#RCUK2025

Reef Conservation UK

Saturday 6th December 2025

Bangor University

Book of abstracts

Reef Conservation UK
Saturday 6th December 2025
Bangor University, Wales, UK

08:30 Registration opens
09:15 Welcome address

09:30 Plenary speaker I

Chris Perry	Changing geo-ecological functionality of western Atlantic reefs: status, trajectories and future options	Exeter University

10:00 Session I: Reef Ecology and Reef Functions

	Speaker	Presentation title	Institution
10:00	Emi Husband	From Coral to Cay: The Formation of Caribbean Coral Reef Islands	Northumbria University
10:15	Lucy Mae Gorman	Coral venom and toxins as protection against crown-of-thorns sea star attack	PSL Université Paris, France
10:30	Agustin Capriati	Integrative Monitoring of Nutrient Pollution to Support Coral Reef Management and Conservation	Wageningen University, Netherlands
10:45 Speed	Laura-Li Jeannot	Seabirds & small critters: how allochthonous nutrients are funnelled into reef food webs	Lancaster University
10:50 Speed	Niamh Tooher	Early-Stage Testing of Mineral Accretion Technology to Support Coral Spat Development	University of Oxford

10:55 Morning break & poster session (45 min)

11:40 Session II: Reefs in a Changing World

	Speaker	Presentation title	Institution
11:40	Nick Graham	Seabirds and native vegetation increase atoll island resilience to sea level rise	Lancaster University
11:55	Noam Vogt-Vincent	Population growth rate and adaptive capacity, not thermal tolerance, drive long-term coral persistence under climate change	University of Oxford
12:10	Danielle Spring	Climate change impacts to upwelling and shallow reef nutrient sources across an oceanic archipelago	Bangor University
12:25 Speed	Sebastian Hennige	Coralporosis of cold-water coral ecosystems – from 3D printed minireefs to in silico models of habitat loss	University of Edinburgh
12:30 Speed	Sasha Hills	Biophysical characteristics shape functional traits and life-history strategies across an atoll seascape	University of Oxford
12:35 Speed	Laura E. Richardson	Quantifying coral reef–ocean interactions is critical for predicting reef futures under climate change	Bangor University

12:40 Speed	Stephanie Martinez	Hidden microbes of Raja Ampat: How nutrients and temperature reshape benthic cyanobacterial mats	Naturalis Biodiversity Center, NL
12:45 Speed	Orlando Timmerman	Calcification under Climate Change: A Global Meta-Analysis of Reef Responses	University of Cambridge
12:50 Speed	Margot Aubin	Habitat Loss and Invasive Species Plasticity: Lionfish Feeding Strategies in a Degraded Reef in Tela, Honduras	University of Plymouth

12:55 Lunch break & poster session (65 min)

14:00 Plenary speaker II

Melita Samoilys	Fishes and fisheries on western Indian Ocean coral reefs: applied research for conservation	CORDIO, Kenya

14:30 Session III: Under the microscope

	Speaker	Presentation title	Institution
14:30	Konstantinos Georgoulas	Modelling the Goldilocks Zone: Flow and Growth Dynamics of Cold-Water Corals	University of Strathclyde
14:45	Raphaela Gracie	Nutrient availability alters prokaryotic community response to thermal stress in coral holobionts from the world's hottest reef	University of Southampton

15:00 Afternoon break & poster session (60 min)

16:00 Session IV: Reef Conservation

	Speaker	Presentation title	Institution
16:00	Oliver Kippax-Chui	Modelling Hydrodynamics and Larval Settlement in Artificial Reefs	Imperial College London, ZSL
16:15	Adriana Humanes	Cross-stage trade-offs in coral offspring performance following selection for adult heatwave tolerance	Newcastle University
16:30	Maria Loreto Mardones	Long-term acclimation of Persian/Arabian Gulf corals to oceanic salinity: physiological trade-offs and implications for reef conservation	University of Southampton
16:45	John Stratford	Applying Easy AI to Locate Coral Seeding Devices for Reef Restoration Monitoring	Newcastle University
17:00 Speed	Hayley-Jo Carr	The Reef Rescue Network - Coral Restoration Ecotourism	Perry Institute for Marine Science, US

17:05 Student prizes & closing remarks

17:30 Conference closes & drinks reception at Powis Hall

Plenary I – Professor Chris Perry

Professor in Tropical Coastal Geoscience at the University of Exeter

Chris' research focuses on addressing questions about the response of tropical coastal and shallow marine ecosystems (specifically coral reefs and coral reef islands) to the impacts of environmental and climatic change. Increasingly this work has been focussed on the consequences of these impacts, and on resultant reef species transitions and biodiversity shifts, for the geo-ecological functions that reefs sustain. These functions include the maintenance of reef structures and reef structural complexity, reef accretion potential and reef-derived sediment supply. Central to addressing these challengers has been the development of two reef status and monitoring tools, ReefBudget and the more recent SedBudget methodologies. Both are census-based and have potential to be integrated within wider reef monitoring programmes.

Changing geo-ecological functionality of western Atlantic reefs: status, trajectories and future options

The ecology of coral reefs across the tropical western Atlantic (TWA) has been changing rapidly. Coral cover, which commonly averaged 50-60% in the 1970’s, now rarely exceeds 15% and is often lower. Key reef-building species including Acropora palmata and A. cervicornis have largely disappeared, and recent disease outbreaks and periods of extreme thermal stress are diminishing remaining coral populations. These transitions are fundamentally changing the capacity of the regions reefs to sustain the key geo-ecological functions of reef framework construction, vertical reef-building and sediment generation. Rates and processes associated with each have changed markedly, with cumulative negative consequences for reef-derived ecosystem services. Our work over the past ~15 years has shown that the carbonate budgets of most TWA reefs have generally collapsed, and that contemporary vertical reef growth rates are well below long-term historical rates. Sources of reef-derived sediment are also changing – with potentially negative consequences for shoreline sediment supply. Future projections of reef growth potential, factoring for climate change impacts on coral cover and calcification, and substrate erosion rates are grim. Existing low coral cover levels will see many reefs becoming net erosional by mid-Century, but if warming reaches 2°C above pre-industrial all reefs are projected to be net eroding by 2100. Water depths above reefs would increase 0.7–1.2 m, elevating coastal flooding risks and modifying nearshore hydrodynamics and ecosystems. Limiting the impacts from these changes will be challenging. Restoration is one option for enhancing reef growth but would need to be highly targeted geographically and (without significant thermal acclimation) realistic in its use of species. This will require a revised view of what successful restoration in the TWA looks like and what it can deliver ecologically and functionally. The need for accompanying urgent actions on carbon emissions and regional marine environmental conditions are a given.

Plenary II – Dr Melita Samoilys

Director at Coastal Oceans Research and Development in the Indian Ocean, Kenya

Melita is a Director of CORDIO East Africa, a non-government marine research and conservation organisation, based in Mombasa, Kenya, working throughout the western Indian Ocean. She works on coral reefs, artisanal fisheries, marine protected areas, community-based conservation and vulnerable species protection. She is Co-Chair (Snappers), Vice Chair (Africa Sharks) and member (Groupers & Wrasses) of three IUCN Species Specialist Groups. Exploring conservation approaches that are rights-based and improve resilience to climate change for both ecosystems and coastal communities informs her work. She has contributed to marine protected areas and fisheries policy development in four east African countries, Djibouti and Sudan in the Red Sea, and in Australia, Philippines and Solomon Islands.
Melita was born in Tanzania, educated in Uganda, UK and Australia and is a permanent resident of Kenya. Her MSc and PhD were from Queensland University and James Cook University in Australia. She is an Adjunct Academic Staff at Pwani University, Kilifi, Kenya.

Fishes and fisheries on western Indian Ocean coral reefs: applied research for conservation

Fish provide an entry point for understanding biodiversity, fisheries, climate change and peoples' access to food in coral reef ecosystems. Many reef-associated fishes are under threat and food security is being challenged, calling for more innovative marine conservation approaches. I use marine conservation broadly to mean sustainable use and protection for nature and people. I will discuss some of my research in the western Indian Ocean to illustrate how it has informed marine conservation approaches.

Session I:
Reef Ecology and Functions

From Coral to Cay: The Formation of Caribbean Coral Reef Islands

Emi Husband[1]*; Dr. Holly East[1]; Dr. Pauline Gulliver[2]; Dr. Emma Hocking[1]

**Presenting Author*

[1]*Northumbria University*

[2]*Scottish Universities Environmental Research Centre, Glasgow*

Assessing the physical vulnerability of coral reef islands has been a long-standing, global conservation priority amid concern that reef island nations could be uninhabitable by 2,100. Ongoing coral reef degradation is threatening island sediment supplies, which combined with accelerating sea-level rise and more frequent extreme weather events, is predicted to cause widespread island instability and erosion.

Predictions of reef island futures are strengthened by reconstructions of the timing and drivers of past island formation. Indeed, extensive chronostratigraphic research in the Indian and Pacific Oceans has provided valuable insights into Holocene reef island responses to environmental change. However, no comparable data currently exists for the Caribbean, where unique coral reef communities and hydrodynamic conditions limit the transferability of reef island formation knowledge from the other ocean basins.

We present the first chronostratigraphic data for Caribbean reef islands, reconstructed from sediment cores from three Honduran reef islands. Radiocarbon dating revealed that the islands are relatively young, forming after 2,600 cal yrBP, primarily during four sedimentation episodes. Paloma Cay (Cayos Cochinos) accreted first, between 2,600-1,300 cal yrBP, in an oceanward direction, followed by Morgan's and South West Cays (Utila) between 1,500-600 cal yrBP in a lagoonward direction. Date clusters within island cores align with Caribbean hyperactive storm periods. Alongside abundant coral rubble-rich facies, these results indicate a critical role of high-energy events in island formation, where periodic high wave-energies mobilised coarse coral material from surrounding reefs and deposited it atop reef platforms.

The formation of all three islands occurred later than many Indo-Pacific reef islands, and notably, as Caribbean sea-level continued to rise throughout the late-Holocene. Our results thus have important implications for understanding reef island resilience under future environmental change and sea-level rise scenarios, particularly where declining coral cover reduces the availability of suitable reef-derived sediments critical for island maintenance.

Coral venom and toxins as protection against crown-of-thorns sea star attack

Lucy M. Gorman[1,2]*; Ariana S. Huffmyer[3,4]; Maria Byrne[5]; Suzanne C. Mills[1,2]; Hollie M. Putnam[3]

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[4]School of Aquatic and Fisheries Sciences, University of Washington, Seattle

[5]Marine Invertebrate Futures Group, School of Life and Environmental Sciences, Marine Science Institute, The University of Sydney, Australia

Tropical and reef habitats are arguably the most speciose ecosystems worldwide. Despite their general decline, and subsequent efforts to assist their imperilled status, new levels of biodiversity are still being recorded from these regions, further emphasising the need for their protection. In this talk, I summarise my and others' work highlighting one ecological axis little studied but largely important in structuring Caribbean reef diversity: the 12 hours between dusk and dawn. Every night, Caribbean reefs are home to a massive variety of ostracod species (Luxorina, Crustacea) which perform bioluminescent displays to attract mates, analogous to terrestrial fireflies. Males swim up from the benthos to secrete discrete sachets of cerulean slime into species-specific patterns that females use to track and follow them. To catalogue this diversity, we undertook extensive field sampling over the past decade, discovering ~50 new species. When compared with those previously known, biogeographic patterns suggest high endemism, potentially due to low dispersal. To further understand the origins of this diversity, I focused on molecular mechanisms underpinning disparity in their mating displays, which should be important during mate choice. From combining phylogenetics, transcriptomics, and in vitro protein assays, current results show rampant gene duplication and subsequent divergence has generated functional variation in the proteins responsible for creating light during bioluminescence. Despite this, physiological data hint at constraints which may limit display variation. Because these behaviours were only scientifically recorded ca. 1980, and coupled with their small size (~2 mm) and restricted activity to periods of darkest night, Luxorine ostracods have a potentially widening Linnean shortfall with their degrading habitat. To bridge this, future work will focus on species description while connecting functional to phenotypic diversity, and assessing the role of behaviour in reproductive isolation in this understudied but charismatic clade.

