lava flow at Gunung Api, Banda Islands, Indonesia (center); strong hard coral recruitment, both in terms of numbers and diversity. (photos by Rod Salm)

Another key consideration for conservation scientists is understanding the governance framework in which conservation happens, or not. This too requires exposure at multiple levels from local to national to global, and the layers in between. These contacts are crucial to giving relevance to our work. Understanding the governance structures helps us communicate with key decision makers and facilitates adoption and implementation of our observations, science, and proposals.

Over the decades of my career, progress in coral reef resilience science and applications and high-level commitments to marine conservation have been very uplifting. Things that are going well include establishment of large, multi-objective/multiple-use MPAs and the emphasis of effective management that is integrated across land and sea. Equally valuable is engagement of communities significantly in planning, monitoring and management of MPAs, some of which may be small sites nested and networked in larger management frameworks. As the field gets increasingly crowded, and people become more specialized, team work has developed leading to partnerships among organizations, agencies and disciplines, which can make the outcomes stronger. Climate change is now widely embraced as a force with which to reckon and is changing the focus of much coastal and marine conservation. It has given value to green infrastructure as an acceptable, even preferred, investment to protect coastlines. And coral reef resilience has seen great advancement leading to refinement of the principles and their application to both ecosystems and people.

However, equally inspiring to me has been the changing attitudes and advancing skills to do work on coral reefs in so many countries. For example, when I first went to help the governments start their marine conservation programs, there were seldom national experts to work with me. Sometimes, I had to work alone. If assigned counterparts, I occasionally first had to teach them to snorkel and then scuba dive before initiating them in field work. It's very different today. Counterparts come with degrees or post-graduate degrees in marine science, are skilled divers and consummate field workers. They love and understand the importance of their work, work hard, and have fun. They will be the ones to lead change over the next decades, which is uplifting and cause for hope.

Over the past two and a half decades, I dedicated myself to building leadership in IUCN's, The Nature Conservancy's,

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and their partners' tropical marine programs, believing strongly that building the leaders of tomorrow is vitally important. I've consistently put up younger researchers and practitioners as the faces of the work I led, advised, and directed; and stepped aside to celebrate their career advancement and the accolades they earn. It has been immensely rewarding to guide career development of numerous individuals facing pivotal choices of direction through both informal and formal mentoring and participation on post graduate degree committees. Although now removed from this in my day to day activities, I continue building the leadership of tomorrow and achieve this facilitated by advisory roles in the Pew Marine Fellows Program, as a Linked-In mentor, and as Adviser Emeritus for The Nature Conservancy's Pacific Division Marine Program.

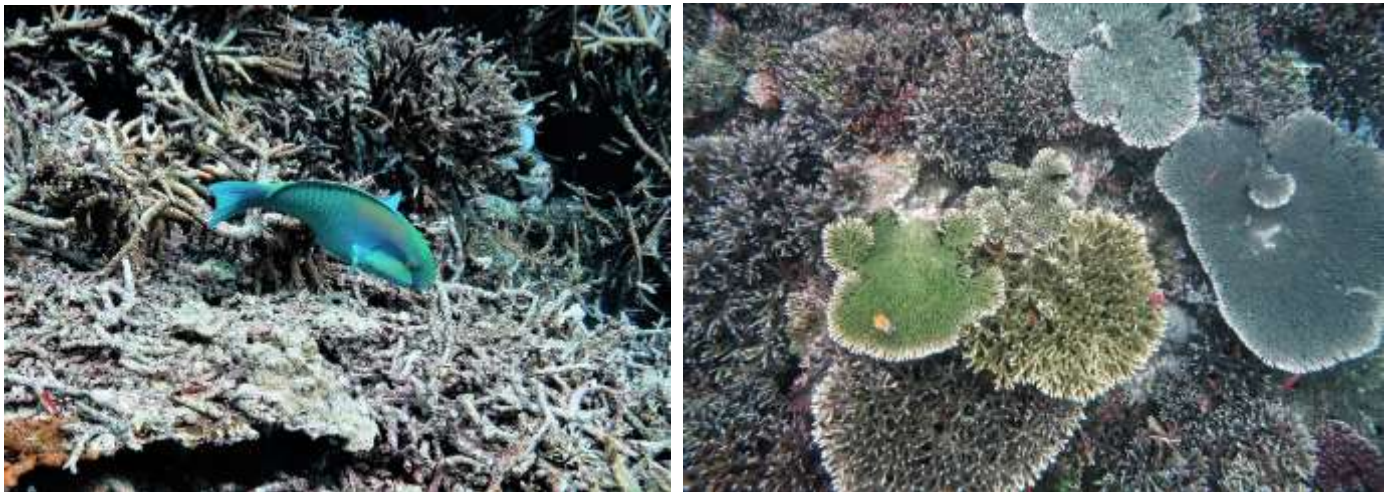


Figure 6. Parrotfishes contribute to reef recovery by grazing down algae and preparing the substrate for coral recruitment (left); high cover by diverse *Acropora* corals, which are highly susceptible to a variety of stresses, is a good indicator of resilience (right).

Currently, as time permits and inclination prompts, I slowly enter my coral reef observations and scientific data from the late 1960s to the present into Google Earth. General descriptions are accompanied by interpretations of coral community resilience potential and conservation actions wherever possible. This endeavor is undertaken to meet the many requests for original observations at sites where conservation activities or research are being initiated and to make the information freely accessible to all who may find it useful. It is about sharing information and enabling others to establish a baseline where one otherwise might not exist.

Finally, here are some nuggets I'd like to share with younger and mid-career coral reef conservation scientists and practitioners to help them better interpret what they are seeing and make their science more applicable. Seize every opportunity to get into the field, spend as much time as possible in the water over reefs, and work with local practitioners in a variety of contexts. It will impress on you how much science is enough and how much is too much to be absorbed and implemented by communities at the coalface of conservation. Broaden your experience, travel, get exposure because things are not always what they seem; listen, learn, adapt. Also, be independent and unbiased by current "wisdom;" be bold, don't fear failure, and look hard to find what is happening before designing your methods to prove it. Sometimes simple explanations are there in plain sight waiting to be found; even in their formative stages they are valuable and can catalyze action. Nothing can be too trivial or simplistic if it is all that exists. And most of all, be curious and observant always.

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Remembering RN Ginsburg: From Geology of Tropical Marine Environments through the Centennial Celebration of the Carnegie Laboratory (1973-2005).

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Figure 1. Robert Nathan Ginsburg

I first crossed paths with Bob Ginsburg² in the summer of 1973 when I saw a prospectus about a month-long course on “The Geology of Tropical Marine Environments.” Bob and several other eminent marine geologists at the Comparative Sedimentology Laboratory led the class. Fortunately, I was successful in finding support from my employer to cover my expenses. The Comparative Sedimentology Laboratory was the old quarantine station on Fisher Island, Government Cut, Miami. It was semi-isolated by the ship channel; they had a pontoon ferry to shuttle folks back and forth. During the course, I lived for a week with my former University of Miami mentor and eminent plant ecologist, Dr. Taylor Alexander. For the later portion of the course, I stayed in the Baltic Hotel (Bob knew the owner and they cut us a deal) with others in the class for \$5.00 per night. It was a run-down 1920s mausoleum mostly occupied by elderly Jewish folks who had escaped the Holocaust. At this point, South Beach was full of old hotels, little delicatessens, and thrift emporiums; the jet set had yet to discover it. Yiddish was the street lingo; close your eyes, and you could think you were in Warsaw, except for the heat.

The faculty included Bob, Noel James, Don Marszalek, and Don Moore. About 20 people were enrolled. Bob ran the show; the program alternated between classroom lectures, laboratory exercises (sorting sediments, interpreting cores, identifying organisms and parts of organisms), and going off into the field to see it all first hand. We examined mangroves, seagrass beds, and coral reefs, starting at Cape Florida, then on to Matheson’s Hammock, Solider Key, Tavernier, North Key Largo, Flamingo, Everglades, and Florida Bay. Bob had arranged to operate out of the Ocean Reef Club in North Key Largo for the reef component. We focused on shallow-water patch reefs off Old Rhodes Key; these became our study reefs (Corsair and Donner). The fieldwork was with snorkel (no scuba). To protect the students from the intense sunshine, Bob secured a batch of WWII surplus suntan protective ointment that was typically issued to ski troops. It was vintage, hard as plaster of Paris. You placed a can on the deck for an hour in the sun, and it was like cream cheese; the European students ended up with severe sunburn. I also had an opportunity

² We also include a short formal obituary in the REEF DEPARTURES Section.

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to fly in a small airplane to observe and photograph the reefs, which was a good way to better understand the big picture. Because my undergraduate university experience included a class in paleontology, I had some knowledge; however, the course provided good expansion in learning the ways that sediments are a trove of information on environmental history and change. The coring exercises were often challenging and required muscle and flexibility.



Figure 2. RN Gisburg: masterminding and enthusing a field course.

The first two weeks were spent alternating between classroom and field observations; the second two weeks were devoted to independent research projects; we set about resolving a question or hypothesis. I teamed with Gerold Wefer, a German student; we hit it off because I was stationed in Germany when in the Army. We studied *Porites astreoides* (mustard hill coral); examined growth forms, distribution, and abundance on the study reefs, and tried to determine if it was common in the Pleistocene. Our work included coral demographics from the fieldwork and examining fossil limestone structures from the Key Largo Limestone to see if we could identify *P. astreoides* in the fossil record. One of the limestone structures we looked at was the Coral Gables City Hall. Shoppers would walk on by on Miracle Mile and wonder what in the world these peculiar folks were doing! We used magnifying glasses to examine the rock walls, and photographed and sketched interesting fossils. Another interesting aspect was dark room technology; we learned how to process 35 mm film.

As my friend and colleague Gene Shinn has noted elsewhere, Bob had more questions than answers; his game was to get you to think beyond the norms to find new insights. His method was often a bit confusing, but after a while you came to find value in it. The class was very interesting and opened my mind to try to understand how the reef system was formed, sea level changed, and how we find answers to challenging questions. It was stimulating and a great experience. Bob had that special knack of stimulating discussion and looking at things in a different view. By the way, we did validate that *Porites astreoides* was indeed a common coral in the Pleistocene, Key Largo Limestone. In hindsight, the experience of this course provided me with important tools that I used throughout my career.

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The next nexus with Bob was the Third International Coral Reef Symposium (ICRS) held on the campus of the University of Miami in June 1977 (the 1st ICRS was held in Madpam Camp, India, in 1964, and the 2nd ICRS was aboard the cruise ship *Marco Polo* on the Great Barrier Reef off the east Coast of Australia in 1973). Bob was the chairman of the 3rd ICRS; his collaborators on the organizing committee included DL Taylor, IG Macintyre, FR Fosberg, EA Shinn, and JI Tracy. The growth of coral reef science in the 1960s and 70s is exemplified by the number of papers published in these symposia: 1st ICRS: 37, 2nd: 113, and 3rd: 180. A goal of the 3rd ICRS was to contrast the differences and similarities of Atlantic reefs with those of the Indian and Pacific Oceans, including the Red Sea. One of the products of this symposium was a collection of field guides of Atlantic-Caribbean reefs; they were used during field trips pre- and post-symposium. Bob organized and planned the symposium to perfection; his thumbprint can be seen in the organization, the multiple field trips (Field Trips were a trademark of a Ginsburg workshop or symposium), and his dictate that to present a paper at the 3rd ICRS, you were required to submit a manuscript in advance of the meeting; no manuscript, no presentation. By doing this, the proceedings were handed out at the registration desk in advance of the symposium. There was a good bit of grumbling, but it was beneficial to have the proceedings in hand during the meeting. This was my first exposure to the ICRS, and it was eye-opening; there was much to learn and comprehend. Concurrent sessions were frustrating; venues were spread over the campus; it took time to go from one venue to the next, often in the rain; synchronization was a bit ragged, and, if a presentation was cancelled, tough. By this time in the late 70s, there were early signs that reefs and corals were suffering. Although the picture was a bit muddled, the decline in reef vitality was coming into focus, and this symposium was a signpost to a downward trend.

Bob created the Atlantic Reef Committee (ARC) during the 3rd ICRS to find alternative sources of funds to support research projects and education. He succeeded in finding money from corporations like Bacardi Rum and Carnival Cruise Line. By now, Bob was devoting considerable energy and time to coral reef science and management. Some coral reef conservation efforts began to take effect locally. The State of Florida, realizing that coral collection was not a good thing, enacted statutes to ban coral collecting and the use of certain fish collecting chemicals on reefs; it also purchased a large tract of land north of John Pennekamp Coral Reef State Park. The federal government agencies were taking more interest in reefs, especially after the U. S. Supreme Court ruled in a landmark decision that the Continental Shelf Act could not be used to protect natural resources, such as coral reefs. Following this decision, any reef outside state jurisdiction was unprotected. Thus, we saw the start of initiatives by NOAA's Sanctuaries Program and the Fisheries Management Councils to establish marine sanctuaries and Habitat Areas of Particular Concern to protect reefs.

In 1984, Bob proposed that ARC host the annual meeting of the International Society for Reef Studies at the University of Miami. This was one year before the 5th ICRS in Tahiti. Bob used this opportunity to attract promising students to give papers, exchange ideas, and meet established researchers. The meeting was very successful in the quantity and quality of abstracts. As a member of the organizing committee, I participated with Bob purchasing coffee and snacks for the two-day event. Bob was a frugal shopper. He always found the on-sale products and made sure the budget stayed in the black. I learned about hosting meetings, multitasking, and a multitude of other necessary crowd pleasers, as well as advancements of science, since Bob also gave me an opportunity to help organize and be a session chair that was beneficial to my career.

In 1993, the University of Miami celebrated the 50th anniversary of the founding of their marine lab, which, interestingly enough, was originally located in Coral Gables and not on the water. The marine lab was in the "Anastasia" Building, an old hotel the university acquired and used for laboratories, and the lab was founded in 1943.

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The University of Miami built the first marine lab on Virginia Key in 1953. A significant gift enabled the building of new and improved laboratories and infrastructure on Virginia Key in 1965; the benefactor family was honored by having the facility named the Rosenstiel School of Marine and Atmospheric Science (RSMAS). To celebrate the anniversary, a Colloquium on Global Aspects of Coral Reefs: Health, Hazards, and History was held June 10th and 11th, 1993, at RSMAS. Bob was the principal organizer along with J Bohnsack, A Myrberg Jr, PW Glynn, A Szmant, and PK Swart. The meeting honored the pioneering work of the marine lab founders: FGW Smith, G Voss, and others. The format was unorthodox, ala Ginsburg tendencies to do things in a different way. Summaries about reef health were published in advance of the meeting; during the two day conference, there were nine Plenary talks, each followed by lengthy group discussions. Conclusions were reached that reefs were in trouble from many causes, and the proceedings included papers documenting a variety of reef difficulties. We contributed the story of the decline of *Acropora palmata* at Dry Tortugas since 1878 (we used a paper published originally by Alexander Agassiz in 1881 as the baseline). The abundant elkhorn coral was estimated to cover 44 hectares by Agassiz in 1881 but had declined to less than 1,400 m² by 1993. I was unable to attend the Colloquium because of a new project commitment; however, Bob phoned me and demanded the story on the Tortugas elkhorn. He was a great persuader!

Bob was very respectful of the early marine research that went on in Florida, especially the pioneering work of TW Vaughn (he named the Comp Sed Lab after him) and his many discoveries on Florida geology and the coral reef system. The Florida reef science community was in awe of Alfred G Mayer(or) and the many scientific contributions he made, especially as the founder and director of the Carnegie Laboratory on Loggerhead Key, Dry Tortugas.



Figure 3. R.N. Ginsburg, June 2005, Loggerhead Key, explaining beach rock diagenesis (left), and pointing out details of beach rock diagenesis in an electron microscope image of sand grains, to field trip participants, Centennial Celebration of the founding of the Carnegie Laboratory.

We all agreed on the importance of a special event to commemorate the 100th anniversary of the Carnegie Marine Lab (in 2005), for which Mayer received a grant in 1903 and which was built on Loggerhead Key in 1905. Bob convened the interested parties, assigned the work, found seed money, and marketed to find sponsors and interesting dignitaries. It was a fun gathering. Bob and I came up with special scholarships for students to attend; students submitted short essays on their research goals and how attendance at the meeting would benefit their research. The top ten received a stipend to cover registration and room and board. The meeting was convened in Key West, and we chartered boats to transport the group to Dry Tortugas to see and feel the place. Bob was in fine form leading the field trip up the beach at Loggerhead Key to explain beach rock formation (Figures 1 and 2).

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Participants included Archer Mayor, grandson of Alfred G. Mayor; he had family memories to share with the group. The only remains of the Carnegie Lab are the salt-water tank foundations that Mayor used for his thermal tolerance studies. The Mayor Memorial marker sits in the middle of Loggerhead Key and was visited by the group; it reads:

“ALFRED GOLDSBOROUGH MAYOR WHO STUDIED THE BIOLOGY OF MANY SEAS AND HERE FOUNDED A LABORATORY FOR RESEARCH FOR THE CARNEGIE INSTITUTION DIRECTING IT FOR XVIII YEARS WITH CONSPICUOUS SUCCESS BRILLIANT VERSATILITY COURAGEOUS UTTERLY FORGETFUL OF SELF HE WAS THE BELOVED LEADER OF ALL THOSE WHO WORKED WITH HIM AND WHO ERECT THIS TO HIS MEMORY BORN MDCCCLXVIII DIED MCMXXII”

Alfred Goldsborough Mayor was born April 16, 1868, at his mother's father's home; "Sunnyside," near Frederick, Md., son of Dr. Alfred Marshall Mayer, professor of physics at Lehigh University and Katherine Duckett Goldsborough. He died of tuberculosis. Despite a warning that it might be fatal, he returned to Dry Tortugas in 1922 and died June 24th while bathing on the beach at Loggerhead Key.

“Dr. Asa Schaeffer was with him at the Tortugas on that last day (24 June), writes: As I think of Mayor's great and absorbing devotion to marine biology, his childlike love of the sea, his passion to get away from the conventional, that peculiar ingredient of weirdness in his personality, but particularly the loving care with which he looked after every detail of the laboratory at Tortugas, even to planting the laboratory grounds with Coconut palms, Australian pines, the beautiful scarlet Hibiscus and the delicate Spider Lilies-as these things pass through my mind I cannot help but feel that there was a certain appropriateness in his saying his last farewell on the shores of beautiful Tortugas.”

The above quote is from:

BIOGRAPHICAL MEMOIR ALFRED GOLDSBOROUGH MAYOR 1868 -1922 BY CHARLES B. DAVENPORT 1927.
Proceedings of the National Academy of Sciences 22(8), 13 pp.

