National Coral Reef Monitoring Framework

Capacity Building Training at Laamu Atoll

Ministry of Climate Change, Environment and Energy

ENDhERI

BLUE MARINE FOUNDATION

MALDIVES Resilient Reefs

UN environment programme

gef global environment facility INVESTING IN OUR PLANET

Prepared by Enhancing National Development through Environmentally Resilient Islands (ENDhERI) Project for the Ministry of Environment, Climate Change and Technology

M. Green Building, Handhuvaree Hingun, Male' 20392, Republic of Maldives

Author: Mohamed Najih Waleedh, ENDhERI Project Coordinator

TABLE OF CONTENTS

ACRONYMS

CRM	Coral Reef Monitoring
ENDhERI	Enhancing National Development through Environmentally Resilient Islands
GEF	Global Environment Facility
MECCT	Ministry of Environment, Climate Change and Technology
MMRI	Maldives Marine Research Institute
MCQs	Multiple Choice Questions
MRR	Maldives Resilient Reefs
NCRMF	National Coral Reef Monitoring Framework
NCRM	National Coral Reef Monitoring
NGO	Non-Governmental Organization
OWD	Open Water Diver
PADI	Professional Association of Diving Instructors
PIT	Point Intercept Transect
PQs	Photo Quadrats
SCUBA	Self-Contained Underwater Breathing Apparatus
UNEP	United Nations Environment Program

1 BACKGROUND

There are 11 inhabited islands in the Laamu Atoll, located in the South-Central Province of the Maldives. Laamu Atoll, also known as Hadhdhunmathi, compromise a total of 75 islands and is acknowledged as one of the sites in the nation with a diverse marine environment. It encompasses several marine species, coral reefs, seagrass meadows, numerous wetlands, and mangrove, contributing to the atoll's rich biodiversity. Building human capital with the necessary skills to conduct surveys and monitor the atoll's reefs is deemed crucial, given the abundance of marine life.

Enhancing National Development through Environmentally Resilient Islands (ENDhERI) is a project by the Government of the Republic of the Maldives through the Ministry of Environment, Climate Change and Technology (MECCT). It is funded by the Global Environment Facility (GEF) and assisted by the United Nations Environment Program (UNEP). It aims to enhance reef protection, resilience, and ecosystem recovery by minimizing development impacts in a selected project location of the Maldives, designed for replication in other sites.

The Maldives Marine Research Institute (MMRI), which conducts maritime research through the Ministry of Fisheries, Marine Resources, and Agriculture (MoFMRA), is responsible for monitoring the Maldives' coral reefs. As a result, it has administered the National Coral Reef Monitoring Program since 1998, evaluating the condition of the nation's reefs and focusing on selected permanent monitoring sites dispersed across numerous atolls. The National Coral Reef Monitoring Framework was established as a part of this effort to enhance the spatial and temporal representation of data through the development of a citizen science network and the development of a standardized set of marine monitoring techniques.

The Blue Marine Foundation is a charitable organization dedicated to securing marine protected areas, tackling overfishing, supporting sustainable, equitable use of the sea and restoring marine habitats. Blue Marine works using a combination of top-down intervention to improve ocean governance and bottom-up project delivery to help local communities who are at the front line of ocean conservation. Blue Marine works with the local non-profit organization (NGO), Maldives Resilient Reefs (MRR).

Given the Laamu Atoll's abundant marine life, it is critical to develop human capital trained to conduct survey and monitor reefs within the atoll. Hence, a Memorandum of Understanding (MoU) was executed on 18th January 2023, by and between the MECCT, MMRI, and the Blue Marine Foundation.

2 INTRODUCTION

The National Coral Reef Monitoring Framework (NCRMF) functions as a support system for the National Coral Reef Monitoring program by establishing a framework for collection and compilation of marine data essential to more precise and thorough assessment of the health of coral reefs and associated marine flora and fauna nationwide. Both the NCRMF and National Coral Reef Monitoring Program (NCRM) receive support from the CoralDatabase, a web-enabled database facilitating storage, rapid evaluations, and collaboration.

Currently, only one contributor from Laamu Atoll is established in NCRMF. Considering the atoll's size, the number of monitoring locations is limited in both quantity and characteristic cover. As a result, as part of the NCRM program and the NCRMF, to broaden the scope and consistency of monitoring, providing additional support to partners collecting data and information.

As part of ENDhERI project, an expert from MMRI conducted theory sessions online from 8th to 10th May 2023, while trainers from Blue Marine Foundation conducted practical sessions in L. Gan in July 2023. The objective was to establishing a minimum of 11 coral reef surveyors in the Laamu Atoll. Participants who completed the training program received certificates by ENDhERI project of MECCT endorsed by MMRI during the Awarding Ceremony on August 14, 2023.

3 AIM AND OBJECTIVES

The objectives of the training were as follows:

- To train and build human capital at the Laamu Atoll in the coral reef monitoring.
- To build capacity with regards to data collection and analysis of coral reef monitoring.
- To clarify the importance of establishment of a standard data collection method in the country.
- To obtain the status of coral reefs in the Laamu Atoll, which contributes to the understanding of the Atoll's marine life.

4 SCOPE OF THE TRAINING

Eleven (11) residents from Laamu Atoll underwent training in the methods used by the National Coral Reef Monitoring (NCRM) program and the National Coral Reef Monitoring Framework. (NCRMF). The training was consisted of both theoretical and practical components.

Hana Amir, a Marine Biologist from MMRI, seamlessly assumed a dual role in the NCRMF training program, adeptly serving as both the trainer for the training of trainers and the instructor for the theory sessions delivered to the NCRMF training participants. MMRI conducted an online training of trainers (ToT) workshop to train Blue Marine Foundation and ENDhERI staff to gather data for the NCRMF, prior to the training of participants from Laamu Atoll.

Blue Marine Foundation in partnership with local NGO MRR, conducted the open water dive training, fish identification session, and practical training which includes the fish census, point intercept transect, and monitoring invertebrates' methods of NCRMF. Local instructors Hassan Hameez and Mohamed Mazin, along with Reveries Scuba Zone, ensured successful open water dive training, fostering skilled and responsible divers.

5 APPLICATION PROCESS

Interested individuals residing in Laamu Atoll were requested to submit their application forms to the ENDhERI project of the MECCT via email at endheri@environment.gov.mv before 1400hrs on March 9th, 2023. The call for applications was announced in the Gazette, and island councils were emailed a social media post to publish on their respective platforms. Additionally, ENDhERI shared a post on their Instagram and Facebook pages to invite expressions of interest.

A total of 13 applicants submitted their expressions of interest, which were then evaluated using a combined evaluation sheet by representatives from the MECCT, MMRI, and Blue Marine. Initially, priority was given to selecting at least one participant from each inhabited island in Laamu Atoll, resulting in the selection of candidates from Maabaidhoo and Kalaidhoo. The remaining 10 candidates were selected based on the highest scores received during the evaluation process.

After thorough consideration, the evaluation committee agreed to increase the number of selected candidates to 12 for the training. Hence, based on the outcome of the evaluation, a total of 12 candidates were successfully chosen to participate in the training. However, 11 participants were selected for the physical training component of the program, as one individual was absent from two theory sessions.

6 TRAINING OF TRAINERS

The three-day online training program was attended by members of the Blue Marine Foundation and ENDhERI staffs, providing insights into the National Coral Reef Monitoring Protocols. This included training on monitoring techniques, data entry and data management to prepare trainers for the NCRMF. The goal is to enable these trainers to guide at least 11 individuals in the Laamu Atoll.

6.1 KEY AREAS COVERED

The training was delivered through online sessions and discussions, concluding with a group activity- a mock survey on day 3. The sessions covered four main areas;

1. NCRMF Overview and Scientific Diving
2. Methods and Types of Coral Reef Monitoring
3. Other NCRMF Surveys and Reports
4. Maldives Coral Database

6.2 TRAINER AND PARTICIPANTS' PROFILE

Hana Amir, a Marine Biologist from MMRI, led the NCRMF training of trainers. The Participants included members of the ENDhERI Project Implementation Unit (PIU) and the Blue Marine

Foundation. The total number of participants were 7, including two from the ENDhERI Project and five from the Blue Marine Foundation/Maldives Resilient Reefs.

The following table shows a list of the participants:

Name	Organization/Institution
Najih Waleedh	ENDhERI Project
Aminath Nazeela	ENDhERI Project
Shaha Hashim	Blue Marine Foundation
Afaaz Zahid	Blue Marine Foundation
Hassan Moosa	Blue Marine Foundation
Mufliha Ziyad	Maldives Resilient Reefs
Naufal Shiyam	Maldives Resilient Reefs

Table-1: Participants list of the ToT workshop

6.3 SCHEDULE

The Training of Trainers on NCRMF panned three days online from 24th to 26th January 2023, 14:30 to 17:30. The training was set up as a recurring Microsoft Teams meeting.

6.4 PROCEEDINGS

6.4.1 DAY 1

The first day commence with introduction and an overview of NCRM and NCRMF, covering topics such as coral reed trends, recreational and scientific diving, diving safety considerations, monitoring objectives, and limitations, monitoring methods, types of surveys and setting up the survey, data entry and management.

SESSION I: NCRMF Overview and Scientific Diving

This session provided an understanding of NCRMF, NCRM and the distinction between the recreational diving and scientific diving. The safety considerations and primary purpose of scientific diving were discussed, along with the aims and objectives of the NCRM and NCRMF.

SESSION II: Methods and Types of Coral Reef Monitoring

The Day 1 also covered an introduction on coral reef monitoring, discussing the reason for monitoring, objectives, limitations, monitoring methods, types of survey and survey roles and gear.

6.4.2 DAY 2

Day 2 focused on Benthic monitoring, Point Intercept Transect (PIT), Substrate categories, bleaching severity, Photo quadrats (PQs), PQ protocols, Coral recruitment, Skill level, Monitoring Invertebrates, Coral disease, Monitoring Reef and Reef associated fauna.

SESSION II: Methods and Types of Coral Reef Monitoring (Continued)

The second session was continued on day 2 and was briefly explained the methods and types of coral reef monitoring. At first, the monitoring methods for benthic communities was discussed. Point Intercept Transect (PIT), a reef check method is also used in NCRMF for benthic monitoring. The importance of understanding the morphology and bleaching severity was also included in the topics. The Photo quadrats (PQs) method and protocols were also discussed. Additionally, the trainer compared and explained the manual and semi-automated PQs analysis and the coral recruitment survey. Secondly, the method and survey for monitoring invertebrates and coral disease was explained. At last, the methods and types of survey for monitoring reef and reef associated fauna including the common types of fauna, abundance, and size classes in the Maldives was discussed.

6.4.3 DAY 3

Day 3 covered monitoring reef complexity, reef rugosity, other NCRMF surveys and reports such as aerial guidance for bleaching and coral spawn, mock survey, and Maldives coral database.

SESSION II: Methods and Types of Coral Reef Monitoring (Continued)

The second session was continued in day 3 as well to explain the method for monitoring reef complexity. Also, what is the reef complexity and reef rugosity along with structural complexity was discussed.

SESSION III: Other NCRMF Surveys and Reports

After the discussion and explanation on the main session (session II), the trainer briefed the other NCRMF surveys and reports which includes Aerial guidance which is used for identifying coral bleaching and coral spawning. Next, there was a group activity among the participants as a mock survey.

During the mock survey all the participants expressed their perspectives and comprehension of the topics, as well as their suggestions for improvement. The discussion was afterwards opened for questions and responses. The participants were questioned about their strengths and weaknesses. The participants were also asked to provide feedback on how the trainer performed. Following the mock sessions, trainer Hana offered comments and discussed the process for improvement.

SESSION IV: Maldives Coral Database

The last session was regarding the Maldives coral database hosted by MMRI. Coral database is a web enabled database supporting the Maldives NCRMF.

7 THEOROTICAL COMPONENT

The objective of this workshop was to train Laamu residence on the National Coral Reef Monitoring program, the National Coral Reef Monitoring Framework protocols and the CoralDatabase. Participants attended the three days theory sessions online through the Microsoft Teams platform.

7.1 KEY AREAS COVERED

The training method involved online sessions and discussions, culminating in an evaluation exam one week after of the theory sessions. Presentation slides from the workshop were shared to the participants prior to the evaluation exam.

The training included the following topics similar to the ToT workshop:

- I. NCRMF Overview and Scientific Diving
- II. Methods and Types of Coral Reef Monitoring
- III. Other NCRMF Surveys and Reports
- IV. Maldives Coral Database

7.2 TRAINER AND PARTICIPANTS' PROFILE

Hana Amir, a Marine Biologist from MMRI conducted the theory session. The participants in the training come from diverse sectors, including utility services, education, law, environment, and

fisheries. Twelve participants from seven islands attended the first session of the theory sessions, with 11 managing to join at least two out of the three sessions. Trainers and representatives from Blue Marine Foundation and MRR also attended the sessions.