Integrative Monitoring of Nutrient Pollution to Support Coral Reef Management and Conservation

Agustin Capriati[1,2,3]*, Stephanie J. Martinez[2,3], Ingrid A. van de Leemput[1], Thomas Kemenes van Uden[4], Purwanto[5], Leontine E. Becking[2,3]

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Nutrient pollution is one of the major drivers of coral reef decline worldwide, especially near urbanized coasts. However, current monitoring approaches are often insufficient to capture the spatial variability of nutrient pollution and its ecological impacts on coral ecosystems. Here, we assessed nutrient pollution at reef ecosystems with varying exposure levels (populated areas, non-populated areas, and river mouths) in the Lease Islands, Indonesia, using a combination of water quality measurements (Chl-a, PO4, DIN, physical characteristics), isotopic (δ15N) nitrogen signatures of macroalgae (Halimeda, Padina, and Dictyota), and the potential use of microbial indicators from benthic cyanobacterial mats (BCM). We found that water quality and inorganic nitrogen measurements vary over short distances (<100m from the coast) across locations, likely reflecting that nutrient levels fluctuate due to mixing and local conditions. Macroalgae species were not present at all sampling locations, with some sites found only Dictyota, Halimeda, or Padina, which might limit their reliability as universal bioindicators of nutrient pollution. In contrast, microbial communities within BCMs showed a separation between river mouth sites, populated and non-populated sites. All sites showed relatively high abundances of pathogenic bacteria such as Vibrio, and populated areas were characterized by high abundance of Okeania, suggesting that BCMs show some signal of nutrient enrichment and environmental stress. Environmental variables (NO2, PO4, NH4, temperature, and turbidity) explained a proportion of variation (47.68%) in BCM community composition. In the river mouth site, BCMs were strongly associated with higher turbidity, while populated sites aligned with elevated PO4 levels. While methodological challenges limited evidence for widespread direct and indirect impacts of nitrogen pollution, our results show some potential ecological risks and warrant closer monitoring. This research demonstrates the value of a multi-method approach for signaling nutrient pollution on coral reef ecosystems to support reef management and conservation.

Seabirds & small critters: how allochthonous nutrients are funnelled into reef food webs

L.-L. Jeannot[1]*; R.E. Dunn[1,2]; J. Velos[3]; G. J. Williams[4]; C.E. Benkwitt[1]; N. A. J. Graham[1]; S. J. Brandl[3]

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Nutrients moving across ecosystems can boost productivity, stability, and resilience. Their integration through food webs is often mediated by small, abundant taxa channelling subsidies from primary producers to higher trophic levels. On coral reefs, cryptobenthic fishes and invertebrates could fill these roles, yet their responses to allochthonous nutrients are poorly understood. We compared cryptofaunal communities and associated trophic dynamics across islands with or without seabird-derived nutrients in the Chagos Archipelago, Indian Ocean. Most cryptobenthic fishes and some invertebrates showed nutrient enrichment. Community patterns revealed strong asymmetries: cryptobenthic fish biomass doubled in nutrient-rich environments, with a tenfold increase in larger piscivorous fish productivity, while cryptic invertebrate biomass stagnated, with reduced invertivore productivity. We hypothesize that their unique life-history traits enable cryptobenthic fishes to exploit subsidies more efficiently, intensifying predation and competition pressure on invertebrates in nutrient-rich environments. Our findings reveal how nutrients are routed through cryptofaunal pathways, underscoring the far-reaching impacts of cross-ecosystem nutrient vectors on trophic functioning.

Early-Stage Testing of Mineral Accretion Technology to Support Coral Spat Development

Samia Sarkis[1], Niamh Tooher[2]*, Alexis Ingham[3]

**Presenting Author*

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Coral reef restoration is increasingly reliant on innovative methods to enhance early growth and survival of coral recruits. Low-voltage electrolysis, which promotes deposition of calcium carbonate on settlement substrates, has been proposed as a means to accelerate skeletal formation. However, its performance in aquaculture settings, especially during the most vulnerable post-settlement phase, remains underexplored. We tested the effects of electrolysis on Porites astreoides spat produced in controlled spawning events in June-July 2025. Spat were settled on ceramic tiles and monitored across three weeks of treatment, with perimeter and surface area quantified using image analysis. Electrolysis substantially enhanced early growth in the 8-week-old cohort. By week 2 of treatment, electrolysis spat averaged 21.1mm perimeter compared to 15.8mm in controls, maintaining a consistent size advantage throughout monitoring. In contrast, the 4-week-old cohort showed no sustained benefit: although electrolysis matched or slightly exceeded controls early in treatment, controls were larger by week 2 (14.3mm vs 11.3mm). Surface area analysis reinforced this pattern, with older spat under electrolysis achieving nearly fivefold greater coverage than controls, while younger spat did not show consistent gains. Health assessments suggested variability among cohorts, with some spat already scoring “poor” at the start. These were excluded from growth comparisons, but their presence raises an important question: can electrolysis aid recovery of compromised spat, or does it mainly benefit already healthy recruits? These findings highlight both the promise and limitations of electrolysis as a restoration tool. Whilst it can stimulate rapid deposition of calcium carbonate, its benefits appear cohort- and context-dependent, with potential health trade-offs. Future work should focus on fine-tuning current levels and exposure duration to balance growth stimulation against colony stress, and on integrating electrolysis with broader husbandry practices to maximise restoration success.

Session II:

Reefs in a Changing World

Talk

Seabirds and native vegetation increase atoll island resilience to sea level rise

Nicholas A J Graham[1*]; Cassandra E Benkwitt[1]; Ines D Lange[2]; Chris T Perry[2]; Eleanor R Thomson3; Lisa M Wedding[3]; Ruth E Dunn[1,4]; Sebastian Steibl[5]; Courtney E Stuart[3]; Laura-Li Jeannot[1]; Jennifer Appoo[7,8]; Julia Rodriguez Fillol[2]; Marleen Stuhr[9]; Pirta Palola[3]; Peter Carr[6]; Jayna L DeVore[10,11]; Simon Ducatez[12]; Anna Zora[13]; Ayla K Hastings[13]; Solène Fabre Barroso[14]; Sean Evans[15]; Melissa Schulze[15]; Emma Cotton[16]; Hazel Reddington[3]; Yadvinder Malhi[3,17]

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[14]Fenua Ecologie; 98702 Faaa Centre, Tahiti, French Polynesia.
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[16]Island Conservation Society; Pointe Larue, Mahe, Seychelles.
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Restoring of ecosystems is expected to enhance ecosystem adaptation to climate change, but there remain very few empirical and mechanistic demonstrations of such assertions. Sea-level rise is an existential threat to low-lying atoll islands and the globally significant biodiversity they support. Nature-based solutions may increase island resilience to sea-level rise, yet the empirical evidence linking nature-based solutions, for example seabird and native vegetation recovery, to the geo-ecological processes that support atoll resilience is missing. Here, we unify science on nutrient subsidies, metabolic ecology and geo-ecological functions to assess the extent to which seabirds and native forests enhance the resilience of atoll islands to sea-level rise. Using gradients of seabird densities and native forest cover across 28 islands and three geographies in the Indo-Pacific, we demonstrate how primary productivity and secondary metabolism on islands and adjacent coral reefs are increased with more native forest cover and seabird nutrient inputs. This enhanced metabolism scales with the key processes of fine root production on islands, and carbonate and sediment production on adjacent coral reefs. Examining the potential impacts of island restoration through seabird recovery and restoration of native vegetation, we show that the resultant increases in fine root length, vertical reef accretion and sediment delivery potential are at levels that would substantially enhance island resilience to future sea-level rise. Collectively, our findings provide an integrated energetics and geo-ecological perspective that suggests rewilding of atolls can meaningfully promote climate resilience.

Population growth rate and adaptive capacity, not thermal tolerance, drive long-term coral persistence under climate change

Noam Vogt-Vincent[1,2]*; Mariana Rocha de Souza[1]; Kathryn Feloy[3]; Robert Toonen[1]; Lisa McManus[1]

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[3]*School of Ocean and Earth Science and Technology, University of Hawai'i at Manoa, USA*

While various factors affect coral population persistence under climate change, it is widely assumed that corals with a narrower thermal tolerance and greater bleaching susceptibility are at most risk under anthropogenic climate change. Using a simple eco-evolutionary model, we investigate coral reef futures under climate change through a factorial approach, across millions of simulations. We find that, in contrast to expectations, coral population persistence at the end of the 21st century is primarily determined by the maximum population growth rate and additive genetic variance, with relatively little influence of thermal tolerance. Anthropogenic climate change exceeds the thermal tolerance of all corals, so adaptive capacity and the ability to rapidly recover from disturbance primarily sets long-term persistence. This importance of growth rate over thermal tolerance suggests that branching corals may grow increasingly dominant from the second half of the century onwards. On the other hand, simulations suggest that branching coral populations experience greater fluctuations and higher extirpation risk over the coming decades. As a result, it is plausible that branching corals could fare better than slower growing, stress-tolerant counterparts in the long term, but only if they can weather the greater acute threats in the short term. Since the response timescale of corals to climate change varies considerably across taxa, and due to the particular importance of genetic variance in facilitating evolutionary adaptation, restoration approaches should aim to conserve a broad range of coral species and genotypes, rather than aiming to optimise one particular trait.

Climate change impacts to upwelling and shallow reef nutrient sources across an oceanic archipelago

Danielle L. Spring[1,2]*; Michael D. Fox[2]; J. A. Mattias Green[1]; Robin Guillaume-Castel[3]; Zoe Jacobs[4]; Ronan C. Roche[1]; John R. Turner[1]; Gareth J. Williams[1]

**Presenting Author*

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[4] National Oceanography Centre, Southampton, UK

Upwelling delivers key nutritional and energetic subsidies to coral reef communities that affect the growth, abundance, and ecology of organisms across trophic levels. However, the cross-scale oceanographic and atmospheric drivers of localized upwelling on many reefs remain unresolved, limiting our ability to predict how climate change might disrupt upwelling patterns and impact reef communities across geographies. Using high temporal resolution (10 second) in situ temperature measurements collected over 18 months that encompassed the strongest positive Indian Ocean Dipole phase of this century, we demonstrate a highly nonlinear effect of climate-driven mixed layer depth on upwelling intensity across the latitudinal range of the Chagos Archipelago (~ 200 km). The exposure of shallow (10–25 m depth) reef communities to deeper upwelled waters was maximized when the mixed layer depth was shallower than ~ 40 m, but virtually absent when the mixed layer depth was deeper than ~ 60 m. By combining these temperature data with nitrogen stable isotopes (δ15 N) from a common macroalga, we show these variations in upwelling correlate with altered nutrient sources that have direct measurable impacts on reef organisms across the Archipelago. We further show that over the past 40 years, positive phases of the Indian Ocean Dipole correlate with an anomalously deep surface mixed layer on these reefs, each time likely restricting upwelling. Given these extreme events are increasing in frequency under climate change, this poses the possibility of a markedly different upwelling regime across the Archipelago over the coming century, with currently unknown ecological consequences.