DURING THE SPECIAL COMMEMORATIVE EVENT, Bob arranged to use the “Little Theater” in downtown Key West for evening lectures that were open to the public. The two evening events were well attended, and it was great to have local citizens participate. The best part of the program was the gathering of many researchers from far and nearby who had worked and collaborated with Bob over the decades. This brought so many of us together, to share time, to talk about the good old days, and to enjoy some food and drink. As Bob would reflect on occasion, “It was a halcyon time and we were so blessed to be there.” The meeting’s legacy is a publication: *Field Guide to the Major Organisms and Processes Building Reefs and Islands of the Dry Tortugas: The Carnegie Dry Tortugas Laboratory Centennial Celebration (1905-2005)*. The guidebook (available as a PDF file through researchgate) has high quality historical photos of the laboratory, vessels, old-time dive gear, early underwater photos, and scientists working. Many people scoured the archives to locate these. Habitat maps in the guidebook include Agassiz’s map.

Robert Nathan Ginsburg inspired and mentored many; his legacy lives on through many publications and findings, great memories, and multiple organizations and programs that he had a hand in creating and nurturing. It was a pleasure and honor to work with Bob; he gave much to many! Thank you.

The Sea is Giving Birth!

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Figure 1. The author and Squeezezy (*Epinephelus itajara*). Photo: Juan Camilo Zárate.

In the Rosario Archipelago, on the Caribbean coast of Colombia, the island elders say that, every once in a while, “the sea gives birth”. Bundles of little white dots float towards the sea surface. No one has seen fish giving birth, but fishers suggest that these are fish eggs, because sometimes they also find them inside the bodies of fish they have caught. None of the islanders can imagine that corals, like fish, can also give birth.

It is the time of the August Full Moon. At the *Centro de Investigación, Educación y Recreación* (CEINER) laboratory, on the Isla de San Martín de Pajares, researchers took fragments of *Acropora cervicornis*. An abundance of some sort of white seed (unobserved during the previous three years) dissipates all doubts; the corals in the coral nurseries are about to spawn. So, beginning the second night after the Full Moon, the researchers install traps, hoping to collect the eggs to be released from the various colonies and morphotypes.

That night the researchers did not find eggs, but the next morning they learned, through the Coral Spawning Research Group, that corals of the same kind had spawned in nearby Curaçao. So, the next night the traps were set out again and this time collected eggs from one colony. This signal, together with news of spawning in other places in the Caribbean, announced “the big night”. At 11 o’clock at night a fisher sets out for fishing. It is the fifth night after the Full Moon, and the winds are quiet. He knows it is a good time for a night of fishing. He did not know what it means to the scientists, but he knows that the sea was giving birth. He barely saw the white dots on the surface of the ocean. In any case, fishing with a nylon line is an art, of feeling the weights - the weight of the anchor at the bottom of the sea, the weight of the nylon together with the stone and the hook, and the weight of the fish taking the hook. The night was good. When he returned back home he had fish.

Back at the lab, after the excitement of the mass spawning, the scientists were being overcome by tiredness. The slightest mistake in checking for temperature changes in the medium of the embryos, and all of them could die. The

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researchers tried to save them all, but soon the embryos began to look “off” to the naked eye, and to smell bad. Under the microscope the scientists witnessed how the cells had collapsed. But from amongst thousands of bundles of embryos in the sea, the researchers had collected but a few. The remainder could place their faith in an ocean of variable temperatures. The corals might not lose anything, whereas the scientists had lost a chance to witness embryogenesis. All that is now left is the memory of a night when the sea gave birth. For another chance to see such an event these researchers must wait for at least a year, and likely much longer, for the synchronicities of their own personal lives to coincide with the corals. Still, the scene had been breathtaking. Even sick corals had spawned, releasing gametes through their expanded polyps. Houndfish, sardines, and dolphins, all seemed to celebrate under the starry skies. But the feast was extremely fragile. The night of the spawning, the researchers counted first, second, third, and thirty-sixth cleavages, but the day after, all the embryos died.

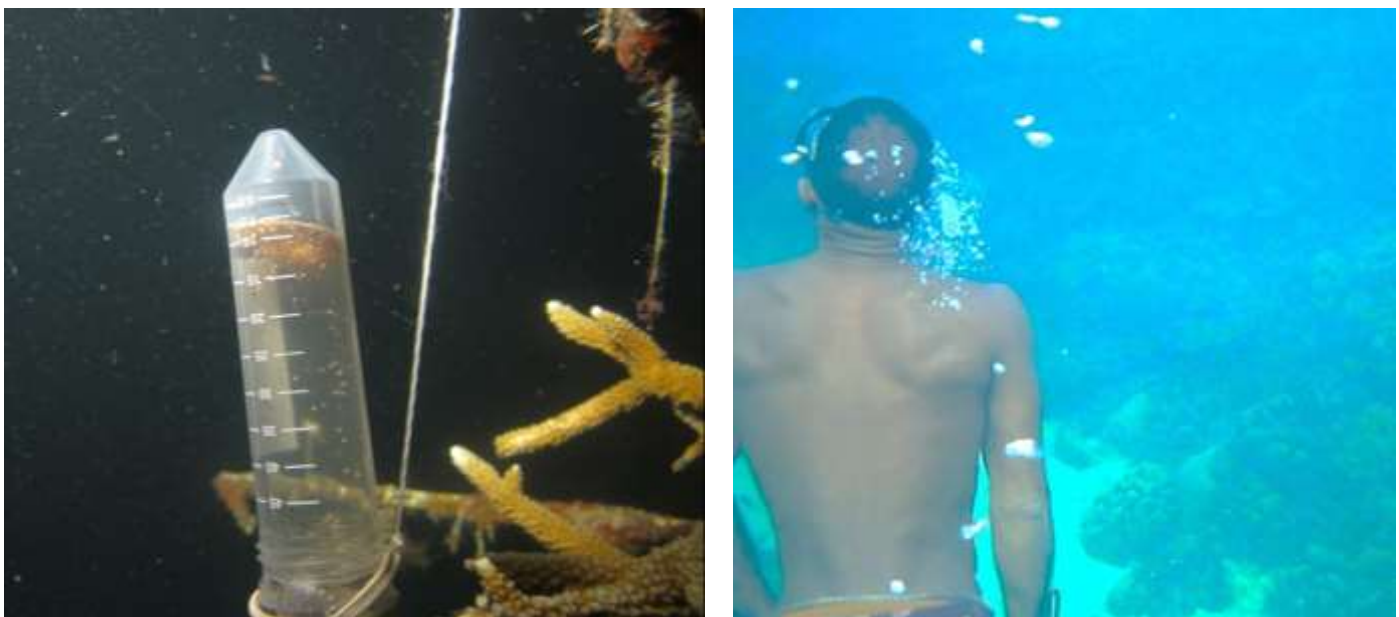


Figure 2. (left) Results of coral spawning at the CEINER lab nurseries. photo Denise Klinkenbuß; (right) local reefs and fisher.

Back at the Laboratory however, in another tank, the last *mero* fishes (*Epinephelus itajara*) from the archipelago remain alive. The fishers believe that they are the last ones not because they are the only ones, but because in the words of the fishers “the *meros* have moved away.” They think they have moved to deeper and more remote reefs, where neither fishers nor scientists can reach them. But at the end of the spawning season, there were no *mero* eggs. The oldest *meros* had died the year before, from a disease, while the younger adults had not produced either eggs or semen when the researchers tested them, from May to July. Some fishers think that sometime in October a *mero* will come and place its eggs in the mangroves, before escaping back to its refuge. Perhaps then a lucky fisher will catch it, and together with the *mero*, become another entry in the list of “the last ones”.

Early in the morning a young islander goes to work. He does not fish as his parents used to. He is now a “subaquatic guide”, trained to name species and be aware of their importance in a reef ecosystem. But when the youth stop fishing, so the last fishers die, and their memories that the *meros* evoked will be lost. Then, if the *meros* in captivity die, scientists will have only the name of *Epinephelus itajara* to transmit. The memory of *meros* fishing together with fisher islanders will be lost. But that night, against all odds, one coral colony with white band disease produced abundant spawn. The night when corals spawn leads to uncertain futures: the continuity in time of the corals themselves, of the islands and the islanders, of refuges for *meros*, of spots for fishing, of snorkeling trails, and of scientific research. Today the corals are themselves the nurseries of these and unnamed futures.



GRADUATE FELLOWSHIP REPORTS

Improving Coral Climate Resilience via Interspecific Hybridization: Calcification Responses of *Acropora* Hybrid and Purebred Corals

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Introduction

Coral reefs worldwide are experiencing unprecedented changes in their environments and are being lost at an alarming rate. Investigating new and innovative methods that may facilitate reef restoration is thus becoming increasingly important. This PhD project investigates the value of interspecific hybridization as a tool to develop coral stock with enhanced climate resilience. Hybridization can increase genetic variation, break genetic correlations that constrain evolvability of parental lineages, and assist species to acquire adaptive traits (Hoffmann and Sgrò 2011; Becker et al. 2013; Carlson et al. 2014; Hamilton and Miller 2015; van Oppen et al. 2015; Meier et al. 2017). Hybridization is an important and widely applied concept in agriculture. Since the late 1990s, more than 65% of maize, sorghum and sunflower productions worldwide have been hybrid-based (Duvick 1999). The benefit of hybridization is evident from the massive increase in yields over the past 60-70 years following the introduction of hybrid crops (Lippman and Zamir 2007). Further, numerous field and laboratory studies have shown the value of hybridization for adaptation in the wild. For example, natural interspecific hybridization in Darwin's finches has provided most of the genetic variance in morphology for adapting to changing conditions (Grant and Grant 2010).

In this project, colonies of *Acropora* spp. from the Great Barrier Reef are experimentally crossed to create F1 (i.e. first generation) interspecific hybrids, and the fitness of purebred and hybrid corals are then examined under ambient and elevated temperature and $p\text{CO}_2$ conditions. *Acropora* spp. were chosen as they are among the most important reef builders in the Indo-Pacific, yet are also known to be vulnerable to environmental changes (Marshall and Baird 2000). We investigate: 1) is inter-specific hybridization possible between *Acropora* spp.? 2) do *Acropora* purebreds and hybrids differ in biological fitness, and 3) do *Acropora* purebreds and hybrids differ in their microbial communities. Funding support from ISRS focuses on the question of whether hybrid and purebred corals differ in their calcification responses under ambient and elevated temperature and $p\text{CO}_2$ conditions. Coral recruits maintained under high $p\text{CO}_2$ conditions have been shown to have reduced mineral deposition and increased skeletal deformity and porosity (Foster et al. 2016).

Experimental design

Adult parental corals were collected from Trunk Reef, central Great Barrier Reef, in November 2015, and crossed to form 1) an *Acropora tenuis* x *Acropora loripes* cross, and 2) an *Acropora sarmentosa* x *Acropora florida* cross. Hybrid and purebred recruits were allowed to settle onto ceramic plugs, then randomly distributed and reared under ambient

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conditions (i.e. 27°C and 415 ppm $p\text{CO}_2$) or elevated conditions (ambient +1 °C and 685 ppm $p\text{CO}_2$) for seven months ($n = 12$ tanks per treatment, and $n = 20$ plugs per offspring group per tank) (Figure 1). Fitness comparisons between hybrid and purebred offspring groups were reported and higher survival and larger size were found in some hybrids (Chan et al. 2018) (Figure 2). At the end of the seven-month experiment, five samples of each hybrid and purebred offspring groups were randomly selected for each treatment (Figure 3). Inorganic material in the recruits was removed by immersing them in ~5 % sodium hypochlorite, and rinsed in deionized water for three times, before being sent to the Centre for Microscopy, Characterization and Analysis (CMCA) of the University of Western Australia for 3D X-ray microscopy (Figure 4).

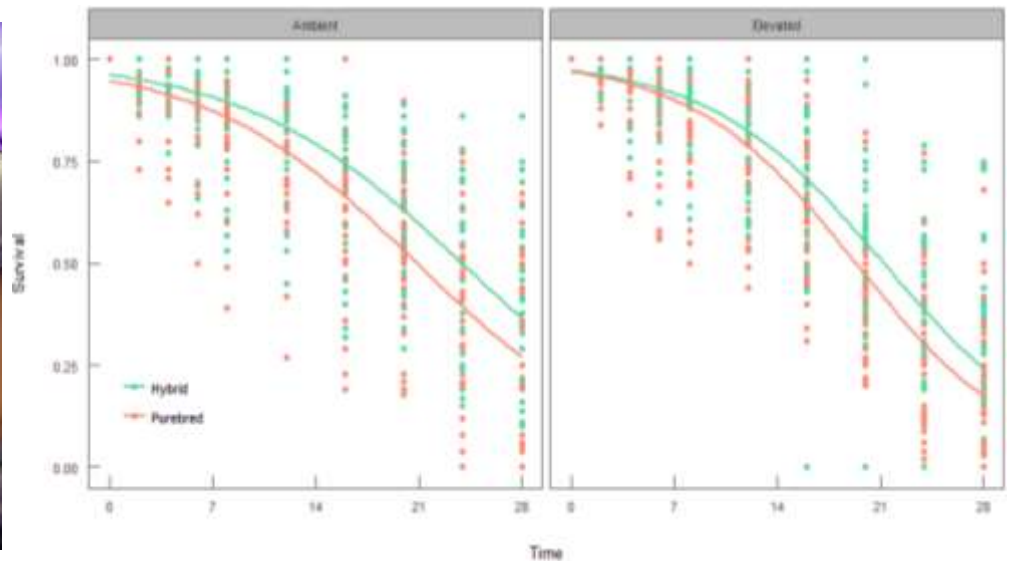


Figure 1 (left). Organizing hybrid and purebred recruits into different treatment conditions. Photo credit K. Green. **Figure 2** (right). Overall survival of the *Acropora* purebreds vs. hybrids under ambient and elevated conditions in the 28-week experiment (Chan et al. 2018).

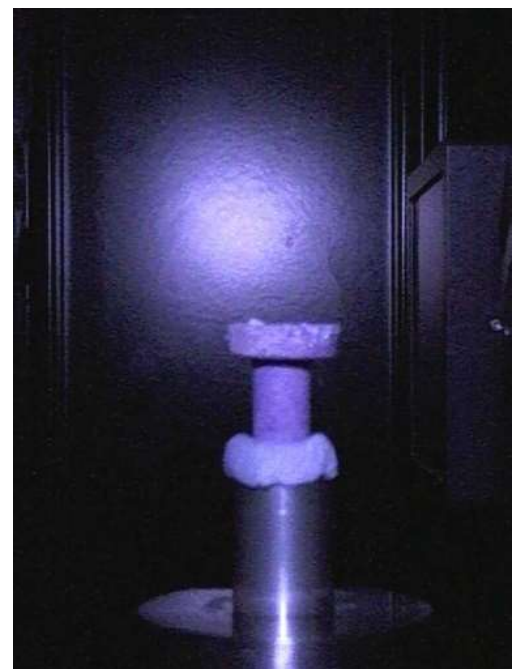
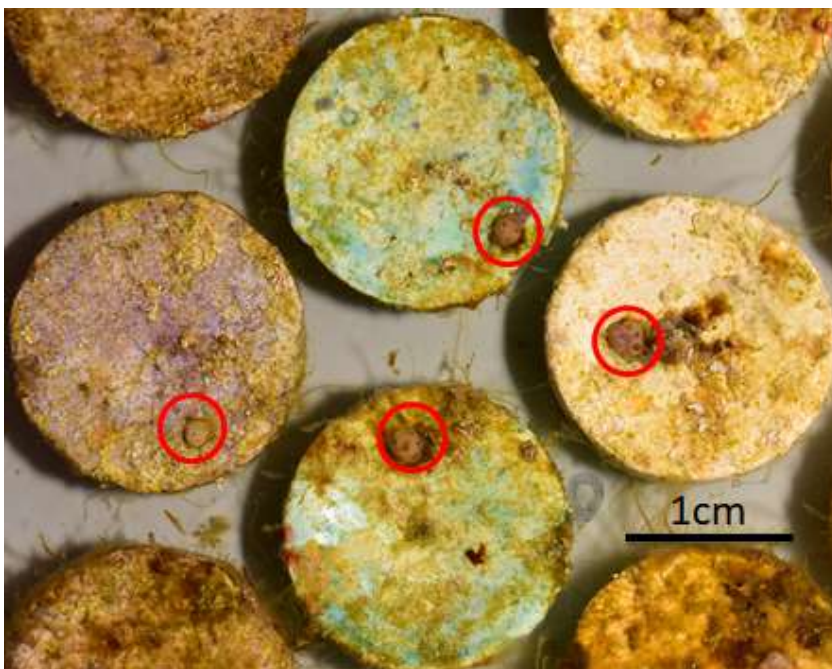


Figure 3 (left). Examples of seven months old recruits collected for 3D X-ray microscopy. **Figure 4** (right). A coral recruit being scanned at CMCA, University of Western Australia.

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The component supported by ISRS involved measurements of coral basal plate thickness, corallite wall thickness, surface area to volume ratio, the presence/absence of fractures and deformity, and diameter and maximum height of the recruits using 3D X-ray microscopy. These parameters are proxies for testing the calcification response of the recruits under ambient and mid-century condition.

Challenges

A slight curvature in the ceramic plugs on which the recruits settled caused some interference in the scans (Figure 4). The curvature blocked the light from reaching parts of the recruit, resulting in an incomplete reconstruction. After many trials, we managed to remove the coral sample from the plug using a drop of agar. Being a low-density material, the agar does not interfere with the scans and we have successfully constructed 3D models of recruits set in agar (Figure 5). In addition, the agar method allowed the scanning of several recruits that are stacked vertically, in contrast to the previous method, that only allow the scanning of a single recruit; the new method significantly reduces the amount of time needed to complete the scanning step. The remaining coral samples will be scanned with the new method in the coming months. After the scans, Software Avizo Fire will be used to process the reconstruction and obtain quantitative data following Foster et al. (2016).