The following table provides an overview of the participants who were selected to attend the theory sessions:

Name	Island
Abdulla Naseem	L. Kalaidhoo
Ahmed Latheef	L. Maamendhoo
Ahmed Rameez	L. Kunahandhoo
Ahmed Shaafee	L. Gan
Ali Shafeeu	L. Mundoo
Aslam Mukhuthaar	L. Maamendhoo
Hussain Niam	L. Mundoo
Ibrahim Inan	L. Gan
Ismail Ibrahim	L. Fonadhoo
Mohamed Faig	L. Fonadhoo
Mohamed Irushaan	L. Maabaidhoo
Ranjan Thomas	L. Maamendhoo

7.3 SCHEDULE

The NCRMF theory sessions workshop was an online training program scheduled to take place from 8th to 10th May 2023, between 15:00 and 17:00. This three-day training has been organized as a recurring Microsoft Teams meeting.

7.4 PROCEEDINGS

7.4.1 DAY 1

The first day mirrored the ToT workshop, starting with an introduction to NCRM (National Coral Reef Monitoring) and NCRMF (National Coral Reef Monitoring Framework). Throughout the day, various topics were covered to provide a solid foundation for understanding coral reefs and their monitoring. These included discussions on the trends observed in coral reefs, both in terms of recreational and scientific diving. Safety considerations for diving were also emphasized.

The sessions further delved into the different techniques used for monitoring coral reefs, as well as the various types of surveys conducted to gather important data. Practical aspects such as setting up surveys, entering data, and effectively managing it were also explored.

The first day's theory session drew the participation of a total of 12 trainees from Laamu atoll and 5 trainers from Blue Marine/MRR.

7.4.2 DAY 2

Day 2 focused on monitoring benthic communities, which are the organisms living on or near the seabed. Several monitoring methods were introduced and discussed to assess the health and changes in these communities.

The use of PIT, which involves placing a line or tape measure across the reef and recording the types of organisms or substrate that intersect the line at specified intervals. The severity surveys for coral bleaching, an important indicator of stress on coral reefs, were also highlighted. Additionally, the participants were educated on PQs, a method involving capturing images to document and analyze benthic organisms and their abundance. The importance of annotations, which involve making detailed observations and notes during surveys, was emphasized for accurate data interpretation.

Another significant aspect covered during Day 2 was the introduction of Reefcloud, a digital platform used for data collection, storage, and analysis in coral reef monitoring. The methods for monitoring coral recruitment, which focuses on the reproduction and settlement of coral larvae, were presented as crucial for assessing the reef's ability to recover and grow.

Lastly, the participants were acquainted with monitoring invertebrates (non-spine-bearing animals) and diseases in coral reef ecosystems. Understanding the presence and abundance of various invertebrate species and monitoring the occurrence of diseases are essential for assessing the overall health of the reef.

Day 2 of the theory sessions saw a total of 11 trainees and 5 trainers actively engaging in discussions and presentations, enriching the learning experience for all involved.

7.4.3 DAY 3

Day 3 explored on monitoring reef and reef-associated fish, as well as monitoring reef complexity and rugosity. Participants learned about the importance of studying fish populations and their relationship to coral reefs, as well as the methods used to monitor their abundance and diversity.

The concept of reef complexity and rugosity, which refers to the physical structure and intricacy of the reef habitat, was also explained. The participants were introduced to various techniques for quantifying these parameters, as they play a significant role in supporting biodiversity and ecological processes within coral reef ecosystems.

Additionally, the training covered other surveys outlined by the NCRMF, providing an overview of their objectives and methodologies. The participants were also introduced to the Coral Database, which serves as a centralized repository for storing and managing coral reef monitoring data in the Maldives.

On the last day of the online training, the session was concluded with an opportunity for the participants to ask questions and seek clarification on any topics covered. The workshop organizer then wrapped up the training, acknowledging that it was the final day. Furthermore, the participants were informed that there would be an evaluation Multiple Choice Questions (MCQs) exam online on May 18, 2023 (Thursday).

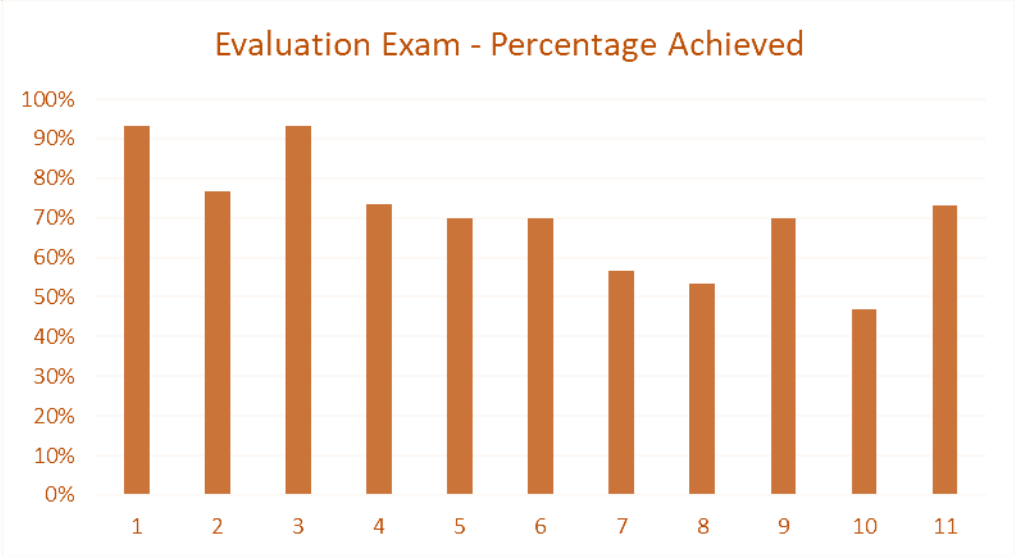
On the last day of the online course, 11 trainees and 4 trainers actively engaged, ensuring an interesting and meaningful learning experience for all.

7.4.4 EVALUATION EXAM

On May 18th, 2023, the MCQs for the Coral Reef Monitoring (CRM) Training Theory Sessions were made available to the participants. The purpose of the MCQs was to assess their understanding of the training topics and evaluate the effectiveness of the program. By completing the MCQs, participants could gauge their own learning progress.

7 out of 11 participants completed the MCQs. Two trainees from Blue Marine/MRR also participated and completed the evaluation exam. Those unable to complete the MCQs on the designated date had an alternative chance to complete the MCQs on July 5th, 2023.

To accommodate the participants' schedules and work commitments, the MCQs link remained open for a period of 6 hours on both May 18th and July 5th. This timeframe allowed the trainees to choose a convenient time within that window to engage with the MCQs. It ensured that participants had sufficient time to carefully respond to the questions and complete the evaluation accurately.



The trainers who completed the Training of Trainers (ToT) workshop achieved the highest percentage in the evaluation exam conducted. Moreover, all the participants who completed the MCQs achieved a score of more than 50%, except one. This indicates that the training program effectively conveyed the necessary information and helped participants grasp the core concepts of NCRM and NCRMF.

8 PRACTICAL COMPONENT

The practical session for the National Coral Reef Monitoring Framework (NCRMF) were conducted at L. Gan. The open water diver training took place from July 6 to July 9, 2023, with two sessions spanning Thursday through Sunday. Additional NCRMF practical sessions were conducted on July 14 to 15, 2023, falling on the weekend.

8.1 KEY AREAS COVERED

The training included a mix of classroom sessions and field training. Prior to the practical sessions, participants underwent PADI Scuba Open Water Diver (OWD) training, aimed at acquainting them with essential scientific diving skills.

The practical sessions included the following topics:

- I. Coral morphology training
- II. Fish ID training
- III. Invertebrates ID training
- IV. Data entry techniques

8.2 TRAINER AND PARTICIPANTS' PROFILE

Blue Marine Foundation and Maldives Resilient Reefs led the NCRMF practical sessions, with assistance from Reveries Scuba Zone in L. Gan and PADI Maldives.

Eight participants from six islands successfully completed the OWD training, obtaining certification as PADI Open Water Divers. Seven participants were able to successfully finish the National Coral Monitoring Framework (NCRMF) capacity building training. Those who completed the training in July were awarded with certificates endorsed by the Maldives Marine Research Institute (MMRI).

The following table provides an overview of the participants who completed the NCRMF capacity building training:

Name	Island
Abdulla Naseem	L. Kalaidhoo
Ahmed Latheef	L. Maamendhoo
Ahmed Rameez	L. Kunahandhoo
Ahmed Shaafee	L. Gan
Ali Shafeeu	L. Mundoo
Aslam Mukhuthaar	L. Maamendhoo
Ibrahim Inan	L. Gan

8.3 SCHEDULE

NCRMF practical sessions held from July 14 to July 15, 2023. Preceding these practical sessions, an open water diver training was held from July 6 to July 9, 2023. The diver training included two daily sessions covering Thursday through Sunday.

8.4 PROCEEDINGS

8.4.1 DAY 1

The first day began with participants and the trainer introductions. Details were noted to register for the insurance prior to PADI OWD training. Afternoon activities included SCUBA basic, a Discover Scuba Diving experience and participants receiving OWD training course materials.

8.4.2 DAY 2

On the second day participants progressed to confined dive sessions 1 and 2, with two groups led by two dive instructors. The day also marked the initiation of the first open water dive session, adding an element of excitement to the training. Following the dives, the participants gathered for dive theory session 1 related to the PADI Open Water Diver course at the MRR office.

8.4.3 DAY 3

Day three included confined dive sessions 3, 4, and 5 at Gan lagoon, open water dives for their second OWD session. Following the diving sessions, the participants assembled at the MRR office for theory session 2, which covered topics pertinent to the PADI Open Water Diver course.

8.4.4 DAY 4

On the fourth day focused on the OWD session 4, which took place in the morning. Following the practical session, the participants engaged in theory sessions during the afternoon.

8.4.5 DAY 5

On the fifth day participants engaged in their final confined dive and open water dive sessions. Following these practical diving sessions, participants successfully completed a theory test in the afternoon. The culmination of their efforts was marked by the certification of all participants as licensed PADI Open Water Divers on July 10, 2023.

8.4.6 DAY 6

After successfully completing the OWD course during their earlier visit to L. Gan, participants revisited the NCRMF theory covered in previous theoretical sessions. Following this refresher, they embarked on their first practical session, involving the survey of benthic Photo Intersect Transect (PIT), Fish Census, and Invertebrates using the standardized NCRM techniques. In the afternoon of Friday, participants engaged in snorkeling practices, honing their skills in coral morphology monitoring, and gaining proficiency in the identification of fish and invertebrates. The day concluded with practical training on the aforementioned survey techniques.

8.4.7 DAY 7

Final day involved honing of NCRM techniques through SCUBA diving. Subsequently, they recorded and entered the data collected during their surveys.

9 CLOSING CEREMONY

Participants who successfully completed the National Coral Reef Monitoring Framework (NCRM) training, organized by the ENDhERI Project, were honored with certificates. In a ceremony held in L. Fonadhoo on 14th August 2023, Mr. Abdullah Shareef, the Senior Executive Director at the Ministry of Environment, Climate Change and Technology, presented certificates to the six accomplished participants.

NCRMF training, encompassing three days of theoretical training, two days of practical training and four days of PADI dive training, was orchestrated through the combined efforts of notable entities, including the Maldives Marine Research Institute (MMRI), the Blue Marine Foundation, Maldives Resilient Reefs, PADI, and Rivers Scuba Zone.

The ceremony was graced by the presence of MMRI's Senior Scientific Officer, Dr. Ahmed Riyaz Jauhari, who addressed the participants. In his speech, Dr. Jauhari underscored the significance of acquiring and nurturing participants skill sets.

10 CONCLUSION

The National Coral Reef Monitoring Framework Capacity Building Training conducted at Laamu Atoll stands as a significant achievement in strengthening coral reef surveying and monitoring in this ecologically diverse atoll. Through the concerted efforts of the Enhancing National Development through Environmentally Resilient Islands (ENDhERI) Project, the Maldives Marine Research Institute (MMRI), the Blue Marine Foundation, and other partners, this training initiative has effectively equipped participants with the knowledge and practical skills needed to monitor and assess the health of coral reefs.

The comprehensive training program encompassed both theoretical and practical components, ensuring a well-rounded understanding among participants. The theoretical sessions, expertly led by a marine biologist from MMRI, delved into critical topics including the National Coral Reef Monitoring Framework (NCRMF) overview, scientific diving techniques, various methods of coral reef monitoring, and the utilization of the Maldives Coral Database. These sessions provided participants with a solid foundation for the subsequent practical activities.

The practical component of the training, facilitated by skilled trainers from the Blue Marine Foundation and the Maldives Resilient Reefs, not only included open water diver training but also hands-on survey exercises. Participants gained proficiency in essential diving skills, enabling them to engage confidently in underwater surveys. They also acquired crucial competencies such as coral morphology assessment, fish and invertebrate identification, and accurate data entry techniques.

The successful completion of the training by participants, celebrated through a certificate awarding ceremony, is a testament to their commitment and enthusiasm for marine conservation and management. This collaborative endeavor signifies the critical role of partnership between governmental bodies, research institutions, non-profit organizations, and local communities in promoting environmental resilience. As these newly trained surveyors take on their roles as custodians of the marine environment, their impact is poised to extend beyond the boundaries of L.Gan, contributing to the broader understanding and protection of coral reefs within the Laamu Atoll, but also on the country scale. This program underscores the immense potential of education, cooperation, and sustained effort in safeguarding our natural resources for generations to come.