Coralporosis of cold-water coral ecosystems – from 3D printed minireefs to in silico models of habitat loss

Sebastian Hennige[1]*; Kristina Beck[1]; Mateus Morais[2]; Carlos Alberto Fortulan[2]; Uwe Wolfram[3]; Marta Peña Fernández[4]

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[3] UT Clausthal
[4] Heriot-Watt University

Cold-water corals form large yet fragile ecosystems that support a wide range of biodiversity. Due to their depth and inaccessibility, these important, biodiversity-supporting habitats are hard to study directly, and as such face major challenges in their future protection. This creates a significant challenge in determining their tolerance to environmental change, and efforts to date have largely focussed on the environmental impacts to the live coral. However, of increasing concern is the impact of ocean acidification to the dead coral skeletons that form the foundation of these structurally complex habitats. Ocean acidification leads to the dissolution of dead coral skeletons and crumbling of the 3D reef structures they make through the process of coralporosis. As the dead coral becomes more porous, they become unable to support the weight of the live coral above them, leading to habitat crumbling. As the dead coral skeleton forms the major component of most cold-water coral ecosystems, and is where a significant amount of the biodiversity in these ecosystems is found, its loss fundamentally changes the function of these habitats. Here we use a novel approach with 3D printed calcium carbonate 'mini-reefs' to visualise how vulnerable cold-water coral habitats will collapse in response to ocean acidification. These mini-reefs will be created in a variety of formats to represent the natural variability of cold-water coral habitat structures. We will subject these mini-reefs to acidification conditions to quantify how much habitable volume is lost (i.e. the spaces within the framework), and how quickly this loss occurs. This will be combined with existing data to create the first in silico model of cold-water coral reefs, where future habitat loss and timescales of such loss can be quantified.

Biophysical characteristics shape functional traits and life-history strategies across an atoll seascape

Sasha Hills[1]*; Rosalie A. Wright[1,2]; Kaya Malhi[1]; Cassandra E. Benkwitt[4]; Hannah E. Epstein[5]; Nicholas A. J. Graham[4]; Stephanie J. Green[3]; Julia K. Briand[3]; Pirta Palola[1]; Courtney E. Stuart[1]; Melissa Ward[1,6]; Teva Salmon[7]; Yadvinder Malhi[1,8]; Lisa M. Wedding[1]

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Coral reef ecosystems are vital for global ocean and human health. However, human-induced stressors can override the influence of natural biophysical drivers that have shaped coral reefs for millennia, thereby eroding their resilience to environmental change. Biophysical drivers filter coral community composition by selecting for traits suited to the unique environmental context. The resulting coral community provides the reef structure, whilst the associated functional traits contribute significantly to coral reef ecosystem functioning. Therefore, understanding the influence of biophysical drivers on coral traits can provide insights into coral reef community characteristics, functioning and responses to environmental change. We studied coral community trait composition on a remote Pacific atoll (Tetiaroa), using multivariate regression analysis to identify key biophysical drivers such as depth, nutrient enrichment and intercardinal bearing. We found that ~75% of the hard coral community harbours stress-tolerant life-history strategies, with dominant traits including sub-massive growth forms, spawning and gonochoric sexual systems. Spatial variability in coral trait composition between sites was largely due to wave exposure, which was highly variable across the atoll. Our results align with Tetiaroa's socio-ecological context and highlight the relationships between natural drivers and traits that promote resilience. Moreover, our findings support the recent identification of the region's coral reefs as some of the most resilient in the world to climate change. Traits-based approaches can inform more successful coral reef management and restoration efforts in Tetiaroa and globally by providing predictive power of coral community responses and building resilience to future environmental change.

Quantifying coral reef–ocean interactions is critical for predicting reef futures under climate change

Laura E. Richardson [1,2]*, Gareth J. Williams [1], Aislinn Dunne [2], Tim Jackson-Bué [1], J. A. Mattias Green [1], Tiffany H. Morrison [3,4,5], & Michael D. Fox [2]

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Coral reefs are inextricably linked to their surrounding seascape, ecologically shaped by ocean circulation patterns and dependent on upwelled nutrients and planktonic subsidies. Physical ocean processes that occur across local and regional scales regulate currents, temperature regimes and the delivery of oceanic resources to shallow reefs. These dynamics govern larval dispersal and population connectivity, shape trophic dynamics and drive reef productivity. Yet, a lack of a clear understanding of ocean–reef interactions has led to coral reefs being mistakenly viewed as isolated from their broader seascape. This failure to account for oceanographic context dependence can in part explain why models of reef trajectories under climate change increasingly lack predictive power: reef observations do not match projected expectations. To better predict coral reef futures, we must more effectively quantify and incorporate these fundamental biophysical interactions. We highlight the current lack of coordinated ecological–oceanographic studies and urge ecologists and oceanographers to codesign studies to elucidate biophysical links to advance our understanding of reefs under climate change. We also outline the urgency of this endeavour, as climate change disrupts previously stable bio-geophysical processes that have long-supported life in our ocean. This disruption threatens fundamental reef functioning and productivity, posing critical management and governance challenges.

Speed talk

Hidden microbes of Raja Ampat: How nutrients and temperature reshape benthic cyanobacterial mats

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Coral reefs are under increasing stress from rising seawater temperatures combined with nutrient enrichment from land-based sources (runoff, coastal development, sewage). Benthic Cyanobacterial Mats (BCMs) have become more prevalent on Caribbean reefs over the past two decades, and recent reports indicate rising abundance in the Indo-Pacific. BCMs host diverse microbial communities, yet how nutrients and temperature shape their composition in natural systems remains poorly understood. Our natural sampling settings were reefs and marine lakes of West Papua, Indonesia. We sampled reefs and marine lakes in West Papua, Indonesia. Eight reefs were surveyed across a gradient of water quality and human impact, and eight marine lakes—landlocked seawater bodies—which spanned a range of temperatures. Our study aimed to (1) characterize BCM microbial communities in Raja Ampat for the first time using visual surveys and 16S rRNA metabarcoding, and (2) test whether community composition shifts with nutrient levels and temperature. The BCMs microbial consortium across sites was not dominated by Cyanobacteriota, but by members of the Phylum Protobacteriota. A shared core microbiome was present across habitats (90% sample prevalence), with only 5% of unique ASVs present in each habitat. On reefs, mats near human activity (resorts, villages) showed elevated phosphate and dissolved inorganic nitrogen (DIN), with several Proteobacteria and Cyanobacteriota genera decreasing as phosphate and temperature increased. In marine lakes, all measured environmental variables influenced the community dispersion, with DIN, phosphate and salinity influencing the abundance of most Phyla. Our main findings indicate that BCMs in Raja Ampat are influenced by both nutrient enrichment and increased temperature, underscoring their potential as indicators of reef health under changing conditions. Monitoring their occurrence and community dynamics provides critical insight into ecosystem responses and can inform management strategies in this globally significant yet increasingly impacted region.

Calcification under Climate Change: A Global Meta-Analysis of Reef Responses

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Tropical coral reefs stand at the frontline of climate change, with their survival hinging on the delicate balance between calcification and dissolution. Decades of laboratory experiments have measured how reef-building organisms respond to anomalies in temperature and ocean acidity, offering insights into the biological processes that underpin reef accretion, recovery, and collapse. Among these, calcification rates provide a direct window into the future structure and resilience of reef ecosystems.

Here we present the most comprehensive synthesis of this work to date, using a meta-analytical framework to combine hundreds of independent academic studies. This dataset enables us to evaluate long-standing hypotheses about the sensitivity of calcification to environmental change, while identifying critical gaps in our understanding – both geographically and taxonomically. By linking these findings with climate model projections of ocean conditions to 2100, we generate forecasts of how shallow-water tropical reefs may change in composition, function, and contribution to the global carbonate budget.

Our analysis highlights both the stark vulnerability of reef calcifiers under intensifying ocean change and the unevenness of research effort across the tropics. These insights are vital not only for anticipating the future of reef ecosystems, but also for guiding conservation and restoration priorities. To encourage further exploration and collaboration, we also present the complete dataset as a dynamic database alongside an interactive, no-code platform that allows researchers and practitioners to run their own meta-analyses or upload new data to see how global predictions shift.

Speed talk

Habitat Loss and Invasive Species Plasticity: Lionfish Feeding Strategies in a Degraded Reef in Tela, Honduras

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Invasive species intensify reef decline when combined with climate-driven habitat loss. The Indo-Pacific lionfish (Pterois volitans), established across the Caribbean, is a generalist predator whose impacts may be magnified under disturbance. In 2023, Banco Capiro (Tela Bay, Honduras), once one of the region's most coral-rich reefs, experienced >90% coral mortality, shifting abruptly to algal dominance. This natural experiment enabled assessment of lionfish feeding plasticity in degraded habitats. Using a Before–After–Control–Impact (BACI) design, this study analysed 1,803 stomach samples collected over a decade alongside fine-scale habitat assessments, comparing Banco Capiro (impact) with the more stable La Ensenada reef (reference). Results showed size- and stage-dependent responses: juveniles and small lionfish rapidly shifted from crustaceans to fish, while medium individuals increased piscivory with limited loss of invertebrate prey. Large adults maintained stable, fish-dominated diets. Habitat collapse, therefore, accelerated ontogenetic shifts, advancing piscivory into juvenile stages and creating convergence across size classes. This earlier onset of fish predation intensifies pressure on small reef fishes, particularly herbivores vital for algal control, and enhances lionfish growth and reproduction. These findings highlight the importance of stage-specific management. Targeting juveniles and medium lionfish in degraded habitats could reduce predation on functionally important species, but effective control must also integrate habitat restoration, herbivore protection, and socio-economic incentives. Anticipating behavioural responses of invasive species to disturbance is crucial for adaptive, ecosystem-based management of Caribbean reefs in a rapidly changing world.

Session III:
Under the Microscope

Modelling the Goldilocks Zone: Flow and Growth Dynamics of Cold-Water Corals

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Cold-water corals build complex three-dimensional reef structures sustaining rich biodiversity and delivering vital ecosystem services. Their survival however depends on effective prey capture: currents that are too weak allow prey to evade capture, while those that are too strong push back polyp tentacles and prevent feeding. In this study, the Goldilocks Principle, survival within a ‘just right’ velocity range, is applied within a computational fluid dynamics (CFD) framework to model coral growth under varying flow and food conditions. The model explicitly incorporates food delivery alongside hydrodynamics, requiring coral polyps to reach an energetic survival threshold before investing in new tissue development. This enables us to investigate how colonies prosper in optimal regimes, but also how they adapt under sub-optimal conditions where prey capture is constrained. Validation against in situ observations and experimental procedures shows that colony longevity is strongly influenced by their ability to regulate energy under changing flows. Simulations identify four growth phases, revealing that food-rich conditions accelerate expansion but also intensify intra-colony competition, often shortening individual polyp lifespans. By coupling flow dynamics with energetic constraints, this work provides a novel, more holistic perspective on cold-water coral development. Beyond advancing ecological understanding, the modelling framework offers additional applied value: it can inform the design of artificial reefs and habitat restoration strategies by identifying flow regimes that best promote coral resilience. It provides a predictive tool for assessing how cold-water coral ecosystems may respond to environmental stressors in a changing ocean.