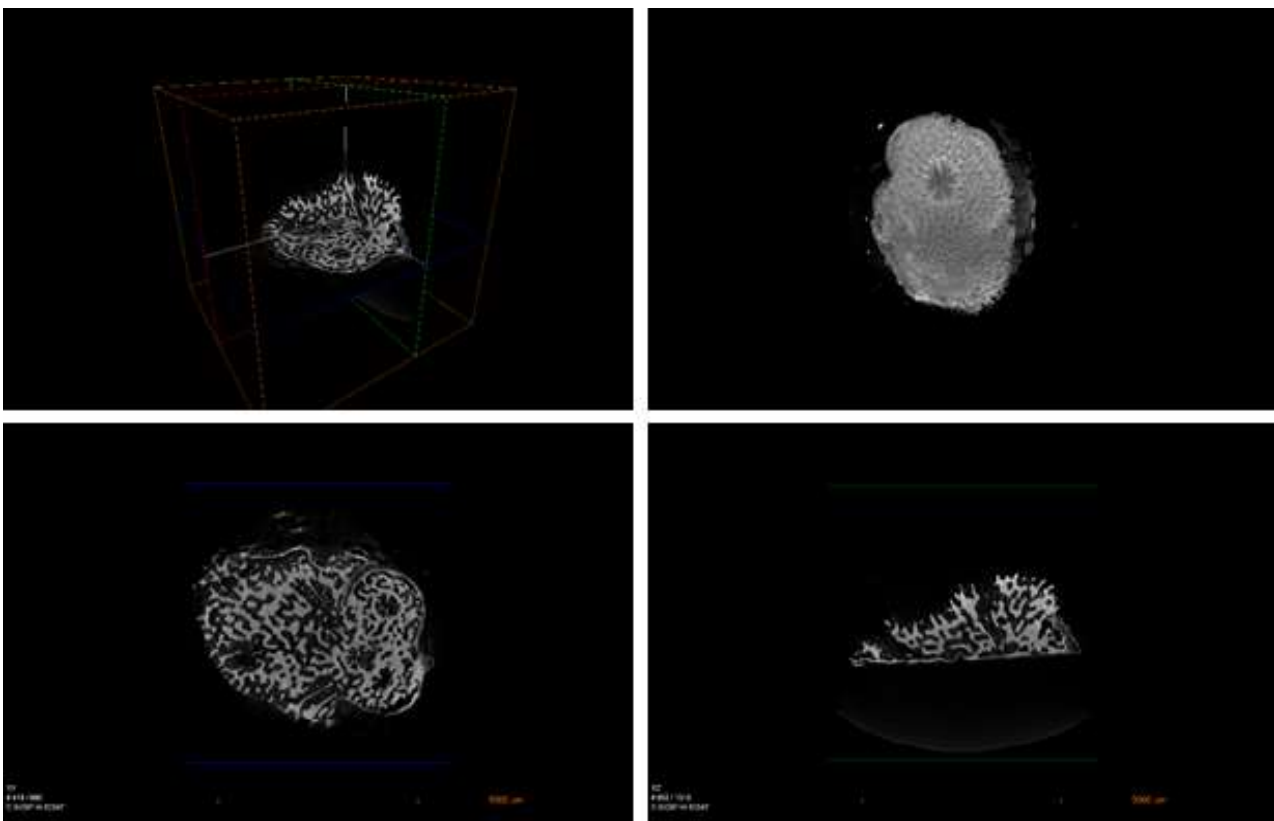


Figure 5. (top) 3D perspectives of a coral recruit. (bottom) Cross section perspective of a coral recruit.

Acknowledgement

This study was funded by the ISRS Graduate Fellowship, the Paul G. Allen Family Foundation and the Australian Institute of Marine Science (AIMS), and completed under the supervision of M. van Oppen, P. Clode and A. Hoffmann. I also acknowledge the contributions of L. Peplow and P. Menéndez in this project.



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Interactive effects of acidification, increasing temperature and micronutrient enrichment on the physiology of *Mussismilia harttii*

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Rationale for the Study: Global warming, ocean acidification, nutrient enrichment and urban pollution are major threats to the future of coral reefs. These stressors are expected to occur concomitantly; however, key aspects concerning their interaction remain poorly understood. Thus, the aim of my ISRS sponsored study was to evaluate the combined effects of global (acidification and warming) and local (copper enrichment) threats in the scleractinian coral *Mussismilia harttii* and their endosymbiotic dinoflagellates (*Symbiodinium* spp.). Physiological responses of the symbiotic holobiont were evaluated including oxidative status, calcification and photosynthesis.

Methods and Materials: *Experiment.* Experiments involving acidification, increased temperature and micronutrient enrichment with copper (control condition: 28°C, pH 8.1) were conducted in a marine mesocosm in Arraial d'Ajuda/BA, Brazil). Fragments of four colonies of the coral *M. harttii* were collected (Porto Seguro, BA, Northeastern Brazil), acclimated in the mesocosm (15 days), and then exposed (up to 28 days) to nominal copper concentrations of 0 or 5 µg/L, with increased temperature (to 2°C above control condition) and acidification (to 0.3 pH below control). Treatments were selected according to IPCC (2014) predictions, applied both in isolation and in combined form (totalling 8 treatments), and run in triplicate.



Bleaching assessment and physiological analyses. Assessment of coral bleaching was performed using a coral health monitoring chart (Siebeck et al. 2006). Chlorophyll *a* content was determined according to Jeffrey and Humphrey (1975). Maximum quantum yields of endosymbiotic dinoflagellates PSII (*F_v/F_m*) were measured using pulse amplitude modulation fluorometry (Diving-PAM, EffeItrich, Germany). Coral and zooxanthellae tissue homogenates were analyzed for: AC activity as described by Henry (1991); total antioxidant capacity (TAC) using a commercial kit (OxiSelect™ TAC assay Kit, San Diego, CA, USA); and intracellular peroxynitrate levels using a commercial kit (Amplite™ Fluorimetric Peroxynitrate Quantification Kit, Sunnyvale, CA, USA). In order to normalize data to biomass, the total protein content in each homogenate was determined using a commercial reagent kit based on the Bradford assay (Sigma-Aldrich, St. Louis, MO, USA). Biochemical (Lipid peroxidation and Ca-ATPase activity) and molecular (evaluation of changes in endosymbiont community) analyses are still being performed at the Universidade Federal do Rio Grande (FURG) and Universidade Federal do Rio de Janeiro (UFRJ).

Data analyses. Physiological data were analyzed using one-way ANOVA for data obtained at each sampling time (4- or 28-d exposure). Data were log-transformed to meet the ANOVA assumptions when necessary. Bleaching frequencies were evaluated using a GLM with binomial family. ANOVA and GLM analyses were followed by Dunnett’s test to compare all means with the control scenario.

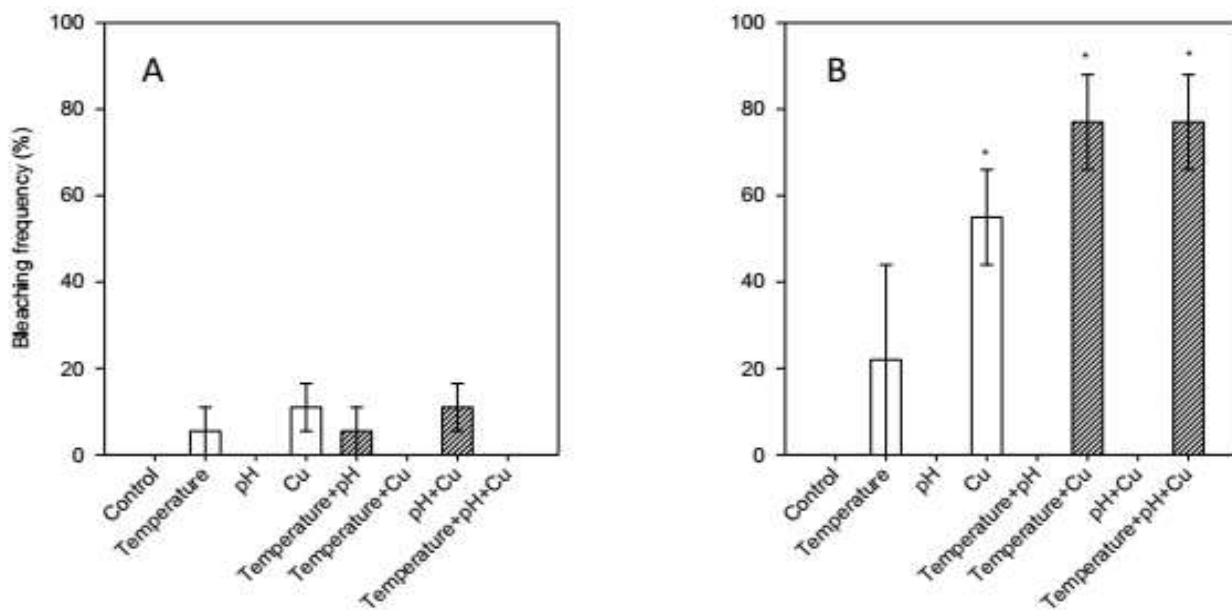


Figure 1. Bleaching frequency in the coral *Mussismilia harttii* exposed to different scenarios of isolated or combined stressors (increased temperature, acidification and copper enrichment). Data are expressed as mean \pm SE (n = 9). (A) Bleaching frequency after 4 days of exposure; (B) Bleaching frequency after 28 days of exposure. Asterisks indicate significantly different mean values ($p < 0.05$) with respect to control values.

Results: Preliminary results indicate noticeably greater deleterious effects on the corals subject to treatments in which different stressors were applied in combination, especially when global (seawater acidification and increasing temperature) and local (Cu enrichment) stressors were tested in combination (see examples shown in Figs 1 – 3). These findings highlight the likely importance of maintaining seawater quality at a local level in reef areas as part of efforts to minimize the potential biological impacts of climate change.

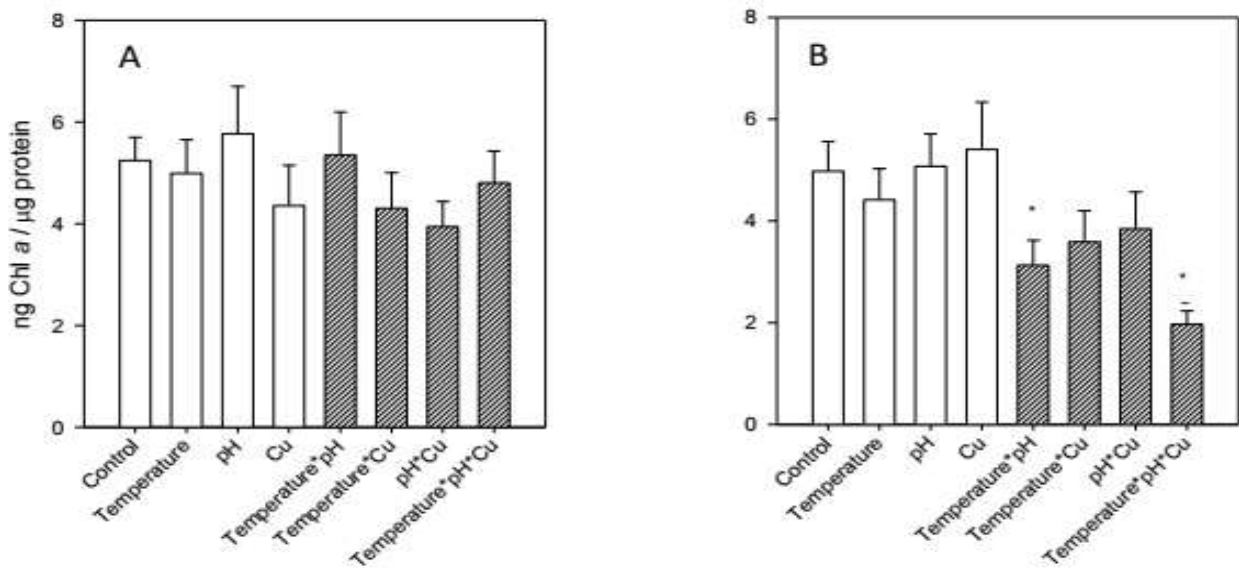


Figure 2. Chlorophyll *a* content in the coral *Mussismilia harttii* under different scenarios of isolated and combined stressors (increased temperature, acidification and copper enrichment). Data are expressed as mean ± SE (n = 9). (A) Chlorophyll *a* content in corals after 4 days of exposure; (B) Chlorophyll *a* content in corals after 28 days of exposure. Asterisks indicate significantly different mean values (p<0.05) respect to control values.

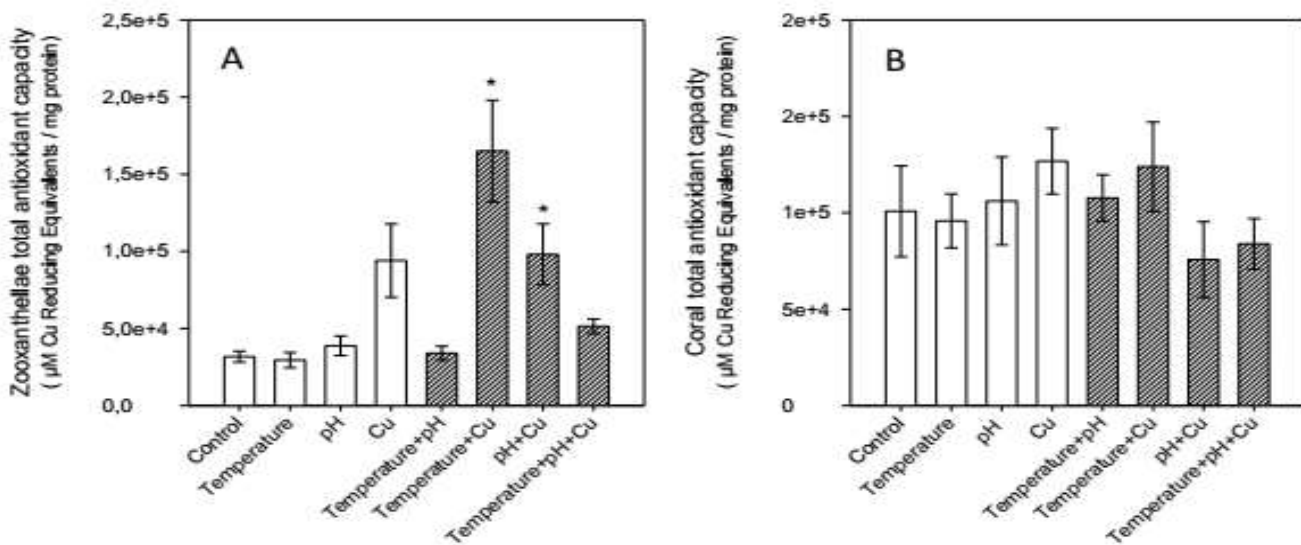


Figure 3. (A) Total antioxidant capacity (TAC) in zooxanthellae and (B) in corals, after 28 days of exposure to different scenarios of isolated and combined stressors (increased temperature, acidification and copper enrichment). Data are expressed as mean ± SE (n = 9). Asterisks indicate significantly different mean values (p<0.05) respect to control values

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Coral reef-turf algal phase shift at Kayts Island, Jaffna Peninsula, Sri Lanka

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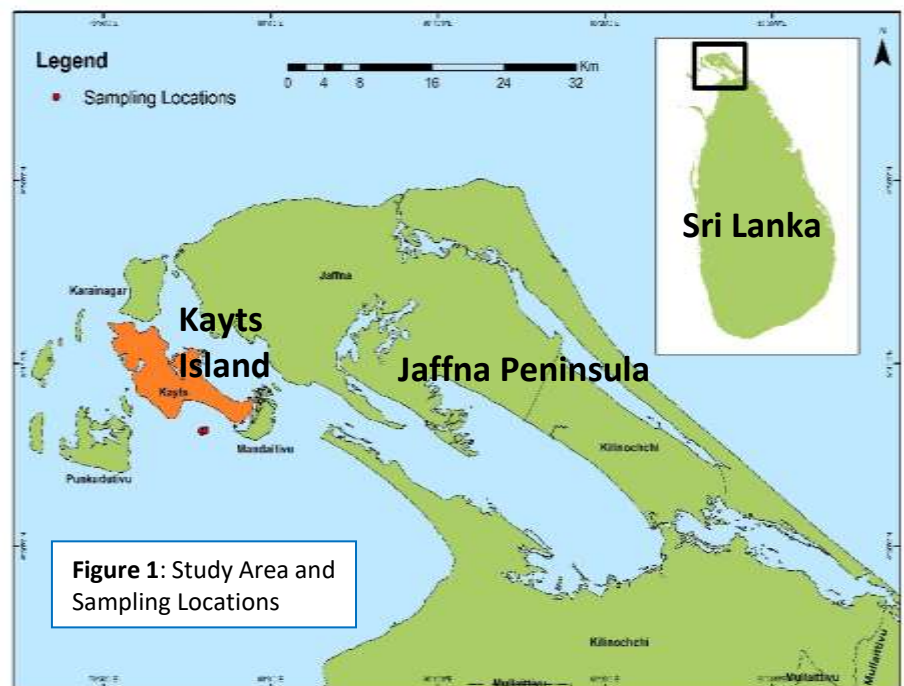
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Kayts, also known as “Leiden” in Dutch, is one of the larger and major fishing islands located ($9^{\circ}39'09''N$ $79^{\circ}54'11''E$ / $9.65250^{\circ}N$ $79.90306^{\circ}E$) off the south-west coast of the Jaffna Peninsula in Northern Sri Lanka (Figure 1). Fringing coral reefs are present along the southern and south-eastern coasts of the island (Figure 1), which are up to 2 km long and 200m wide towards the open sea of Palk Bay (Figure 1). The extensive and well-developed coral environment provided by these reefs is recognized as one of the important sources of sea food to local people; they also serve as nurseries for a variety of commercially exploited fish, crabs, squids, and sea-cucumbers that generate income through both local and global marketing. In this way the area’s reef-related resources are of socio-economical value to thousands of local coastal people.

At the same time these reefs are encountering a looming catastrophe, mainly due to human activities that have included destructive fishing practices, over-exploitation of renewable resources, and ineffective management of resources, consolidated with the global threat of climate change. However, these impacts have been poorly documented due to the lack of scientific records documenting the nature of benthic flora and fauna and the status of marine resources over the last 30 years. In particular, from 1985 to 2010, during the recent civil war, there were severe barriers preventing entry into the sea by local fishermen or the general public. Even 8 years after the ending of the war, there have not until now been any scientific studies carried out on the bathymetry of the northern seafloor around the Jaffna Peninsula, the only available data being that acquired by the British Admiralty, many years ago, for navigational purposes (Sachithanathan & Perera 1970).

Otherwise there have been only very limited findings available concerning the distribution of corals and reefs around the Jaffna Peninsula (Rajasuriya 1997, 2005). Consequently information regarding the impact of the past three major bleaching events and other anthropogenic threats to the areas coral reefs has been minimal, hampering planning of management and conservation activities. Therefore, the present study was initiated at the Kayts Island in order to assess the current status of its reefs and the distribution of its coral communities, as a preliminary step towards initiating conservation activity and promoting public awareness of the need for effective monitoring and management of the marine environment.



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For the study selected reef sites on Kayts island were surveyed according to the standard Reef Check methodology. Surveys focused on the shallow inner reef with a depth of one to three metres. Substrate categories were documented from a randomly laid 100 m long transect using the Line Intercept Transect (LIT) method.

Our underwater visual surveys revealed that corals on Kayts Island were mostly dead and colonised by turf algal communities (Figure 2). Mean live coral cover was about 18% while the cover of dead coral and related substrates was of 66% (Figure 3). The coral mortality index value was estimated at 0.79 which is considerably higher than the 0.33 considered typical of optimum coral health (Sreenath et al., 2015).

The causes of this massive death of corals and consequent overgrowth of the reefs by turf algae are very hard to determine, since there was no scientific monitoring before or during the El Nino years of 2016, 2002 and 1998, or in relation to any other anthropogenic stressors affecting northern Sri Lanka.