11 ANNEX 1: NCRMF Overview

Implementing NCRMF in L. Atoll as via the ENDHERI project
Maldives Marine Research Institute
Ministry of Fisheries, Marine Resources and Agriculture
April 2022

IMPLEMENTATION OF THE NCRMF IN LAAMU ATOLL VIA THE ENDHERI PROJECT

The National Coral Reef Monitoring Framework [NCRMF]

Overview

Given the logistical, financial, and technical constraints involved in capturing sufficient temporal and spatial data the National Coral Reef Monitoring Framework [NCRMF], which defines a set of standardized methods for marine monitoring and consists of a network of monitoring sites, was developed. The NCRMF functions as a support to the National Coral Reef Monitoring program by providing a framework by which to collect and collate marine data required to assess the health of coral reefs and associated marine flora and fauna across the country more accurately and precisely. The NCRMF and the NCRM program are further supported by a complementary web-enabled database, the CoralDatabase, which allows for storage, rapid assessments, and collaboration.

Laamu atoll within the NCRMF

Several atolls of have identified as either data deficient or of spatial interest due characteristics or reports that indicate notable diversity or resilience. Laamu atoll is one such atoll. Currently, Six Senses submits data from Laamu atoll to the NCRMF from their monitoring sites. However, compared to the size of the atoll, the number of monitoring sites is limited both in number and characteristic representation, and there is only a single contributor from the entire atoll.

Hence, as part of the NCRM program and the NCRMF there is a need to both increase the scale and consistent longevity of monitoring as well as provide additional support to the partners already collecting data and information.

Protocols

A series of protocols have been developed to meet the objectives of both the NCRM program and the NCRMF. These protocols are reviewed overtime to determine whether they are inline with current scientific literature, recommendations by international coral reef research and monitoring bodies like ICRI and GCRMN and most importantly the monitoring, research, and assessments of the Maldives.

MMRI published the latest update to the protocols in 2022 and includes several additional protocols. These protocols are listed below:

1. Coral reef and coral reef associated fauna (water column - fish)
2. Coral reef and coral reef associated fauna (seabed - inverts) and coral disease
3. Sedentary marine life – PIT
4. Coral recruits
5. Reef rugosity
6. Random photo quadrat protocols
7. Transect photo quadrat protocols
8. Bleaching severity – complex
9. Bleaching severity – simple
10. Collecting of aerial imagery for spotting bleaching and coral spawn

ހ. ވައިޓްވޭވްސް، މޫންލައިޓް ހިނގުން، މާލެ-20025 | ފޯން: 322-2242، ފެކްސް: 332-2509
H. White Waves, Moonlight Higun, Malé-20025 | Tel: +(960) 332-2242, Fax: +(960) 332-2509

Site selection

Sites for the NCRM program sites are selected based on the “management” regime, exposure, atoll, and the location within an atoll.

During its establishment, the NCRM program utilized three main “management” categories: uninhabited, community, and resorts. With development, the “management” type of islands has changed with most uninhabited reefs converting to resorts. Moreover, there are additional categories in terms of “management” that affect coral reefs though the frequency of such categories differs from atoll to atoll – e.g., industrial, agricultural, etc. There are currently efforts to increase the number of sites whilst accounting for these changes.

Establishment of the NCRMF allows for data to be captured from a variety of sites by the data contributors and enables a better understanding of reef health as well as the impacts they face.

Data management

Data collected can be stored within the CoralDatabase. Meant to function as the national repository for marine data, the CoralDatabase, allows for the collection, storage, rapid analysis and sharing of data (contingent of data sharing inclination of the user) collected by the NCRMF.

The database is currently under redevelopment though a temporary database is active to ensure uninterrupted access to protocols, reporting forms and data submissions (https://sites.google.com/view/coraldatabase). It is expected that the redeveloped database and database website will be published in 2022.

ހ. ވައިޓްވޭވްސް، މޫންލައިޓް ހިގުން، މާލެ-20025 | ފޯން: 322-2242، ފެކްސް: 332-2509
H. White Waves, Moonlight Higun, Malé-20025 | Tel: +(960) 332-2242, Fax: +(960) 332-2509

Long term Monitoring & Citizen Science via ENDHERI

Though the ENDHERI project long term monitoring sites and stronger citizen science network trained in the NCRMF protocols and using the CoralDatabase can be established in Laamu atoll.

Long term monitoring

Establishment of long-term monitoring sites should ideally build on sites of the monitoring program by Six Sense. Any additional sites should be targeted at creating a balanced design for statistical analysis in terms of site characteristics such as "management," exposure and representation within an atoll (e.g., similar number of sites within the east, west, north, and south of the atoll).

For the duration of the project at minimum, ENDHERI can hire locals to be trained to utilize the NCRMF protocols and conduct surveys at these sites. The hired staff can then survey the sites at least once per year minimum though dependent on funding twice per year to account for potential differences driven by the monsoon season. As per standard, surveys should at minimum be conducted at 5m and 10m depths for most data collection protocols for consistency though this can be adjusted based on site.

The hired locals can be trained during a workshop that covers the theory behind the protocols, utilizing protocols, conducting surveys in coral reefs, data entry and data management, submitting data to the CoralDatabase, reporting and potentially quick simple analyses.

Citizen science

Simultaneously a Citizen Science Network of data collectors and contributors and trainers can be established via workshops within the atoll. The citizen science network would be contributors to the NCRMF who further support the long-term monitoring work and better the understanding of Laamu atoll's coral reef system. Such workshops would additionally fulfil the objective of increasing awareness and disseminating information and skill to support capacity building efforts.

These workshops would target marine science/science students within the atoll, interested and capable citizens, NGOs, dive schools and potentially other interested parties. Ideally the workshop will be run in community islands within the atoll.

The workshop can be split into multiple sessions or multiple short workshops that can be held specifically targeting a specific group of people (though this would be dependent on the capacity to run the workshops). Ideally such workshops would be held towards the end of the year so that participants would be freshly ready to collect data the following year if they wish.

Similar to the workshop run to train the long-term monitoring staff, these workshops would cover using the NCRMF protocols to collect data, data entry and management, and submitting data to the CoralDatabase. Theory sessions would be followed by practical sessions to ensure that both skills are developed within participants of the workshop.

ހ. ވައިޓްވޭވްސް، މޫންލައިޓް ހިގުން، މާލެ-20025 | ފޯން: 322-2242، ފެކްސް: 332-2509
H. White Waves, Moonlight Higun, Malé-20025 | Tel: +(960) 332-2242, Fax: +(960) 332-2509

12 ANNEX 2: NCRMF Training Outline

NCRMF Training Outline for ENDHERI Project implementation
Maldives Marine Research Institute
Ministry of Fisheries, Marine Resources and Agriculture
June 2022

NCRMF Training Outline for ENDHERI Project Implementation

Overview and Timeline

Interested individuals/organizations/etc. will be offered the opportunity to take part in the training in protocols utilized for the National Coral Reef Monitoring (NCRM) program and the National Coral Reef Monitoring Framework (NCRMF). The training will include a theoretical and a practical component.

The remainder of the 2022 will be used to provide any theoretical training required to carry out surveys and monitor reefs within Laamu atoll. Practical training that supplements the theoretical training can be carried out by partners in Laamu atoll after the theoretical training in 2022 or by MMRI in the first quarter of 2023.

Participants completing the training course will be given a certificate by the ENDHERI project, endorsed by MMRI.

Theoretical Component

The theoretical component of the training will take place over 2-3 days. Outlined below are topics to be covered each day in an online format. Dates TBD October-November 2022.

Day 1 (5 hours)

- Overview of the NCRM program, NCRMF, the state of the Maldivian reefs and information gaps
- Survey techniques, determining objectives for monitoring, limitations
- Differences between recreational and scientific diving, safety precautions
- Monitoring of benthic communities
    - Survey techniques overview
    - Types of benthic communities and ID
    - PIT
    - PQ
    - Recruitment

Day 2 (4.5 hours)

- Monitoring of benthic communities
    - Bleaching
    - Aerial surveys
    - Spawning
    - Brief on coral disease
- Monitoring of reef complexity
    - CIT method
- Monitoring of macroinvertebrates
    - Types of macroinvertebrates and ID
    - Belt transects
- Monitoring fish assemblages
    - Types of fish assemblages and ID
    - Belt transects

Day 3 (4.5 hours)

- Data entry
- Data management
- Submission to the Coral Database
    - Overview of Coral Database
- Reporting and interpretation

ހ. ވައިޓްވޭވްސް، މޫންލައިޓްހިނގުން، މާލެ-20025 | ފޯން: 322-2242، ފެކްސް: 332-2509
H. White Waves, Moonlight Higun, Malé-20025 | Tel: +(960) 332-2242, Fax: +(960) 332-2509

Practical Component

The practical component of the training will supplement the theoretical component and offer participants the opportunity to carry out an actual survey. The practical component will include the following activities and be completed over 1-2 days.

- Planning a monitoring outing
    - Objectives, site selection, organization
- Carrying out a survey
    - Going to a site, survey order, immediate post survey activities
- Data entry, management and submission of collected data

ފ. ވައިޓްވޭވްސް، ހިންމަރިޔާ ރޯޑު، ހިޔާ-20025 | ފޯނު: 322-2242، ފެކްސް: 332-2509
H. White Waves, Moonlight Higun, Malé-20025 | Tel: +(960) 332-2242, Fax: +(960) 332-2509

13 ANNEX 3: Theory Session Slides

1.1 NCRMF Overview

1.2 Scientific Diving

1.3 Monitoring Overview

2.1 Monitoring Benthic Communities: PIT & Bleaching Surveys

2.2 Monitoring Benthic Communities: PQs & Reefcloud

2.3 Monitoring Benthic Communities: Coral Recruitment

2.4 Monitoring Invertebrates and Coral Diseases

3.1 Monitoring Reef and Reef Associated Fauna

3.2 Monitoring Reef Complexity

3.3 Other NCRMF Surveys and Reports

3.4 Coral Database

NATIONAL CORAL REEF MONITORING WORKSHOP

ENDHERI PROJECT

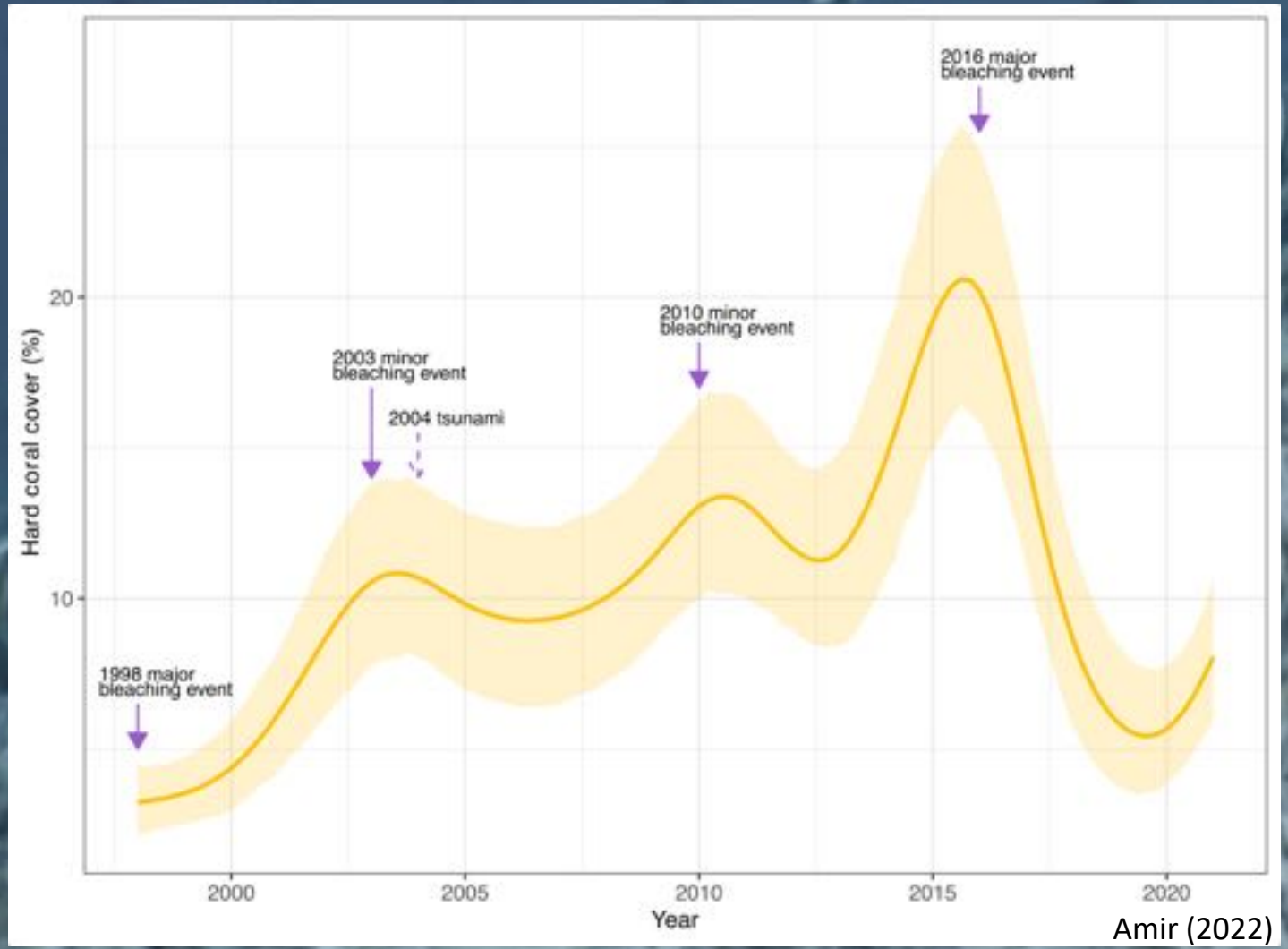
Maldives Marine Research Institute

8th to 10th May

NCRM and the NCRMF

- The National Coral Reef Monitoring Program
  - Active since 1998
- Aims:
  - Long term changes of Maldivian coral reefs
- Objectives
  - Recovery from bleaching events
  - Changes to reef over time
  - Determine drivers of change