Nutrient availability alters prokaryotic community response to thermal stress in coral holobionts from the world's hottest reef

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The Persian/Arabian Gulf ('the Gulf') is a shallow, geologically young and hypersaline marginal sea that is home to some of the world's most heat tolerant scleractinian corals. In this region, reef-building corals, such as Porites lobata, experience large seasonal fluctuations in seawater temperatures ranging from ~20°C to ~34°C. Despite summer seawater temperature maxima frequently reaching up to 36°C, corals from the Gulf show remarkable tolerance to conditions that would cause bleach or mortality in conspecifics in other open ocean environments. However, corals in this region are experiencing increasing nutrient loads from anthropogenic activities such as sewage discharge and agriculture. Nutrient enrichment can increase the susceptibility of corals to bleaching and disease, yet the impacts of altered seawater stoichiometry on these heat-tolerant corals remain understudied. Here, we conducted a fully crossed, multi-stressor study on Porites lobata from the Gulf to determine the influence of nutrient availability on the response of these heat tolerant corals to thermal stress. Critically, we assessed the response of both host coral physiology and the community of coral-associated prokaryotes - members of the coral holobiont which are considered to be extrinsically linked to heat-tolerance. We found that phosphate limitation was the primary driver of bleaching under controlled aquaria conditions, particularly when combined with elevated levels of nitrate. In contrast, we observed that temperature, rather than nutrient availability, was the primary driver of prokaryotic community composition. Importantly, nutrient availability modified host and symbiont physiology and prokaryotic community restructuring in response to heat stress. Our results show that seawater nutrient stoichiometry is a critical environmental stressor in the context of heat tolerant corals from the Gulf.

Session IV:
Reef Conservation

Modelling Hydrodynamics and Larval Settlement in Artificial Reefs

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Coral reefs are critical marine ecosystems, yet they are declining rapidly due to climate change, coastal development, and overfishing. Artificial reefs (ARs) are widely deployed to restore habitat, but design is often guided by trial-and-error, with limited understanding of how reef structure influences local hydrodynamics and coral larval settlement. My PhD aims to bridge this gap by combining field measurements, high-resolution 3D reef models, computational fluid dynamics (CFD), and larval particle tracking.

I have developed a workflow to create accurate AR meshes from photogrammetry, capturing fine-scale geometric complexity. These meshes serve as input for multi-million cell CFD simulations in OpenFOAM, allowing detailed analysis of flow fields and turbulence around different reef designs. Complementary particle simulations in Unity visualize potential larval transport.

Current work focuses on quantifying AR mesh complexity and examining how local flow conditions influence particle interactions. The next stage involves refining larval tracking experiments at Horniman Museum, parameterizing larval movement, and integrating these data with CFD simulations. This combined approach will provide insight into how reef structure and hydrodynamics shape settlement patterns, informing evidence-based AR design.

By linking reef geometry, flow, and larval behaviour, this research develops a pipeline for designing artificial reefs that enhance coral recruitment and resilience. The methodology also produces open-source tools to support restoration practitioners and guide future reef deployments. This presentation will showcase the workflow, preliminary simulations, and upcoming experimental plans, highlighting how a combination of scanning, modelling, and behavioural data can transform artificial reef design from trial-and-error to science-driven.

Cross-stage trade-offs in coral offspring performance following selection for adult heatwave tolerance

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Marine heatwaves are triggering mass coral mortality, threatening the persistence of coral reefs under climate change. Identifying and propagating heat-tolerant corals is being considered as a strategy to enhance population resilience, yet, the fitness cost of adult heat tolerance across life stages remains poorly understood. Here, we selectively bred Acropora digitifera from parents with experimentally determined high or low tolerance to simulated marine heatwaves and assessed how parental phenotype influenced early stages performance. Embryos from distinctive heat tolerant families were exposed for 27 hours to either control conditions or acute heat stress (+3°C), after which larval survivorship, settlement success, and early recruit growth were quantified. Parental heatwave tolerance significantly influenced offspring performance. Under ambient conditions, larvae from high heat-tolerant parents showed reduced survivorship and settlement compared to those from low tolerant parents. Under heat stress, offspring from high tolerant linages performed equally or better than those from low tolerant parents. When the effects of larval survivorship and settlement were combined, overall reproductive success declined with increasing parental tolerance under ambient conditions, indicating a potential life-stage trade-off, but showed no improvement under acute stress. These results demonstrate that selection for adult heatwave tolerance can influence offspring fitness in complex and context-dependent ways, underscoring the importance of evaluating cross-stage trade-offs and multi-generational responses when designing interventions such as selective breeding for coral conservation.

Long-term acclimation of Persian/Arabian Gulf corals to oceanic salinity: physiological trade-offs and implications for reef conservation

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Global warming and repeated bleaching events are reshaping coral reef ecosystems, driving efforts to identify and propagate corals capable of surviving in warming oceans. Corals from the Persian/Arabian Gulf (PAG) are among the most thermally tolerant in nature. Their unique association with the Symbiodiniaceae Cladocopium thermophilum allows them to withstand summer temperatures up to 36 °C, whereas most tropical corals bleach and die at temperatures ≥32 °C. However, this tolerance appears to be linked to the Gulf's unusually high salinities (often 42-44), as PAG corals seem to lose their exceptional tolerance when transplanted to normal oceanic salinities (33-36). To test whether this resilience is restricted to Gulf conditions, we investigated the long-term acclimation of Porites lobata colonies under reduced salinities. After ten years in standard oceanic salinities, P. lobata colonies grew more slowly than colonies maintained at PAG conditions, despite maintaining similar photosynthesis and respiration rates. Acclimated colonies exhibited increased coral host's antioxidant capacity and lipid peroxidation in the symbiont cells, indicating physiological stress. The corals maintained the same symbiont taxa throughout the long-term acclimation, suggesting that the observed physiological responses were the result of phenotypic adaptation of the whole holobiont. When exposed to 36 °C, acclimated colonies endured thermal stress by temporarily stagnating growth, increasing photosynthesis and respiration, and undergoing a mild bleaching. Remarkably, five months after heat-stress, they regained growth, with symbiont density, and metabolic activity comparable to high-salinity colonies. Taken together, these findings demonstrate that PAG corals associated with C. thermophilum can survive long-term under oceanic conditions while retaining thermal tolerance up to 36 °C. However, this acclimation incurs trade-offs – particularly reduced growth – that could limit their contribution to reef resilience.

Talk

Applying Easy AI to Locate Coral Seeding Devices for Reef Restoration Monitoring

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Coral seeding devices (CSDs) are a promising coral reef restoration tool with potential to deliver much-needed increases in coral abundance. However, a viable strategy for monitoring their effectiveness at scale (e.g. across multiple sites and thousands of CSDs) is needed. The major bottleneck constraining CSD monitoring is the process of first locating CSDs within reef imagery to then enable tracking them through time. We investigated the performance of an AI (an image segmentation machine learning network) at locating CSDs within large-area reef orthoimages, and assessed the amount of manual training effort required to create satisfactory classifiers for two types of CSDs across multiple sites. We found that DeepLab V3+ classifiers were highly proficient at locating different CSDs within multiple orthoimages, detecting them with excellent recall and high precision (up to 99.9%). Using the annotation software TagLab, highly effective classifiers could be created with under 15 minutes of manual annotation effort and no machine learning expertise. We provide evidence that AI classifiers for CSDs can be both a highly effective and accessible tool for the reef restoration community. We provide guidance and a step-by-step protocol to facilitate wider uptake of comprehensive CSD monitoring by restoration practitioners with no previous knowledge of AI or machine learning. By improving access to more evidence-based feedback, this research can contribute to more effective and better-supported restoration efforts.

The Reef Rescue Network - Coral Restoration Ecotourism

Hayley-Jo Carr[1]*

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The Reef Rescue Network (RRN), led by the Perry Institute for Marine Science (PIMS), is a collaborative initiative that unites dive resorts, non-profits, and businesses in a shared mission to restore and protect coral reefs across the Caribbean, including The Bahamas, Aruba, Barbados, Grenada, and St. Lucia. The network currently manages over 40 coral nurseries that serve as platforms for ecological restoration, scientific research, and public engagement. PIMS is a multinational team operating across several countries, with the majority of its staff being Bahamian. This strong foundation of local expertise underscores the Reef Rescue Network's origins in The Bahamas, where most partner organisations are also based.

By integrating community participation with rigorous science, the RRN has created a model that advances reef recovery while fostering local stewardship. Residents, volunteers, and visitors actively contribute to nursery maintenance and coral outplanting, building awareness and ownership of marine conservation. This approach strengthens resilience not only within ecosystems but also within the communities that depend on healthy reefs for coastal protection, fisheries, and tourism.

A key feature of the RRN is the Reef Rescue Diver course, which trains recreational divers in coral ecology and restoration methods. Participants gain both theoretical knowledge and hands-on experience, learning how to maintain nurseries and outplant corals. This course, offered by trained local instructors throughout the network, generates financial support for restoration activities, reduces operational costs, and enhances program sustainability.

By linking scientific research, education, and regenerative tourism, the Reef Rescue Network provides a scalable, community-driven model for coral reef conservation. Its work contributes directly to ecosystem resilience while supporting the blue economy and sustainable tourism. In doing so, the RRN demonstrates how collaborative conservation initiatives can create long-lasting ecological and socioeconomic benefits across the Caribbean.

Poster Session

Poster

Status of coral reefs in Wadi El Gemal National Park

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Coral reefs are among the most biodiverse and threatened ecosystems on Earth, with Marine Protected Areas (MPAs) promoted as key tools to safeguard their resilience. This research evaluates the effectiveness of Wadi El Gemal National Park (WGNP), a Category II MPA on Egypt’s southern Red Sea coast, in protecting coral reef ecosystems. A mixed-methods approach was employed, integrating in-situ reef surveys, abiotic water quality measurements, and stakeholder questionnaires.

Fieldwork was conducted in July 2025 across five reef sites (three onshore, two offshore) and compared with baseline data collected in 2015/16. Using belt transects, coral demographics, benthic cover, juvenile recruitment, and associated fauna were assessed. Abiotic indicators (temperature, salinity, dissolved oxygen, and pH) were measured to evaluate local stress conditions.

Results revealed significant reef degradation over the past decade. Dead coral now dominates benthic cover, while bleaching and mortality rates have increased markedly since 2015/16. Offshore reefs showed higher dissolved oxygen and slightly better resilience compared to onshore sites, though both exhibited substantial declines in live coral cover. Signs of recovery were evident in certain locations, with higher juvenile recruitment and herbivorous fish abundance suggesting potential for regeneration if stressors are effectively managed. However, local pressures—including poor water quality, inadequate sewage infrastructure, and tourism-related impacts—continue to undermine reef health.

Stakeholder perspectives echoed these findings, with dive centre staff and fishermen reporting declining coral health and reduced fish diversity. The study concludes that while WGNP provides a framework for conservation, current management practices are insufficient to halt coral degradation. Strengthened enforcement of zoning regulations, improved waste management, and stricter control of tourism activities are urgently needed to support coral reef resilience in the park.

Interactions between Hard Coral and Soft Coral

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Changing environmental conditions are causing shifts in benthic dominance on coral reefs, altering global coral reef composition and function. Soft corals (Octocorallia, Malacalcyonacea) are key living components of many tropical reefs, however, under certain conditions (e.g. disturbed reefs), soft corals can displace hard corals and become the dominant benthic organisms. In the Indo-Pacific, soft coral-dominated reefs are the most common alternative reef type, but limited knowledge exists on the extent of soft coral impacts on hard corals. This study uses field experiments to investigate direct interactions between five dominant soft coral species (Capnella imbricata, Conglomeratusclera coerulea, Sclerophytum flexible, Lobophyton crassum, and Xenia sp.) and a branching hard coral (Acropora cf. pulchra) in North Sulawesi, Indonesia. Damage to A. pulchra was assessed through observations of bleaching, necrosis, algal cover and mucus production. All soft coral species induced damage to A. pulchra, however the severity of damage was highly species-specific. Xenia sp. induced the greatest severity of damage across each measure, in contrast, S. flexible and C. imbricata induced comparatively weaker damage. Bleaching was highest at the interaction point compared to the whole fragment, demonstrating the role of direct contact in interaction outcomes. These findings indicate the role of aggressive competitive interactions to aid replacement of hard coral. As soft coral dominance increases on Indo-Pacific reefs, understanding these interactions is essential for informing reef conservation and restoration strategies.