However, the sea surface temperature (SST) anomalies received from the National Oceanographic and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHRR) satellite sensor for the last El Nino year in 2016 indicate that the bleaching threshold (BT) SST exceeded from April 16th to May 5th, with the SST at Kayts reaching 31.5°C. Since the warming period at that time was not very prolonged, it is very possible that the live coral cover on the island had also been reduced by other impacts. In particular it is suspected that the initial reduction in coral cover may have occurred during the bleaching event of 1998, since most of the older artisanal fishermen at Kayts said that they had not witnessed beautiful extensive areas of live

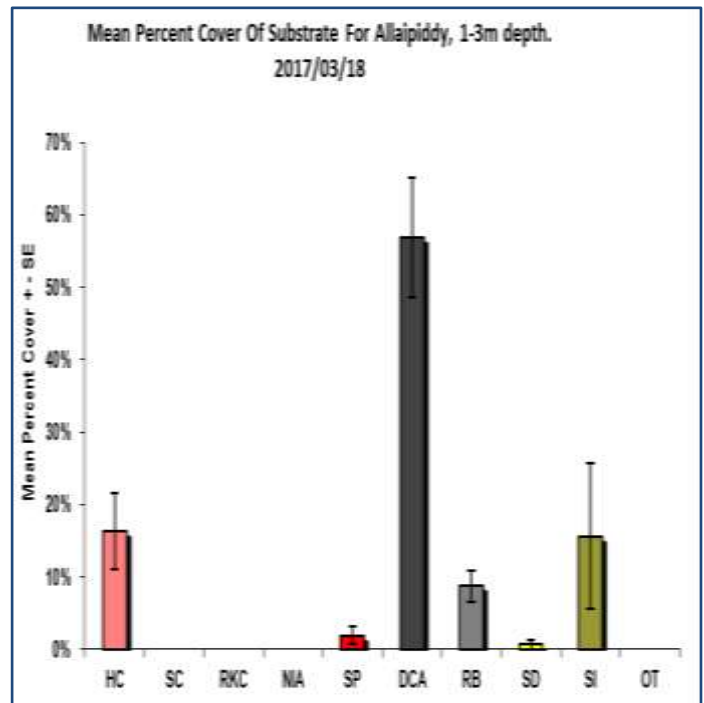


Figure 3: HC: All living hard coral, SC: Soft corals, RKC: Coral that has died within the past year (appears fresh and white or with corallite structures still recognizable), NIA: All macroalgae, SP: All erect and encrusting sponges, DCA Any hard substrate (includes dead coral more than 1 yr old and may be covered by turf or encrusting coralline algae), RB: Reef rubble (broken corals), SD: Sediment less than 0.5cm in diameter; SI: silt, OT: Any other organism including sea anemones, tunicates, gorgonians or non-living substrate



Figure 2: Photographs of coral-turf algae contacts observed during surveys. (A) Branching *Acroporids* covered by turf algae, (B) Staghorn corals broken by destructive fishing practices and largely colonised by turf algae.

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coral since about 1995. At the same time, from discussions with fishermen and the records from the Department of Fisheries and Aquatic Resources in Jaffna, we found that there had been increasing reports from 2002 onwards of damage to the reefs being caused by the operation of bottom trawlers and by the use of other destructive fishing methods including use of monofilament gill nets that damaged the corals and of explosives being used to kill or stun fish. All these fishing practices appear to have been common around Kayts Island and in many other regions of the Jaffna Peninsula, where they appear to have caused both extensive direct damage to coral species and also loss of coral-associated algal grazers.

Thus, we believe that the coral reefs around Kayts Island have experienced a phase shift from dominance by scleractinian corals to domination by turf algae, such has been experienced in recent decades by many other reef areas (Wild *et al.* 2014; Burke *et al.* 2011). This has likely been driven by a combination of insults, among which overfishing and destructive fishing practices, together with global thermal stress, appear likely to have been the most important. The results of this study point to the urgent need to protect the best areas of remaining coral reef at Kayts Island from further stress, and to introduce active management measures and a coral restoration programme.

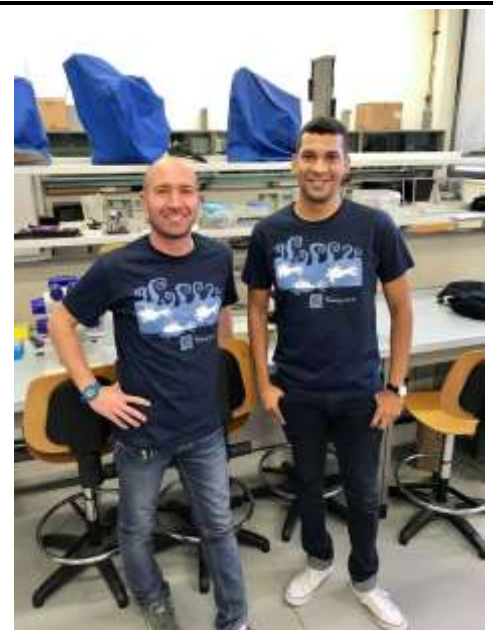
Acknowledgements. This study was supported by an ISRS (International Society for Reef Studies) Graduate Fellowship awarded to Arulananthan Ashani and by a grant from the Postgraduate Institute of Agriculture, University of Peradeniya Research Facilitation Fund (RFF). The authors also thank IDEAWILD for the donation of Corals of the World, Vols.1 -3 together with various invaluable field equipment.

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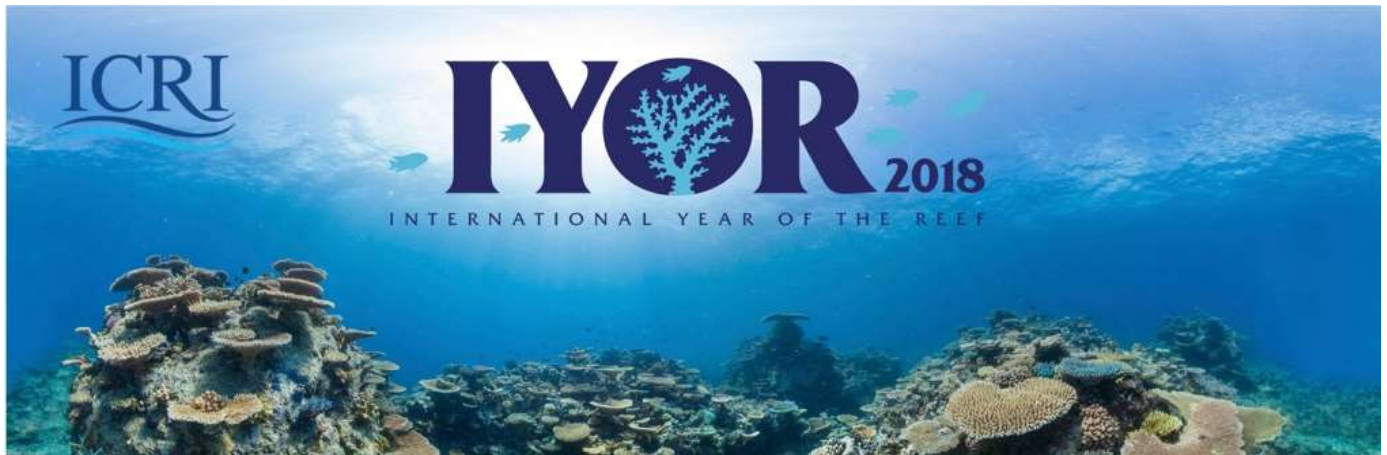
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Other Graduate Fellowship Reports

Reports were also received from **Soffia Rivera Sotelo**, University of California, Davis (but her article on page 32 included in preference) and from **Yohan Didier Louis** (University of Mauritius). The latter's graduate fellowship allowed him to travel to the University of Milan-Bicocca, Italy, (which co-funded the visit) to carry out part of his PhD under the supervision of Dr Davide Seveso (see picture, right). The research aimed to compare spatial and temporal modulation of the expression of Heat Shock Proteins in the hard coral *Acropora muricata*, collected in Mauritian waters before and during the 2015-2016 El Niño. It was intended to assess the use of Hsp70, Hsp60 and Hsp32 as potential proactive biomarkers of heat stresses in corals with different bleaching susceptibility.



PROGRAMS & PROJECTS



2018 is the International Year of the Reef!

To date, over 100 events have taken place around the world in support of the IYOR. Countries such as the Commonwealth of the Northern Mariana Islands (CNMI), Guam, Japan, Germany, Seychelles, Philippines, the UK and Trinidad & Tobago have formally declared their support with official launches and awareness raising events. For example, Guam launched its IYOR in February and formed “[Guam Year of the Reef](#)”, which has involved the local community in outreach events, educating the tourism sector in coral conservation and have also produced their own range of IYOR ‘swag’ including t-shirts, hats, and reusable shopping bags! [CNMI](#) signed a proclamation aimed at bringing about greater awareness of the value of coral reefs.



Individuals, schools, charities and businesses have organised beach cleans, reef photography exhibits and educational community outreach days. As in previous IYORs, the event has been particularly successful in getting the involvement of children and students, and thus making the next generation aware of the problems on reefs, and also inspiring artists and other media and communications experts to turn their attention to the oceans and corals.



The International Coral Reef Initiative (ICRI) supported the [Khaled bin Sultan Living Oceans Foundation](#) in their annual Science Without Borders® Challenge, a student art competition. For IYOR2018, the competition had a theme of “*Why coral reefs matter*”, which led to 600 entries from 38 countries, as described [here](#). [Kids Care About Climate Change](#) is another competition, run by the Australian Institute for Marine Science and CSIRO, for children aged 5-14 who are asked to draw a picture responding to the question ‘What do penguins and coral reefs have in common?’. The IYOR logo will be included on the flag that will show all submissions and that will be flown in Antarctica.

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The Australia Post celebrated IYOR by releasing five new *'Reef Safari'* themed stamps for August Stamp Collecting month, reminding Australians about the amazing biodiversity of the Great Barrier Reef. The UK organised a [competition](#) for children aged 4 – 17 to design official stamps for the British Indian Ocean Territory (BIOT), which resulted in hundreds of entries for stamps from around the world on the theme *'Why are coral reefs and oceans important?'*.

Coralmorphologic, a Miami-based art-science duo comprising a marine biologist and a musician, have created [Tangerine Reef](#) a visual tone poem consisting of time-lapse and slow pans across

surreal aquascapes of naturally fluorescent coral and cameos by alien-like reef creatures. In Barcelona, the Italian artist Paula Indrantino has produced [Evanescent](#), a 2x4 metre multi-media sculpture, inspired by the plight of coral reefs which is on display in the Maritime Museum.

Other organisations have undertaken practical reef conservation projects. The [Reef World Foundation](#) has launched the Green Fins IYOR 2018 Campaign aimed at making sustainable diving practices the social norm and encouraging stakeholders, such as equipment manufacturers, to take action. The infographic [#AlternativestoAnchoring](#) explains how dive companies and boat owners can be more environmentally aware and have zero-impact boat trips, and have managed to reach thousands across social media and through the Green Fins-certified dive centres.



The [Ocean Agency](#) has been supporting *Coral Guardian* in their initiative to involve former dynamite fishermen on coral reef restoration. With the involvement of these former fishermen, a locally managed 1,550-acre MPA has been set up and 26,000 coral fragments planted out. Monitoring indicates that fish abundance is increasing. The Ocean Agency has also undertaken an IYOR expedition in the Coral Triangle, using underwater scooters, 360° cameras and artificial intelligence to survey reefs and to identify corals

Further events are scheduled around the world and can be found in the [IYOR calendar](#). You can sign up to the [IYOR newsletter](#) to keep up to date, and find out more about IYOR on the website www.iyor2018.org.

Social media: Twitter: [@iyor2018](#) #iyor2018; Facebook: www.facebook.com/iyor18;
Instagram: <https://www.instagram.com/iyor2018/>

Kirsty Richards and Claire Rumsey (ICRI International Year of the Reef Coordinator)
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Conservation of South Atlantic Reefs: The Coral Vivo research network

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A brief introduction to Brazilian reefs

Brazil has the only true coral reefs in the South Atlantic Ocean, a diversified historical, morphological and biological ecosystem. The geological history of the Quaternary Period indicates that Brazil's current coral reefs only began to grow 8,000 years ago, when sea level rose and flooded the continental shelf. However, several sea level fluctuations have occurred in the last 4,000 years, which led to the emergence of many reef flats that were subjected to erosion. These reef structures could only grow laterally, resulting in mushroom-shaped “chapeirões”, a unique form of reef growth, shown by some Brazilian reefs. In contrast to the Caribbean and Pacific reefs, Brazilian reefs present a low diversity of zooxanthellate scleractinian corals (16 species). However, Brazilian reefs present an elevated biological diversity, showing a distinct fauna with a high degree of endemism, with 49% of coral species being endemic (Scleractinia, Antipatharia, Octocorallia, Milleporidae). Additionally, these reefs occur in waters with high levels of turbidity, when compared to the reefs of other regions around the world (see Castro e Pires, 2001 and Zilberberg et al. 2016 for a review on Brazilian reefs). But as in other regions, Brazilian reefs are under threat. Estimates indicate that approximately 50% of Brazilian reefs have been impacted by the combined action of large-scale global threats (e.g. global warming and ocean acidification) and local impacts, including nutrient and micronutrients enrichment (Rodriguez-Ramirez et al., 2008).

Coral Vivo research network

The “Coral Vivo Project” (Projeto Coral Vivo) is a non-profit organization, idealized and organized by researchers from the National Museum of the “Universidade Federal do Rio de Janeiro” (UFRJ, Rio de Janeiro, RJ, Brazil). It was implemented as a project focusing on the characterization, formation and renovation of coral communities. Throughout its existence, the Coral Vivo Project has expanded its activities to include research, environmental education, public policies and public outreach. Since 2011, a collaborative group of Brazilian researchers, from several universities/scientific institutions, was formalized as the “Coral Vivo research network” (Fig. 1). Several research areas, encompassing a broad range of topics (ecology, physiology, microbiology, etc) are currently being explored by



Figure 1. Members of the Coral Vivo network during the “IV Coral Vivo research network Workshop” in 2015 at the Museu Nacional, Universidade Federal do Rio de Janeiro, RJ, Brazil.

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researchers belonging to the network. Considering that studies on the effects of climate change in Brazilian reefs are scarce and that little is known about how Brazilian corals may respond to such global impacts, this network is developing studies that will contribute to the conservation of South Atlantic coral communities, through a better understanding of the possible impacts of global and local stressors affecting Brazilian reefs (see some recent contributions in Santos et al. 2015; Sarmiento et al. 2015; Scherner et al. 2016; Zilberberg et al. 2016; Fonseca et al. 2017; Marques et al. 2017; Marangoni et al. 2017 a,b).

Ongoing projects and ISRS support

Fulfilling its commitment to take action on climate change and to stimulate research and management actions through which the science community can help mitigate the threat to reef environments, the ISRS offered financial support through a 2016 Graduate Student Fellowship. This grant was used to fund an ongoing study into the physiological implications of concurrent stressors associated with climate change (increasing ocean temperature and seawater acidification) and other associated with local impacts (chemical pollution and eutrophication) on a major reef building coral species of the Southwestern Atlantic. An experiment testing the effects of reducing pH, increasing temperature and micronutrient (copper; Cu) enrichment was conducted in the marine mesocosm of Project Coral Vivo in Arraial d'Ajuda (Porto Seguro, Bahia, Northeastern Brazil (Fig. 2; see Duarte et al. 2015 for a detailed description of the mesocosm system), using the endemic zooxanthellate coral *Mussismilia harttii*, as experimental model (Fig. 3).

Fragments of four colonies were collected at the "Recife de Fora" Marine Municipal Park (Porto Seguro, BA, Northeastern Brazil). After acclimation in the marine mesocosm system, they were maintained under control conditions (natural environmental conditions) or exposed to 5 µg/L copper (nominal concentration), increased temperature (2°C above the natural conditions), and acidified seawater (0.3 pH below natural conditions) for up to 28 days. Treatments were selected according to predictions of the IPCC (2014) and run in triplicate. They were tested both isolated and in combination, with a total of eight different treatments. After treatment, response of several molecular, biochemical and physiological parameters, such as chlorophyll *a* content, photosynthetic efficiency, coral and zooxanthellae total antioxidant capacity and intracellular concentrations of peroxynitrite were analyzed. Further analyses on the oxidative status, calcification process and endosymbiont community are still being performed at the Universidade Federal do Rio Grande (FURG), and at UFRJ, Brazil.



Figure 2. Experiment of seawater acidification, increasing temperature and micronutrient (copper) enrichment conducted in the marine mesocosm facility of the Coral Vivo Project, Arraial d'Ajuda (Porto Seguro, Bahia, northeastern Brazil).

Preliminary results indicate greater deleterious effects when stressors were applied in combination (e.g. higher intracellular concentrations of peroxynitrate, lower photosynthetic efficiency and higher bleaching occurrence), especially when both global (seawater acidification and increasing temperature) and local (Cu enrichment) stressors were tested in combination. It is worth noting that this is a likely future scenario to which some reefs worldwide will likely be exposed. This finding highlights the importance of monitoring and maintaining the seawater quality at a local level, in order to minimize the potential biological impacts of climate change. Considering the paucity of studies on

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the ecophysiology of Southwestern Atlantic coral species, as well as of those considering scenarios involving the impact of multiple stressors associated with global climate changes and local chemical contamination, findings reported by the Coral Vivo research network are expected to provide key information for the conservation of reefs not only at a national scale, but in other global regions.

Acknowledgements

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Figure 3. Colonies of the zooxanthellate coral *Mussismilia harttii*, a major reef builder species in the Southwestern Atlantic, and used as experimental model by the Coral Vivo research network.



USAID SEA: Coral Reef Conservation in Indonesia

The United States Agency for International Development Sustainable Ecosystems Advanced (USAID SEA) Project is a five-year project (2016-2021) to support the Government of Indonesia to improve biodiversity conservation through the governance of fisheries and marine resources.

Currently, the USAID SEA Project is working to advance 14 selected MPAs (both existing and new in the eastern Indonesian provinces of North Maluku, Maluku and West Papua) to at least achieve level 3 status (conservation area minimally managed per the Indonesian MPA evaluation system) by 2021. In addition to supporting more than 1 million hectares of new MPAs under effective management, USAID SEA supports policies that promote marine conservation interventions that reduce destructive practices and pressures on the nearshore marine ecosystems. Through the application of MPAs, the Project aims to enhance fish stocks and improve the condition of coral reefs in at least 1,000 ha of no-take-zones while at the same time advancing opportunities for alternative livelihood for fishers and communities living in and around MPAs.



Reefs and Islands within one of the project MPAs



A USAID-SEA reef survey in progress

USAID SEA is implemented by Tetra Tech with a consortium of 13 implementing NGO and academic partners that work closely with the Indonesian Ministry of Marine Affairs and Fisheries as well as the provincial, district and village governments in the project areas.

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Scientific letters or notes describing observations or data

Pox-like Blemishes on Caribbean Corals are Fish Induced: Is there a Link with Emerging Coral Diseases?