Current reef trend



Amir (2022)

NCRM and the NCRMF

- Permanent monitoring sites
- Aims to capture representative spatial distribution
  - National, atoll, site
- Temporal distribution
- Currently 47 monitoring sites
  - 1998: HDh, K, Ari, V, GA, S
  - 2011: N, R, B, Lh

NCRM and the NCRMF

- National Coral Reef Monitoring Framework
- NCRMF is a framework that structures and guides coral reef monitoring to capture the state of the reef on national scale
- Supports the NCRM
  - Cannot monitor all reefs
- Encompasses the national protocols, web coral database, citizen science network

E.g., Laamu atoll

- No MMRI and NCRM permanent monitoring sites at Laamu atoll
- Contributions by SS Laamu via the NCRMF network give some representation
- Requires additional monitoring and support for proper
  - This is why programs like ENDHERI program are important

NCRM and the NCRMF

- Protocols to standard data collection in the country
- Minimum information to be collected for Maldivian surveys to assess the state of the reef
- Improve spatial representation
- Improve temporal representation
- First published in 2018
  - Updated in 2022

Scientific Diving

Maldives Marine Research Institute

8th to 10th May

Why think about the differences between a scientific dive and recreational dive?

There are additional logistical/practical/safety considerations and skills required to carry out a scientific dive

Recreational Dive

Primary purpose: leisure or entertainment

Scientific Dive

Primary purpose: specialized dive to study the marine environment

Safety considerations

- Pre dive survey briefing
- Keep within your limits
- Define your roles and who's doing what
- Equipment
  - Securing
  - malfunctions
- Communication and coordination
  - With your survey buddies
  - With the boat
- Be aware of marine fauna

Safety considerations

- Be aware of when to remove transects
- Know how to do an emergency ascent
- Know what to do when you loose sight of your survey buddies
- Start wrapping up your work at 50 bar (especially if you’re new or working with a new team)

An Overview on Monitoring

NCRMF Workshop: 8th to 10th May 2023

Maldives Marine Research Institute

Setting up a survey


WHY ARE YOU
MONITORING A REEF?

Consider your objectives and limitations

OBJECTIVES

- Outcomes that you are trying to achieve by an activity
- Should be determined early on
- SMART
  - S = specific
  - M = measurable
  - A = Achievable
  - R = relevant
  - T = Time based
- Practical & realistic

LIMITATIONS

- Money
- People
- Equipment
- Time
- Technology
- Skills

Setting up the survey

1. Why are you monitoring a reef?
2. Objectives
3. Limitations
4. Methods and types of surveys

MONITORING METHODS

- Dive surveys
- Diver operated surveys
  - Videos
- Remote sensing
  - RV
  - Drones
  - Satellite

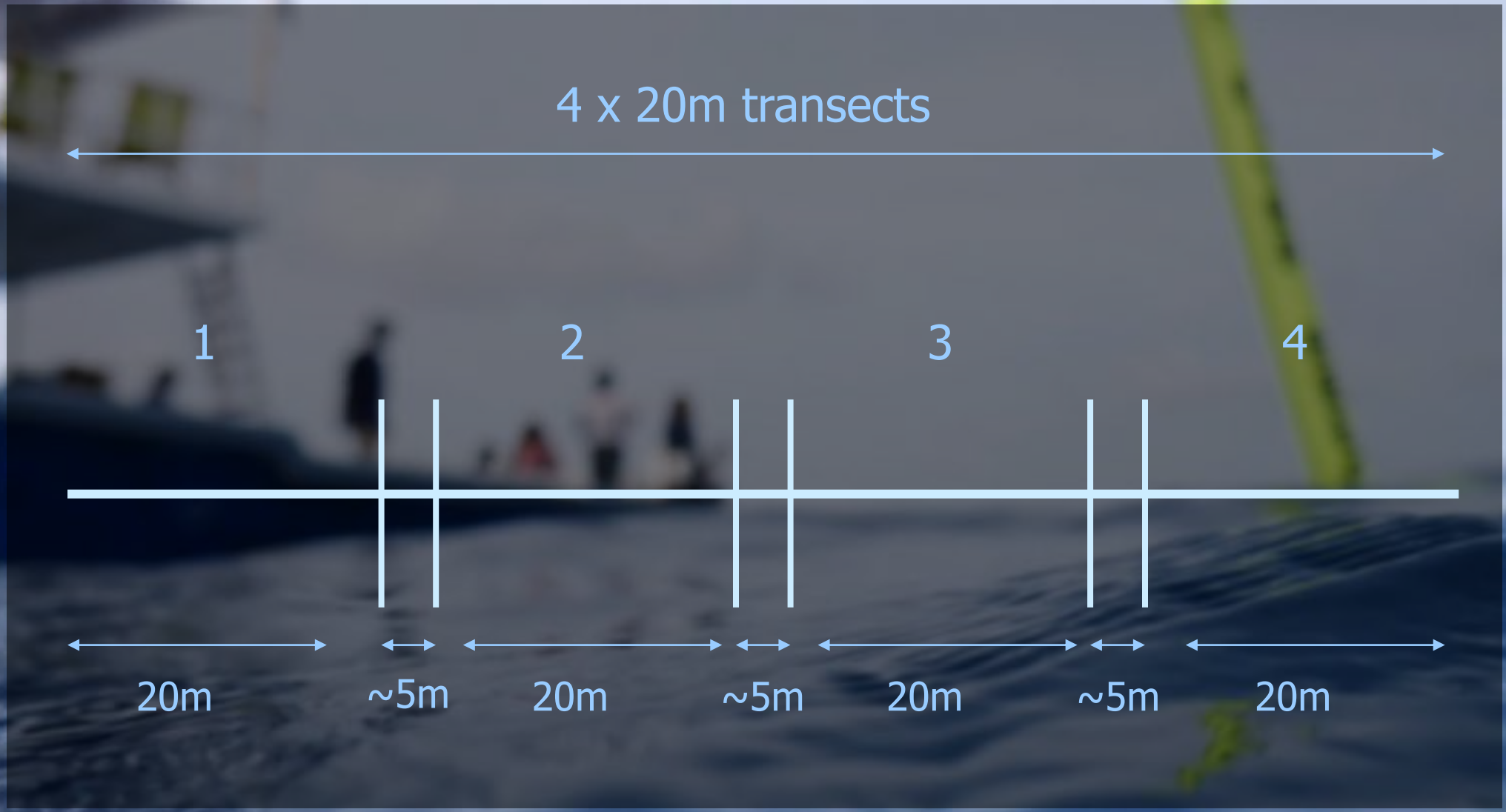
TYPES OF SURVEYS

- Benthic
  - PIT
  - PQ
  - Rugosity
  - Recruitment
  - Bleaching – Seasonal
- Fish
- Inverts
- Disease
- Aerial surveys – seasonal
  - Bleaching
  - Coral spawning

TYPES OF SURVEYS

- Benthic
  - **PIT**
  - **PQ**
  - Rugosity
  - Recruitment
  - Bleaching – Seasonal
- **Fish**
- **Inverts**
- Disease
- Aerial surveys – seasonal
  - Bleaching
  - Coral spawning

ABSOLUTE BARE MINIMUM SURVEYS THAT SHOULD BE CARRIED OUT IN A MONITORING TO UNDERSTAND REEF HEALTH


4 x 20m transects
1
2
3
4
20m
~5m
20m
~5m
20m
~5m
20m

Setting up the survey

1. Why are you monitoring a reef?
2. Objectives
3. Limitations
4. Methods and types of surveys
5. Data entry and management


Data entry and management

Don’ts

01

Forget that your data is the most expensive item of your survey

- (With the exception of your life)

02

Not have a plan

03

No/Poor meta data

04

Do your entries days after you collect it

- Unless it specifically planned

05

Forget not everyone can read your handwriting

06

Not have back ups

Dos

01

Have a data entry and management plan

- File structure
- Naming conventions
- Back up plans
- Role divisions
- Dates and deadlines

02

Make sure to always record your metadata

03

Digitize your handwriting

04

Use consistent conventions

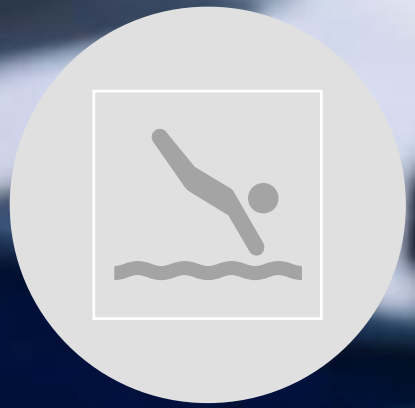
05

Enter your data while you clearly remember what you did

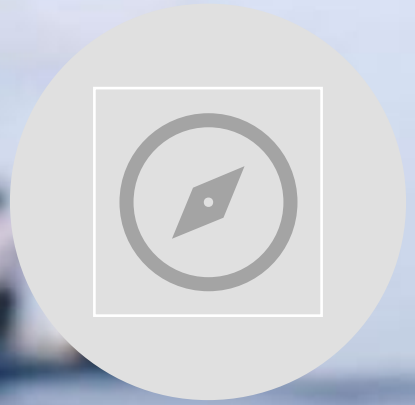
Setting up the survey

1. Why are you monitoring a reef?
2. Objectives
3. Limitations
4. Methods and types of surveys
5. Data entry and management
6. Roles and gear

Gear



DIVE



SURVEY

FIRST AID

Gear

- Functioning and serviced
- All gear accounted for all planned activities
- Spares are available
- Makes it to the survey site/survey boat

Roles – Dive roles and coordination

- Assign roles to people's strengths where possible
- If possible, pair up when doing new surveys
  - With someone experienced – compare data collection efforts
  - Buddy pairs with complementary surveys
- Make sure each person understands their role
- Make sure others in the team understands other people’s roles
- Order of operations
  - Survey order
  - Expected survey dive time

Monitoring Benthic Communities: PIT & Bleaching surveys

NCRMF Workshop: 8th to 10th May

Maldives Marine Research Institute

Why do we have different protocols?