Aldabra Atoll: monitoring varied coral bleaching responses in the 4th Global Bleaching Event

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Thermal stress-induced bleaching is one of the most prominent and widespread threats to coral reef ecosystems today, and examining the bleaching trajectories of corals through mass bleaching events is critical in understanding their future responses to climate change. Aldabra Atoll is a remote island in the Western Indian Ocean, where corals within its lagoon were found to be more resilient to bleaching than those on the outer reef during previous mass bleaching events. This varying thermal bleaching resilience within the atoll, combined with its remoteness and pristineness, makes it a natural laboratory to study the effects of a global bleaching event on corals.

As part of a wider study during the 4th global bleaching event (2023/24) to examine biological pathways that enhance resilience in heat-stressed corals, we performed a combination of in-person and video bleaching surveys across different sites in the lagoon and outer reef, assessing the health of Aldabra's coral reefs throughout. In particular, we focused on three dominant hard coral taxa: Porites, Pocillopora and Isopora, where individual colonies were digitally tracked through the bleaching event, providing high resolution data at a colony-scale.

From Dec 2023-Nov 2024, we found that near peak temperatures, 86% corals at the outer reef study site were undergoing various stages of bleaching, compared to 63% of corals at the lagoon site. Following the trajectories of the different genera of interest, preliminary analyses showed variation in both resistance and resilience to bleaching. For instance, Pocillopora colonies were highly susceptible to bleaching compared to Porites and Isopora colonies, with a higher degree of intraspecific variation in its bleaching responses. Our results demonstrate the variability in bleaching responses on a remote reef, and highlight the importance of through-bleaching monitoring to distinguish resistance vs. resilience, and fully capture the spectrum of responses by corals to thermal stress.

Effect of Temperature and Salinity on Prokaryotic Communities associated with Heat Tolerant Porites lobata

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Coral reefs are increasingly threatened by coral bleaching driven by rising ocean temperatures. Understanding temperature resilience mechanisms, especially in reef-building corals such as Porites lobata, is vital for protecting these ecosystems. The Persian/Arabian Gulf (The Gulf) experiences extreme heat and large seawater temperature fluctuations that would be lethal to corals elsewhere, raising the possibility of unique temperature resilience mechanisms in Gulf corals. The Gulf also has unusually high salinity levels, leading to the question of whether temperature and salinity resilience are linked in its corals. One potential explanation for the temperature resilience observed in Gulf corals lies in the coral's prokaryotic communities, which are central to nutrient cycling, disease dynamics, and other functions within the microbiome and holobiont. The contribution of prokaryotic communities to coral temperature resilience remains poorly understood, including in relation to environments with extreme salinity. Here we show that P. lobata from the Gulf, when exposed to increased temperature and reduced salinity water in a controlled aquaria system, displayed significant shifts in beta diversity, while alpha diversity remained unchanged. This suggests that community restructuring, rather than diversity loss, drives prokaryotic plasticity under altered temperature and salinity conditions. Furthermore, we found no evidence for an interaction between salinity and temperature's effects, indicating that these stressors independently shape prokaryotic community structure. We also identify specific prokaryotic taxa with significant changes in relative abundance under altered temperature and salinity. These results advance our understanding of how P. lobata in the Gulf may have adapted to extreme environments. More broadly this perspective provides valuable insight into how corals may adapt to future warming seas and transplants between salinity conditions. Therefore, it could inform conservation strategies, including microbiome-based interventions, to enhance coral resilience to temperature and salinity stress.

Diversity of Sexual Systems and Gametogenesis in the Indo-West Pacific Coral Porites lichen

Chieh-Jhen Chen[1]

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Metazoans have evolved a complexity of sexual system and gonad development, however, sexual reproduction of scleractinian corals is not well understood. This study aimed to address the sexual system and gametogenesis in Porites lichen, a common species in the Indo-West Pacific. This study represents the first description of sexual system, which were determined by histological analysis of the samples collected in northern Taiwan. In addition, female and hermaphroditic colonies were separately cultured in aquarium to further monitor the release of eggs/larvae and thereby confirm the breeding system. The results demonstrate that P. lichen is a polygamodioecious brooder and displays seasonal gametogenesis and embryogenesis that ends in late summer. In hermaphroditic colonies, male polyps are predominant and hermaphroditic polyps make up a very small percent (1%–19.3%). In addition, two new gametogenic features were observed from the histological analysis: 1) oocytes developed within the spermaries in hermaphroditic polyps during the early stage of gametogenesis and 2) melanin granular cells were clustered in spermaries in both male and hermaphroditic colonies. This study demonstrated the plasticity of gametogenesis and melanin related cells appeared in corals, which provides an important information to explore hormones and molecular mechanism involving in gonadal arrangement and production of melanin for further studies.

Characterisation of a Novel Porites lutea Small Heat Shock Protein

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Porites lutea, a widespread species of scleractinian coral native to the Indo-Pacific, is known for its high resilience towards bleaching. While its heat tolerance has been investigated extensively at the genomic, transcriptomic, and proteomic levels, much less is known about the individual proteins that contribute to this resilience. A preliminary selection scan has implicated small heat shock proteins (sHSPs) in thermal tolerance. sHSPs are a class of ATP-independent molecular chaperones that protect cells during cellular stress by sequestering misfolded proteins. We selected a sHSP, chr3, with an unusual architecture, containing two alpha-crystallin domains (ACDs) instead of the typical one, to express recombinantly and characterise.

To better relate structure to function, we split chr3 into individual and multi-domain constructs. On the structural front, AlphaFold predicted the ACDs to fold properly, which was validated by circular dichroism spectroscopy. The oligomeric states of the various constructs were measured by native mass spectroscopy (nMS), revealing that the C terminal domain (CTD) was necessary for oligomeric states larger than a dimer. Furthermore, AlphaFold highlighted the XIX motif in the CTD as a key interaction in dimerisation, which we confirmed by nMS. Functionally, an in-vitro anti-aggregation assay showed that the CTD was a pre-requisite for chaperone activity.

The combination of in-silico and experimental tools have elucidated the key relationships between the various structural elements of chr3, its quaternary structure, and its activity as a chaperone. More broadly, our work establishes a framework for investigating other coral sHSPs. By illuminating the molecular mechanisms behind the heat resilience of P. lutea, this may shed light on how corals are adapting to the warmer temperatures induced by climate change.

Impacts of corallivory on the physiological functioning of scleractinian corals.

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Corallivory refers to the predation of corals from a variety of animals such as crown of thorns sea stars, parrot fish, and butterfly fishes, particularly from the Chaetodon genus. This genus of fishes predates mostly on scleractinian corals feeding on live coral tissue, polyps and mucus. These preferences usually lead to an area of injury around the targeted feeding site. As a result of this, corals often sustain skeletal and tissue damage, retracted polyps, and mucus production, yet survivorship is rarely threatened and functioning can appear normal. Furthermore, the presence and abundance of Chaetodon sp. on reefs can be used as a potential biomarker, a higher biomass is likely to be correlated with greater coral abundances. However, research has shown that when corals are under stress (e.g. heat stress), corallivory can impair coral growth and reduce their capacity for recovery. As such, further research is needed to fully understand the relationship between corallivorous reef organisms and coral health and functioning. Here, we investigate the interactions of Chaetodon sp. corallivory on coral symbiosis and growth. We observed mixed predation rates of Chaetodon interruptus upon various colour morphs of Montipora sp. in a captive mixed taxa environment. Predation levels of ~ >600 bites per hour were documented for purple morphs and ~ >200 bites documented for red whilst green resulted in a low-level interest ~ <8 bites per hour. Following predation exposure, purple and red morphs exhibited a surge in growth, whereas green showed minimal growth. We identified that coral colonies subjected to more frequent bites showed a substantial increase in growth after predation events. Our results indicate that predation by C. interrupts can alter coral growth and functionality. Collectively, these findings suggest that corallivory may act as a mechanical trigger within coral colonies, stimulating growth following predation events.

Poster

Lionfish in Hot Water: Responses to Coral Bleaching on Honduran Reefs

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This study examines temporal trends in lionfish (Pterois volitans) aggregations, abundance, and sex-based distribution across two reef systems across the north shore of mainland Honduras, La Ensenada and Banco Capiro, over three time periods (2014–2016, 2017–2019, and 2023–2024), which span multiple mass coral bleaching events. At La Ensenada, although the median frequency of lionfish aggregations remained consistent, aggregation variability declined over time. Banco Capiro showed greater stability in aggregation patterns across periods, though statistical analysis detected significant changes over time ($p < 0.001$), indicating subtle but meaningful shifts in aggregation dynamics. Lionfish counts increased between 2014–2016 and 2017–2019 at both sites, followed by a sharp decline post-2023. Significant temporal changes in lionfish counts were found at La Ensenada ($p < 0.05$) and Banco Capiro ($p = 0.04$). Non-parametric tests confirmed a significant decline in lionfish abundance after the 2023 bleaching event at both La Ensenada ($U = 19.96$, $p < 0.001$, $r = 0.62$) and Banco Capiro ($U = 6.63$, $p < 0.001$, $r = 0.84$), with higher counts recorded prior to the event. Sex-based analysis showed that males were significantly more abundant than females at both sites. At La Ensenada, sex was a strong predictor of lionfish type ($p < 0.001$), while year had no significant effect. Conversely, both year and sex were significant predictors at Banco Capiro ($p < 0.001$), suggesting shifts in population structure over time. These findings highlight localised differences in lionfish dynamics and underscore the potential ecological impact of climate-driven bleaching events on invasive species behaviour and abundance.

Effects of acoustic enrichment and substrate conditioning on settlement behaviour of coral larvae

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Coral reefs in the Gulf of Mexico underpin regional biodiversity and coastal economies by supplying vital habitat and ecosystem services. However, coral reefs worldwide, including those in the Gulf of Mexico, are among the most heavily impacted ecosystems, with declines in coral health driven by cumulative anthropogenic stressors. While global efforts to mitigate climate change are essential, local-scale interventions are urgently needed to sustain reef resilience in the meantime. Restoration involving settling larvae onto substrate typically relies on conditioning settlement tiles with crustose coralline algae and microbial films, a time-consuming process that creates a temporal bottleneck for large-scale out-planting. Species-specific preferences between coral and CCA exacerbate this issue. To overcome these issues, emerging research has explored bioacoustic cues as a potential substitute or complement to substrate conditioning. We tested whether playback of healthy reef noise could bypass the conditioning step in an ex situ 2 × 2 factorial experiment using larvae of the grooved brain coral, Diploria labyrinthiformis. Over ten days, larvae were added ex situ in a 2 x 2 factorial design to (1) conditioned tiles with reef noise, (2) conditioned tiles with no playback, (3) unconditioned tiles with reef noise, and (4) unconditioned tiles with no playback. Pre-conditioning nearly doubled larval settlement compared to unconditioned tiles. Payback of reef noise produced a secondary, non-significant increase in settlement yield. These results reaffirm that substrate conditioning remains critical for effective restoration and indicate that, under our conditions, ambient reef sound cannot be used to bypass this step. Future work should fine-tune acoustic parameters and test across species and contexts to determine whether optimised bioacoustic treatments can reliably enhance coral settlement.