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Adult Yellowtail damselfish, *Microspathodon chrysurus* (Cuvier 1830), occupy a number of shallow-water reef habitats in the Caribbean (Carter and Kaufman 2002, Figure 1A). The Yellowtail damselfish are territorial with territories that cover an area up to 3 m². *M. chrysurus* roam these territories, repeatedly biting and bumping into coral heads and branches. *M. chrysurus* is omnivorous, showing a gradual change from mainly carnivorous as juveniles, to mostly vegetarian as adults (Ciaridelli 1967). Because the adults are herbivorous, it is unknown if *M. chrysurus* bite the coral for direct food value, for territorial marking, or both. These fish-on-coral contacts create small lesions and zooxanthellae-free blemishes on the living tissue of coral colonies. Coral species that most commonly exhibit these lesions include the hydrozoan *Millepora complanata*, and the scleratinian species *Siderastrea siderea* and *Acropora palmata* (Glynn 1973, Bruckner et al. 2003, Chaves et al. 2012, NOAA 2012; Figures 1B, 1C, 1E). The 1-2 cm diameter wounds are generally dispersed over the entire surface of exposed colonies and are circular to crescent-shaped. In some cases, open-mouthed, head-long bumps by *M. chrysurus* result in ring-like lesions on *A. palmata* branches. Recently, a number of papers and websites have misidentified these circular blemishes as coral disease. There especially seems to be confusion regarding these markings and white pox disease-like symptoms on *A. palmata* (see Rogers et al. 2005, Weil et al. 2006, Polson 2007).

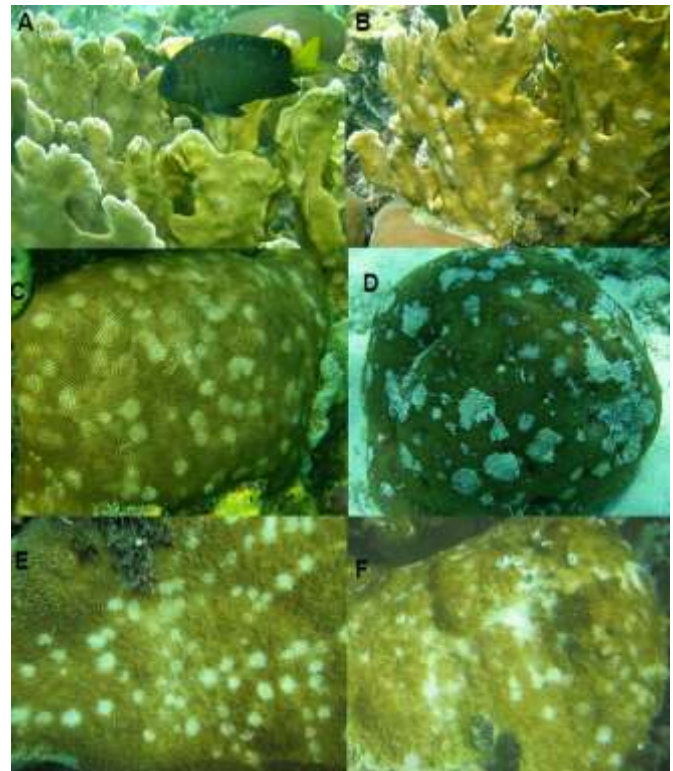


Figure 1. Photograph of *Microspathodon chrysurus* roaming within its territory (A); *M. chrysurus* induced circular blemishes on blades of the fire coral *Millepora complanata* (B); *M. chrysurus* induced blemishes in various stages of healing on massive *Siderastrea siderea* (C); expanding fish-induced white spots that resemble recently described coral disease termed *Siderastrea* White-Blotch Syndrome (D) *M. chrysurus* induced circular, pox-like lesions on *Acropora palmata* (E); and expanding and coalescing white spots (large irregular white areas) that do resemble white-pox disease on *A. palmata* (E).

In most cases, individual corals often exhibit lesions in various stages of recovery with new tissue regenerating over and/or zooxanthellae returning to the initial point of injury. Most lesions completely heal within a few weeks of formation. Long-term observations of these blemishes and lesions reveal little or no adverse effects on coral survival or longevity on the affected colonies. However, in some cases a small proportion of the lesions fail to heal and become infected. These lesions then apparently become the focal points of expanding areas of tissue exfoliation and

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disease (Figure 1D and 1F). Bruckner (NOAA 2012) coined the term “ulcerative white spots” to describe these expanding circular lesions. We should note, there is no relationship between the ulcerative white spots described by Bruckner and “*Porites* ulcerative white spot disease” described in the Indo-Pacific by Raymundo et al. (2003).

So, are these lesions precursors to coral disease? In the Caribbean, it is likely that the pathogen(s) involved in these secondary infections use the lesions as an entry point into its coral host. Repeated measures monitoring of individual affected colonies has shown that in some cases there appears to be a direct linkage between these fish-induced white spots and various coral diseases including those with outward pathologies resembling a recently described disease in *Siderastrea siderea* known as *Siderastrea* white-blotch syndrome (Figure 1D), and white-pox disease on *Acropora palmata* (Figure 1F). However, these observations are far from universal as many coral diseases or disease infected corals are not associated with or contingent upon fish-induced lesions.

At present, it is unknown why these secondary infections form, or which pathogen or group of pathogens may be responsible. Are they simply opportunistic infections in a compromised coral host (Lesser et al. 2005), or do the damselfish act as a vector for disease transmission? Unfortunately, the etiology of most coral diseases remain cryptic. An important first-step in answering these questions will be to better understand the linkage between fish-induced lesions and coral disease (Bruckner and Bruckner 2016). Thus, it will require a process approach utilizing precise field observations to accurately determine causality, and then a “repeated measures” monitoring protocol to follow these lesions through time (see Work and Aeby 2006, NOAA 2013). Understanding the difference between a fish-induced lesions, coral disease lesions, and if they are related may seem trivial; however, with the rate at which emerging diseases are killing corals throughout the Caribbean there is no time to wait to answer some of these most basic of questions.

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First record of the Northern Star Coral *Astrangia poculata* (Ellis & Solander, 1786) (Cnidaria: Anthozoa: Hexacorallia: Scleractinia: Rhizangiidae) from Irish waters

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Introduction: Although at least 15 species of *Astrangia* are currently recognised worldwide, the vast majority (75%) are found in tropical waters, particularly in the Pacific region (Cairns 1999). Only five species are known to occur in the Atlantic region, including three from the Western Atlantic (*A. poculata* (Ellis & Solander, 1786), *A. rathbuni* Vaughan, 1906 and *A. solitaria* (Le Sueur, 1818)), and two from the Eastern Atlantic (*A. macrodentata* Theil, 1940 and *A. mercatoris* Theil,

1941). *A. macrodentata* has been recorded from the Congo (Punta Noire) northwards to Morocco (Agadir) (Ocaña *et al.* 2015), and *A. mercatoris* from Angola (Bay of Elephants) northwards to Sierra Leone (Peters *et al.* 1988, Ocaña *et al.* 2015).). It is interesting to note that *A. solitaria*, which is generally regarded as endemic to the tropical Western Atlantic, has also been reported from the Cape Verde Islands off Senegal, NW Africa (Boekschoten and Borel Best 1988). Although it has been suggested that *A. poculata* may occur on the Atlantic coast of Africa, its current status within this region is still unresolved (Peters *et al.* 1988).

Observation: On 28 December 2017, RH discovered a dead colony of the Northern Star Coral *A. poculata* encrusted on a piece of white expanded polystyrene (EPS) stranded in Saint Finian's Bay (51.50°N, 10.20°W), near Waterville, County Kerry, SW Ireland (Figs 1 & 2). The maximum length, width and depth of the colony was 43, 26 and 21 mm respectively (Figure 1).

The current specimen, which represents the first confirmed record of *A. poculata* from Irish waters, was donated to the National Museum of Ireland – Natural History Division (NMNH:2018.2.23). There is only one previously confirmed record of *A. poculata* from NW European waters. During November 2009, Hoeksema *et al.* (2012a, b) discovered several dead colonies of *A. poculata*, which were initially misidentified as *Favia fragum* (Esper, 1793), attached to a metal gas cylinder stranded on the island of Texel, off NW Holland (North Sea). An unconfirmed damaged specimen was discovered during the early 1990s attached to a plastic float stranded by the golf club at Ballyconneely (53.421°N, 10.144°W), Co Galway, on the west coast of Ireland (Dan Minchin pers. comm.).

Discussion: *A. poculata* is endemic to the eastern coast of North America, ranging from temperate waters off Cape Cod (Massachusetts) southwards to tropical waters in the eastern Gulf of Mexico, with isolated records from the Caribbean coast of South America (Dimond *et al.* 2013). The species is particularly hardy, tolerating a wide range of salinities (16-36 ppt) and water temperatures (-1.5 to 22°C), and represents one of a few ahermatypic (non-reef-building) Scleractinian corals known to occur in shallow waters (0-263 m) well

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outside the tropics (Peters et al. 1988). Dimond et al. (2013) observed that both the growth rate and maximum northern range of *A. poculata* along the east coast of North America was limited by water temperatures below 10°C. Higuchi et al. (2015) reported similar observations for the northern limit of *Acropora* corals in temperate waters of Japan. In particular, they noted that the resilience of *Acropora pruinosa* (Brook, 1893) to bleaching by cold was adversely affected by water temperatures below 13°C. It is interesting to note that *A. rathbuni* extends into Antarctica (Cairns 1999).

The rafting colony of *A. poculata* found stranded in SW Ireland completely covered what would have represented the underside of the floating piece of EPS. However, its potential growth was most likely limited by the relatively small surface area (c.7cm²). Although it is possible that the colony may have reached its maximum size prior to departing the east coast of North America, it is also conceivable that it might have continued to grow and possibly reproduce during its subsequent minimum 14-18 month passive trans-Atlantic drift via the Gulf Stream and North Atlantic Drift to SW Ireland (Quigley et al. 2014 and references therein). Indeed, it is likely that the colony would have survived the average winter (10°C) and summer (16°C) surface sea water temperatures (SST) along the predicted route (see Hoeksema et al. 2012a, b). Although SST around Ireland are about 7-8°C warmer than the global average at equivalent latitudes, primarily due to the North-Atlantic drift which transports warm water from the Gulf of Mexico to NW Europe (Anon, 2018), they are probably still too low to support the long-term survival of *A. poculata*. The average SST on the west and south of Ireland ranges from 8-10°C in February-March and from 14-17°C in August, and is a couple of degrees colder on the north and east. Although it is possible that *A. poculata* could survive present day average SST in southern European Atlantic waters south of Ireland, the species may need consistently warmer temperatures (>20°C) in order to successfully establish self-sustaining populations within this region (Dimond pers. comm.). However, if current and predicted future increases in climatic warming continue (Hiscock et al. 2004; Boelens



Figure 1. *Astrangia poculata* encrusted on expanded polystyrene, above: lateral view; below: dorsal view

et al, 2005), it is possible that some passively rafting non-native species such as *A. poculata* may eventually become established in Irish and other NW European waters.

Thiel and Gutow (2005b and references therein) noted that the most commonly reported Cnidarian rafters were Hydrozoans. They listed a maximum of 102 species and 39 genera of rafting Hydrozoans compared with only 28 species and 17 genera of Anthozoans, including 15 species of Scleractinian corals belonging to the following genera: *Acropora*, *Balanophyllia*, *Goniopora*, *Montipora*, *Phyllangia*, *Pocillopora*, *Porites*, *Seriatopora*, and *Stylophora*. All of these tropical and sub-tropical Scleractinian rafters, except one, the Hidden Cup Coral *Phyllangia americana mouchezii* (Lacaze-Duthiers, 1897), which was recorded

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on plastic from Florida (USA), were reported from the Pacific (Fiji to Australia, Hawaii, Marshall Islands, Lizard Island and California).

Jokiel (1990) remarked that rafting on natural substrata has facilitated the dispersal and successful colonisation of new geographical areas by many coastal marine organisms for millennia. Where natural colonisations have been unsuccessful, Kornicker and Squires (1962) warned that floating dead corals deposited far from where they originated could lead to erroneous distribution and wrong ecological interpretations. Over the last century, the contribution of anthropogenic rafting substrata (e.g. plastics) to the dispersal of marine organisms has been increasing (Barnes and Milner 2005; Thiel and Gutow 2005a, b; Thiel and Hays 2006; Bravo et al. 2011). For example, Creed et al. (2017) described the history, pathways and modern vectors (e.g. hitch-hiking on oil and gas platforms) which have led to the worldwide invasion of tropical waters by three species of Scleractinian corals: *Tubastraea coccinea* Lesson, 1829, *T. tagusensis* Wells, 1982, and *T. micranthus* (Ehrenberg, 1834).

The vast majority of rafting Scleractinian corals have been found in association with naturally occurring floating substrata such as volcanic pumice (65%), wood, macroalgae, and seeds (23%), whereas only 12% were reported from anthropogenic plastics (Thiel and Gutow 2005a, b). The high percentage of reports from pumice may be related to the large volume and persistence of this inorganic material in the world's oceans, particularly in the Pacific. Organic substrates, such as macroalgae, wood and seeds are less persistent and generally represent more ephemeral rafting materials (Gutow et al. 2015). Nevertheless, it is interesting to note that a large specimen of the Scleractinian Grooved Brain Coral *Diploria labyrinthiformis* L. (as *D. cerebriformis*), weighing c.7.7 kg, was found attached to a beam of wood stranded on the Faroe Islands during March 1891 (Feilden 1893). Perrault et al. (2015) also reported *A. poculata* as an epibiont on the carapace of a nesting female Loggerhead Turtle *Caretta caretta* L. at Casey Key, Florida. Considering the large volume of plastics in the world's oceans and their long-term persistence in the environment (Theil and Gutow

2005a, b; Thiel and Hays 2006), it is surprising that there are relatively few reports of Scleractinian corals associated with this abiotic rafting substrate. Although the physical and chemical properties of plastics may either inhibit or limit Scleractinian colonisation, the current paucity of records from this rafting substrate may simply reflect a lack of recording effort.

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Northern star coral (*Astrangia poculata*) found growing on the spider crab *Libinia emarginata* in Long Island Sound, USA

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Astrangia poculata (Ellis and Solander 1786) is the only scleractinian coral found along the Southern New England coast. It is also broadly distributed on the east coast of the United States from Cape Cod south to northern Florida reef tracts (Indian River Lagoon) with additional presence in the Gulf of Mexico (Dimond et al. 2013). Along the East Coast, it is commonly found on hard, rocky substrates, piers, pilings, artificial reefs and occasionally on mollusk shells inhabiting a wide range of salinity, depth and temperature regimes. *A. poculata* has been observed as an epibiont on the shells of the thin-stripe hermit crab *Clibanarius vittatus* on the Mississippi coast (Bruce 1989), and on loggerhead sea turtles *Caretta caretta* (Frick et al 2000; Perrault et al 2015) on the coast of Georgia and in the western Gulf of Mexico, respectively. Additionally, corals of this species have rafted across the north Atlantic to the Netherlands after settling on floating flotsam (Hoeksema et al. 2012, 2015) and plastics (Hoeksema et al. 2018).

Here we report the presence of *A. poculata* on the carapace of the spider crab *Libinia emarginata* in the Long Island Sound estuary. Corals and crabs overlap throughout their Long Island Sound distribution. White corals (indicating a decreased density of zooxanthellae) occurred only on the carapace near mouthparts (Fig.1 A, B, C) of female, gravid crabs. No corals were observed on male crabs. Corals may benefit from the mobility of crabs and from the natural crab diet leftovers. The symbiotic state of the corals observed and their location near the mouthparts on the crab indicate the possibility of opportunistic heterotrophic feeding. The frequency of this occurrence in the Long Island Sound is currently being investigated collaboratively between the Werth Center for Coastal and Marine Studies at Southern Connecticut State University and the Norwalk Maritime Aquarium in Norwalk, CT.

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Figure 1. A (top): *Astrangia poculata* located near the eye-stalk of *L. emarginata*. B (centre) *Astrangia poculata* located just posterior to the eye-stalks of *L. emarginata*. C.(bottom) Small colony of *Astrangia poculata* adjacent to the mouthparts of *L. emarginata*.

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Morphology or genetics – the case of Caribbean branching *Porites* corals

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Recent contributions of genetics towards creating an integrative taxonomy of Caribbean Scleractinia are timely and welcome. They build on centuries of taxonomic research. The three Caribbean branching nominal species *Porites porites*, *P. furcata* and *P. divaricata* provide an interesting case study. In the dawn of coral studies, when these species were first described, they were based on morphological descriptions of scarce material found wave cast on beaches or hooked during fishing excursions. Later, at the start of the 20th century, with researchers' entrance into the natural coral habitat, the extraordinary corallum variability was increasingly appreciated. This led to the introduction of an intraspecific category of forma. This occurred for the first time for Scleractinia

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in the case of the branching Caribbean *Porites* (Vaughan 1901). When numerous field observations and sampling were undertaken, the corallum variability caused increasing difficulties with species designation. Further it became evident that sampling strategy could affect taxonomic decisions. More than a century ago, it became evident that reliable sampling was the first *condicio sine qua non* for successful coral taxonomy.

Recently, an information theoretic analysis was used to investigate genetic species delineation among the three species (Prada et al. 2014). Surprisingly, it did not make use of the existing previous morphological expertise. Nevertheless, it was based on morphologically selected material. The authors analyzed 37 “individuals” (samples) of the branching species. They noted (p. 1021) that “[...] colonies were identified by using standard keys (Humann 1993) with special references to the diameter and spacing of branches and to microhabitat, in accordance with the species discrimination made by Jameson (1997) and Jameson and Cairns (2012).” In fact, Humann’s book appeared in 1992 and later had second and even third Editions (Humann 2002, 2013). Use of the latest edition, which reflects the evolution in the conventional taxonomic judgment on the contentious status of three branching *Porites*, would have been more appropriate. The information on the 37 “individuals” used in the analysis came from six localities considered representative *pro parte* of the geographic, bathymetric and ecologic distribution of the species. A synonymy list would also have strengthened the genetic work by showing its relationship to antecedent taxonomic work.

In contrast, during a previous study in the early 1970s, 548 specimens of the three branching nominal *Porites* species were collected from different zones of Cuban coral reefs from depths upto 55 m and were studied morphologically (Zlatarski 1980, 1982). The presence of coralla showing intermediate characteristics between the three nominal forms made, in many cases, their species designation impossible, and clearly supported the earlier Vaughan approach of applying the taxonomic category of “forma”. *Porites porites* forma *typica* was established in 27 transects and 56 stations; *P. p. f. furcata* in 10 transects and 13 stations; *P. p. f. divaricata* in 32 transects and 58 stations; and a morphological continuity between *P. p. f. typica* and *P. p. f. furcata* in 29 transects and 46 stations. An analysis of skeletal variability led to the notion of the “phenoide” as a graphic presentation of the structure and dynamic of a species.



Figure 1. The three nominal species of Caribbean branching *Porites*. Top: *Porites porites* (Photo Mary Stafford-Smith). Centre: *Porites furcata*, Bottom: *Porites divaricata* (Photos both by Charlie Veron). From Corals of the World (www.coralsoftheworld.org). With thanks from Reef Encounter to these authors..

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Another study based on massive coralla sampling of the species in question was completed in Mexico during 1983 to 1984. 478 specimens were sampled from 39 transects, 141 sites and 174 stations, and established a morphological continuity of 299 specimens, that were designated as *P. porites* – *P. furcata*. In areas with a constant strong current, such as San Juan on the west coast of Cozumel, inseparable colossal colonies within this morphological continuum densely covered areas the size of a football field (Zlatarski 2008).