To achieve different predetermined objectives. The same protocol may not be able to achieve all of these objectives

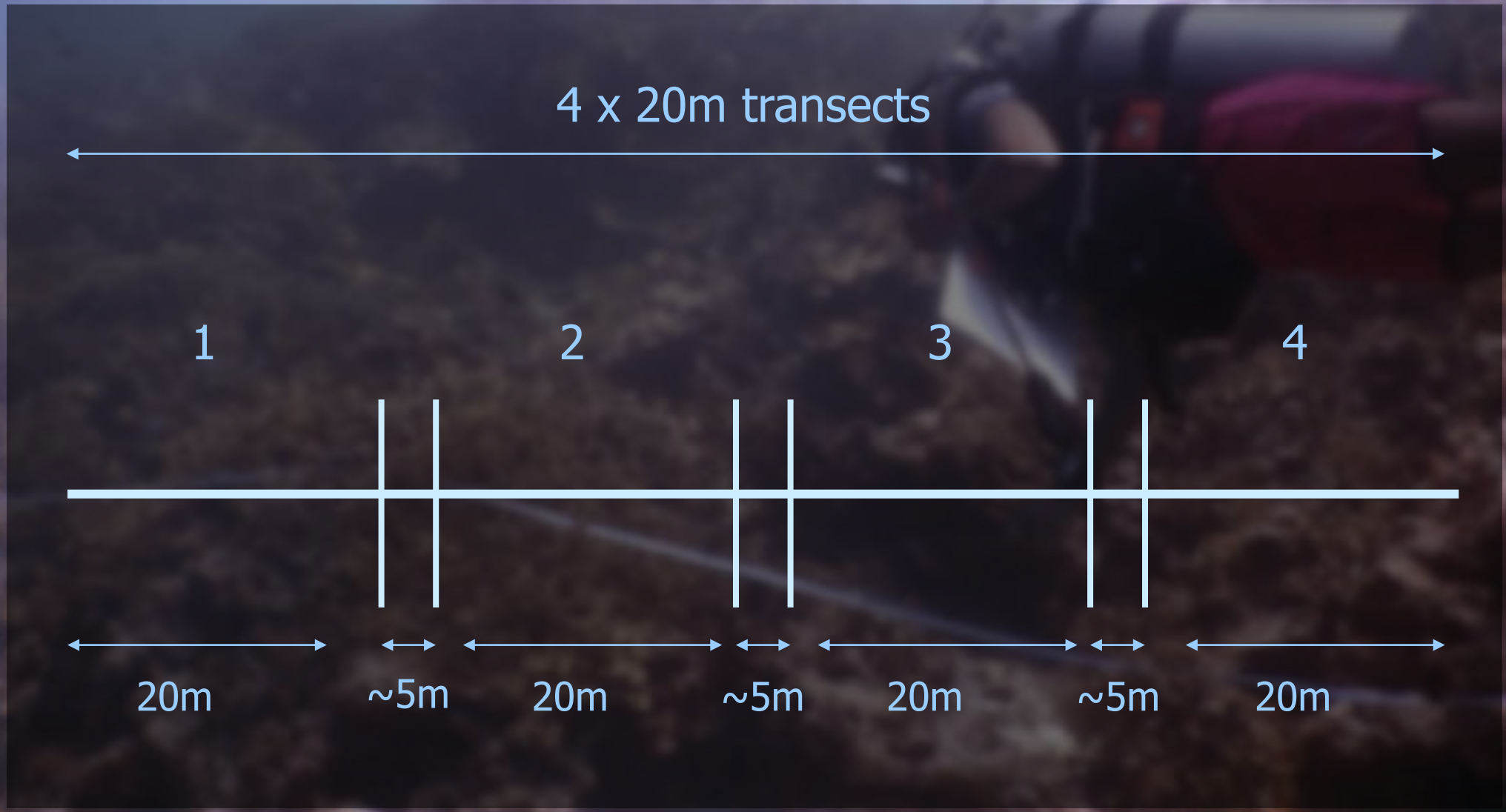
Different objectives

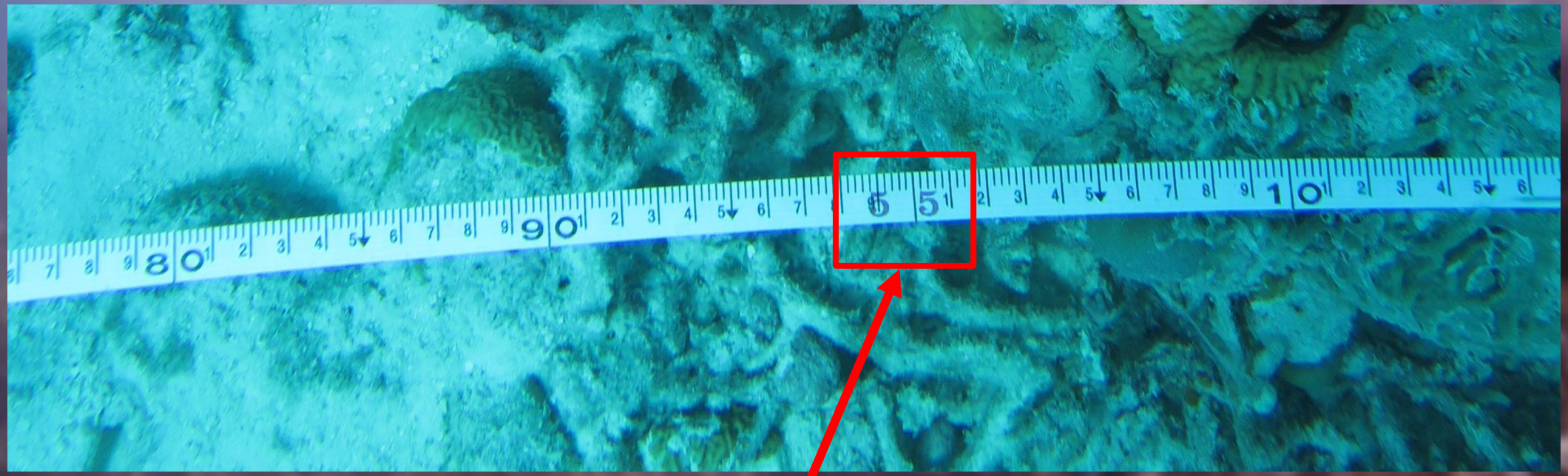
- Measure composition of various reef components
  - Biotic
  - Abiotic
- Measure bleaching impact
- Measure capacity of reefs to recover
- Measure complexity of reefs

POINT INTERCEPT TRANSECT

PIT

- Record what is under each interval
  - Intercepts with the transect
  - Reef Check also uses PIT as part of their protocols
- 20m x 4 transects
- 0.5m Intervals


4 x 20m transects
1
2
3
4
20m
~5m
20m
~5m
20m
~5m
20m



0.5 intervals = 40 points per transect

20-40 minutes for the survey

Cobble

PIT

- Updated in 2022 to capture hard coral morphology to comply with International Coral Reef Initiative recommendations
  - Maldives is a member of ICRI, a global partnership for coral reef ecosystems and research

MARINE SEABED SEDENTARY LIFEFORM v2 - 2022

National Coral Reef Monitoring Framework

POINT INTECEPT TRANSECT

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

LIFEFORMS/ SUBSTRATES	*Hard coral genera or coral morphology*		Brachning coral	*BHC*	Tabular coral	*THC*	Foliose coral	*FHC*	Solitary coral	*SHC*	
			Encrusting coral	*EHC*	Boulder coral	OHC	Soft coral	*SC*	Sponge	*SP*	
			Seagrass	*SG*	Zoanthid	*ZN*	Giant Clam	*GC*	Other	*OT*	
	Coralline algae	*CCA*	Halimeda	*HA*	Micro algae	*MI*	Macro algae	*MA*	Turf algae	*TA*	
	Boulder(rock) > 256mm	*BD*	Cobble(rubble) 256-64mm	*CD*	Gravel (rubble) 64-2mm	*GV*					
	Sand 2mm-62.5µm	*SD*	Silt 6.25µm-3.9µm	*SL*							
CONDITIONS	Bleached	*BL*	Ripe	*RP*	Damaged	*DM*	Whiteband disease	*WB*	Blackband diseae	*DB*	Other disease *OD*
	Dead	*DD*	Other	*OT*	No record	*NR*					

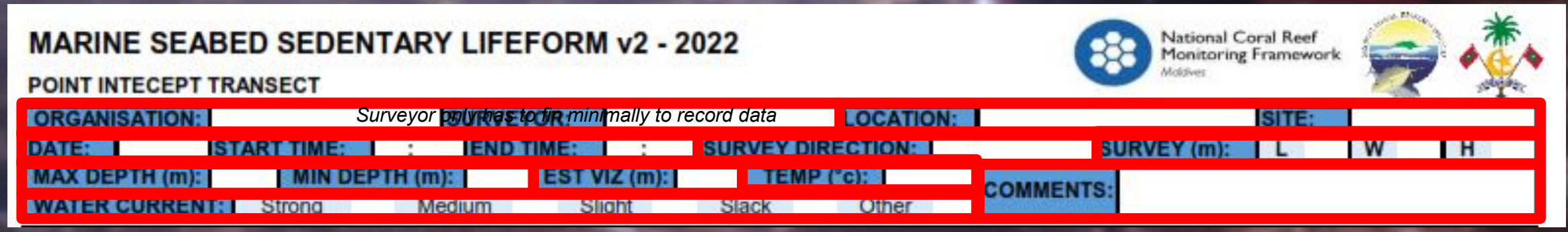
TRANSECT 1						TRANSECT 2						TRANSECT 3						TRANSECT 4					
Start time :			Depth:			Start time :			Depth:			Start time :			Depth:			Start time :			Depth:		
End time :			Dir:			End time :			Dir:			End time :			Dir:			End time :			Dir:		
Dis	Lif	Con	Dis	Lif	Con	Dis	Lif	Con	Dis	Lif	Con	Dis	Lif	Con	Dis	Lif	Con	Dis	Lif	Con	Dis	Lif	Con
0.5			10.5			25.5			35.5			50.5			60.5			75.5			85.5		
1.0			11.0			26.0			36.0			51.0			61.0			76.0			86.0		
1.5			11.5			26.5			36.5			51.5			61.5			76.5			86.5		
2.0			12.0			27.0			37.0			52.0			62.0			77.0			87.0		
2.5			12.5			27.5			37.5			52.5			62.5			77.5			87.5		
3.0			13.0			28.0			38.0			53.0			63.0			78.0			88.0		
3.5			13.5			28.5			38.5			53.5			63.5			78.5			88.5		
4.0			14.0			29.0			39.0			54.0			64.0			79.0			89.0		
4.5			14.5			29.5			39.5			54.5			64.5			79.5			89.5		

META DATA

VARIABLES

ENTRY

Meta Data



MARINE SEABED SEDENTARY LIFEFORM v2 - 2022

POINT INTECEPT TRANSECT

National Coral Reef Monitoring Framework
Maldives

Surveyor only has to fin minimally to record data

ORGANISATION: | SURVEYOR: | LOCATION: | SITE:

DATE: | START TIME: : | END TIME: : | SURVEY DIRECTION: | SURVEY (m): L W H

MAX DEPTH (m): | MIN DEPTH (m): | EST VIZ (m): | TEMP (°c):

WATER CURRENT: Strong Medium Slight Slack Other

COMMENTS:

- Organization: name of organization
- Surveyor: name of surveyor
- Location: name of reef or area that is being surveyed
- Site: name of the survey site – can the same name as location in some instances
- Date: Date of survey
- Start time: time survey started underwater
- End time: time survey ended underwater
- Survey -> L = transect length, W = transect width, H = transect height
- Max depth: maximum surveyed depth
- Min depth: minimum surveyed depth
- Estimate visibility: estimate of how far you can see underwater
- Temperature: water temperature from dive computer

- Currents
  - Strong: Surveyor has to continuously strongly fin and/or use reef hooks to keep in place to record data. Surveyor is dragged a long distance (>10m) if stopped.
  - Medium: Surveyor has to fin with some effort to survey in place and is dragged in the current direction to a short distance (0-5m) if stopped.
  - Slight: Surveyor only has to fin minimally to record data
  - Slack: Surveyor is able to hover in place to record data
  - Other: Any other type of current
- Comments: notes of observations or survey issues/details that are significant

Substrate categories

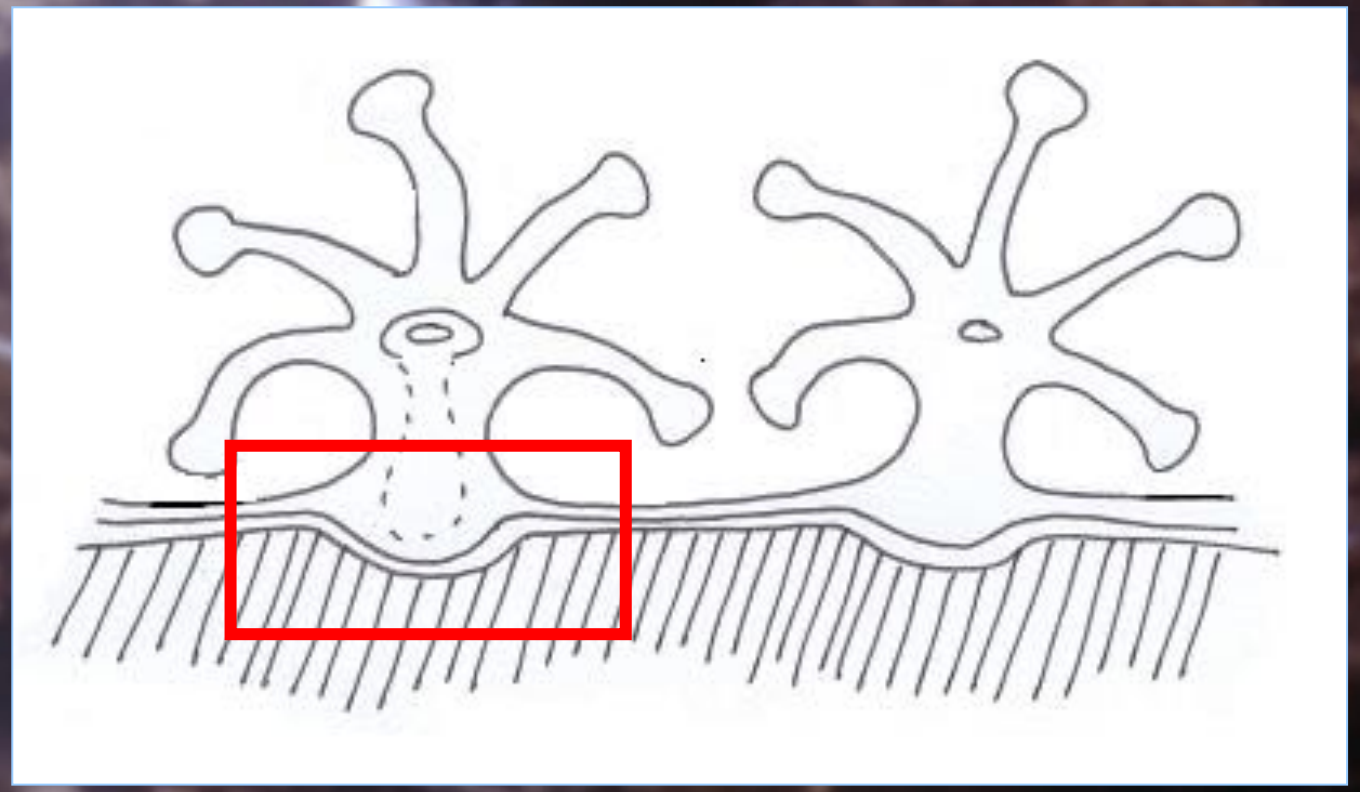
- Hard coral
  - Morphology
- Soft coral
- Seagrass
- Zoanthids
- Giant Clams
- Sponges
- CCA
- Halimeda
- Macro algae

