University of Glasgow Thailand 2022 Expedition report

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01.09.2023

This expedition was supported by the British Sub-Aqua Jubilee Trust

The British Sub-Aqua Jubilee Trust

1. Document control

Applicant's name:	Dylan Ashby & Ashlynn White
Nature of project:	University research expedition
Scientific/non-scientific:	Scientific
Grant awarded	06.07.2022
Profession of applicant	Undergraduate student
Date of report	01.09.2023

2. Project summary

For the first time since 2019, the University of Glasgow Thailand Expedition was able to go ahead. Due to diving safety concerns, the expedition destination was changed from Phuket to Koh Phangan Island. This meant that ours was the first University of Glasgow Expedition team on the island. The expedition team consisted of eight undergraduate students, Laura Hänninen, Dylan Ashby, Ashlynn White, Jennifer Sibbald, William Omand, Maren Andvik McLean, Kerensa Ballantyne and Paula Popa, all studying a biology subject at the University of Glasgow. In collaboration with the Centre for Oceanic Research and Education South-East Asia (COREsea), the expedition team undertook three research projects over the six-week expedition on Koh Phangan Island, situated in the Samui archipelago in the Gulf of Thailand. The expedition took place over 6.6.2022-17.7.2022.

Three research projects were undertaken, a terrestrial project studying amphibian populations, and two SCUBA-projects, one studying the impact of live coral cover on finfish abundance, and another on the densities and distributions of corallivorous *Drupella* snails. The SCUBA-projects were undertaken in collaboration with the NGO, Centre for Oceanic Research and Education South-East Asia (COREsea), following their methods of data collection when applicable to allow sharing of data between our expedition and the NGO. One scientific dive was done every working day, followed by data analysis and scientific lectures from COREsea. Dive sites were situated on the northern coast of the island, and data from five different sites were used in our scientific reports. The methodologies for all three projects were amended upon arrival to Koh Phangan, as our knowledge of the environment was limited due to the destination of the expedition being a novel one.

Our corallivore project results found a positive relationship between the *Drupella* sea snails and the coral genera *Montipora*. The abundances of *Drupella* were found to be below outbreak levels. Our fish abundance project results demonstrated positive

trends in live coral cover and fish abundance, as well as some positive trends between live coral cover and finfish abundance, depending on the functional group of the fish. Our experiences and findings have already helped the Thailand 2023 expedition team in the planning of their research. The Thailand 2023 expedition team carried out their own research this summer.

3. Acknowledgements

The University of Glasgow 2022 Thailand Expedition team is grateful for the grant funding received from the British Sub-Aqua Jubilee Trust. Our other supporters include the Glasgow Natural History Society, the Turing Fund, and the Chancellor's Fund. The expedition team is also grateful for supervisors Dr. David Bailey, Dr. Oskar Brattström and Professor Roger Downie for all of their patience and academic guidance. We extend our gratitude to Victoria Fahey and Stefan Follows from COREsea for their invaluable expertise and support.

4. Table of contents

5. University of Glasgow Thailand Expedition history

The expedition is part of the University of Glasgow Exploration Society, who have been running geographical and zoological research expeditions dating back to 1920. The society is affiliated with the University of Glasgow, Scottish Charity Number SC004401.

In 2019 the first expedition to Phuket was successfully carried out, focusing on marine research in the surrounding Andaman Sea. The 2022 expedition worked on a foundation from the 2019 expedition, as the previous two Thailand expeditions (2020 & 2021) could not happen due to Covid-19. Instead, the 2021 Thailand expedition was able to carry out a smaller scale expedition in Scotland and studied seaweed agriculture.

The destination of the 2022 expedition was changed from Phuket to Koh Phangan Island in the Gulf of Thailand for dive safety reasons as weather conditions in Phuket can be dangerous during the expedition period.

6. Expedition aims and objectives

The expedition aimed to:

- evaluate whether Koh Phangan Island was an appropriate destination for future expeditions
- make contacts with local scientists, NGOs, and dive centers
- investigate the reefs and forests of the Island to gain a baseline knowledge for future expeditions
- carry out a pilot project on *Lepidoptera* species on the island, cataloguing the different species found in order to facilitate the planning of possible future *Lepidoptera* projects
- carry out three research projects (The aims of these projects are discussed further in sections 13.2, 14.2 and 16.)

The grant funding provided by the British Sub-Aqua Jubilee Trust ensured that the aim of carrying out two marine projects, as well as the individual aims of these projects, could be met. BSAJT grant funding was not used to fulfil any other aims on the expedition.

7. Contact & social media

E-mail: expeditionthailandgu@gmail.com

Website: https://expeditionthailand.wixsite.com/phuket

Facebook: University of Glasgow Thailand Expedition

Instagram: @thailandexpedition22

Our instagram account and website are the best places to find out more about us. Information about our fundraising process, team introductions and posts about our experiences in Thailand are found in both. Our social media have been handed over to the 2023 expedition team, so much more information about them is available as well.

8. Expedition destination – Koh Phangan Island

Koh Phangan is a small island in the Surat Thani province in the Gulf of Thailand. It has a population of 10094 and an area of 167 km^2 (Bruno and Cottarelli, 2015 & Wikipedia). The middle of the island is very mountaineous and largely inaccessible, and the island is therefore mostly populated around the coast. Over half of the island's area is designated as a national park. The island is a big tourist destination and popular amongst snorkellers and divers (Stuhldreier, 2012 & Wikipedia)

9. Collaboration

Our expedition made a new connection with an NGO called the Center for Oceanic Research and Education (CORESea), who were our main collaborator. CORESea is a framework for marine environmentalists, scientists and divers based on Koh Phangan. More about COREsea can be found at https://coresea.com/. Our two marine research projects were conducted in partnership with the Centre for Oceanic Research and Education South-East Asia (COREsea). COREsea have vital connections with the Thai Department of Marine and Coastal Resources (DMCR) and Angthong marine national park and have extensive knowledge of the surrounding MPAs useful for our expedition. COREsea is so able to communicate our findings to the DMCR, as well as their other local collaborators, such as the Thai NGO Phangan Sea Guardian.

The methods used in our marine projects were the same as those used by COREsea, so that we could share data. The data and reports from our marine research projects were shared with COREsea to be used for long term monitoring programmes, and archival data from COREsea was used in our research reports. Aside from this, in Thailand, COREsea also provided our expedition with laboratory facilities, transportation to dive sites, access to diving and scientific equipment (such as transect tapes), lectures on coral reef ecology and Koh Phangan Island and supervision and guidance in our research. Our expedition's collaboration with COREsea was entirely made possible due to grant funding from the BSAJT.

Our expedition also established contact with another NGO, Phangan Reptile Rescue centre, a rescue, education, conservation and research centre. Scientific or other collaboration with the NGO would be possible for future University of Glasgow expeditions. Our expedition visited a local animal shelter at which future expeditions can volunteer. Furthermmore, the expedition was in contact with Sail Rock Divers dive centre, through which leisure dives were organised on our free days.

10. Expedition personnel

Expedition team

The 2022 expedition team consists of the two leaders and six other undergraduate students studying at the University of Glasgow. The expedition provided the team members with valuable experience in the field; such as developing logistical planning skills and the ability to work within a scientific team. The expedition team was assembled at the start of term in 2021 by the leaders of the Thailand 2021 expedition based on written applications and interviews with prospective 2022 members. Expedition members no in charge of a research project participated in the data collection for all three projects.

- Expedition leaders ensured the smooth planning and running of the expedition by writing the prospectus, and the risk assessment, assigning and supervising tasks, resolving conflicts and ensuring team cohesion.

- Project leaders developed the research projects, designed the methods and led data collection.

Expedition leaders:

Laura Hänninen (3rd year Marine & Freshwater Biology)

Dylan Ashby (2nd year Marine & Freshwater Biology)

Project leaders:

Laura Hänninen (3rd year Marine & Freshwater Biology)

Ashlynn White (3rd year Marine & Freshwater Biology)

Jennifer Sibbald (3rd year Zoology)

Treasurer: William Omand (2nd year Marine & Freshwater Biology)

Fundraising: Maren McLean Andvik (2nd year Zoology)

Social media: Kerensa Ballantyne (2nd year Zoology)

Grants: Paula Popa (1st year Molecular & Cellular Biology with Biotechnology)

Academic advisors

Dr. David Bailey: Advisor for the marine research projects and expedition advisor

Dr. David Bailey acted as expedition advisor for the 2022 Thailand expedition. With a career in academic science spanning over 20 years, Dr. Bailey has studied a broad range of marine environments from tropical coral reefs to the Antarctic with a focus on conservation and management. David co-supervised the planning of the marine research projects as well as the general logistics of the expedition.