In more recent decades, the majority of SCUBA explorations in the Caribbean have been limited to depths of 15-20 m and typically were only able to undertake close observations and sampling of corals on a smaller scale. For example the Atlantic and Gulf Rapid Reef Assessment Programme focused on monitoring in the upper part of shallow-water coral reefs. Nevertheless, even within this reduced habitat, it became evident that many branching *Porites* looked “intermediate” in form between the three nominal species; these were referred to as *Porites* “digitate” (Lang 2013). As a result it was increasingly recognized that taxonomic study of scleractinian species requires a holistic approach and taxonomic work on Caribbean Scleractinia has taken on this integrative character (Zlatarski 2007, 2009).

This wider issue apart it may be noted that the statement by Prada et al. (2014, p, 1020) that *P. colonensis* is another Caribbean branching *Porites* is not correct. The authors state that “*P. colonensis* forms colonies of flattened and fused branches [...] (Zlatarski 1990)”; however the cited publication does not include content relating to fused branches in *P. colonensis*, and, to the present author’s knowledge, there have been no other reports of a branched colony shape for this species.

As with many other areas of study, coral genetics has its challenges, e. g., the slow rates of mitochondrial DNA evolution. At the same time, genetics can be very powerful when applied jointly with micromorphology and with other new ways of obtaining knowledge about the extraordinary variability of coral forms. Series of *Porites* colonies showing gradual morphological continuity and the existence of bimorphic colonies displaying in their different parts characteristics of more than one nominal species challenge the efforts of morphologists as well as geneticists. An appreciation of the extent of hybridization has further opened up new research horizons and deeply challenged our understanding of what constitutes a coral species.

Collaboration among specialists from different fields is becoming essential in our efforts to save coral species and protect coral reefs.

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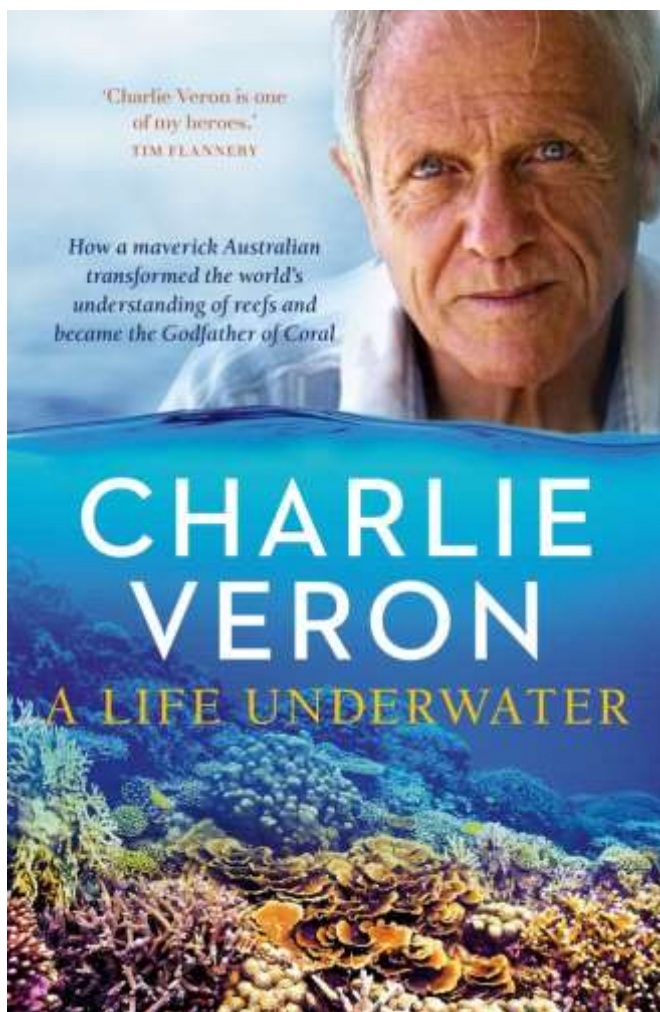
REEF SHELF

Book and Equipment Reviews

A Life Underwater

Charlie Veron

Viking, Australia. 336 pages
Paperback (February 2018)
ISBN 978-0143785460



Over a career that is now well into its fifth decade, Charlie Veron is unique among coral reef researchers in that his personal scientific output is as impressive when

measured in kilograms of books or metres of shelf-space, as it is numbers of publications. Apart from a long list of journal articles, there are the monographs and the books: among others, *Scleractinia of Eastern Australia*; *Corals of Eastern Australia and the Indo-Pacific*; *Corals in Space and Time*; *Corals of the World*; *A Reef in Time: The Great Barrier Reef from Beginning to End*. Another major legacy left by Charlie are the thousands of scleractinian coral specimens collected for taxonomic and biogeographic studies while he was working at James Cook University (1972 – 1975) and the Australian Institute of Marine Science (1975 – 2007). A big part of the world's best-curated and catalogued coral collection, they are available for study at the Museum of Tropical Queensland in Townsville.

This year, Charlie has added his autobiography to his list of publications. His piercing blue eyes peer out from a cover that features a beautiful coral reef scene, lots of endorsements from luminaries like Sir David Attenborough, Iain McCalman, Tim Flannery and Australian Science broadcaster Robyn Williams, as well as the publisher's appellations 'maverick Australian' and 'Godfather of Coral'. These days, Charlie is the public face of coral reefs, walking the media tightrope, balancing his deep knowledge of and love of coral reefs, for which he still holds out some hope, with his evident despair that humanity does not have the political will to address the climate change that is playing out the scenarios of degradation that the coral reef research community has been warning of for over two decades.

Though any of us who come to learn of Charlie's book through this review in Reef Encounter may be forgiven for expecting it may be a rather gloomy, that's not so. He (real name John Veron) reveals the answer to the question 'why Charlie', as he recalls early childhood adventures in the bush and on rocky shores that cemented an love of nature; he recounts that magical moment when, as a teenager, the penny dropped that some lucky people were actually paid to study nature. His memories of our early marine adventures together with a few other friends pretty much coincide with mine. In our early 20s, and doing Monday to Friday PhD work on other stuff, we began studying corals on weekends, Charlie scaring us all witless as we carted too

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many people and too many tanks in small boats, through big, cold seas, to distant islands that had a low coral diversity clinging to their rocky shores.

From this small beginning, and with mining, drilling and crown-of-thorns starfish looming as threats to the Great Barrier Reef, Charlie was able to gain occupancy in Australia's then sparse marine biology profession. Charlie made what seemed a reasonable assumption that it would take him maybe a couple of years to learn the species names of all the corals before moving on to other studies. Instead, it took some years more to produce the monumental collaborative taxonomic works that have been indispensable for field ecologists for years. In the process, he found himself immersed for decades in the complexities and controversies of coral evolution, phylogeny and biogeography, subjects that give the meat to the middle section of his book.

The meat of the book's closing chapters are climate change and ocean acidification, for which Charlie provides a clear lay person's explanation of both the relevant physiological processes and the ecological implications. Interwoven among the science there are, in good measure, as he would put it, accounts of conflicts with bureaucrats, travels, VIPs, and of family life and times surrounding him. There is enough scientific meat in here to engage the brain, and moreover, as one reviewer put it, 'Charlie's book reads with flare, clarity and a sense of adventure'. I couldn't agree more.

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Corals: Indo-Pacific Field Guide

Harry Erhardt and Daniel Knop

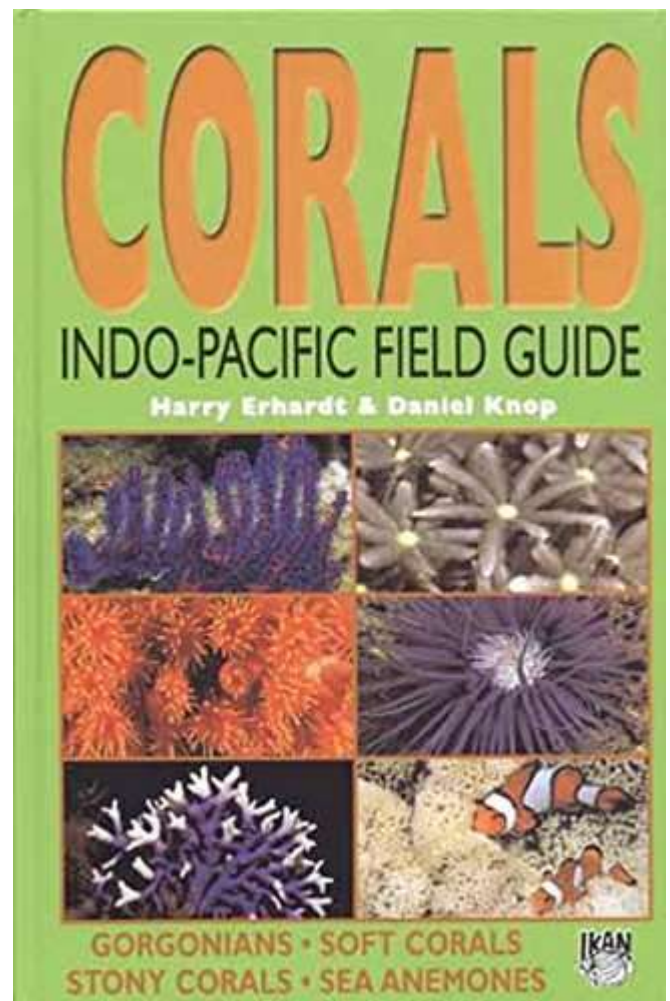
IKAN. 305 pages (February 2005)

ISBN 978-3925919695

This is an amazing book, amazing in the gorgeous color photos and the breadth of what it covers: over 1000 photos of scleractinia (hard corals), gorgonians, soft or leather corals, sea pens, sea anemones, corallimorphs, zoanthids, black corals, and fire corals, plus a few smaller groups. The number of places that the

photographs in this book were taken is likewise amazing, places like Indonesia, Maldives, Red Sea, Malaysia, Vanuatu, Palau, Papua New Guinea, New Caledonia, Philippines, Solomon Islands, Great Barrier Reef, and Thailand. About a third of the book is devoted to soft corals, gorgonians and sea pens, about a third covers scleractinia, and about a third is on sea anemones, corallimorphs, zoanthids, black corals and relatives.

All but 4 of the 183 species of scleractinia are identified to species, the 4 being identified to genus. Thirty of the 96 species of anemones and relatives are identified to genus. Seventy-three of the 152 species of gorgonian, soft corals, and sea pens are identified to genus. The differences between these groups most likely reflect the state of the taxonomy. As difficult as the scleractinia are, the gorgonians, soft corals, anemones and their relatives are even harder, particularly harder to identify alive, since many of the features needed to ID them are anatomical features that can't be seen in the live animals. Species that aren't identifiable to species at present can be highly distinctive, and so in time, when taxonomists connect



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Reef Shelf: Where Corals Lie



up the name with how they look alive, they may become easier or even easy to ID. Plus, it is not bad that some are not identified to species, many of those may be new species and it is good to have them in a guide book and stimulating taxonomists to find them, collect them, and describe new species. In addition, it is better to identify a species to only genus than try to shoehorn it into a named species to which it doesn't fit. Having these species shown alive, even without a species name, can make them identifiable in the sense that you can say that they are something like "*Cerianthus* sp. sensu Erhardt and Knop, p. 279," and that tacks down what you are talking about, so others can understand. It is a very useful contribution and helpful to the users.

It appears that this book has more soft corals, gorgonians, anemones and their relatives identified to species than any other field guide available. On the other hand it has many fewer hard coral species than Veron, 2000, *Corals of the World*, or its on-line version www.coralsoftheworld.org. In a sense, the latter two are limited as field guides, because the 2000 book is three huge volumes, which are too heavy and bulky to lug around on dive trips, and the website can only be accessed if you have an internet connection. The Erhardt and Knop book, on the other hand, is a perfect size to take on a trip.

For soft corals and gorgonians, the field ID guide written by the experts is Fabricius and Alderslade, 2001, *Soft Corals and Sea Fans*. That guidebook only identifies them to genus, in part because identification of live colonies at the species level is so uncertain. For hard corals, the field guide written by the expert is Veron (2000), updated in www.coralsoftheworld.org.

The question arises as to the accuracy of identifications. In the Erhardt and Knop book, I count 183 species of scleractinia, 97 of which appear to be correct identifications. However, 50 images I can't confirm because the coral in the picture is too distant (or some other reason), and 36 appear to be incorrectly identified. One, *Coscinarea macneilli*, on page 145, appears to be a sponge, I think I can see the oscula (though it would take a closeup picture to tell for sure). One of the problems is that to ID scleractinia, you need to know both the colony shape and the fine features, so you need both a colony photo and a closeup or macro shot, and that eats up book pages. Mind you, coral taxonomists are themselves not in full agreement on all species, there are quite a few disagreements. But a field identification guide needs not only excellent photographers, but also expert taxonomists to do the identification, otherwise you end up with a beautiful

coffee table book, not an ID guide, because identification of corals is hard.

The book provides lots of good background information on what corals are. One error is that it states that the skeletons of scleractinia are made from calcite; they are in fact always made of aragonite. There are also 11 picture stories providing more information. In summary, this book is a very useful guidebook as well as a gorgeous picture book, illustrating a wide array of the vast diversity of hard and soft corals on Indo-Pacific coral reefs.

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Where Corals Lie ***A Natural and Cultural History***

J Malcolm Shick

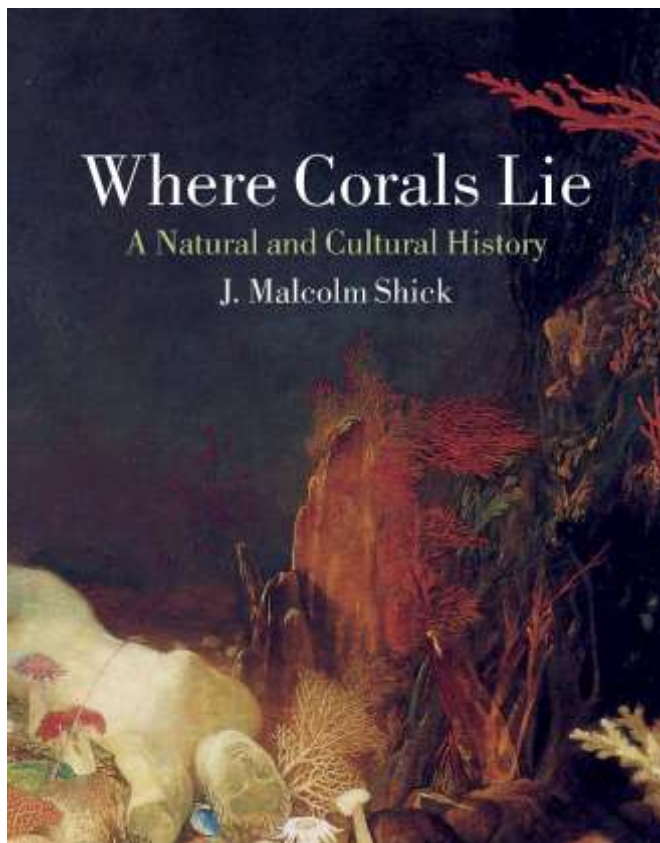
Reaktion Books, London. 352 pages (June 2018)
ISBN 978-1780239347

This is a truly delightful, lavishly illustrated and unusual book, that most seasoned members will be eager to possess and many younger researchers keen to read. For many it will make the perfect Christmas gift!

It is not, by any means, a standard scientific account of the biology and ecology of corals and reefs. Instead, as the second part of the title – *a natural and cultural history* – implies, it approaches the natural history of corals from a historical perspective. The book also includes a fascinating account of the history of corals as artistic and religious objects, as the subjects of poetry, of music, of sculpture and literature, and the material of which cathedrals, forts and airports have all been built. The first two chapters detail the debate going back to Aristotle over whether corals were plants or animals or stones, and the eventual realisation that they are animals that contained algae that photosynthesise. In its final chapter the book comes back to overview our modern scientific perspective and knowledge of coral reefs. This may possibly sound like meagre fare for dedicated scientists, but the book is full of fascinating facts that, I suspect, can be used to intrigue your friends and relations, more easily than any attempted explanation of your latest research paper.

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The author traces in great detail the history of man's knowledge of corals and his/her habit of acquiring samples, most usually in ancient times of precious red coral (*Corallum rubrum*) from the western Mediterranean, that eventually found use not only as beads and necklaces (Mary Lincoln had one), but as religious objects and works of art. This was so not only in Europe, but in Tibet, where from the 8th century pieces were donated to Buddhist monasteries, and in China, where red coral buttons on their ornate hats were the mark of second grade court officials during the Qing dynasty. But I was pleased to note (as a Brit) that the first recorded collector of coral seems to have been a compatriot whose grave from over 200,000 years ago contained a pendant of hard coral (albeit a fossil).

Most active coral reef researchers probably have the idea that prior to the invention of the SCUBA tank and the modern underwater camera, corals and reefs were little appreciated, other than as fearsome hazards to shipping. I remember, after being inspired by Hans Hass' underwater explorations in the Red Sea, how as a student in the late 1960s I was terribly disappointed to find that the then textbooks and lectures seemed to contain no pictures of corals that remotely resembled the living reef. But as Malcolm Shick so well describes, had I known where to look I could have found not only

the elegant anatomical figures of coral by such as Hinrich Nitsche and Henri Milne-Edwards, but also the underwater paintings of Eugene de Ransonnet, who in the 1860s sat in a torso size diving bell, fitted with port holes, so he could sketch what he saw, and the beautiful delicate paintings of live hard coral specimens accurately illustrating their colours contained in W. Saville-Kent's *The Great Barrier Reef of Australia* (1893).

Writings that demonstrate an awareness of the attractive character of corals and reefs also go back much further than most might suppose. As early as the first century CE, Strabo described how the whole of the Red Sea coast was lined with "underwater trees" (i.e. corals), although Pliny warned that such trees could rip the rudders off of passing ships. But Matthew Flinders, who extended James Cook's charting of the Australian coast and was similarly concerned with the dangerous nature of reefs, also describes how one day "the water being very clear...a new creation was presented to our view...wheat sheaves, mushrooms, stagshorns, cabbage leaves and other forms, glowing underwater with vivid tints of every shade.." a description of the stunning beauty of a diverse healthy reef that most of us will recognise. Likewise, a series of early scientists have been moved to indicate the attraction of reefs that they experienced, including Charles Darwin, Carl Klunzinger and Alfred Goldsborough Mayor (see also page 31), who confessed in his *Medusae of the World* (1910) that it was love not logic that impels the naturalist to his work.

In short, this volume is stuffed full of fascinating and curious detail describing man's long relationship with coral, from the earliest times to the present. Happily for Malcolm Shick, there are many more intriguing facts than I can reveal during this short review. If I have one mild criticism of the book (and I mention this only since reviews are meant to be balanced), in a few passages the account of artworks (see page 71) where the author has spotted a coral is in places a touch less structured than it might be.