- Micro algae
- Turf Algae
- Other
- Cobble (6.4 – 25cm)
- Boulders (>25cm)
- Gravel (64-2mm)
- Sand
- Silt

Hard Coral

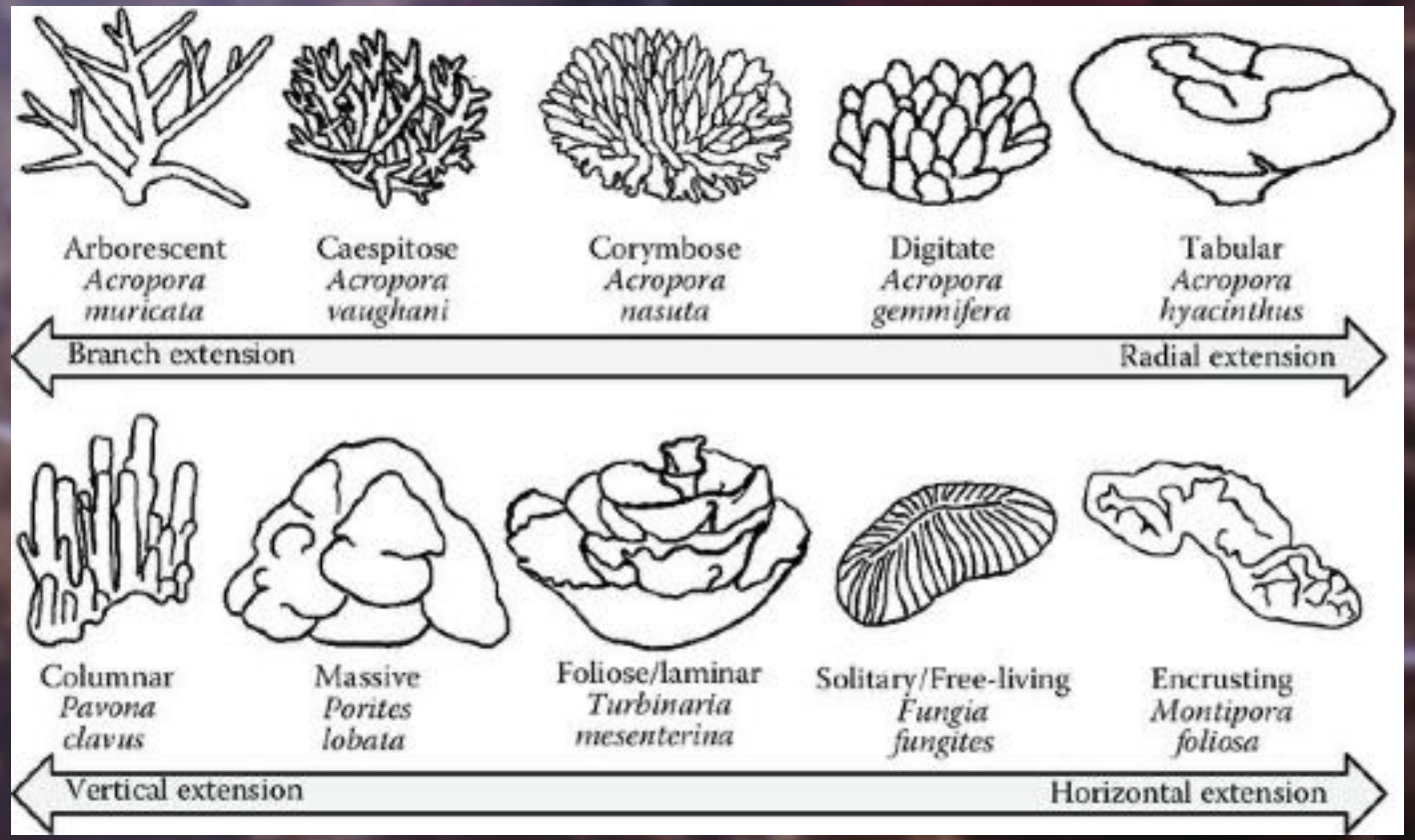
Reef Builders

- Waft the water near it – does it move?
  - Look at texture – coral cups
  - Surface looks like sandpaper



Hard Coral

- Different growth forms
  - Branching
  - Tabular
  - Foliose
  - Solitary
  - Encrusting
  - Boulder/Massive

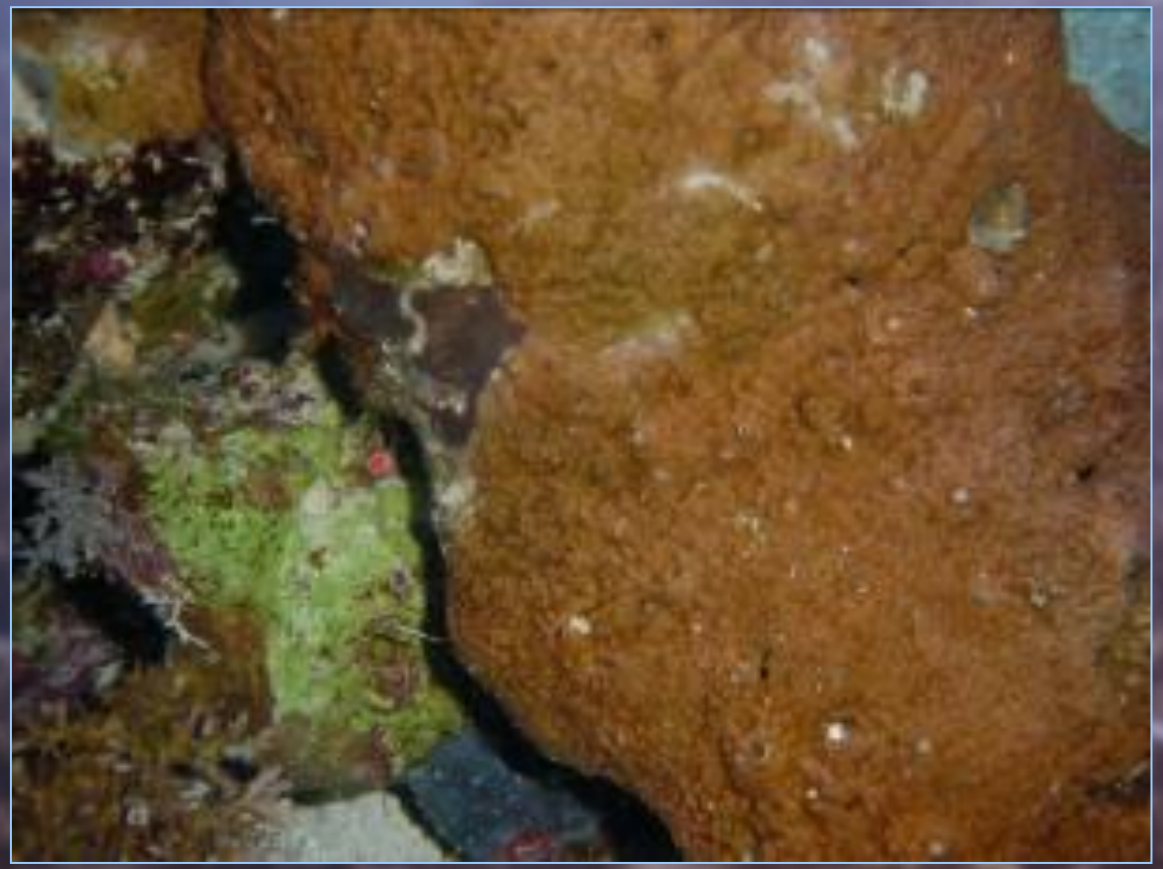


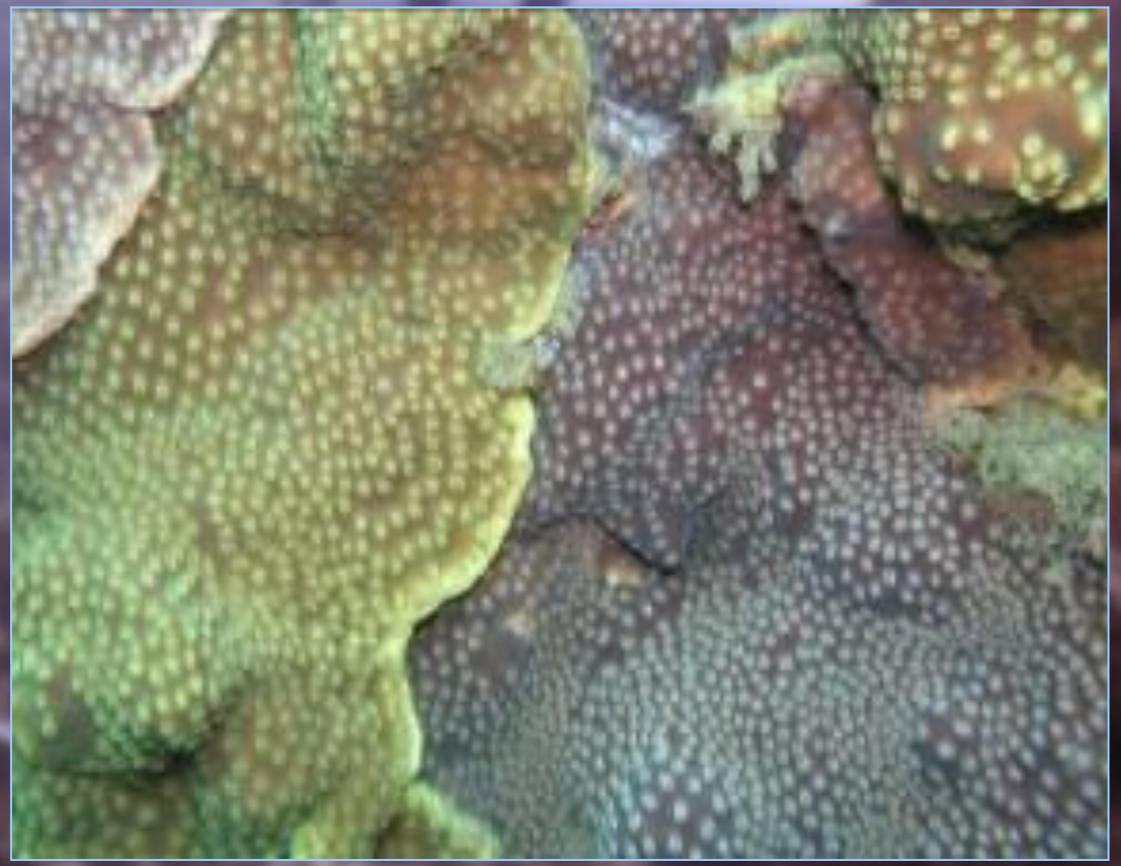
WHY FOCUS on MORPHOLOGY?

There are many reasons to record morphology. This includes being able to gauge ecological and species diversity of corals and better understand the overall health of the reef.