Dr. Oskar Brattström: Co-advisor for the terrestrial research project and expedition advisor

Dr. Oskar Brattström acted as the academic supervisor for our terrestrial project. He is currently lecturing in Animal Biology in the University of Glasgow and has many publications in the field of insect biology, specialising in butterflies. Dr. Brattström accompanied the expedition for a week in Thailand, advising us on general expedition logistics, the terrestrial research project and the *Lepidoptera* pilot project.

Professor Roger Downie (retired): Co-advisor for the terrestrial project

Professor Roger Downie was a professor of Zoological Education and an honorary senior lecturer at the University of Glasgow. He has extensive expedition experience and has chaired the Glasgow University Exploration Society as well as the Exploration Council for several years. His research focuses on amphibian metamorphosis, reproductive ecology of tropical frogs and marine turtle breeding biology and conservation, among others. Whilst he is retired, he co-advised our terrestrial amphibian project with Dr. Brattström.

Victoria Fahey: Expedition advisor, Dive leader

Victoria Fahey works as Field Work Advisor and Research Manager at COREsea for COREsea on Koh Phangan. She supported us in planning our projects, as well as supervised and aided us during SCUBA- data collection. She is a PADI Open Water Scuba instructor and a marine biologist.

Figure 1. The UofG Thailand 2022 expedition team. (Top row left to right: Laura Hänninen, Ashlynn White, Paula Popa, William Omand, Maren McLean Andvik, Jennifer Sibbald. Bottom row left to right: Kerensa Ballantyne, Dylan Ashby.) 2022 Thailand Expedition.

11. Applicant's role

Dylan Ashby was co-leader of the University of Glasgow Thailand 2022 expedition alongside Laura Hänninen. Dylan Ashby was in charge of finances alongside our treasurer, and non-scientific leadership. His responsibilities included administrative tasks such as organising flights and visas and overseeing fundraising endeavours. During the expedition, he assisted with the data collection of all three projects, whilst overseeing the budget.

12. Research projects

12.1. Project outlines

The expedition team carried out three research projects, two marine projects lead by Ashlynn White and Laura Hänninen and one terrestrial project lead by Jennifer Sibbald focusing on cataloguing amphibians on the island. As opposed to the two marine projects, the terrestrial project received no funding from the British Sub-Aqua Jubilee Trust and will therefore only be briefly summarised in this report.

Ashlynn White's research project on the corallivorous *Drupella* sea snails investigated whether they pose a potential risk to the local reefs by studying the distribution of *Drupella* spp. densities between sites and across substrata. Laura Hänninen's project studied the long-term trends in, and interaction between live coral cover and finfish abundance. The marine projects were carried out in tandem and in collaboration with COREsea. Surveys for both projects were carried out on the same dive, using the same transect lines.

Figure 2. Ashlynn (left) and William (right) photographing the substrate next to the transect tape for identification in the lab. 2022 Thailand Expedition.

12.2. Study area

The Gulf of Thailand is a marine embayment located in the South China Sea. It has a maximum depth of 88m and an average depth of 45m. The Samui Archipelago, which consists of over 40 islands, is located in the lower Gulf. The study was conducted on Koh Phangan, the second-largest island in the archipelago, which has an area of 167km^2 and is 55km from mainland Thailand (Bruno and Cottarelli, 2015).

12.3. Study sites

The research was conducted on Koh Phangan Island’s northwest coast. The reefs in the sites were largely intact fringing reefs at a constant depth of around 5 meters. Data collection was conducted at five sites:

Study site	Reef coordinates (Lat/lon):
Ang Thong Lang (ATL)	9.79961, 99.98828
Haad Khom (HK)	9.79869, 100.01505
Haad Salad (HS)	9.78675, 99.97086
Koh Ma (KM)	9.80175, 99.97789
Mae Haad 4 (MH4)	9.7922, 99.97623

The order in which the different sites were surveyed was random, but due to extreme weather, sometimes this was not possible, and site that was easiest and safe to access by long-tail boat was surveyed instead. All sites were quickly accessible (less than 20 minutes by boat) by taxi boat from Chaloklum Bay, where COREsea is located.

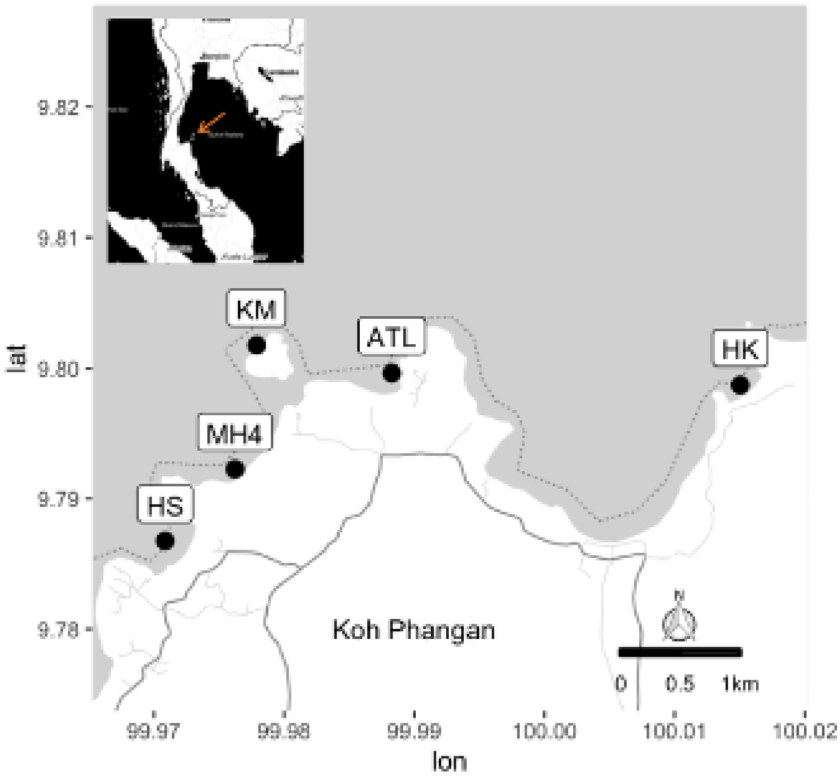

Figure 3: Map showing location of Koh Phangan and the surveyed sites. An inset map in the top left-hand corner shows the location of Koh Phangan in the Gulf of Thailand (as indicated by the orange arrow). The main map shows the northwest of Koh Phangan, with black dots representing the five survey sites. Maps sourced from Stamen and modified using the library "ggmap" in R.

12.4. Diving protocol

The surveying for the two SCUBA-projects was done on the same transect tapes. Both research projects also utilised data from a benthic cover survey done through the Line-Point Transect method. Three 50-meter long transect tapes were laid straight, one after the other, with a small gap between them at roughly five meters depth on the reef. The transects were marked by 50-meter tape measures which were tied to dead substratum on the reef. The transects were laid by a diving buddy pair, with one person navigating via compass, and the other laying the transects. The transect tape was laid to conform to the shape of the benthos, so that there would not be large gaps between the benthos and the tape.

Each survey consisted of three consecutive transects aligned parallel to the shoreline. Two COREsea divers were involved in laying out the transects, one navigating along the reef crest at five metres with a compass and dive computer, the other following whilst reeling out the line. Divers then swam along the transect, collecting the desired data (see below) before reeling in the line. The buddy pair surveying for finfish would swim along the transect first, so that the other buddy pair would not disturb the fish. The buddy pairs surveying for *Drupella* and taking pictures swam behind them. Each dive lasted no more than one hour and took place between 10.00 and 13.00 local time.