Flexible bacterial microbiome in Large Benthic Foraminifera

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Symbiosis has shaped life on Earth, and coral reefs are one of its clearest examples. Among reef builders, Larger Benthic Foraminifera (LBFs) are key contributors to carbonate production, and can have strict symbiotic relationship with diatoms. However, their bacterial partners are still poorly known.This study examines the prokaryotic microbiomes of LBFs by (i) comparing them to surrounding seawater and substrate communities, (ii) identifying potential species-specific core microbiomes, and (iii) testing the influence of site and depth. Sampling took place in the Spermonde Archipelago, Indonesia, where LBFs, seawater, and substrate were collected. The V4–V5 region of the 16S rRNA gene was amplified and sequenced (NovaSeq). Results reveal that LBF microbiomes are highly distinct from their surrounding environment and strongly species-specific, often dominated by one or two bacterial taxa. Some species displayed a clear core microbiome. Both reef area and depth significantly shaped microbiome composition, with greater similarity among LBFs from the same site. This work highlights the importance of LBF-microbe interactions in reef ecology, as well as showing their potential as reef health bioindicators.

How light levels impact coral cover during the fourth global bleaching event: a case study from Kimbe Bay, Papua New Guinea

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The Coral Triangle in the Indo-West Pacific is the largest marine biodiversity hotspot in the world, and it currently houses the highest number of reef coral species and associated biota. Despite an increase in seawater temperatures over the last few decades, the live coral cover in the Coral Triangle has remained remarkably stable. This resilience may, in part, be due to these coral communities thriving predominantly in turbid waters. Water turbidity measures the amount of dissolved organic and inorganic particles, which act as a barrier to sunlight and buffer the effect of rising temperatures. Thus, coral bleaching is less severe, or minimal, which may explain the resilience of reef corals in the Coral Triangle region. This project examines the interactions between water turbidity and coral cover in Kimbe Bay (Papua New Guinea) during the 2023 global coral bleaching event. Video transects of coral reefs and light-level measurements were recorded from March to June 2023. We identified the main substrate components (coral, sponge, and algal cover) in both turbid and non-turbid coral reefs using the AI program CoralNet. Over the course of the survey period, coral cover increased in low-light environments. Meanwhile, coral reefs in higher-light environments increased in crustose coralline algae. Comparisons of the bleaching effects under different turbidity regimes at a local level allows researchers to establish priorities for conservation of resilient reef ecosystems and planning of protected areas. Our outcomes are also significant for marine conservation and management strategies at a regional level, as they provide crucial information about the vulnerability and resilience of the Coral Triangle reef ecosystems.

The spatial and temporal dynamics of the benthic community composition and diversity of coral reefs in Nosy Be, Madagascar

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Coral reefs of Madagascar provide critical ecosystem services, increase biodiversity, provide coastal protection and support fisheries which provides livelihoods to many people, yet remain among the least studied in the Western Indian Ocean. Understanding the dynamics of coral reefs is essential to assess their resilience and guide future conservation efforts. Our study provides monitoring of the benthic community composition at six sites in Nosy Be, Madagascar which were surveyed using point intercept transects in 2018, 2023, and 2024.

Benthic categories were quantified into 19 groups and community changes were analysed using percentage cover data to calculate diversity indices, multivariate ordinations, and coral-algae interactions.

Hard coral cover declined significantly between 2018 and 2024, with an average decrease of 2.2% per metre of depth. Turf algae and sand increased across most sites, while a temporary spike in soft coral and dead coral with algae in 2023 led to a short-lived increase in diversity. Spatial heterogeneity was pronounced. Gorgone retained high diversity and soft corals, while Louann was heavily degraded, dominated by turf algae and dead coral with algae. Depth also influenced community composition, with deeper reefs supporting more soft corals and higher evenness.

Generalised additive models revealed a negative association between algal cover and both hard and soft corals, supporting evidence of competitive displacement. Together, these results indicate that Nosy Be reefs are undergoing degradation but retain pockets of resilience that may act as refuges.

Conservation should prioritise protecting resilient sites, reducing local stressors such as sedimentation and overfishing, and expanding long-term monitoring. These findings contribute an evidence base for reef management in Madagascar and highlight the importance of Operation Wallacea’s long-term ecological datasets in under-studied regions.

Poster

Proteomic difference in selectively bred corals suggests tiered heat stress response to mild heat stress

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Selective breeding of Acropora digitfera has yielded two sub-populations, high tolerance offspring and low tolerance offspring. These individuals were exposed to a natural mild bleaching event in 2020, and proteomic data was opportunistically collected. The proteomic responses to the bleaching event were significantly different between the two sub-populations.

Poster

Coral Venom in the Era of Climate Change

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There are many threats that face modern day coral reefs, one of the most highlighted being mass bleaching events due to thermal stress. During these events, coral can only survive for a short period before the stress becomes a mortality event for many of these biologically impactful animals. This in-between state still has many mechanisms that are not well known or characterized, including the predatory habits of corals that are likely necessary to stave off mortality. To prevent starvation coral must make up for their lost energy inputs from their algal symbionts by hunting zooplankton from the water column using stinging cells, known as nematocysts.

The current contents of stinging cells in stony corals are nearly entirely unknown, as are the impacts that bleaching may have on the production of these stinging cells and their venoms. Within the phylum Cnidaria there are many toxins established across the various subphyla and classes, with venoms being used for both predatory and protective behaviors throughout. The most studied cnidarians are jellyfish and sea anemones. These groups have allowed for the characterization of specific toxins that range from neurotoxins to hemotoxins, toxins that target only vertebrates to toxins that target only invertebrates. Additionally, it has been established in the lab model Nematostella vectensis that venom production is metabolically taxing for the animal.

The many nuances of venoms and their toxins have not been characterized in stony corals, Scleractinians. Using both bioinformatics and in vivo techniques we will characterize the 'venome' of stony coral using the model species Stylophora pistillata and assess the impacts that bleaching may have on venom production. This investigation will work towards increasing our understanding of both the biology of scleractinian corals as well as the metabolic cost/trade-offs that are associated with bleached states in stony corals.

Poster

Evaluating User Fee Sufficiency for Sustainable Management of Siete Pecados Marine Park, Coron, Palawan, Philippines

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Marine Protected Areas (MPAs) play a crucial role in conserving marine ecosystems. Yet, many face financial challenges due to inadequate funding, and user fees are often insufficient to cover complete management and conservation costs, leaving ecosystems vulnerable.

This study evaluates the sufficiency of user fees and dive shop operators' perceptions in supporting the sustainable management of Siete Pecados Marine Park (SPMP) in Coron, Palawan, Philippines. Employing a mixed-methods approach, the study assesses whether the user fees collected from visitors adequately cover operational and conservation-related expenses. It also explores dive shop operators' perspectives on the fairness, implementation, and impact of the current user fee system on marine conservation efforts and their business operations. The data were collected through archival research and key informant interviews. Financial analysis was also conducted to determine the sustainability of revenues generated from user fees.

The findings reveal that the current user fee of PHP 100 per visitor is insufficient to cover the operational and conservation costs of SPMP. The amount also falls significantly below international benchmarks, which range from PHP 269 to PHP 1,628. The results underscore the need for stronger stakeholder collaboration, transparent financial reporting, and participatory conservation planning. It is recommended to revise the user fee structure, establish a crisis reserve fund, and employ adaptive management strategies. The study concludes that aligning user fees with actual conservation costs is essential for achieving long-term ecological and financial sustainability in SPMP as well as for strengthening its role as a model for community-based marine conservation and ecotourism.

Poster

Spatial patterns and scale mismatches in tropical coral reef fish ecological surveys

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Effective ecosystem management requires rigorously collected data that are representative of actual conditions. However, scale mismatches between data collection and their interpretation can compromise management decision-making. This study used tropical coral reef fisheries as a case study to quantify the spatial scales, methods, and statistical sampling designs of ecological fish surveys. We conducted an evidence synthesis of studies published between 2010–2020, screening 7381 studies (321 included in the final analysis). We found a geographic concentration of surveys in the Indo-Pacific (37.4%) and Tropical Atlantic (27.7%), with a focus on fore reef habitats (43.6%), at 1-30 m depth, and widespread use of belt transect methods (70.1%). On average, <1% of the study area spatial extent (area encompassed by all replicates) was actually surveyed for reef fishes (actual extent: sum of all spatial replicates), and <10% of studies reported statistically robust spatial sampling designs behind their data collection. This raises concerns regarding the rigour of interpreting these small scale survey footprints across larger spatial extents to inform management. To improve ecological inference and support effective reef fish management, future efforts should prioritise statistically robust spatial sampling designs and standardised spatial reporting to improve data comparability, ecological inference, and decision-making effectiveness.

There's plenty more fish in the sea to genotype! Low-cost SNP genotyping to quantify large-scale population dynamics in anemonefishes

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Most coral reef fishes have a bipartite life cycle with a pelagic larval phase, during which larvae can disperse hundreds of kilometers from a spawning site. Given that their range is generally more restricted in their adult phase, patterns of larval dispersal are the key drivers of genetic and demographic processes such as population structure, local retention and adaptation. Understanding how populations are connected through larval dispersal is therefore crucial for informing conservation management, and molecular techniques have significantly advanced our ability to characterise these patterns. However, these methods are often associated with significant inputs of time and resources, limiting the scale at which population dynamics can be traced.

Here, we present a novel genotyping approach to quantify the dispersal of the orange clownfish Amphiprion percula. We first developed a panel of SNPs from 94 anemonefish (68 A. percula and 26 congenerics), designed to represent genome-wide variation and carry out accurate DNA fingerprinting for a range of Amphiprion species. Following this, we optimised a workflow based on dual barcoding and multiplexed PCR to genotype thousands of A. percula individuals at 288 targeted SNPs in a single sequencing library (genotyping-in-thousands). The genetic information obtained will allow us to reconstruct multi-generational pedigrees of A. percula in Kimbe Bay, Papua New Guinea and track population dynamics through time and space.

By quantifying population dynamics to a high resolution, this high-throughput approach is a powerful tool to monitor metapopulation-level responses to the threats faced by tropical coral reefs, such as marine heatwaves and habitat fragmentation. With remarkable reductions in cost, effort and time compared to commercial and existing methods, we believe that this method can be widely adopted towards assessing the impacts of environmental and climate change on population connectivity across wide geographic and temporal scales.

Understanding Spatial Patterns and Opportunistic Insights into Elasmobranch Diversity from Reef Surveys in Southern Inhambane, Mozambique, Africa

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Reef fish assessment using Baited Remote Underwater Video Systems (BRUVs) was conducted in Inhambane between 2017 and 2024, with Elasmobranch sightings recorded opportunistically since 2019. Here we examined shark and ray sightings and composition across reefs in Zavora, Guinjata, Rocha, Tofo, Barra, and Morrungulo. A total of 266 hours of footage from 228 deployments across 34 reefs (4–40m depth) were analyzed. Elasmobranch presence was recorded in 21% of the deployments (48 deployments), with 74 individuals identified, belonging to 17 species, 11 genera, and 8 families. Among these, 79% (n=11) of the recorded species are classified as threatened on the IUCN Red List, and 21% (n=3) are protected under REPMAR.