"Where Corals Lie"? - the title of the book is taken from that of a poem by Richard Garnett, written in 1859, and best known after being set to music by Edward Elgar in 1899. It's first verse perhaps refers to the spirit that drew so many of us to tropical shores:

*The deeps have music soft and low
When winds awake the airy spray,
It lures me, lures me, on to go
And see the land where corals lie.*

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CONFERENCES & WORKSHOPS

ECRS2017

The European Coral Reef Symposium, Oxford, UK

conference accounts by students awarded ISRS travel grants

A Winter's Tale - of coral reef research!

The trip to Oxford started with a very long coffee break at the airport, not because of the snow, but because the crew of our flight went to bed late the previous night and needed some more sleep (yes this was actually the official announcement). We suspected that this was probably caused by a crew excursion to the Bremen Christmas market, including some mugs of Glühwein, and decided to use the time to start exploring the conference app. This tool turned out to not only be very useful for arranging my personal schedule for talks and workshops, but later also revealed to be awesome for communication throughout the entire conference and beyond.

Arriving to Oxford felt a bit like driving into a Harry Potter movie, first passing by the little houses outside town that looked like a Dursley would just step out the door any moment, and then the stunning historical buildings of golden limestone that emit a glint of mystery and wisdom, reminding me of Hogwarts. After dropping our bags, we wandered over to the conference venue to register and pick up our conference materials. To our great excitement, these eco-friendly bags were filled with sustainable products such as a reusable coffee mug made from bamboo, as well as a wooden toothbrush, nametag and USB stick.

Still amazed by the beautiful scenery around us, we headed over to the student pub-crawl. Besides meeting some old and new friends here, I learned to my great surprise how many different kinds of beers and ales there are in the UK, and that they don't all just come out of taps, but some have to be pumped up manually.

The first conference day started with an inspiring opening plenary, followed by interesting and diverse talks about mechanistic insights into coral calcification, functional microbial ecology and coral reef research in the furthestmost regions of Europe. At the end of a long day of stimulating presentations, we were all rewarded



The ECRS venue was the historic Examination Hall (Schools) located in Oxford's busy and picturesque High Street (photo: C. Schmidt).



The largest of the conference rooms in the historic Examination Schools, the T-shaped South Hall.

by a drinks reception in the picturesque Oxford University Museum of Natural History. This gave the perfect opportunity to engage into discussions and reunite with some colleagues, while enjoying the striking exhibition which even contained one of my favourite and sadly more than rare animals, the dodo.

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Conferences & Workshops: Impressions of ECRS2017



Left: The daily walk to the venue gave my colleagues and myself some time to discover the city. Centre: During the drinks reception we had plenty of time to admire the fascinating Oxford University Museum of Natural History with its interesting architecture and its impressive collection, while meeting up with colleagues and discussing science. Right: Showing off my penguins and seeing so many other people wear Christmas jumpers made the Friday very cheerful (photos: N. Herran).

The Thursday program made it hard to decide where to go with many fascinating sessions about emerging techniques in reef studies, the diversity and function of coral symbionts, climate-induced shifts in structure and assemblages of reefs, speed talks about coral reefs in the Anthropocene, and workshops on reef genomics and bioinformatics, as well as on imaging techniques, often running parallel. The following poster session was so well attended that it was hard to get around, and even harder to leave. Luckily, many conversations could be continued during the RCUK 20th anniversary conference dinner in the hall of Somerville College.



A little bicycle race between sessions (right, photo: C. Schmidt) not only recharged the phone battery so I could continue scheduling the meeting and communicating with other researchers on the ECRS app, but also nicely illustrated the amount of energy some electric devices are consuming (left), as well as bringing my brain back up on track for the next round of presentations.

Friday was unfortunately already the last day of this gathering of coral reef enthusiasts. Dressed in a most charming Christmas jumper, borrowed from a friend, I spent another day jumping between sessions to learn

about new findings in the fields of coral reef building and breakdown, coral reef engineering (made me happy to finally also see some forams represented), epigenetics, and the capacity of corals to adapt or acclimatise. After listening to a row of quite depressing talks the day before, which reported the vast extent of bleaching and mortality affecting coral reefs worldwide, following the terrible last El Niño, it was great to see some signs of “adaptability” as a spark of hope for coral reefs. Accordingly, this intensive and highly intriguing day was completed by a closing plenary on assisted evolution of corals for the future reef restoration.

Highly motivated and with a head full of new insights and ideas, I was very sad that the end of ECRS had already come. Meeting so many former colleagues and discussing science with them made it feel a bit like school reunion, while the variety of institutions represented made the conference more like an International one than a European symposium. I am still amazed by the elaborate and thoughtful organisation that took sustainability so seriously, avoiding all unnecessary paper and plastic, providing very tasty vegetarian food and even making us cycle to charge our phones. Thank you very much for putting so much effort into this meeting, and many thanks to the ISRS for funding my participation! I had a great time and went home with lots of valuable experiences, from a scientific and personal perspective.

Marleen Stuhr

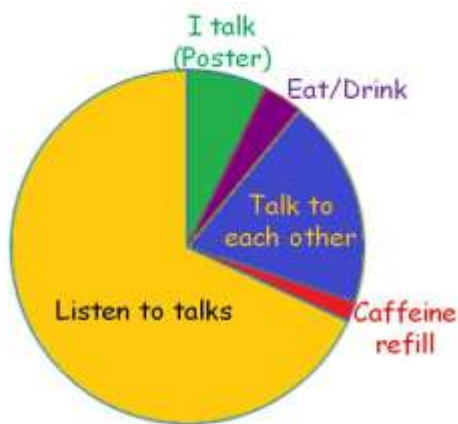
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Conferences & Workshops: Impressions of ECRS2017



An ECRS Experience

The conference venue for the European Coral Reef Conference was as contrasting as it could possibly be from the tiny research station in Okinawa, Japan, where I am currently pursuing my PhD. It felt incredibly surreal, talking about tropical coral reefs in English gothic style buildings surrounded by cold winds and rain, as if I were in an alternate reality where Harry Potter was a marine biologist. And so, the three-day event started at Hogwarts School of Coral Reef Research.



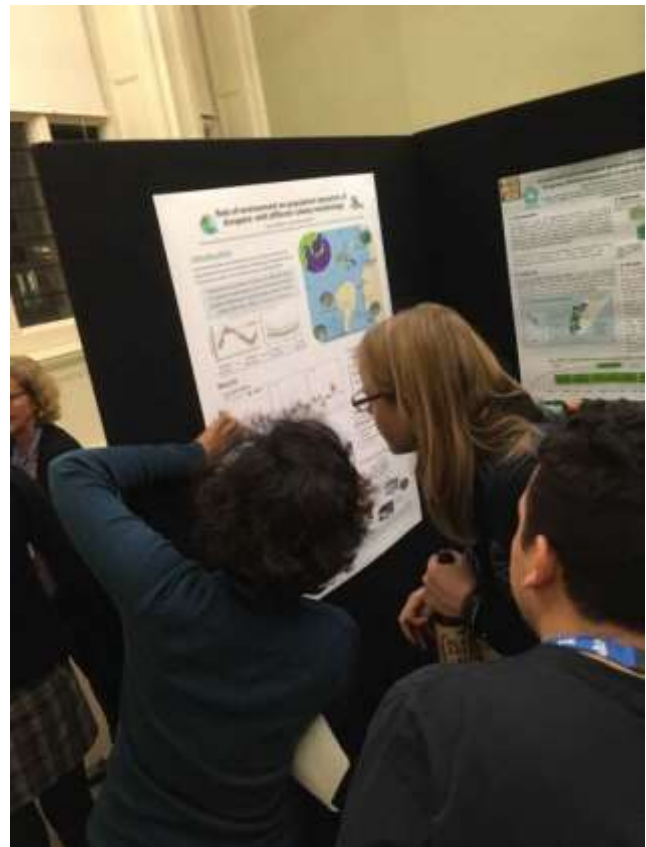
Pie-chart showing my time spent on various activities

As indicated by the pie-chart (above), apart from listening to presentations, a maximum amount of time was spent interacting with other conference attendees; this was possible because of coffee/tea breaks after each sub-session, which allowed to us to interact with presenters and other attendees, and to really just absorb the information we had got during the talks. Aside from coffee breaks, “lunch with the mentors” organized by the ISRS student committee contributed to this section of pie chart. This was an extremely useful experience for me, especially considering that this was my first big international conference. We received some very useful advice on tackling some of the common problems we face as students, as well as some concrete advice and comments on our own research.

Moving on to my own main event at the conference - the poster presentation: I found that event gave me the opportunity to share my research with fellow researchers from a wide range of specializations and backgrounds. I received some very useful critiques and, above all, the experience made me feel confident about sharing my research. Meanwhile my biggest difficulty was navigating among highest density of ≥ 6 feet tall individuals km^{-2} I had ever witnessed in my entire life.



Our “Mentor Lunch” with Peter Mumby and Morgan Pratchett

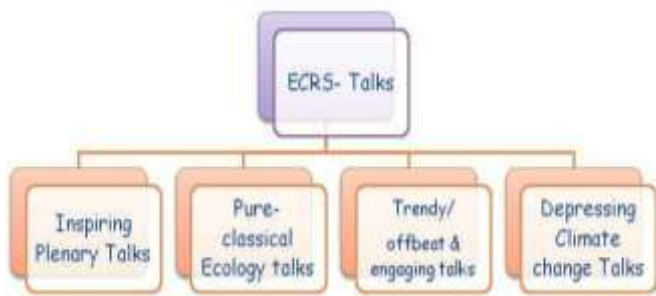


Poster and poster session!

A major chunk of my time was spent “presentation-hopping”. I was actually really impressed and a bit overwhelmed by the sheer number of talks I attended. At first it felt like I had read thirty or so research papers in just three days. However, after some deliberation, I decided I could divide all the talks into the themes shown in the diagram below:

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My own classification of symposium presentations!

As we all know, coral reefs are increasingly facing the threats of global climate change, so it's crucial for us to assess the current state of reefs and consider how we can possibly manage/mitigate the harmful effects. However, a full day of talks on climate induced shifts in reef ecology can be extremely depressing. Most of these talks emphasized the loss of functional diversity or structure of coral reefs.

My personal research interests align more towards ecology; hence these were the talks which excited me the most. Most of the pure ecology talks I attended were in the "drivers of reef ecosystem" session. These talks ranged from subsurface currents driving macro-algae distribution around islands to understanding coral species richness across depth gradient. Then there were few trendy topics (basically any talks which were on topics relatively new to me!), and many talks in the "trait ecology" session (not surprising since this trait-based ecology is a rather recent phenomenon in coral reef science). One particular talk which comes to my mind was on habitat formation in free-living massive corals (coraliths) by free-living stabilization in poor substrate environments. In simple terms it was about a rolling living rock providing substrate for colonization in poor (high sediment) habitats.



Barbara Brown's presentation on her long-term field study. Note the elegant ceiling work and picture frames!

Finally, I must mention the plenary talks; I am confident that every attendee of this conference would agree with my classification for these talks. They were truly inspirational. Heather Koldewey opened the conference with talk on ocean optimism, focusing on her work on marine conservation and its socio-economic applications. Barbara Brown gave a talk on the importance of long-term monitoring and coral acclimatization to light irradiance, citing her extensive 40 years survey in the Andaman Sea, off Thailand. As I mentioned earlier, there were plenty of important yet depressing talks in this conference, but Madeleine van Oppen's talk on coral reef restoration via assisted evolution, transgenerational acclimatization gives us at least some hope for corals in the Anthropocene.

But this symposium wasn't all work and no play. There were plenty of non-scientific activities with the highpoint being the drink reception at the University Museum of National History - because nothing, absolutely nothing, is better than looking at a humongous T-rex fossil skeleton after a few glasses of wine, following which I could cuddle all their stuffed animal exhibits (Note: no specimens were harmed during this event).

Tanya Singh



Drinks with Dinosaurs!

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Corals, Cake and Conservation



Arriving for ECRS2019 (Oxford)

As a recipient of the ISRS's student travel grant I was fortunate enough to be able to attend the European Coral Reef Symposium in Oxford in December 2017. As my first large conference (my previous experience being with the excellent RCUK event last year), December rolled around faster than expected, with a mix of nerves and excitement. Elena Bolatti's blog post on the ISRS student page about how to get the most out of ECRS was timely inspiration for me to work up the courage to talk to as many people as I could, and to remember to enjoy the experience!

This gathering happened in the wake of the worst global coral bleaching event on record. Whilst the Great Barrier Reef was particularly devastated, few parts of the globe have remained unscathed, and unsurprisingly this was a talking point in many of the presentations and workshops. Though there was a sense of loss, my overwhelming impression was that coral reef scientists, managers and conservationists have been approaching their work with renewed urgency and the presentations reflected this. Listening to Heather Koldewey's opening

plenary surrounded by the academic giants of the coral reef world was a powerful reminder to harness some #oceanoptimism, and this galvanizing speech was an excellent way to kick off the conference.

The ECRS organisers successfully scaled up the friendly, inclusive atmosphere of RCUK to a much larger conference, where students just beginning their careers spoke alongside established scientists and the leaders in their field, all in the grandeur of the Oxford University Examination Schools. The obvious effort that the ECRS team and volunteers put in on this made for an incredibly rewarding, positive experience as both a presenter and audience member. This inclusivity was particularly notable in that there were so many incredible women speaking from all over the world (including the three plenary speakers). This was in pleasing contrast to the rows of men glowering down from the portraits on the walls in many of the rooms!



The Examinations School – venue for ECRS2019

Equally wonderful was that every single person that I spoke to was unfailingly kind, and generously found time amidst all the dashing between conference sessions to chat about corals with me. Hats off to the international coral reef community for being absolutely lovely!

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Atmospheric evening drinks in the Oxford Museum of Natural History

Social events alongside the conference included a student meeting in the pub, the night before ECRS proper began, drinks in the Natural History Museum, and a conference dinner at Somerville College celebrating 20 years of RCUK (with a truly magnificent cake). These events provided an opportunity to get to know other people in a more relaxed context, albeit in extraordinary buildings, and proved to be great fun.

Another particular highlight for me was Professor Barbara Brown's plenary about her career-long work on the intertidal reef flats of the Andaman Sea. Barbara's work there encompassed the changing coral community structure over a monitoring period of thirty-eight years, the variety of ways in which corals cope with highly stressful conditions, and the changing impacts of human activity. She also emphasized the need for ongoing monitoring studies and discussed frankly the challenges in funding such work.

ECRS concluded in a blur of caffeine (all in a handy reusable coffee cup) and new ideas. The discussions generated by ECRS have challenged and further informed my own thinking, alongside being a valuable

opportunity to catch up with old friends and make new ones, all with boundless enthusiasm for coral reef science. The experience was hectic and brilliant, and a high bar has been set for ICRS 2020!

Nevertheless, I came away also with a deeper appreciation for the joys of the annual RCUK meetings and drinks in the aquarium at London Zoo. I'll certainly be back there come December 2018.

Louise Anderson



The Reef Conservation UK 20th Anniversary Cake!

ISRS thanks RCUK's Organising Committee (Kirsty Richards, David Curnick, Dominic Andradi-Brown, Robert Yarlett, Rebecca Short, Bry Wilson, Victoria Jeffers, Catherine Head & Mike Sweet) and their team of volunteers, for organising such an enjoyable and successful event.

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Conferences & Workshops: Coral Triangle Mesophotic Workshop



ECRS 2017 Best Student Presentations

RCUK and ISRS were pleased to be able to announce the winners of the ISRS sponsored awards for the best student presentations at ECRS 2017! The four winners received, who each received a US\$100 cash prize and an ISRS T-shirt, were:

Laura Stoltenberg (Southern Cross University, Australia) for her talk entitled "Temporal variation in sediment dissolution rates under ambient and elevated pCO₂ in a shallow coral reef lagoon."

Jessica Bellworthy (Bar Ilan University, Israel) for her talk entitled "Corals in the Gulf of Aqaba are pre-adapted for climate change: trans-generational effects upon early life history physiology."

Nils Rådecker (King Abdullah University of Science & Technology, Saudi Arabia) for his talk entitled "Understanding coral bleaching in the light of holobiont nutrient cycling."

Jamie Craggs (Horniman Museum & Gardens and University of Derby, UK) for his talk entitled "Developing land-based coral facilities to simulate multiple ex-situ broadcast spawning events per year for reef restoration."

The home institutions of the winners were indicative of the range of participants attracted to the conference. Huge congratulations to the winners and thanks to all the other graduate and undergraduate students who provided an excellent range of presentations and posters.

Workshop to Develop Collaborative Mesophotic Coral Research in the Coral Triangle

2nd and 6th of October 2017

Place: Hasanuddin University, Makassar, Indonesia

Mesophotic coral ecosystems (MCEs) are widely recognised as ecosystems of special interest. Between their potential role in biodiversity preservation in an era of climate change, the specific nature of their coral and associated assemblages and the general lack of knowledge about these remote ecosystems, research on MCEs is developing rapidly. However, most of the information on MCEs is concentrated in a few parts of the world's oceans. In particular, the mesophotic zone remains largely unexplored in the region of the world hosting the most important coral biodiversity, the Coral Triangle. To remediate to this situation a workshop was organised to develop collaborative mesophotic research in the Coral Triangle.



Photo above: Preparing photo-quadrats while leaving Makassar for the Spermonde Archipelago.

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Conferences & Workshops: Coral Triangle Mesophotic Workshop



This workshop was co-organised by the Harii Lab in the University of the Ryukyus, Japan (Dr. F. Sinniger) and the Faculty of Marine Science and Fisheries from the Hasanuddin University, Indonesia (Prof. Jompa). It was held in the campus of the Hasanuddin University in Makassar between 2nd and 6th of October, 2017. In addition to participants from the host institution, Dr. H. Madduppa and several members from Bogor Agricultural University (Indonesia) shared their research experience on Indonesian coral reefs. From the Philippines Dr. Patrick Cabaitan, from the Marine Science Institute of the University of the Philippines, joined the discussions and provided insights on the situation in the Philippines. The 16 researchers participating to the workshop also enjoyed the presence of several students.

The discussions allowed us to raise numerous research topics that could be addressed in the region, from coral reproduction to biodiversity. This workshop emphasised the great importance of developing fair collaboration, with local researchers being involved in all steps of the research, from field work to data processing and publication. With this perspective, a short field trip was organised in the Spermonde archipelago to provide relevant training to participating researchers on some accessible methods for exploring MCEs and surveying the coverage and biodiversity of mesophotic corals. Most of the training was made on shallow reefs, since the deeper areas at the site were largely covered with sand. However, after moving further offshore, and despite the background noise of dynamite fishing (a first and deeply disturbing experience for the Japanese researchers), we finally found some mesophotic corals and were able to share our excitement with local students and researchers.

Overall, the workshop allowed us to develop the core of an international network for researchers sharing the same philosophy on collaborative studies of MCEs in the Coral Triangle. Hopefully, more researchers and institutions will join this effort to develop mesophotic coral research in the Coral Triangle, while the network will be able to provide exchange opportunities for Coral Triangle students and researchers, so that they can acquire and develop new skills, and so become leaders in mesophotic research within the region. Ultimately, the knowledge obtained from this region will contribute to the global understanding of MCE biogeography and biology.