13. *Drupella* research project

13.1. The genus *Drupella*

Drupella is a genus of marine snails (Claremont, Reid and Williams, 2011). Found throughout the Indo-Pacific and Red Sea, *Drupella* spp. populations normally occur at low densities (<1.4m^{-2}) (Morton, Blackmore and Kwok, 2002; Boneka & Mamangkey, 2013; Moerland, Scott and Hoeksema, 2016). However, populations of *Drupella* spp. are known to increase exponentially during outbreaks (>1.4m^{-2}); causing coral tissue loss faster than it can regenerate. Outbreaks have occurred globally, including off the coasts of Kenya, Western Australia, Jordan, Thailand, and India (McClanahan, 1994; Cumming, 2009; Al-Horani, Hamdi and Al-Rousan, 2011; Scott et al.,2017; Thaha and Rathod, 2022) and can reduce live coral cover by over 85%, as seen at Ningaloo Reef, Australia (Cumming, 2009). The causes of outbreaks are still widely unknown, with theories including overfishing of larval predators, eutrophication, and water temperature changes (McClanahan, 1994; Turner, 1994). In addition to coral predation, *Drupella* spp. can transmit coral diseases, including brown band disease, black band disease and white syndromes (Antonius and Riegel, 1997; Onton et al., 2011; Nicolet et al., 2013).

Interaction between coral and corallivores is changing due to increased anthropogenic stressors. Overfishing and coral bleaching have been seen to cause relative increases in generalist invertebrate corallivore populations, including *Drupella* spp., compared with other corallivores, such as fish (Rice, Ezzat and Burkepile, 2019). There are still many gaps in our knowledge regarding the population dynamics of *Drupella* spp.; the majority of existing studies have focused on outbreak populations, and most conservation methods are reactive instead of preventive (Saponari et al., 2021). The most common management method currently used is extermination, which is usually labour-intensive and inefficient (Kitamura et al., 2021). Continuous monitoring and research are crucial for understanding *Drupella* spp.'s natural ecology and how this may shift with environmental change, aiding the construction of better outbreak prediction and management regimes.

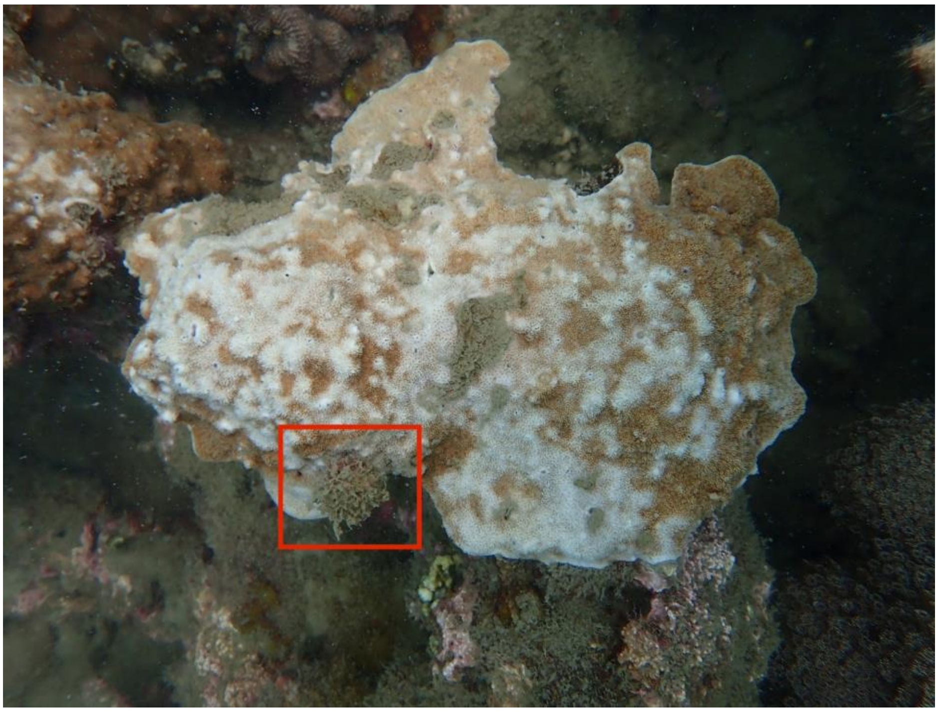

Figure 4: *Drupella* spp. scarring on a *Montipora* spp. coral colony. The red box highlights an individual *Drupella* spp., and the white marks on the *Montipora* show scarring caused by the snails' feeding. *Drupella* spp. feed using their radula, specialised for scraping and removing coral tissue, resulting in the discolouration visible in the image.

13.2. Project aims

The study aimed to provide information regarding the current state of the *Drupella* spp. populations on Koh Phangan and identify whether they pose any potential risk to the coral reef community. This was achieved by investigating the distribution of *Drupella* spp. densities between sites and across substrata.

13.3. Methods

13.3.1. Overview

The data for this project were collected in 2022, over June and July by the UofG Thailand expedition. COREsea data was not used for this report. Surveys were conducted by divers using SCUBA along 50 m transects following the "Belt-Transect Sampling" and "Line-Point Transect" methods following protocols from Global Coral Reef Monitoring (Hill & Wilkinson, 2004).

13.3.2. Line-point transect sampling

Line-point transect (LPT) surveys were used to measure benthic community composition. The survey was done by a diving buddy pair using the Olympus Tough

TG-6 camera (see Figure 2). The photographer would take a single picture every 50 centimeters along each transect, starting at zero metres. The picture, taken at a 90-degree angle to the tape, needed to show the transect tape, as well as the substratum under it. The distance from which the picture was taken could vary as long as the photographer thought that the substratum would be identifiable from the picture. If the photographer thought that the substratum at a specific point might be difficult to identify from the picture due to its quality, they took more pictures at the same spot from different angles and under the tape measure if there was a large dip in the benthos. The diver not taking pictures made sure that the metric side of the transect tape was facing the camera.

Photographs were later analysed to record the substratum directly below each point, done by looking to the left at each point and seeing where the transect touched. Where the substratum was identified as ‘hard coral’ it was identified to the genus level using the Coral Finder Identification Guide (Kelley, 2016) with the help of COREsea staff to ensure correct identification. The training for this task was attending COREsea lectures on coral anatomy and identification. Colour was never used to identify corals. If there were multiple pictures of the same spot on the transect, the first picture was used to locate the point intercept, and the other ones could be used to identify the corresponding substratum. Dead coral algae (DCA) and crustose coral algae (CCA) were classified as such due to the level of expertise needed for further identification. Other benthic categories included, but were not limited to, "Urchin", "Soft Coral", "Sand", and "Rubble". This method typically yielded 101 points per transect, but in some cases fewer points were identified due to blurry or missing images. To allow comparisons between transects, the percent abundance of each substratum was calculated by dividing its total count by the total intercepts for a transect and multiplying this value by 100. However, it should be noted that the LPT method has several limitations. As it only samples a portion of the sample area, it has been seen to have some inaccuracies, underestimating encrusting corals and overestimating massive corals (Leujak and Ormond, 2007). Observer bias is another concern, mainly when the transect does not lie directly on the substrata, making it difficult to determine the point under the line. Despite the known limitations, these methods were used to ensure consistency with COREsea, which chose them due to their time and cost efficiency (COREsea, unpublished).