Branching

Tabular





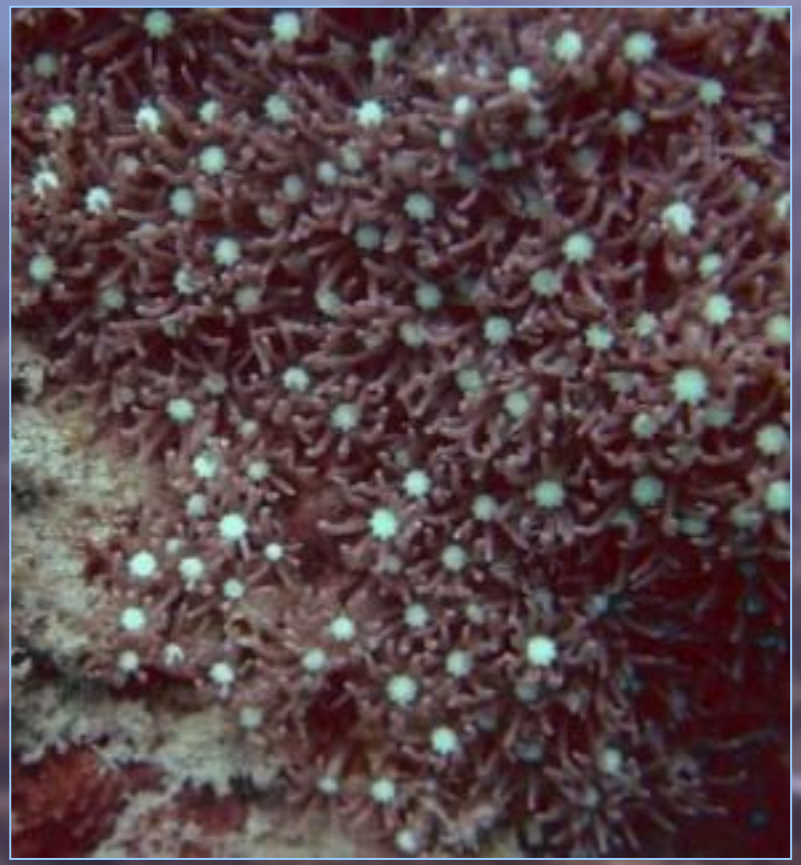
Encrusting

Solitary

Foliose

Massive

Seagrass



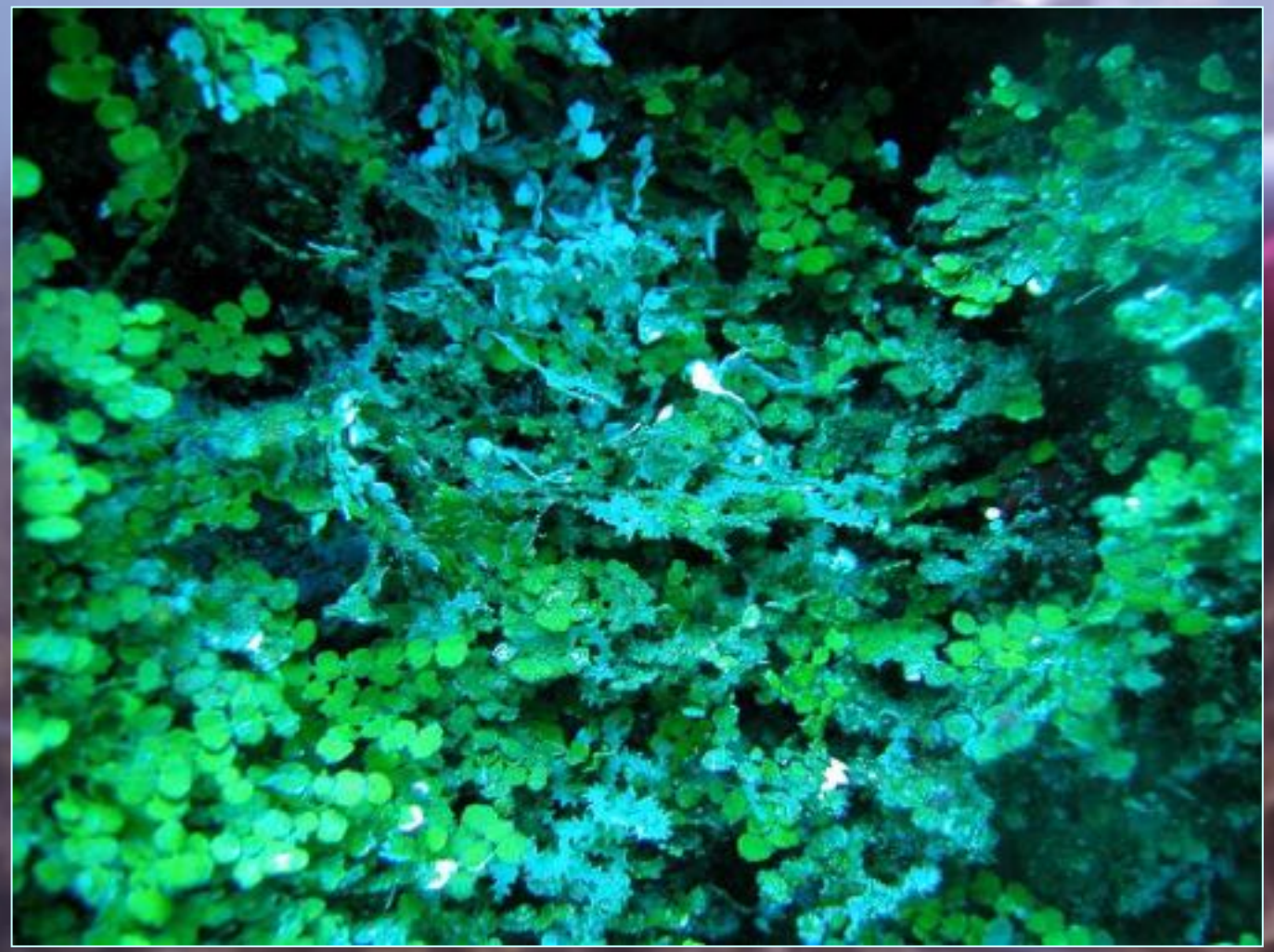
Soft Coral

Sponge

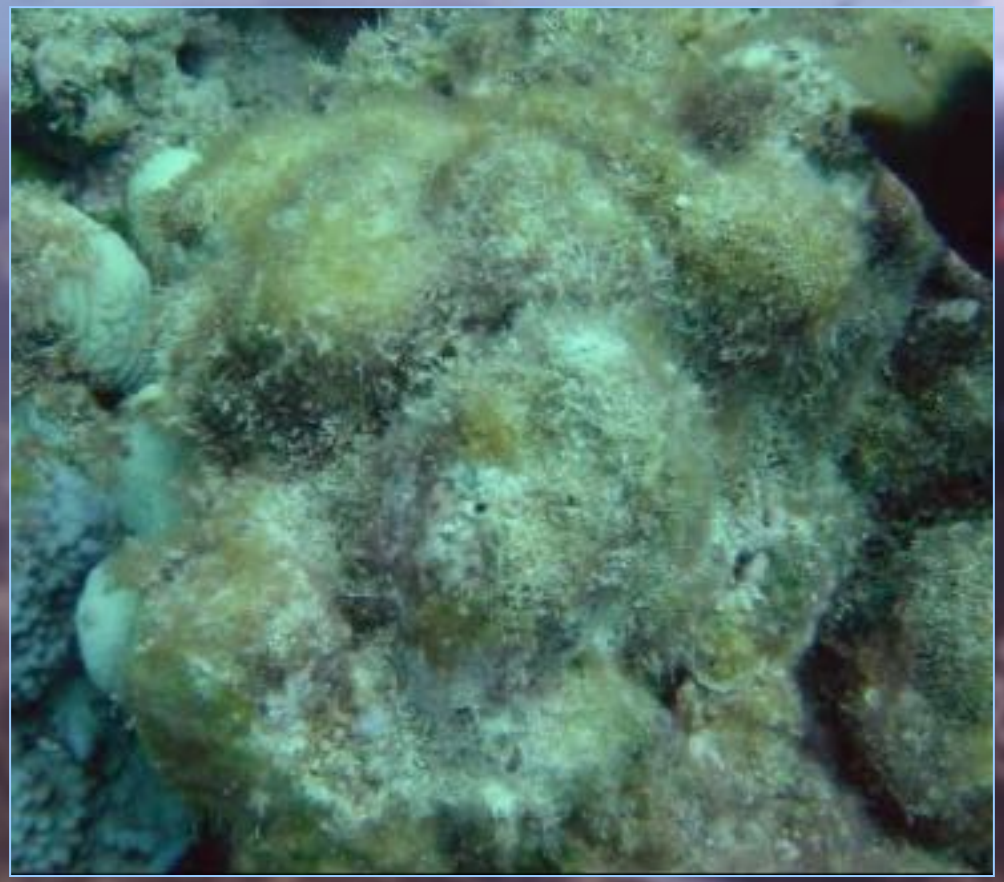
Giant Clam

Zoanthids

Crustose Coraline Algae

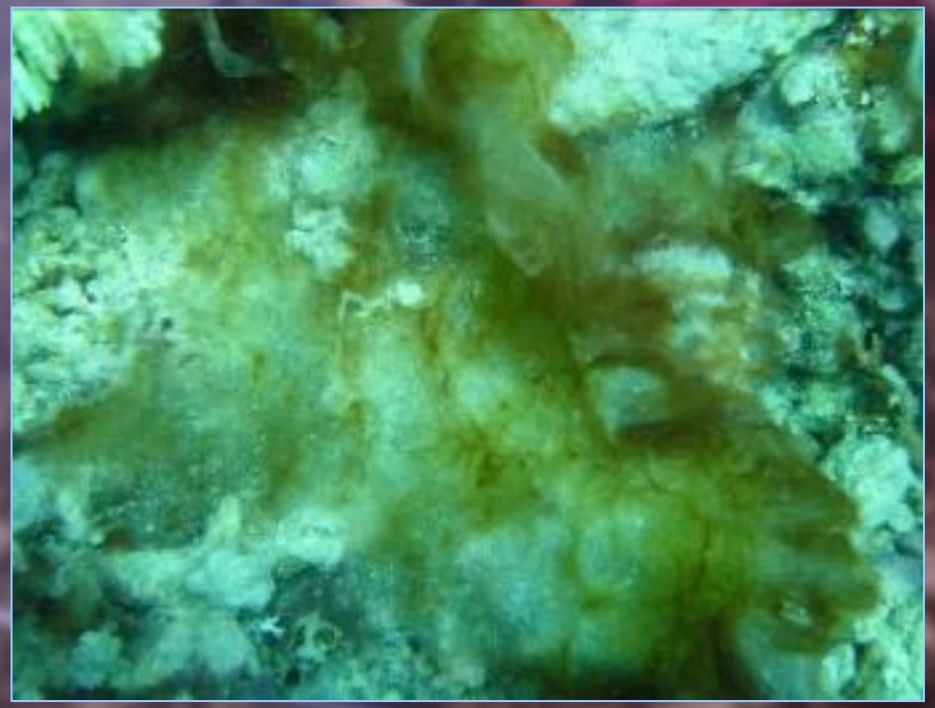


Halimeda



Turf Algae

Macro algae



Micro algae

Bleaching severity

Simple

- PIT protocol
- Requires minimal skill

CORAL BLEACHING SEVERITY PROTOCOL v2 - 2022

National Coral Reef Monitoring Framework
Maldives

POINT INTECEPT TRANSECT | SIMPLIFIED BLEACHED ORGANISMS

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

BENTHOS	Hard coral morphology	Braching coral	*BHC*	Boulder coral	*OHC*	Encrusting coral	*EHC*
		Tabular coral	*THC*	Foliose coral	*FHC*	Solitary coral	*SHC*
	Other organisms	Soft coral	*SC*	Anemones	*ANM*	Coraline algae	*CCA*
		Macro algae	*MA*	Micro algae	*MI*	Turf algae	*TA*
		Halimeda	*HA*	Sponge	*SP*	All other organisms	*OT*
	Substrate	Boulders/Rock >256mm	*BO*	Rubble 256 - 2mm	*CO*	Sand/Silt	*SD*
BLEACHING SEVERITY	Fully bleached	*BC*	Partially bleached	*PB*	Not bleached	*NB*	Recently killed	*RKC*

TRANSECT 1						TRANSECT 2						TRANSECT 3						TRANSECT 4					
Start time			Depth:			Start time			Depth:			Start time			Depth:			Start time			Depth:		
End time			Dir:			End time			Dir:			End time			Dir:			End time			Dir:		
Dis	Ben	Blch sev	Dis	Ben	Blch sev	Dis	Ben	Blch sev	Dis	Ben	Blch sev	Dis	Ben	Blch sev	Dis	Ben	Blch sev	Dis	Ben	Blch sev	Dis	Ben	Blch sev
0.5			10.5			0.5			10.5			0.5			10.5			0.5			10.5		
1.0			11.0			1.0			11.0			1.0			11.0			1.0			11.0		
1.5			11.5			1.5			11.5			1.5			11.5			1.5			11.5		
2.0			12.0			2.0			12.0			2.0			12.0			2.0			12.0		

Bleaching severity

Not bleached

Bleached

Partially bleached

Recently killed

Complex

- Belt protocol
  - 3 x 20m x 1m transects
- Researchers/Skilled resort marine biologist/EIA data collector
- Genus focused
- Additional bleaching categories

CORAL BLEACHING SEVERITY PROTOCOL v2 - 2022

National Coral Reef Monitoring Framework
Maldives

BELT TRANSECT - SCLERACTINIAN GENERA

DATE:		SURVEYOR:		LOCATION/SITE:		STATION:					
START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H		
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		ADDITIONAL STRESSORS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

COLONY BLEACHING CATEGORY	[1] *No bleaching*	[2] *1-10% bleached colony*	[3] *11-50% bleached colony*
	[4] *51-99% bleached colony*	[5] *100% bleached colony*	[6] *Dead colony*

NOTES:
1 Scleractinian hard corals must recorded as genera.
2 Soft corals may be recorded as soft corals
3 Sea anemones (Actiniaria) can be recorded as sea anemones