Rays (Superorder Batoidea) showedì higher frequency of occurrence compared to sharks (Superorder Selachii) (60.3% and 39.7%, respectively). Among rays, Mobula kuhlii had the highest occurrence (17.6%), followed by Aetobatus narinari (13.5%), while Mobula birostris and Taeniura lymma had the lowest occurrence (1.4%). Among sharks, Carcharhinus amblyrhynchos and Triaenodon obesus exhibited the highest frequency of occurrence, both at 10.8%. In contrast, Carcharhinus limbatus and Carcharhinus leucas had the lowest occurrence, at 1.4% and 2.4%, respectively.

When comparing the different locations, species diversity and abundance were higher in Morrungulo and Barra (within the Tofo region), with both locations recording eight species and 21 individuals. In contrast, Zavora (four species and seven individuals) and Guinjata (two individuals) exhibited lower diversity. Regarding elasmobranch interactions with BRUVs, incidental encounters were the most common (72%, n=56), where elasmobranchs were observed cruising through the camera frame without engaging with the bait. This was followed by exploratory interactions (18%, n=14), cautionary responses (9%, n=7), and aggressive behavior, which was the least frequent (1%, n=1).

This residual data assessment provides preliminary insights into the effectiveness of BRUVs as a non-invasive and cost-effective method for monitoring shark and ray diversity in reef systems. These findings contribute to the growing understanding of Mozambique's elasmobranch populations and priority areas for conservation offering valuable information to support the development of national shark and rays conservation and management strategies.

Poster

Personality, predation, and group size: Unravelling behavioural drivers of lionfish (Pterois volitans) invasion success

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Global biodiversity is in rapid decline, with invasive alien species (IAS) playing a major role. Predicting which IAS are most damaging and under what conditions is key to proactive management. We investigated whether behavioural traits, specifically boldness and exploration, predict ecological impact in the invasive red lionfish (Pterois volitans). Using repeated behavioural assays, we found strong personality consistency: 93% of juveniles and 56% of adults used shelter, with traits like latency to interact with novel objects showing high repeatability. Bold individuals spent less time in shelter and interacted more with novel stimuli. However, in groups of eight, personality expression shifted, only 7% of juveniles and 44% of adults used shelter, indicating that social context alters behaviour. Functional response experiments revealed Type II feeding curves across three prey species, with adults showing significantly higher attack rates and lower handling times than juveniles. Maximum feeding rates reached 440.17 for adults (Artemia salina) and 30.63 for juveniles (Gammarus oceanicus). Contrary to expectations, boldness did not correlate with feeding impact but was linked to slower reaction times in shy individuals. These findings highlight the complex, context-dependent relationship between personality and ecological impact during IAS invasions.

Poster

The spatial organisation of coral-algae symbiosis

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How do different organisms interact to unlock new possibilities for life? The diverse capabilities of multicellular organisms stem from the spatial organisation of specialised cells. Unlike the classic paradigm of gradually specified and relatively fixed spatial cell arrangements, corals gain new specialised cell organisations by integrating algal symbionts into their cells, acquiring the ability to access nutrients from photosynthesis. This symbiosis enables corals to survive in nutrient-poor environments, unlocking the existence of the planet's most biodiverse ecosystems - coral reefs.

However, the photosynthetic basis of this symbiosis is highly sensitive to the physical environment and breaks down under light and heat stress in an event called 'bleaching'. Some coral-algal partnerships persist whilst others collapse under environmental change, raising the question - how do corals and algae build a symbiosis for survival in a given environment?

Using a combination of high-resolution imaging, molecular biology approaches and mechanical perturbations we reveal that algal symbionts are not passively accommodated but dynamically patterned within the host. We show that symbionts localise to the tentacles during host morphogenesis and that this organisation can be remodelled under altered environmental conditions. Using a combination of experimental biology and computational approaches, we are investigating how symbiont spatial organisation in the host is regulated and whether it can be modulated to adapt to different environmental conditions. Overall, our work aims to reveal fundamental principles of how interacting organisms dynamically shape each other's biology to survive in demanding ecological niches and has potential implications for coral reef ecosystem conservation approaches.

Poster

The effects of seagrass meadow quality and composition on the abundance of immature green turtles (Chelonia mydas)

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Seagrass meadows, like many marine ecosystems, are vulnerable to environmental and anthropogenic threats and are declining globally. Many organisms depend on seagrass meadows and there are many interspecific interactions that occur. This study aims to understand the relationships between seagrass meadow quality and composition and one of the key species that rely on seagrass, green turtles (Chelonia mydas). Green turtles are endangered, and this study aims to understand how seagrass abundance, epiphyte abundance and the presence of coralline calcareous algae affects the abundance of immature green turtles in Akumal Bay, Mexico. Seagrass abundance had a significant positive effect on green turtle abundance while epiphyte abundance and CCA presence had a non-significant effect. Green turtles in Akumal are most abundant when seagrass abundance is high, regardless of epiphyte abundance and CCA presence. Understanding the relationships between seagrass quality and composition and green turtle populations could benefit the conservation of both seagrass meadows and green turtles preventing their decline.

The Effects of Ocean Acidification on Cold-Water Corals: A Study on Lophelia pertusa using Paraffin Wax

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Ocean acidification is a growing threat to deep-sea cold-water coral (CWC) reefs, reducing live coral tissue growth and accelerating the dissolution of their calcium carbonate skeletons. This is particularly concerning because much of the structural habitat and biodiversity in CWC ecosystems are supported by dead skeletal frameworks. As the aragonite saturation horizon is projected to shoal above the majority of CWC reefs by the end of the century, calcium carbonate will become increasingly undersaturated, hindering coral skeleton formation and compromising the structural integrity of deep-sea reefs. Knowledge gaps are observing end-of-century dissolution in real-time using ecologically realistic coral models. We examine how end-of-century acidification scenarios affect the structural degradation of CWC Lophelia pertusa skeletons using an innovative experimental approach. Paraffin wax was applied to samples to mimic live tissue at various coverage levels (0%, 50%, 90%) and exposed to accelerated pH treatments (7.2, 7.6) over 19 weeks. Individual and colony-sized fragment dissolutions were examined through buoyant weight changes and digital 3D reconstructions. A consistent pattern emerged in which wax-treated samples experienced less dissolution than bare skeletons across size classes at low pH. A 7.2 pH resulted in the greatest mass loss, while 90% wax-treated samples exhibited the least. Colony-scale structures did not demonstrate greater resistance to dissolution than individual fragments, challenging assumptions that size alone offers protective buffering in a reef environment. We conclude that paraffin wax is more effective under acidic conditions by acting as a physical barrier and could be used as a new standard for coral tissue proxies. This highlights the vulnerability of entire CWC reef frameworks to acidification - especially in the absence of live tissue - which could lead to eventual collapse in future environmental conditions. Advancing such methodology is vital to understanding the long-term effects of ocean acidification on benthic biodiversity and reef stability.

Poster

Nutrient-driven responses of calcareous encrusting and endolithic communities on Indian Ocean reefs

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Vacant hard substrate on coral reefs is rapidly colonised by an array of carbonate accreting and bioeroding organisms. During early succession, crustose coralline algae (CCA) recruit to exposed surfaces, contributing to the accumulation of calcium carbonate and the consolidation of complex reef structures. Counterbalancing this accretion, endolithic microorganisms such as chlorophytes and cyanobacteria bore into the substrate, acting as primary agents of carbonate dissolution and removing up to 1.1 kg of CaCO3 m^{-2} annually. As primary producers, these organisms are expected to respond to nutrient inputs, which may shape their abundance, community composition and rates of both accretion and bioerosion. However, studies exploring the effects of nutrients on these reef autotrophs remain scarce, with even fewer addressing natural pathways of nutrient supply. Nutrient subsidies deposited by seabirds on tropical islands are an important resource for coral reef primary producers, like corals and algae. Therefore, we hypothesise that seabird-derived nutrients will increase the abundance of CCA and endolithic microflora on carbonate substrates. Further, the densities of associated heterotrophic taxa, such as serpulid worms and sponges, are also predicted to increase with higher nutrient availability. In 2022, experimental calcite crystals and Porites spp. coral blocks were deployed on shallow reefs across the Chagos archipelago adjacent to islands with and without seabird colonies. After 22 months, deployed samples were collected and preserved to be analysed using a variety of microanalytical techniques, including Micro-CT, Scanning Electron Microscopy (SEM) and stained petrographic thin sections. These ongoing analyses will highlight differences in encrusting and endolithic community composition, as well as accretion and bioerosion rates, across a natural nutrient gradient. Findings from this study also aim to explain how enhanced primary productivity around seabird islands cascades to higher trophic levels, particularly parrotfish feeding on these substrates.

Poster

Ecological Assessment of Benthic Communities on Coral Reef Flats along the Coast of Somalia

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Vacant hard substrate on coral reefs is rapidly colonised by an array of carbonate accreting and bioeroding organisms. During early succession, crustose coralline algae (CCA) recruit to exposed surfaces, contributing to the accumulation of calcium carbonate and the consolidation of complex reef structures. Counterbalancing this accretion, endolithic microorganisms such as chlorophytes and cyanobacteria bore into the substrate, acting as primary agents of carbonate dissolution and removing up to 1.1 kg of $CaCO_3$ m^{-2} annually. As primary producers, these organisms are expected to respond to nutrient inputs, which may shape their abundance, community composition and rates of both accretion and bioerosion. However, studies exploring the effects of nutrients on these reef autotrophs remain scarce, with even fewer addressing natural pathways of nutrient supply. Nutrient subsidies deposited by seabirds on tropical islands are an important resource for coral reef primary producers, like corals and algae. Therefore, we hypothesise that seabird-derived nutrients will increase the abundance of CCA and endolithic microflora on carbonate substrates. Further, the densities of associated heterotrophic taxa, such as serpulid worms and sponges, are also predicted to increase with higher nutrient availability. In 2022, experimental calcite crystals and Porites spp. coral blocks were deployed on shallow reefs across the Chagos archipelago adjacent to islands with and without seabird colonies. After 22 months, deployed samples were collected and preserved to be analysed using a variety of microanalytical techniques, including Micro-CT, Scanning Electron Microscopy (SEM) and stained petrographic thin sections. These ongoing analyses will highlight differences in encrusting and endolithic community composition, as well as accretion and bioerosion rates, across a natural nutrient gradient. Findings from this study also aim to explain how enhanced primary productivity around seabird islands cascades to higher trophic levels, particularly parrotfish feeding on these substrates.

Poster

Quantified variations in the benthic foraminifera assemblages across different substrates in the Mexican Caribbean

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Coral reefs are sensitive coastal habitats defined by a delicate balance between the production, breakdown and transport of biogenic calcium carbonate. Ongoing global and local disturbances disrupt this balance, pushing more reefs into ecological phase shift and altering their benthic composition. These alterations have cascading effects on skeletal fauna and carbonate-secreting organisms that contribute to biogenically derived sediment production, e.g. benthic foraminifera (BF). This work aims to quantify how BF respond to changes in reef benthic composition, providing insights into their roles as a) bioindicators of ecological change and b) biogenically derived sediment producers in the Mexican Caribbean. BF have a well-established history as bioindicators of ecological change, notably as proxies for various water quality metrics. In this study, we investigate how BF assemblages vary across differing sites of varying benthic composition. Here, we quantify how population dynamics of BF vary as a function of a) the wider ecological state and b) the smaller-scale habitat coverage. This study also assesses the impact of groundwater upwelling sites on the composition of associated BF assemblages. Sixty-five different species derived from forty-five different genera were recorded across lagoonal and backreef communities. Assemblages did not differ significantly among sites, but smaller-scale habitat variations did impact BF populations; notably, algal substrates, which hosted a larger number of BF. This suggests that sites are similarly degraded, potentially to the extent that they have surpassed a threshold in which site-level variations are muted and not reflected within the BF assemblage. This leads to variations in BF response being driven by smaller-scale variations in habitat coverage. In contrast, assemblages of near groundwater upwelling zones were compositionally distinct from the surrounding benthos, highlighting BF's sensitivity to localised stressors. Together, these findings advocate for the use of BF as bioindicators of fine-scale environmental change, particularly when tracking groundwater-driven impacts.