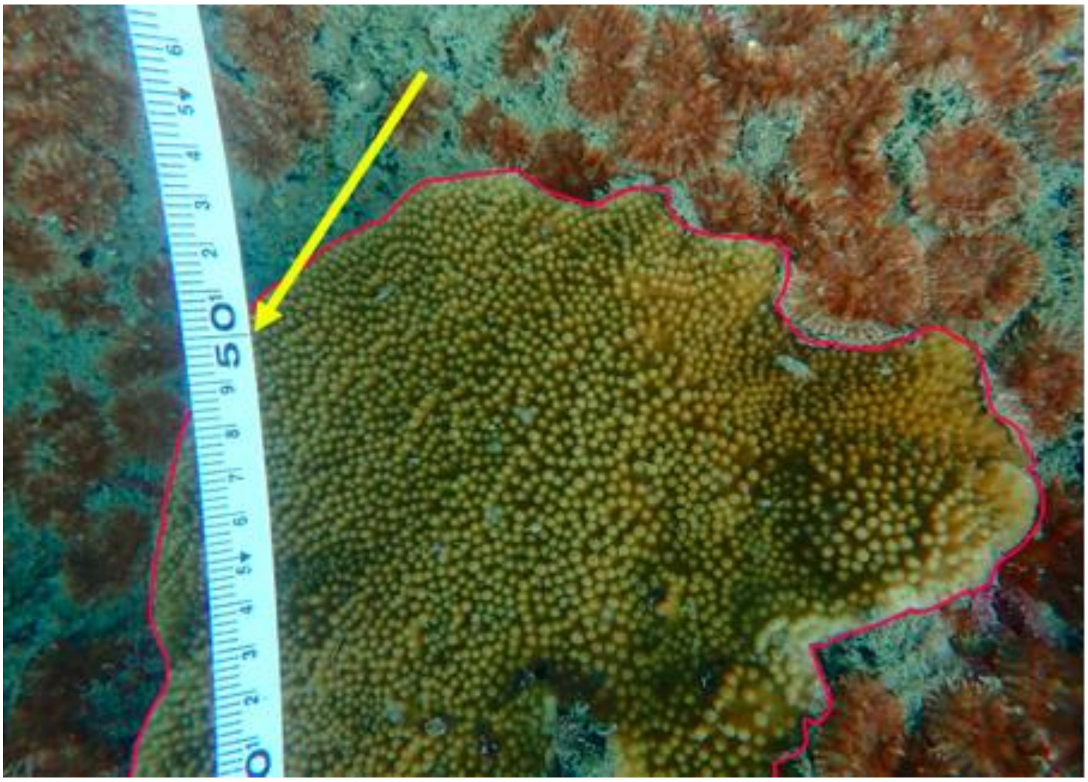

Figure 5. The point at which the substratum is identified is marked by the yellow arrow and is to the right of the 50-centimeter mark on the transect tape. This point falls on the coral which is outlined in red. The whole outlined area can be used for identification, as identifying coral from a single point would be difficult. 2022 Thailand Expedition.

13.3.3. Belt-transect sampling

Drupella spp. numbers were counted within a 100m^2 area along a 2m x 50m belt transect. Two divers swam on either side of the transect, recording any *Drupella* spp. within one metre of the line. Each diver was equipped with a one metre rope which could be used to ensure that the individual was within the sample area. Following adequate coral identification training, the substratum directly beneath the snails was recorded to the genus level. Data on aggregations was collected, recording the number of *Drupella* spp. found on a single coral head. Results were recorded on a slate underwater and transcribed into a spreadsheet upon return to shore. Population densities were calculated by dividing the number of *Drupella* spp. found in one belt transect by the total area surveyed (100 m^2). To maintain consistency in the results, the individuals surveying *Drupella* spp. remained the same throughout the study period. *Drupella* spp. are cryptic and hard to identify due to encrusting algae on their shells. Two *Drupella* spp. surveys were conducted before collecting data to familiarise data collectors with the methods, including practice of in-situ *Drupella* spp. identification. Following past study methodologies, *Drupella* spp. were identified at the genus level to avoid misidentification (Nicolet et al., 2013; Bruckner et al., 2017; Saponari et al., 2021).

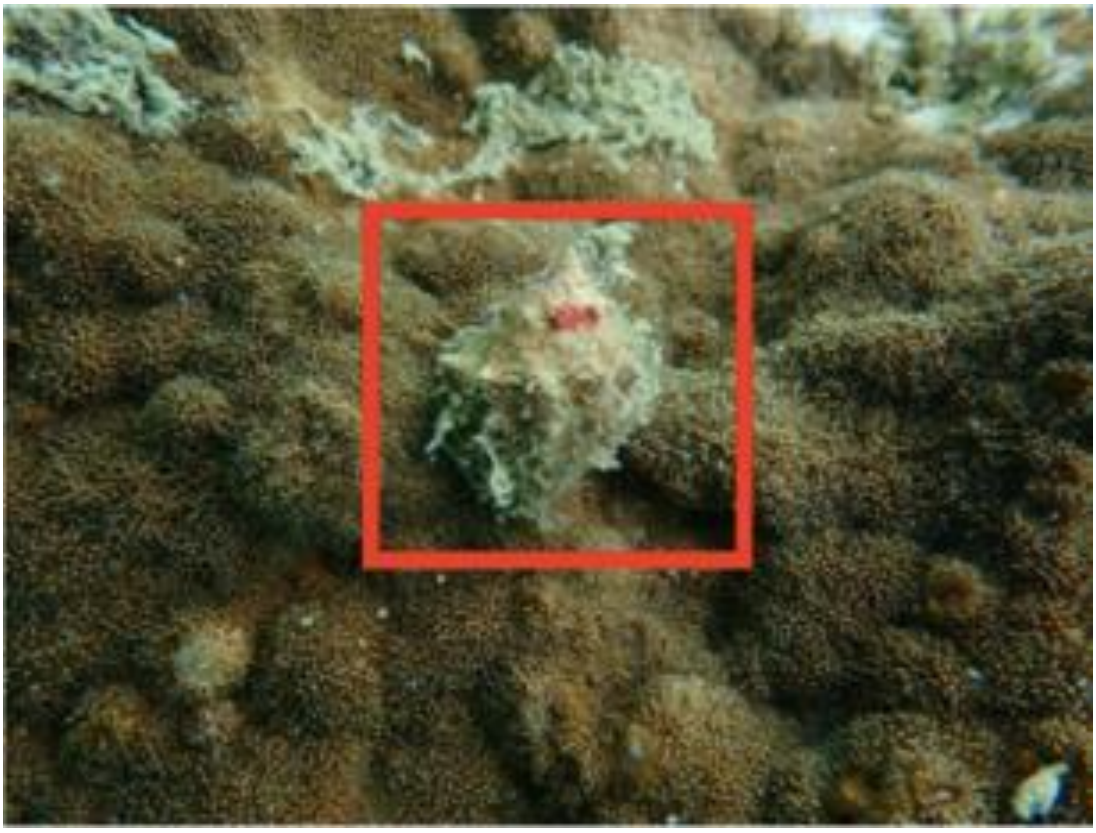

Figure 6: The cryptic nature of *Drupella* spp. located on a species of *Montipora* coral. The Individual snail can be seen in the red box. Algae covers its shell, camouflaging the snail and making in-situ identification challenging. 2022 Thailand Expedition.

13.4. Project findings

Over the three-week study period, 952 *Drupella* spp. were counted with an average density of 0.26 (SE ± 0.02)m^2, mean densities differed significantly between sites (varying from 0.38 (SE ± 0.02)m^2 to 0.11 (SE ± 0.06)m^2). *Drupella* spp. were found on 20 substrata, 15 of which were coral genera. Ivlev's Electivity Indeces showed a preference for the *Acroporidae* genus *Montipora* across all sites apart from one, where the genus Pachyseris was favoured. A positive association was seen between *Drupella* spp. abundance and *Montipora* spp. abundance, suggesting *Montipora* spp. plays a key role in *Drupella* spp. distributions. These results show that while current *Drupella* spp. densities in Koh Phangan may not be of concern, a decrease in the abundance of *Montipora* spp. may cause damaging alterations to their prey selection and should be monitored. Further research modelling location specific thresholds for *Drupella* spp. densities would greatly aid monitoring for early detection of outbreaks.

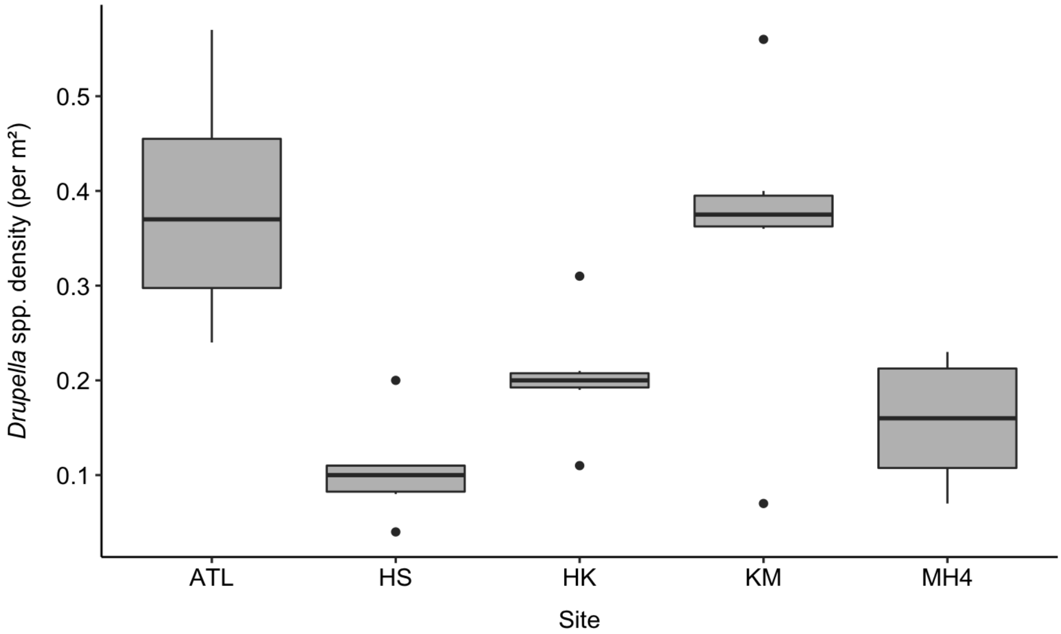

Figure 7: Variation in *Drupella* density at different sites.