Frederic Sinniger



Researchers and students participating in the first day of presentations at Hasanuddin University, Indonesia.



Students training with photo-quadrats on shallow reefs near Barrang Lompo.

on behalf of the participants
fredsinniger@hotmail.com



20th Anniversary Japanese Coral Reef Society (JCRS) Annual Conference: JCRS hosts its First International Symposium

From November 23rd to 26th, 2017, the Japanese Coral Reef Society held its Annual Conference hosted by Prof. Kazuo Nadaoka at The Tokyo Institute of Technology, Tokyo, Japan. This was a very special occasion since that year JCRS celebrated its 20th anniversary. As a mark of this the meeting was also something of a new start for the Society, indicative it is hoped of further exciting developments in the future. On this occasion the 20th Annual Conference was organized as a First International Symposium, with the aim of promoting networking among all relevant researchers in the Asia-Pacific region and as a step towards forming a Regional Chapter on the lines envisioned by the International Society of Reef Studies (ISRS).

The International Symposium was entitled “Asia Pacific coastal ecosystems in danger: Establishing international collaboration networks towards the next decade of JCRS”. It was a stimulating event having the participation of a series of important overseas guests including: Prof. Suharsono from the Indonesian Institute of Sciences (LIPI), Prof. P. Aliño from the University of the Philippines, Prof. T. Yeemin from Thailand, Dr. Tran Dinh Lan from the Institute of Marine Environment and Resources (IMER) Vietnam, Dr. Yim Golbuu from Palau and Dr. Ranjeet Bhagooli from the University of Mauritius. Among Japanese researchers participants included Dr. T. Nakamura (University of the Ryukyus), Prof. H. Kayanne (University of Tokyo), Prof. Y. Suzuki (Shizuoka University), Prof. K. Nadaoka (Tokyo Institute of Technology) and Prof. Beatriz E. Casareto (Shizuoka University) who acted as moderator. The symposium included 50 minutes presentations from each of the guests and 1-hour final panel discussion in which the main topics raised during each guest presentations were discussed. All the participants supported the need to strengthen regional networking and recommended strengthening collab-

oration among young scientists in order to continue these efforts. Most of the participants emphasised the need for new proposals for solving regional environmental issues and for promoting cooperation with NGOs, NPOs, stakeholders and policy makers, as a means for achieving such aims in years ahead.

Following this JCRS held a second public symposium on Nov 27 in collaboration with the Sasagawa Peace Foundation (SPF) (<https://www.spf.org/e/>) within the context of a conference series named “Ocean Forum” that SPF is arranging once a month at its headquarters at Minato-ku, Toranomon, Tokyo. The JCRS organized symposium was titled “Challenges for the conservation of coastal ecosystems in the Asia-Pacific region at great risk”, with Dr. P. Aliño, Dr. T. Yeemin, Dr. Y. Golbuu Dr. R. Bhagooli and Dr. Nadaoka as the principal speakers. The audience included not only scientists but also citizens from a wide spectrum of occupations, including staff of private companies, students and the press; they were without doubt impressed and concerned to hear the critical environmental issues facing our coastal and marine ecosystems. The collaboration with the SPF promises to be an important opportunity for the proposed regional chapter, since the main mission of



JCRS International Symposium Panelists: from left Prof. K. Nadaoka, Prof. M. Hidaka (President of the JCRS), Prof. B.E. Casareto, Dr. Tran Dinh Lan, Prof. T. Yeemin, Prof. P.M. Aliño, Prof. Suharsono, Dr. R. Bagooli, Dr. Y. Golbuu, Dr. T. Nakamura, Prof. Y. Suzuki and Prof. H. Kayanne. November 26, 2017 (Tokyo Institute of Technology).

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SPF is to strengthen cooperation at all levels between Japan and countries abroad, and a specific purpose being to promote activities and proposals in Asian and Pacific countries for improving ocean management policies.

The main conclusion of both these twin symposia, was that participants and audience agreed on the need to promote regional collaboration as a means of achieving the protection of our coastal ecosystems, considering that collaborative regional efforts will be more effective than isolated local efforts. It was proposed to organize a second international regional symposium in Indonesia, in 2019.



Panelists at the SPF “Ocean Forum” Symposium: from left to right: Dr. R. Bagooli, Dr. Y. Golbuu, Prof. T. Yeemin, Prof. P. Alino, Prof. K. Nadaoka, and panel discussion moderator, Mr. Kobayashi (SPF). November 27th, SPF headquarters (Toranomom, Minato-ku, Tokyo)

Beatriz E Casareto

Research Institute of Green Science and Technology, Shizuoka University



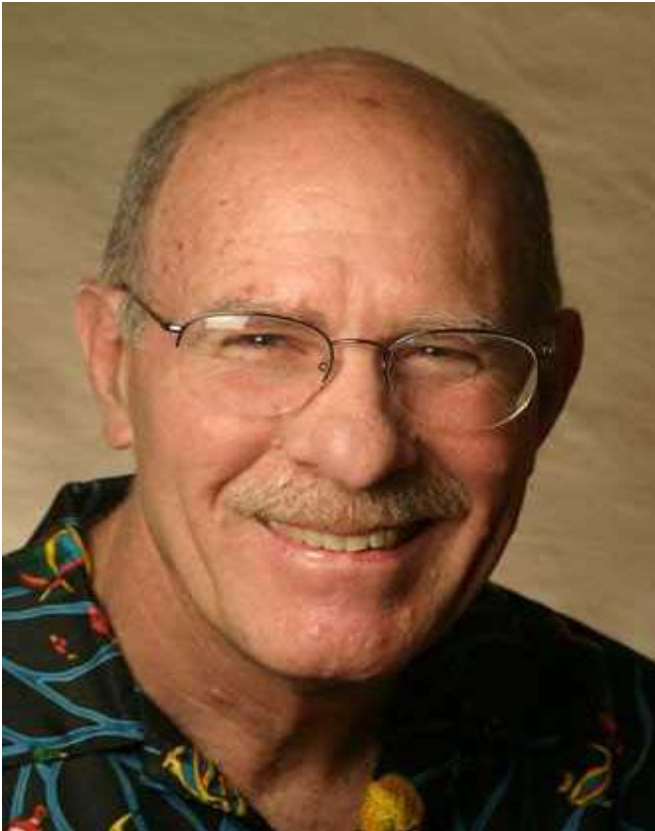
One of the many colourful illustrations to be found in Malcolm Shick’s book *Where Corals Lie*, reviewed on pages 60-61. The picture is of a ceiling painting from the Nishidomari Tenmangu Shrine, showing Daikoku, one of the seven Shinto deities of fortune, and a symbol of wealth, buying an impressive colony of precious red coral. Photograph by Shinichiro Ogi, from Akemi and Nozomu Iwasaki, *Cultural and Historical Perspectives on Precious Corals [in Japanese]*, 2011, with permission.



REEF DEPARTURES

Tributes to recently departed members and reef scientists

John Wesley ("Wes") Tunnell



We regret to inform the coral community that Dr. John Wesley ("Wes") Tunnell, Jr., 73, passed away on July 14, 2018 after a long battle with cancer. Wes was a marine ecologist and biologist focusing primarily on coastal and coral reef ecosystems. Although he did most of his field research in Texas and Mexico, he traveled extensively for research, meetings and presentations in over 35 countries. Wes received his B.S. (1967) and M.S. (1969) in Biology from Texas A&M University, and his Ph.D. in Biology (1974) from Texas A&M University. He served in the U.S Army for two years (1969-71) at Fort Baker, California. He began his academic career in 1974 at what would become Texas A&M University-Corpus Christi and retired from there in 2015, but remained active in research and academic programs until his passing. His recent activity is evident

in the several mss. and abstracts currently in press. Wes held many titles, including Professor of Biology in the Life Sciences Department, Endowed Chair of Biodiversity and Conservation Science at the Harte Research Institute for Gulf of Mexico Studies, Regents Professor and Professor Emeritus. Wes was also a Fulbright Scholar.

Wes advised or co-advised 71 M.S. students, 7 Ph.D. students, and 4 post-doctoral research associates. For 32 years, he taught a Coral Reef Ecology class, perhaps the most popular course at the university, taking students on two-week field trips to Veracruz, or later, the Mexican Caribbean as part of an international teaching and research program. This was one of 18 classes he taught over the course of his career. He was known for conducting class from the deck of a boat and lecturing in scuba gear; many students were inspired to begin their biological careers after taking his courses. Wes cofounded the Center for Coastal Studies, Texas A&M University-Corpus Christi, in 1984 and served as its Director until 2009. He was instrumental in establishing 7 graduate student scholarships at the Center for Coastal Studies. He was the guiding force in the creation of the Harte Research Institute for Gulf of Mexico Studies and served as Associate Director from 2001-2015. He was also Adjunct Curator of Malacology and Marine Biology (2007-2014) and Curator of Marine Biology in the Houston Museum of Natural Science.

Wes published 114 peer-reviewed manuscripts and 76 technical reports, and received 154 research grants and contracts worth more than \$20 million. He also wrote seven books: the most notable were *Coral Reefs of the Southern Gulf of Mexico*, *Encyclopedia of Texas Seashells*, *Texas Seashells-A Field Guide*, *The Laguna Madre of Texas and Tamaulipas*, and *Pioneering Archaeology of the Texas Coastal Bend — The Pape-Tunnell Collection*, all published by Texas A&M University Press. He was also editor of two book series for Texas A&M University Press: Gulf Coast Books, with 31 titles; and the Harte Research Institute for Gulf of Mexico Studies Series, with 14 titles. He received numerous awards and served on many professional and community service boards and councils.

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The News Journal of the International Society for Reef Studies
Reef Departures: Robert Ginsberg



Wes is survived by his childhood sweetheart and wife of 52 years, Kathy Lea Aldridge Tunnell, three children, Stephanie, Jace, and James Tunnell, five grandchildren, and a legion of friends, former students and graduate students. I will miss Wes dearly, as he introduced me to the sea and took me on my first open water scuba dive while I was an undergraduate. Those who knew or corresponded with Wes know of his fondness for the songs of Jimmy Buffett. We hope that Wes has found his "One Particular Harbor".

Dr. Thomas C. Shirley

Professor Emeritus, Texas A&M University-Corpus Christi
Professor Emeritus, University of Alaska Fairbanks

Robert Nathan Ginsburg



Robert Nathan Ginsburg (1925-2017) was a geologist who studied carbonate sediments, their genesis, deposition, and transformation into mature rocks. He defined the profession of carbonate sedimentology and was one of the most influential thinkers in his field working in both industry and academia, retiring at the age of 85. His career began in 1950 when he left the University of Chicago to become a research assistant at the University of Miami's Marine Laboratory, the precursor of the present Rosenstiel School of Marine and Atmospheric Science (RSMAS). Subsequently he moved first to establish and lead a research and training program on carbonates for the Shell Development Company in Coral Gables (1954-65) and then to become Professor of Geology and Oceanography at The Johns Hopkins University (1965-70). In 1970, he was persuaded by Cesare Emiliani to come back to the

University of Miami as Professor of Sedimentology. At that time, he organized the T. Wayland Vaughan Laboratory for Comparative Sedimentology headquartered on ocean-facing Fisher Island at the entrance to the Port of Miami. In 1991, the University sold Fisher Island and Bob moved fulltime to the RSMAS campus, where he continued to develop and pursue new avenues, exchanging his role as head of the Sedimentology Laboratory for an effort to spearhead the assessment of declining coral reefs in the Caribbean. In this new direction, he touched an entire new generation of scientists.

His first published paper appeared soon after his arrival in Miami, 'Intertidal Erosion on the Florida Keys' (1953). It was a harbinger of his future career as it questioned the prevailing chemical explanation for shoreline erosion by offering a biological alternative. In the following half century, with his associates, post-doctoral fellows and students he authored a series of seminal papers, books and reports on the links between contemporary and Holocene processes and products of carbonate deposition and their fossil counterparts. These publications have ranged from the formation of dolomite, precipitation of cements in reefs, health of coral reefs, sedimentation and history of carbonate platforms, and stromatolites. These studies, combined with countless field trips and lecture tours in North America, Europe, North Africa and Australia, have had a significant worldwide influence on research, teaching and the petroleum potential of carbonate deposits. A measure of this impact is the award of Fellowship in the American Association for the Advancement of Science and the Geological Society of America, the Twenhofel Medal of the Society for Sedimentary Geology, the Sorby Medal of the International Association of Sedimentology and honorary membership in four professional societies

While his impact on his profession has been immeasurable, he has also been an inspiring teacher and the principal advisor for more than 20 graduate students as well as numerous post-doctoral associates. While some of his students and post-doctoral associates stayed at home in Miami, others have become distinguished teachers and geologists throughout the world. It would almost be understated to say that Bob Ginsburg's influence upon the study of carbonate environments has been immeasurable.

Peter Swart

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The News Journal of the International Society for Reef Studies
ISRS Membership



ISRS MEMBERSHIP

ISRS membership is open to all persons interested in any aspect of the science of coral reefs. While the society's membership consists principally of researchers, managers and students with interests in coral reefs and associated ecosystems, other people with genuine interests in or concern for reefs, of any type, are welcome.

The benefits of membership include:

- ❖ Receipt of the Society's scientific journal *Coral Reefs* (either on-line or hard copy)
- ❖ Receipt of the Society's newsletter/magazine *Reef Encounter* (by email or on-line)
- ❖ Access to the Society's on-line membership services, including the on-line Membership Directory
- ❖ Reduced registration fees for the International Coral Reef Symposium and other meetings sponsored by the Society.

Full / Individual Member

Membership includes all the benefits listed above, but rates vary depending on whether a hard-copy subscription or on-line access to the Society's academic journal *Coral Reefs* is preferred, and according to the mean income level of the member's country.

Student Membership

The benefits are the same as for a Full / Individual Member, and include hard copy or on-line access to *Coral Reefs* at a much reduced rate.

Family Membership

Family memberships are available for partners who live at the same address. Each receives the same benefits as Full Individual Members, but only one hard copy of any journal is supplied.

Sustaining Membership

Sustaining Membership is for those Members who would like to contribute extra to support the work of the Society. They receive additional minor benefits and their support is acknowledged in Society publications.

Honorary Membership

Honorary Membership has been conferred on a small number of members who have rendered special service to the society or otherwise distinguished themselves in the field of reef science.

Membership services are now operated by Schneider Group which provides such services to academic societies. They may be contacted at:

ISRS Member Services

5400 Bosque Blvd, Suite 680
Waco, Texas 76710-4446 USA
Phone: 254-399-9636
Fax: 254-776-3767
email: isrs@sgmeet.com

The membership subscription varies considerably depending on the type of membership selected and the primary country of residence of the member. Very generous membership rates are available for students and residents of developing countries. For low to low-middle income countries, full membership costs only \$40 (US) per year, and student membership only \$20 (US) per year.

For details of current rates and to complete the on-line membership form or download a hard copy please go to the society's membership services page at:
<https://www.sgmeet.com/isrs/membership/memberlogin.asp>

NOTES FOR CONTRIBUTORS

Reef Encounter welcomes the submission of Scientific Articles, News Items, Announcements, Conference Reports and Book and Product Reviews, relevant to the coral reef researchers and managers. We especially welcome contributions by young researchers with a fresh perspective and seasoned reef scientists able to integrate a lifetime of experience.

Colour pictures or other illustrations (normally 1-3 according to article length) are welcome to accompany an item. Cartoons and stand alone pictures of special note may also be submitted. Different types of item should be sent directly (preferably by email) to the relevant section editors (see inside front cover - page 2 – for details).

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The News Journal of the International Society for Reef Studies
Notes for Contributors



Types of Article

Reef Encounter accepts three distinct types of "Scientific Article". Note that, for any of these types of article, priority will normally be given to authors who are members of ISRS.

The **REEF PERSPECTIVES** section takes 2-4 page articles which express a fact-based opinion about a scientific or management issue. Our goal is to encourage thoughtful and stimulating discussion within and across disciplines and generations. Authors thinking of offering an opinion-type item are encouraged to consult the editor. Readers are encouraged to respond by writing to letters to the **CORRESPONDENCE** section, but such responses should be well reasoned and respectful (in contrast to the faster-paced open discussion characteristic of coral-list).

REEF CURRENTS takes 1-5 page articles which overview a topic or a programme with which the author is familiar or has become acquainted. Priority will be given to articles focusing on subjects which are relative new or poorly known or often misunderstood.

REEF EDGE takes short scientific notes or papers (scientific letters) of three-quarters of a page to two and a half pages in length. The intention is to provide a forum for recording observations of scientific or management value that may be too limited in scope to form the basis of a full scientific paper in a quality journal (such as Coral Reefs). It is especially intended that this section provide a useful vehicle for young scientists or those whose first language is not English. Nevertheless submissions must be based on adequate data and appropriate analysis.

For any of the above type of article no standardised division into sections is required; rather authors can propose section headings as best suited to their material. Similarly abstracts will not be used. However articles should be properly referenced, with typically 3-12 publications cited in a reference section at the end. All types of article will be subject to refereeing by one or more suitably experienced referees.

Style and Format

Contributions should be clearly written and divided into paragraphs in a logical manner. They should normally be in English, but editorial policy is to accept one article per issue written in French or Spanish, but with an abstract in English.

Pages are set with margins as follows: Top 1 cm; Bottom 1.5 cm; Sides 1.3 cm

Reef Currents articles are set as a single column across the page. Reef Perspectives and Reef Edge (and also Reef News) items are set as double columns with the gap between columns = 1 cm

The standard font is: Calibri size 11, with section headings in Calibri 11 Bold. Sub-headings are also in Calibri 11 bold, but set into the beginning of the paragraph. References are in Calibri font size 10, and footnotes in Calibri font size 8.

Paragraph settings are: line spacing = single with a 10 pt line space after a return or at the end of a paragraph, but no additional line spacing before. There is no indentation on either side, except when lists or bullet points are inserted.

Figures & Pictures should have a resolution of at least 350 dpi and be of a size suitable to the format. Each should have an explanatory caption either below or alongside it. Captions should be reasonably full, but not too long. Leave a single line between a figure and a caption below it. Use "Fig." (i.e. abbreviated) in the text, but "Figure" (e.g. Figure 1) to start a caption

Tables may be single column or page width, but large tables are not normally being suitable for publication in Reef Encounter. Each should have an explanatory caption either below or alongside it. Leave a single line between a table and a caption below it.

References

The style of References follows that used by Coral Reefs with no points or stops after initials or abbreviations, but with parentheses / brackets around dates, e.g. for journal papers and books:

Matsuura H, Sugimoto T, Nakai M, Tsuji S (1997) Oceanographic conditions near the spawning ground of southern bluefin tuna; northeastern Indian Ocean. *J Oceanogr* 53: 421-433

Klimley AP, Anderson SD (1996) Residency patterns of white sharks at the South Farallon Islands, California. In: Klimley AP & Ainley DG (eds) *Great white sharks: ecology and behaviour*. Academic Press, San Diego, pp. 365-374

Each reference should have a hanging first line with subsequent lines indented by 0.5 cm. A full list of abbreviations can be found and downloaded from the Springer website at <http://www.springer.com/life+sciences/ecology/journal/338>