Local human impacts interact with geography to drive benthic community depth zonation on contemporary coral reefs

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Changes in biophysical conditions and energetic resource supply across depths are predicted to promote or limit the abundance of different coral reef benthic groups. However, the degree to which regional differences in biophysical processes govern and local human activities might alter naturally occurring depth zonation patterns remains unclear. Here, we used 2239 reef surveys conducted between 0 and 30 m depth around 33 islands (18 unpopulated and 15 populated) across the Pacific Ocean to quantify the percentage cover change of seven broad benthic groups. We tested whether natural depth zonation patterns differed across geographies (using six ecoregions) and whether and how local human impacts might disrupt these natural zonation patterns. We found benthic community depth zonation did not always occur. At the three ecoregions where depth zonation existed, there was no universal 'natural' zonation pattern and the benthic groups most responsible for driving patterns of depth zonation differed across geographies. We also found evidence of human-disrupted changes to benthic community depth zonation; patterns were inversed across depths and less distinct at populated compared to unpopulated islands within two ecoregions. We show coral reef communities are naturally highly variable and that human activities can disrupt natural patterns of ecological organization in contemporary ecosystems.

Poster

Under Pressure: Microbial Life in Hydrothermal Vents

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Projected future climate scenarios are associated with extreme environmental conditions, including higher temperatures and decreased pH levels. This problem is highlighted in coral reef environments where corals and other reef associated organisms are often sensitive to sustained increases in temperature. Shallow-water hydrothermal vents can be used as natural study-systems to examine microbial responses to these conditions. To address this line of inquiry, we investigated microbial community structure at a vent system found in a coral-reef environment off Narage Island, Papua New Guinea. This vent is characterised by the bubbling of mantle-derived gases and high source temperatures up to 98 °C. To adequately characterise the community found at this vent, 41 samples of both water and sediment were taken from sites on and around the vent transect. DNA was then extracted, sequenced (16SV3–V4, Illumina), and processed in accordance with a DADA2 pipeline. Alpha diversity was modelled with GLMMs, beta diversity with NMDS and PERMANOVA, and site-specific associations identified with Indicator Species Analysis. Sediment communities showed reduced Chao1 richness and Shannon diversity across both location and depth. Water communities exhibited weaker trends, with richness differing only between two locations at depth. Significant compositional differences among all sediment sites were observed, whereas seawater showed weaker site-level structuring but significant depth effects. Indicator analysis identified multiple bacterial families which were strongly associated with vent sediments, while seawater indicator taxa were less distinct and more broadly distributed across sites. These results suggest that shallow-water vents impose strong selective pressures on sediment microbial assemblages, while seawater communities demonstrate greater resilience. Our findings highlight the role of microbial indicators in identifying ecological responses to vent-associated stressors like increases in temperature and decreases in pH and contribute to the understanding of changing coral-reef microbiomes during extreme climate events.

Poster

Survival and Growth Variation Across Depths for Sixteen Important Coral Targets from Indonesia

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Indonesia has been recognised as a major contributor to the global ornamental coral trade, exporting over 2 million pieces of coral from 71 species worldwide annually. Sixteen species are particularly popular among reef aquarists, including Acropora tenuis, Hydnophora rigida, Merulina scabricula, Montipora undata, Pocillopora damicornis, Stylophora pistillata, Caulastrea furcata, Euphyllia glabrescens, Favites pentagona, Goniopora stokesi, Mycedium elephantotus, Acanthastrea hemprichii, Cynarina lacrimalis, Physogyra lichtensteini, and Trachyphyllia geoffroyii. These species are classified into three categories: fast-growing, medium-growing, and slow-growing corals, which are harvestable within 3 to 6 months, 8 to 12 months, and over 24 months after outplanting, respectively. This study was conducted in coral husbandry in Banyuwangi, East Java, Indonesia, one of the nation's key cultivation hubs. Survival and coral growth were assessed at two depths, 10 m and 20 m, using linear and vertical extension metrics. Results revealed that different depths had no significant effect on the overall species, though Cynarina lacrimalis showed the opposite. Nevertheless, growth performance are significantly differ among categories, with fast-growing species consistently exhibiting greater growth rate compared to medium and slow-growing corals at both depths which showed ≥7.5 cm per year; ≥6.5 cm per year, and ≥6.5 cm per year, respectively for linear extension and ≥6 cm per year; ≥5 cm per year and ≥4 cm per year, respectively for vertical extension categories. These findings can be incorporated into the long-standing national policies on coral cultivation guidance, thereby reinforcing the effectiveness of Indonesia's coral farming techniques, which have been developed over the past two decades.

Poster

Coral reef restoration in the UK

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The pink sea fan (Eunicella verrucosa), a cold-water octocoral and UK priority species, was successfully spawned in situ for the first time in the UK. This achievement enabled the complete documentation of its reproductive cycle, from egg release to larval settlement, providing critical insights into pelagic larval duration and settlement dynamics. Our study offers the first evidence of thermal plasticity in this long-lived, slow-growing species, revealing both vulnerabilities and potential adaptive capacity in response to ocean warming.

In parallel, we conducted the UK's first out-planting trial for E. verrucosa to test the feasibility and success of population reinforcement. The results demonstrate the potential role of restoration interventions in enhancing population resilience.

Together, these findings advance understanding of E. verrucosa reproductive ecology, larval behaviour, and population connectivity. By addressing fundamental knowledge gaps, this research informs conservation strategies for temperate coral ecosystems under climate change and explores restoration as a complementary tool for safeguarding this priority species.

Poster

Interactions and Feedbacks on Caribbean Coral Reefs: The Role of Structural Complexity, Algae and Herbivorous Fish Assemblages in Shaping a Degraded Ecosystem

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Coral reefs are highly complex ecosystems that are vulnerable to many different threats across varying spatial and temporal scales. Structural complexity, algae and herbivorous fish assemblages all interact; these interactions can be highly nuanced and at a very fine scale, potentially forming feedbacks that either maintain a stable state or trigger a phase shift into an alternative, potentially degraded state. This study collected and analysed data around Utila Island in the Caribbean to test the relationships between structural complexity, algae coverage and herbivorous fish diversity and abundance, to determine any feedbacks that may be exacerbating or reducing the degradation on Caribbean coral reefs. Limited relationships were found between these three variables, suggesting that Utila, and likely other similar reefs across the Caribbean, have entered a stable, algae-dominated state following a phase shift. Limited relationships between variables also suggest that interactions on coral reefs are highly complex and occur on a very small scale. This study reveals the complexities and nuances of Caribbean coral reef ecosystems and highlights the processes and conditions required to effectively reverse algae domination, restoring reefs to their original coral-dominated state.

Poster

Bright but Vulnerable: A Decade of Coral Reef Dynamics in a Changing Caribbean Seascape

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Caribbean reefs are undergoing rapid transformation, with widespread coral decline and shifts towards algal dominance. Yet against this backdrop of decline, some sites stand out, potentially offering insights into persistence under stress. Tela Bay, Honduras, is one such case: a turbid reef system that has until recently maintained unusually high coral cover despite chronic land-based impacts and fluctuating environmental conditions.

Drawing on a decade of monitoring (2013–2023), benthic community dynamics in Tela Bay we compared to those of the nearby island of Utila. Tela consistently exhibited higher coral cover and distinct assemblages dominated by Agaricia spp., contrasting with Utila's typical degraded Caribbean reefs. Episodic thermal disturbances revealed level of resistance in Tela, with signs of recovery following previous declines.

However, a mass bleaching event in 2023 caused coral cover in Tela to collapse to levels comparable with Utila, signalling that even bright spots remain highly vulnerable to acute climate shocks.

These findings underscore a paradox in a changing world: reefs persisting in turbid conditions may provide temporary refugia and insights into survival under stress, yet their fragility reveals that without urgent global action, even these potential refuges remain at risk.

Poster

Recruitment of coral-associated barnacles (Pyrgomatidae) on a turbid reef in Singapore

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Coral-associated pyrgomatid barnacles inhabit the skeletons of living corals as obligate macrosymbionts . These barnacles can be harmful if they occur in high densities or exhibit parasitic behaviours that damage the coral skeleton and tissues. In this study, we investigated the recruitment of pyrgomatid barnacles on common corals from Singapore's turbid reefs. A total of 181 coral fragments (3–4cm diameter) from six coral species (Favites pentagona, Porites rus, Pachyseris speciosa, Merulina ampliata, Pectinia paeonia, Lobophyllia radians) were out-planted on artificial structures deployed along a reef fringing Kusu Island (6–7m depth) in August 2023. Corals were monitored for growth and barnacle density at relatively regular intervals (5 time points) over a period of ~11 months (until June 2024). Barnacle recruitment was significantly different between the coral species. Highest barnacle densities were recorded in March 2024 on Porites rus (0.871 ± SE 0.129 barnacles/cm2) followed by Pachyseris speciosa (0.448 ± SE 0.107 barnacles/cm2). Barnacle densities for the other four coral species ranged from 0.001 to 0.014 barnacles/cm2. Porites rus fragments were found to have the highest incidences of partial and total mortality. Relationship/s between barnacle recruitment and coral mortality is currently being examined. Analyses are also underway to explore the potential drivers of pyrgomatid barnacle recruitment on Singapore corals (e.g. environmental conditions, coral traits, coral health). Our study provides insights into the relationship between pyrgomatid barnacles and different coral species on Singapore's turbid reefs, and implications for reef restoration efforts in Singapore.

The Effects of Elevated Alkalinity and Temperature on the Indo-Pacific Coral, Stylophora pistillata

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Given the impending threat of global warming and ocean acidification, considerable effort is being invested in carbon capture technologies. A prominent approach currently being tested in marine environments is “Ocean Alkalinity Enhancement” (OAE), which removes carbon dioxide from the atmosphere and sequesters it as bicarbonate dissolved in ocean water However, the impacts of alkalinity enhancement on coastal ecosystems is poorly understood. Enhancing alkalinity raises both ocean pH and buffering capacity, with the potential to influence numerous biological processes, including photosynthesis, respiration and calcification. The potential impact on calcification rates is particularly significant, as any increase in calcification rate could reduce the amount of sequestered CO_2 by a factor of ½.

We present the results of a laboratory-based experiment designed to examine the response of coral physiology and calcification rates to both future warming and alkalinity enhancement. We are culturing the common Indo-Pacific coral Stylophora pistillata under elevated temperature (~28 °C) and alkalinity (~3000 µmol/kg) conditions for 6-8 weeks. Over the course of the experiment, corals are sampled periodically for net calcification (buoyant weight), photosynthesis, and respiration rates (O_2 drift). Preliminary results indicate marginal effects of temperature or alkalinity on calcification rates, but significant effects on photosynthesis rates. Corals in combined elevated temperature and alkalinity conditions show a stronger increase in photosynthetic rates compared to corals in seawater where only temperature is elevated. Our results suggest that, even if OAE does not directly impact calcification, the impact of alkalinity enhancement on photosynthesis rates may lead to an increase in light-enhanced calcification at the reef scale, thus reducing CO_2 sequestration by OAE.