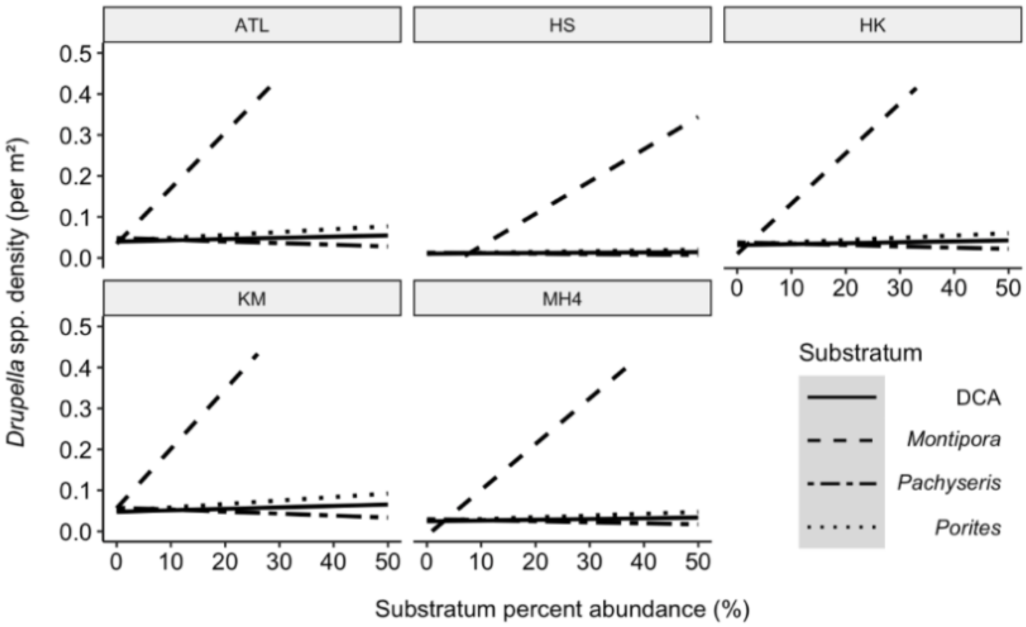

Figure 8: Predicted Drupella densities found on four substrata at corresponding percent abundances (%) across five sites.

The median densities of *Drupella* in KM and ATL are two-fold that of the other three sites, and their ranges are non-overlapping with HS, HK and MH4 (Fig. 7). When the effect of site on *Drupella* abundance was tested using a nbGLM, sites HS, MH4, and HK showed significantly lower predicted abundances than KM. This was also the case when the model was run with ATL as the reference, except for HK, which showed an insignificant difference to ATL ($z_{95,120}$= -1.684, p= 0.0922). *Drupella* densities between ATL and KM were alike, with non-significant variations in their densities. Further visualisation of this can be seen in Figure 8, where the gradient of rise in *Drupella* numbers with substrata percent abundance are steeper for sites ATL and KM. For example, with a relative *Montipora* abundance of 10%, the model predicts the number of *Drupella* observed on *Montipora* per 100m^2 to be 18, 15, 12, 4 and 3 for KM, ATL, HK, HS and MH4, respectively. The same pattern occurs with DCA and *Porites*, with higher numbers predicted at ATL and KM than the other three sites (Fig.7).

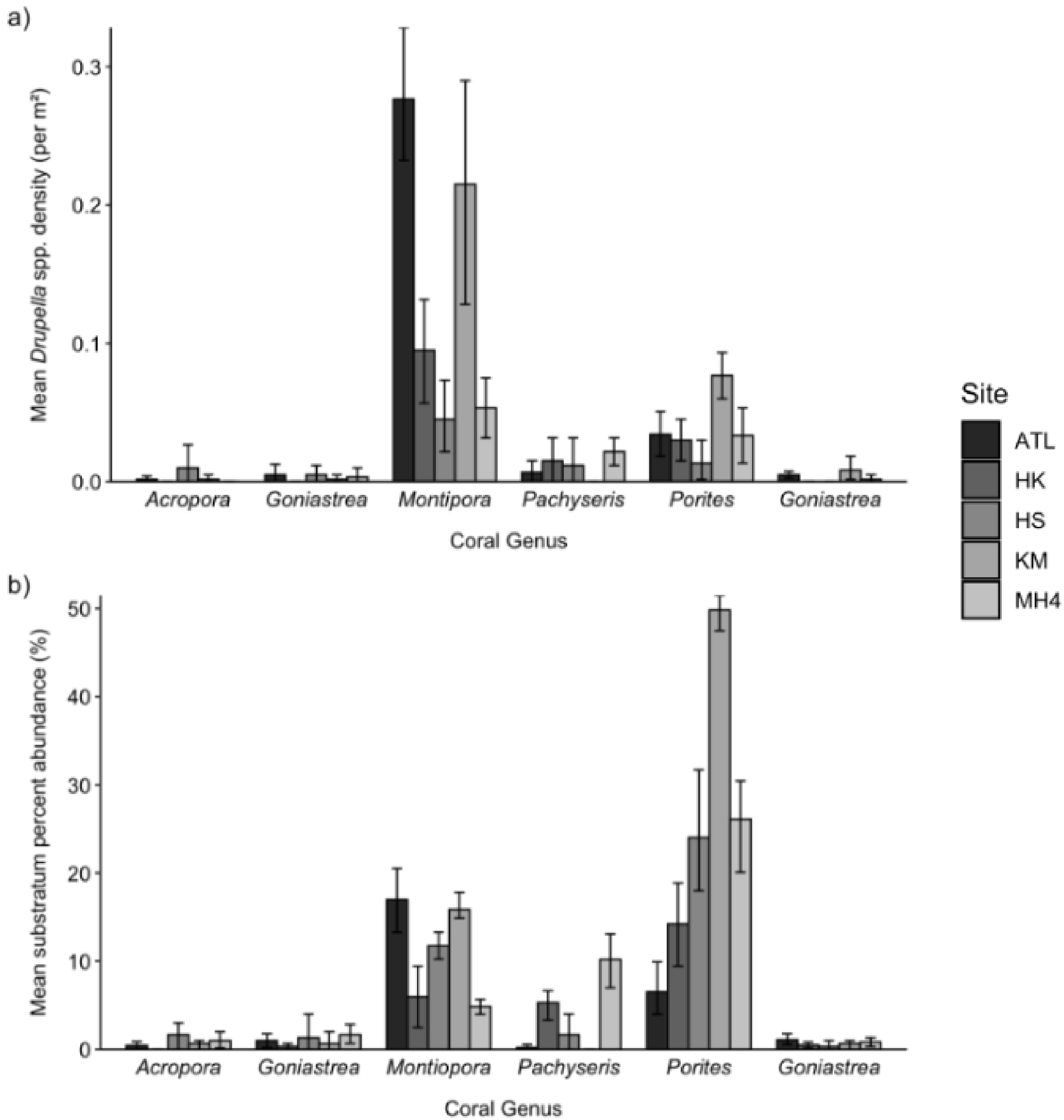

Figure 9. Comparison of *Drupella* spp. density on different substrata and the percent abundance of substrata across five sites. Error bars represent the upper and lower limits for the confidence interval (95%). Substrata were chosen as they encompass the six coral genera that *Drupella* spp. showed preference to at one or more sites, according to Ivlev's Electivity Index. Coral genera on graph encompass all species within. **(a)** Mean *Drupella* spp. density (per m^2) found on six coral genera, separated by site. Where no bars can be seen, no *Drupella* spp. were found on that substratum at the given site. **(b)** Mean percent abundance of the six selected substrata for each site. LCC surveys detected no *Pachyseris* spp. at KM or *Acropora* spp. at HK.

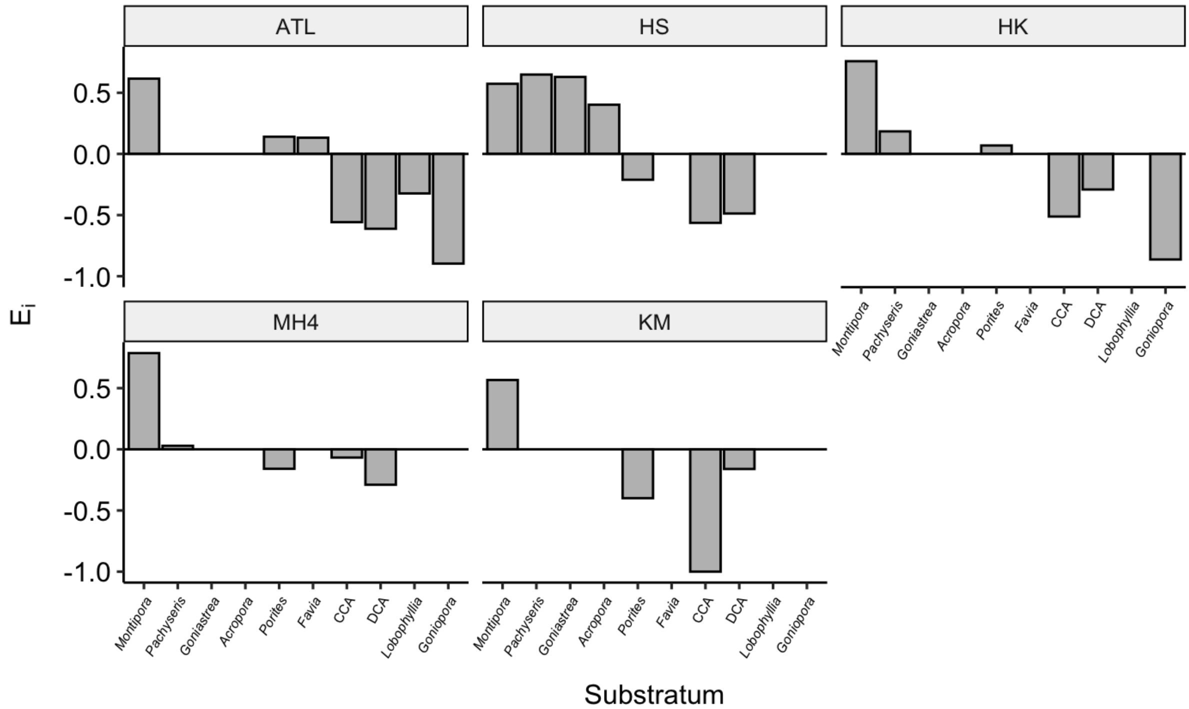

Figure 10: Substratum preference on five sites for *Drupella* spp. according to Ivlev's Electivity Index (E_i). Each bar represents the E_i for a given substratum at a given site. When E_i = 1, a complete preference is indicated, and when E_i = -1, there is complete avoidance of *Drupella* spp*.*

Associations between *Drupella* and substrata

61% of the Drupella observed were found on *Montipora*; this was four times higher than the number found on the next most frequent substrata, *Porities* (14%). Less than a quarter (13.6%) of snails were found on non-living substrata, primarily DCA (12%). This variation was ubiquitous across sites, with *Drupella* occupying *Montipora* more frequently than any other substrata (Fig. 9a).

Accroding to Ivlev's Electivity Indices, *Acropora*, *Favia*, *Goniastrea, Montipora*, *Pachyseris* and *Porites* were preferred at one or more sites. *Montipora* had the highest preference index at all sites, apart from HS, where *Pachyseris* was preferred. DCA and CCA were avoided at all sites, and avoidance was also seen towards *Goniopora* and *Lobophyllia*. *Porites* was the only substratum preferred at some sites (ATL and HK) and avoided at others (MH4, HS and KM) (Fig. 10). Evidence of feeding was found on *Montipora*, indicated by the presence of feeding scars (Fig. 4). However, observation of feeding scars was not explicitly investigated during the surveys, so predation on other coral genera cannot be confirmed.

Effect of *Montipora* abundance on *Drupella* densities
The effect of *Montipora* percent abundance on the number of *Drupella* varied significantly between substrata (LRT: X^2=38.19, df=4, p<0.01). The relationship between *Drupella* numbers and *Montipora* abundance was stronger than the relationship between *Drupella* densities and other substrata across all sites (Fig. 8). When predicting *Drupella* abundance using a nbGLM, all sites show that a rise in the relative abundance of *Montipora* is associated with an increase in expected *Drupella* densities (Fig. 8). Greater numbers of *Drupella* were observed at sites with higher levels of *Montipora,* except HS, which showed the third highest mean *Montipora* abundance (11.7%) but lowest mean *Drupella* density (Fig. 9a,b). The highest mean densities of *Drupella* were seen at ATL and KM, these sites also had the highest proportion of *Montipora*, 17% and 16%, respectively (Fig. 9a,b).

14. Coral cover and finfish abundance research project

14.1. Project aims

The following study aims to understand the relationship between live coral cover (LCC) and finfish abundance on the reefs around Koh Phangan-island in the Gulf of Thailand, investigating long-term trends both in fish abundances and coral cover and differences between the study sites.

14.2. Survey methods

Like the coral predator project, this project also used data from the Line-Point Intersect survey for benthic cover. This survey method is outlined above in section 13.3.2. The project was originally planned to be a snorkelling project, but snorkelling conditions were found to be unfit for scientific data collection due to limited visibility and uniform reef depth of five meters. Future snorkelling projects ideas are not encouraged by the 2022 expedition. The data used in this project was collected by the UofG expedition in 2022, and in the long term by COREsea between 2014 and 2022, excluding the years 2019 and 2020 due to COVID-19.

14.2.1. Finfish abundance survey

Using the same transect tapes as for the benthic cover survey, the finfish survey was done by a diving buddy team using the belt transect method on a 5m x 50m belt. As the different surveys (such as the *Drupella* belt sampling) were done using the same transect lines, the finfish survey was always the first one to be carried out, so that other surveyors would not disturb the fish prior to the fish survey. Fish disturbance was also minimized by waiting for three minutes between laying the transects and starting the survey. Each member of the pair would swim next to the transect noting down the fish they spotted in a 2.5m x 50m belt on their side of the transect. The observations were tallied in a table on a diving slate.

In preparation to the survey, the divers learned to identify different species in the seven fish families based on their appearance and behaviour by attending COREsea lectures. For example, the divers knew to check for fish in the family *Serranidae* hiding between the corals. This reduced bias for the more conspicuous families, like *Chaetodontidae*. If a diver spotted a large school of fish, an estimate of how many fish there were in the school was noted down. If the diver on the right spotted a fish swimming from the left side of the transect tape over to the right, they would not record it on their slate, as they would assume that the diver on the left had already done so.

14.2.2. Study families

Five finfish families representing different functional groups were chosen for this project; *Scaridae* and *Siganidae* are herbivores (Bellwood, 1994, Bos et al. 2017), *Chaetodontidae* are corallivores (Cole et al. 2008) and *Labridae* and *Serranidae* are carnivores (Parenti & Randall, 2020, Parenti & Randall, 2021). These fish families are also monitored by COREsea in their long-term data collection. During our pilot study, a much wider array of 19 fish families was trialed, but it was found that such a project would not be feasible in the limited time frame.

14.3. Project findings

The average live coral cover (LCC) over the years was 51%. The average abundance per $250m^2$ for all fish was 70, and 24 for corallivores, 10 for herbivores and 37 for carnivores. The abundances of Chaetodontids and Labrids have increased and the abundances of Scarids and Serranids have decreased during the study period. Live coral cover has increased significantly, and as global trends in coral cover often show decreases, this finding is striking and promising for the reefs of Koh Phangan.

Live coral cover significantly affected the abundance of fish in all groups, except for all fish in total carnivores as a group, and the family *Serranidae.* Furthermore, a significant interaction between live coral cover and study site was found in *Chaetodontidae, Scaridae* and *Siganidae* abundances and the abundances of corallivores and herbivores. Site and date also had varying effects on the abundances of different fish groups. Corallivores were positively affected by LCC. Unexpectedly, herbivores were also positively affected by LCC and carnivores were not significantly affected at all. Live coral cover has previously been found to have highly varying effects on fish abundance, with some species being affected positively, some negatively and some unaffected. Such variability was also found in this study.

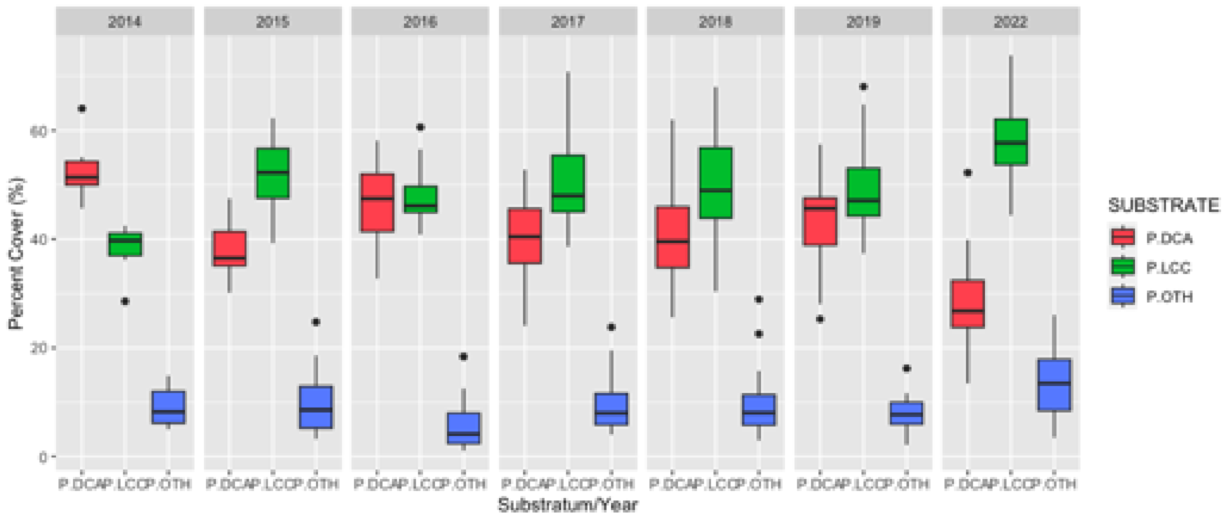

Figure 11: The percentage cover for LCC (P.LCC), dead coral algae (P.DCA) and other substrata (P.OTH) over the years.

LCC and DCA have changed in an oscillating manner over the years. LCC and DCA appear to have a negative relationship, where one increases when the other decreases. The percent cover of other substrates, such as rock or sponges, has stayed low and more consistent.

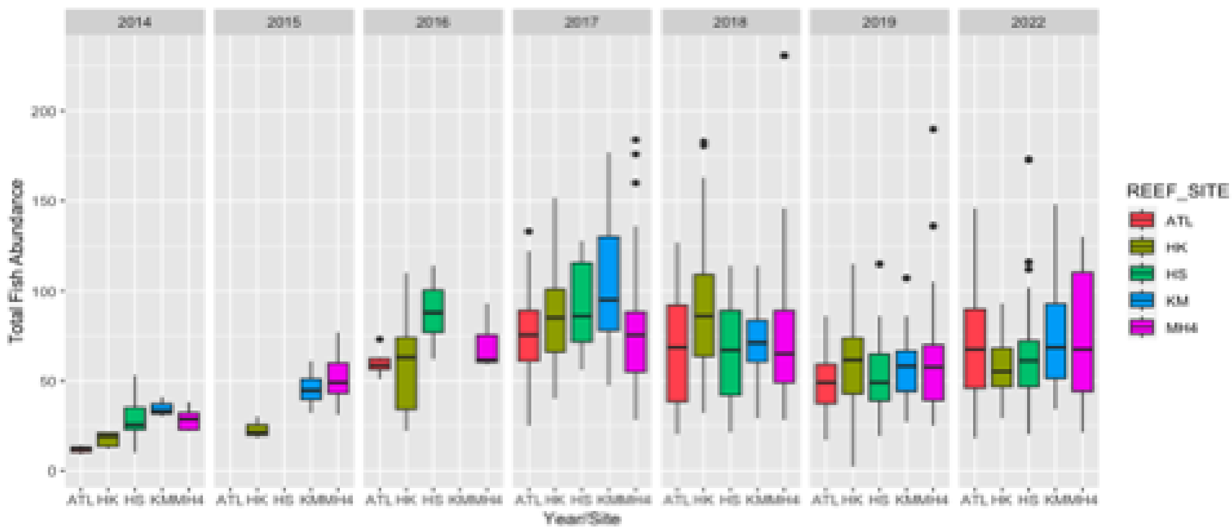

Figure 12: Fish abundances per 250m^2 transect for the five study sites between the years 2014 and 2022.

Total fish abundance was not significantly affected by site (p-value: 0.055) or date (p-value: 0.059), but both p-values were near the threshold. During 2014-2016 finfish abundances were recorded to be low and small in range, meaning there was not much variation in fish abundances between sites or samplings. In 2017-2022 the mean finfish abundances, as well as the range in abundances were higher. Between the years 2014 and 2022, the average abundance for all fish in total was 70 fish per transect. In 2014 the average was 25 fish per transect and in 2022 it was 69 fish per transect. Average fish abundance was highest in HK, which had an average of 74 fish per transect, and lowest in HS, which had an average of 64 fish per transect.

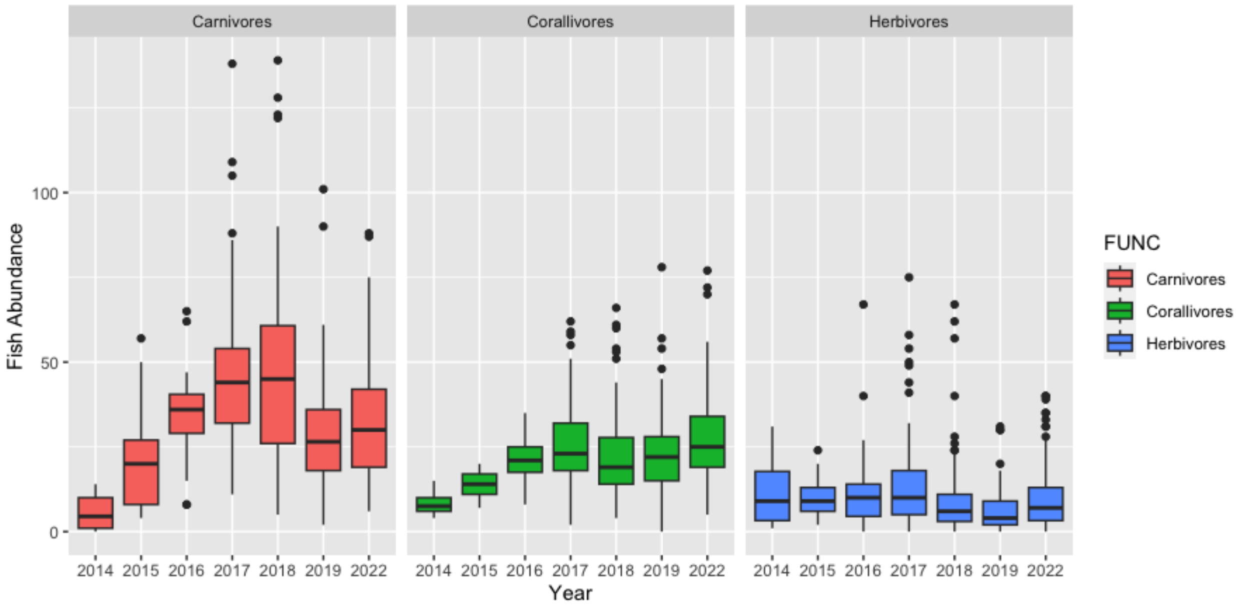

Figure 13: The abundances in fish per 250m^2 transect of the three finfish functional groups over the years.

Herbivore and corallivore abundances were significantly impacted by time but carnivore abundance was not. Carnivore and corallivore abundances were generally high compared to herbivore abundance. Corallivore abundances have increased over time from 8 to 27 fish per transect between 2014 and 2022. Herbivore abundance has stayed lower and the mean abundance of herbivores has decreased from 12 to 8 fish per transect. Over the study period, the average abundance for corallivores was 24, and the average abundances for herbivores and carnivores were 10 and 37, respectively.

15. SCUBA-research safety

Three expedition team members received a first aid training course from Remote Emergency Care catered specifically for expedition safety prior to the expedition. In addition to this, all members undertaking SCUBA-research were certified as PADI Rescue divers prior to the start of the expedition and were therefore also first aid certified. Team members who obtained their Rescue diver certifications in 2022 did so through Blue Hippo Diving. Dive safety was obtained through:

- Group dive at the start of the expedition to get comfortable
- Dive practise with COREsea prior to starting data collection
- Clear dive and data collection plan
- Clear emergency plan
- Buddy pairs and checks
- Use of dive computers
- Supervision by COREsea divemasters at all times (on the boat/diving)

- Weather assessment by COREsea and the taxi boat company prior to boat journey
- Progressive nature of scientific tasks (Team members had enough time to learn tasks or could choose not to do certain tasks they found difficult)
- Only doing one scientific dive per day

All dives were done supervised by COREsea divemasters, who oversaw navigation, organisation of research and safety. All diving was done in buddy pairs in about 5 meters of depth. COREsea also provided taxi boat transportation to dive sites.

During the expedition, COVID-19 was a concern. Risks were mitigated through expedition members being frequently tested for COVID-19. Furthermore, members followed COVID guidance such as regularly washing their hands and wearing PPE.

All activities during the expedition were governed by our risk assessment, which covered travel, location safety, local flora and fauna, general wellbeing, transportation safety, COVID-19, dive safety and boat safety.

Emergency contact numbers

Thai Emergency number: 191

Koh Samui Recompression chamber:

> +66 (0)77 427 427 / +66 (0)81 081 9555 (Emergency 24 h number)

Koh Tao Recompression chamber:

+66 (0)77 456 661 / +66 (0)81 081 9777 (Emergency 24 h number)

Nearest recompression chambers

SSS Recompression chamber on Koh Samui Island

> The nearest decompression chamber is on Koh Samui Island. In case of emergency, it would be accessed by speedboat, which takes around 1.5 hours. There are highly trained and experienced dive medics on Koh Tao who work with the chamber network on Koh Samui to coordinate evacuations.

SSS Recompression chamber on Koh Tao Island

> The next closest decompression chamber is on Koh Tao Island and is accessed by speedboat in about 1,5-2 hours.

Boat handling

Transportation to all dive sites was done by taxi boat, which was operated by a local taxi company. Boat safety was ensured by the boat captains being:

- appropriately experienced
- intimately familiar with the different dive sites and routes between them and Chaloklum Bay
- familiar to COREsea staff as they use this company every day for their boat dives
- understanding of the safety of different weather conditions around the island

On days when the weather was inopportune due to local conditions, we would liase with both CORESEA and the boat captains to ascertain if any of our dive sites were safe to access. When the weather was deemed dangerous, such as high waves, no boat diving took place.

Dive training

Prior to data collection, COREsea staff did education dives with our diving team, working on the following skills:

- buoyancy and trim
- scientific diving position
- swimming backwards
- Navigation
- DMB deployment

16. Terrestrial amphibian research project summary

Prior to our expedition, an amphibian species list had not been published for Koh Phangan Island. Therefore, this baseline study aimed to create a list of species for the island, as well as develop a viable method for surveying their habitat choices. 12 amphibian species were identified on Koh Phangan. These comprised 11 species of anuran (*Limnonectes blythii**, Limnonectes pseudodoriae, Fejervarya limnocharis, Hoplobatrachus chinensis, Occidozoyga martensii*, Kaloula pulchra, Microhyla mukhlesuri, Microhyla heymonsi, Hylarana erythraea*, Polypedates leucomystax, and Duttaphrynus melanostictus),* and one caecilian (*Ichthyophis kohtaoensis*). The species list established could be updated further by covering more area on the island and venturing into a wider range of habitats (e.g. deeper within forests). This study provided some insight into the habitat choices of the 12 species. Two species were observed in sufficient numbers for statistical analysis of their habitat choices. The Blyth's river frog, *Limnonectes blythii*, was associated with running water, rock, and canopy cover. Interactions of running water with both rock and canopy cover were also involved in these associations. The paddy field frog, *Fejervarya limnocharis*, was associated with vegetated ground, sand/soil/gravel, and urban structures. It was an unexpected result that standing water was not statistically significant in explaining the presence of this species. An insufficient number of observations was obtained for the other ten species to carry out meaningful statistical analysis. Descriptive statistics have been provided which predict their habitat choices. All 12 species require further investigation to build upon these preliminary findings to give detailed descriptions of the habitats they are associated with.

17. *Lepidoptera* pilot project

The expedition team ran a pilot project for two weeks at the start of the expedition in preparation for potential *Lepidoptera* surveying projects in the future to test if hanging traps and fruit bait would be a suitable method of capturing butterflies and moths. Four hanging traps were placed in trees near the expedition accommodation in both forested and human habited areas at about 1-meter height. The traps were inspected daily and the *Lepidoptera* species in the traps were captured carefully with tweezers and photographed both on the inside and outside of their wings for identification. These photographs and the dates on which they were taken are available for future expeditions to use in order to evaluate which *Lepidoptera* species could be studied on the island using fruit bait. Overall, the pilot study showed that fruit bait was effective for capturing several different *Lepidoptera* species and that *Lepidoptera* studies could be feasibly carried out in the future.

18. Future and current work

Ashlynn White is planning on returning to Koh Phangan to continue with her research on *Drupella*, in collaboration with COREsea, during her master's course. Laura Hänninen's study could be expanded upon by studying a wider array of fish families, as well as studying the effect of reef structural complexity on fish abundance. The UofG Thailand 2023 Expedition, co-lead by Kerensa Ballantyne from the 2022 expedition, took place this summer, carrying out projects studying the effects of structural complexity and coral cover on butterflyfish abundance, reef soundscapes as a biodiversity proxy and the impact of coral substrate type and algal cover on sea urchin abundance on Koh Phangan. We are expecting this expedition to continue to run for many years, building a deeper scientific understanding of the local reefs, and maybe seeing an increase in terrestrial research projects.


Figures 14 & 15: Butteflyfish swimming & sea urchins next to the transect tape, 2022 Thailand Expedition.

19. Expedition budget

Income	Amount	Total
Personal Contributions	£5,600	
Bucket Shaking	£25.55	
Bake Sale 1	£164.63	
Bake Sale 2	£157.82	
Bingo Night	£600.22	
Pub Quiz	£28.50	
Ceilidh	£385.40	
GNHS Grant	£1,000	
BSAJT Grant	£2,300	
Chancellors Grant	£1,000	
Turing Grant	£7,285	
University Supervisor Fund	£800	
GoFundMe	£710	**£20,057**
Expenses	**Amount**	**Total**
Card Machine	£27	
London - Bangkok Return Flights for 8 Students	£5,249.70	
Supervisor Glasgow - Bangkok Return Flights	£1,006.55	
Bangkok Hotel 1 Night (arrival)	£54.65	
Bangkok Hotel 1 Night (departure)	£55.60	
Bangkok - Koh Samui Return Flights for 8 Students	£1,472.56	
Olympus Tough TG-6	£421.95	
Microphone	£78	
Humidity Recorder	£150.49	
First Aid Kit	£100	
Koh Samui - Koh Phangan Ferry	£67.87	
Koh Phangan - Koh Samui Ferry	£28.95	
House Rental	£3,781.65	
COREsea fee: laboratory facilities, transportation to dive sites, dive and scientific gear rental, dive supervision and guidance & COREsea scientific lectures	£2,313	
Food for 8 Students for 6 Weeks	£2,218.80	
Personal Contribution Refunds	£2,992	**£20,018**

20. Conclusion

Engaging in diving research was a novel and invaluable experience for our expedition members, made possible through the support of the British Sub-Aqua Jubilee Trust. The generous support provided by the BSAJT played a pivotal role in our expedition, enabling us to make substantial contributions to both COREsea's ongoing research efforts on live coral cover and finfish abundance, as well as do our own research on the relationship between the two. Furthermore, with BSAJT funding, we were able to establish an in-depth study of the corallivorous *Drupella* populations on Koh Phangan Island, which is an exciting step for both the expedition, as well as COREsea, and helps us understand whether the local reefs might be at risk of potential *Drupella* outbreaks. Our expedition was a big step for the University of Glasgow Expedition society, as we established an expedition in a novel destination, and made valuable contacts. Future expeditions will be able to build from this base built with the help of our BSAJT grant, and continue researching the important ecosystems of Koh Phangan Island, contributing to their understanding and conservation.

Figure 16. A beautiful reef on Koh Phangan, 2022 Thailand Expedition.

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