Tr #	Hard coral genera/Soft coral/Anemone	Bleaching Severity					
		1	*2*	*3*	*4*	*5*	*6*
1							

Common Genus

Acropora

Porites

Pocillopora

Pavona

If the part of the coral to the right of the red line is white, we would record this as either category 2 or 3

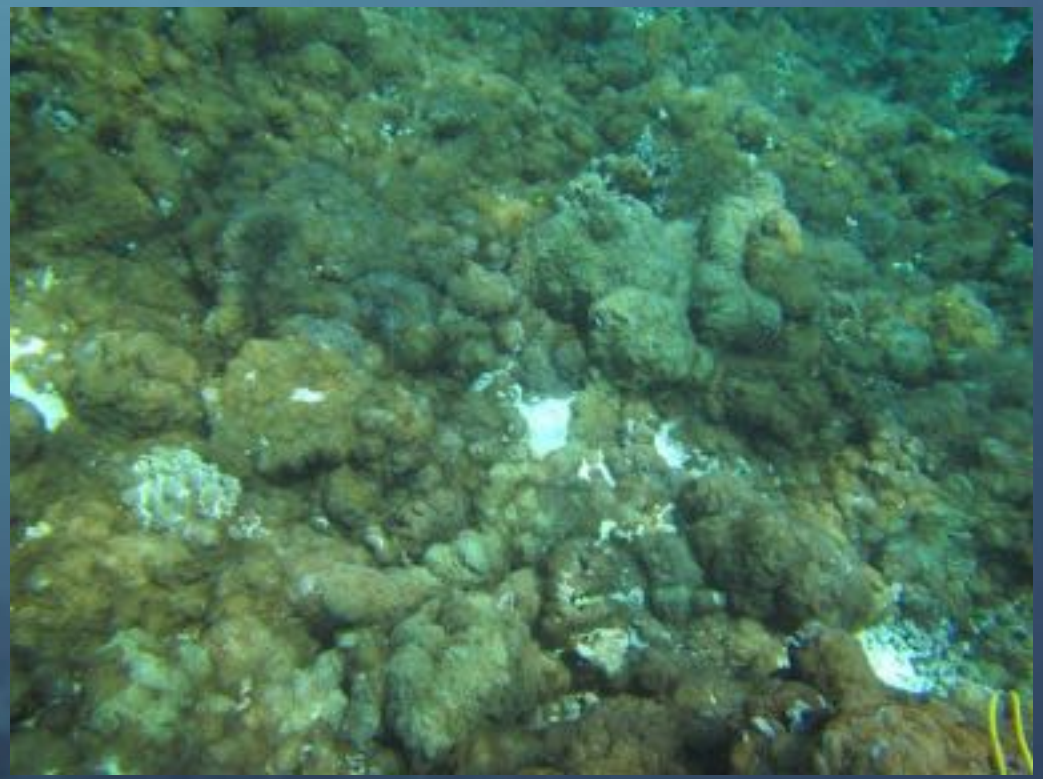
Monitoring Benthic Communities: PQs & Reefcloud

NCRMF Workshop: 8th to 10th May

Maldives Marine Research Institute

Photoquadrats - PQs

- Image data - image of the reef “floor”
- Captures a specific area
  - Estimated
  - Calibrated
- Image is analyzed



Why take PQs?

- Permanent record
- References library
- Improved ID
  - Cross reference
  - Cross ID
- Low stress ID compared to in field
- Chance to develop ID skills
- Lots of post survey work
- Opportunity to pursue multiple objectives
- Annotations tomorrow!

What do you need?

- Underwater camera
  - White balance
- Calibration/Reference stick

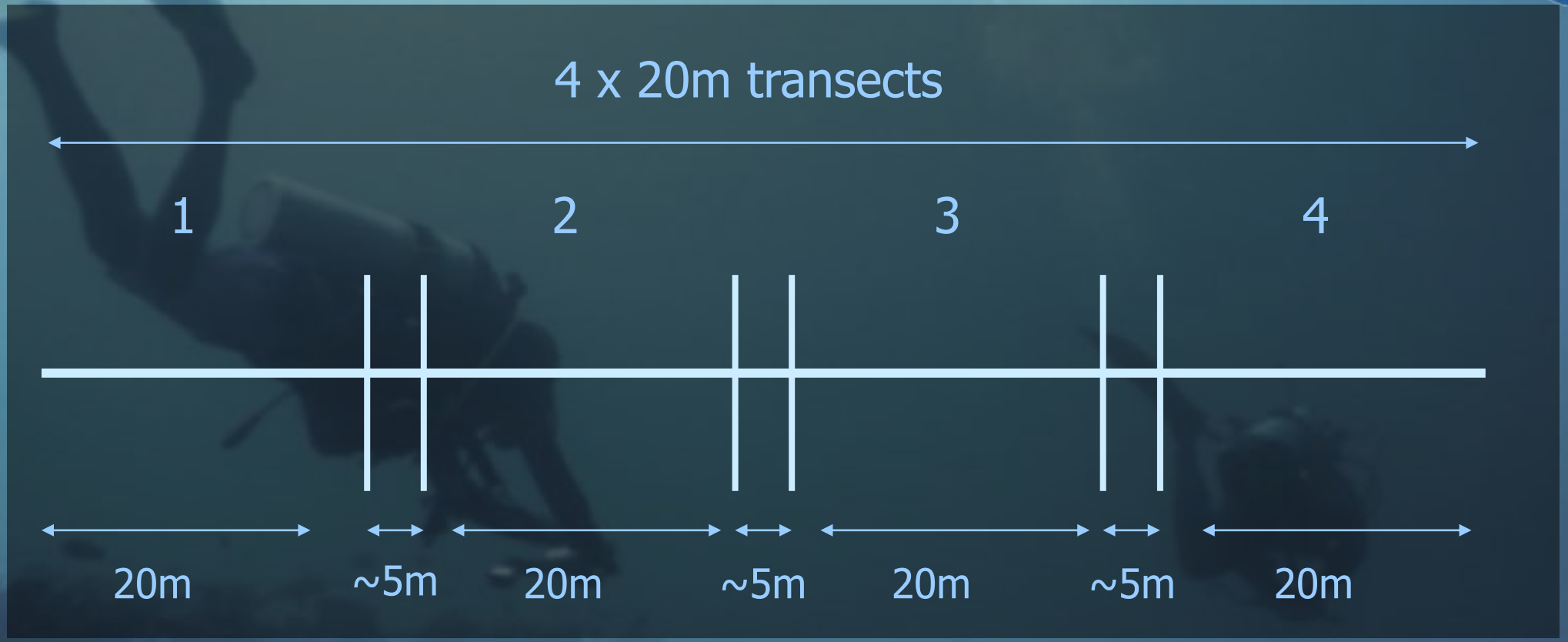
PQ protocols

TRANSECT

RANDOM

Transect protocol

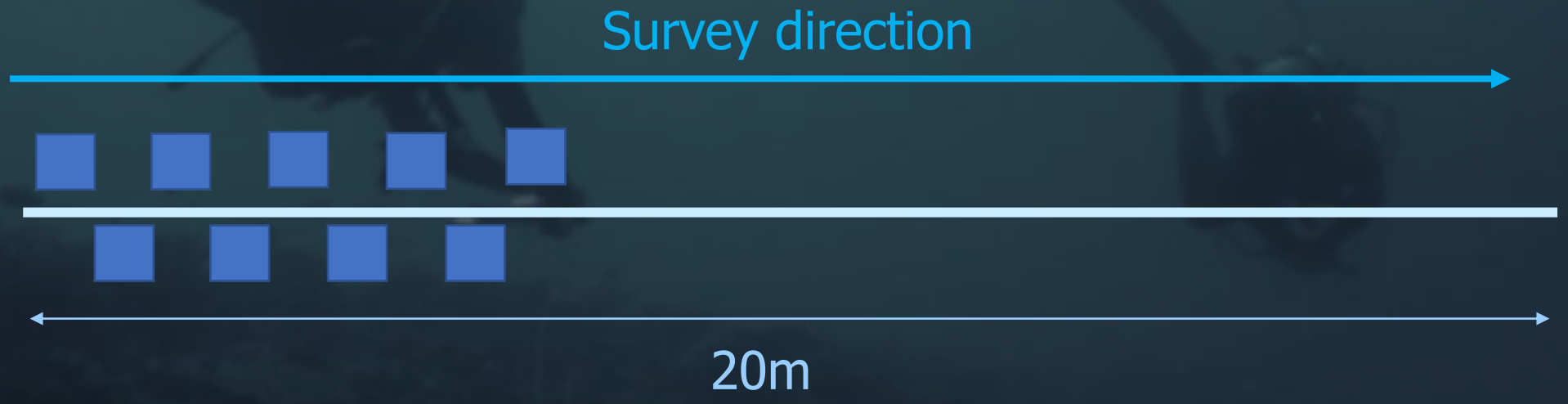
- Utilizes a transect with start & end markers
- 4 x 20m, taking an every 1m
- 20 images per transect, 80 images per depth
- Marine biologist, NGOs, Students Researchers etc.…



1 image every m = 20 images per transect

20 images per transect = 80 images per depth

Alternate side to avoid overlap



Random protocol

- No transects
- Location information
- 20 images per depth
- Divers and snorkelers with willingness and time during leisure dives/snorkels

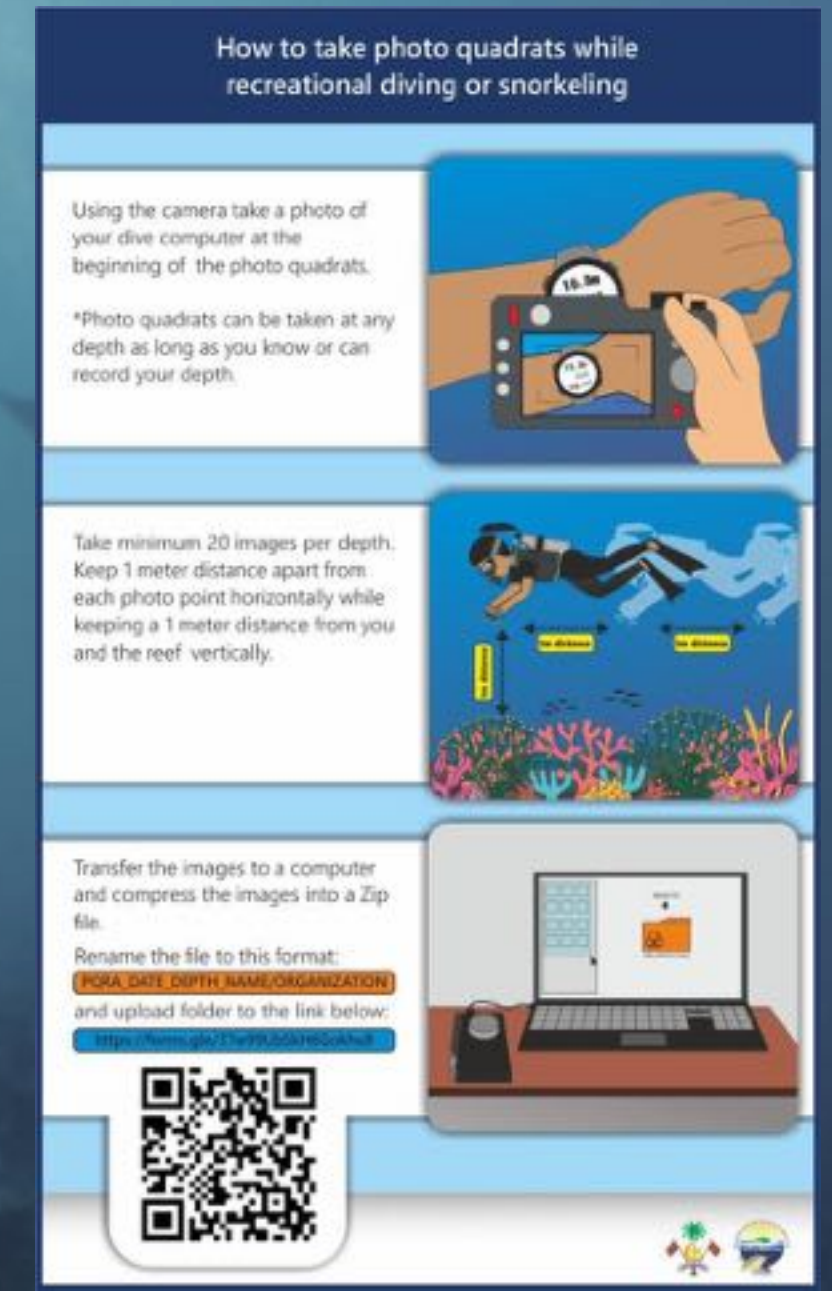



Image Collection ----> Image Annotation

Image annotation

- Means of reef analysis via quantification of image data
- Recording what is there on the PQ images
  - CPCe
  - CoralNet
  - Reef Cloud

What you need before you start

- Have your images properly sorted
- Make sure your meta data sorted and readily available
- Choose your software
- Consider your objectives
- Build a label set

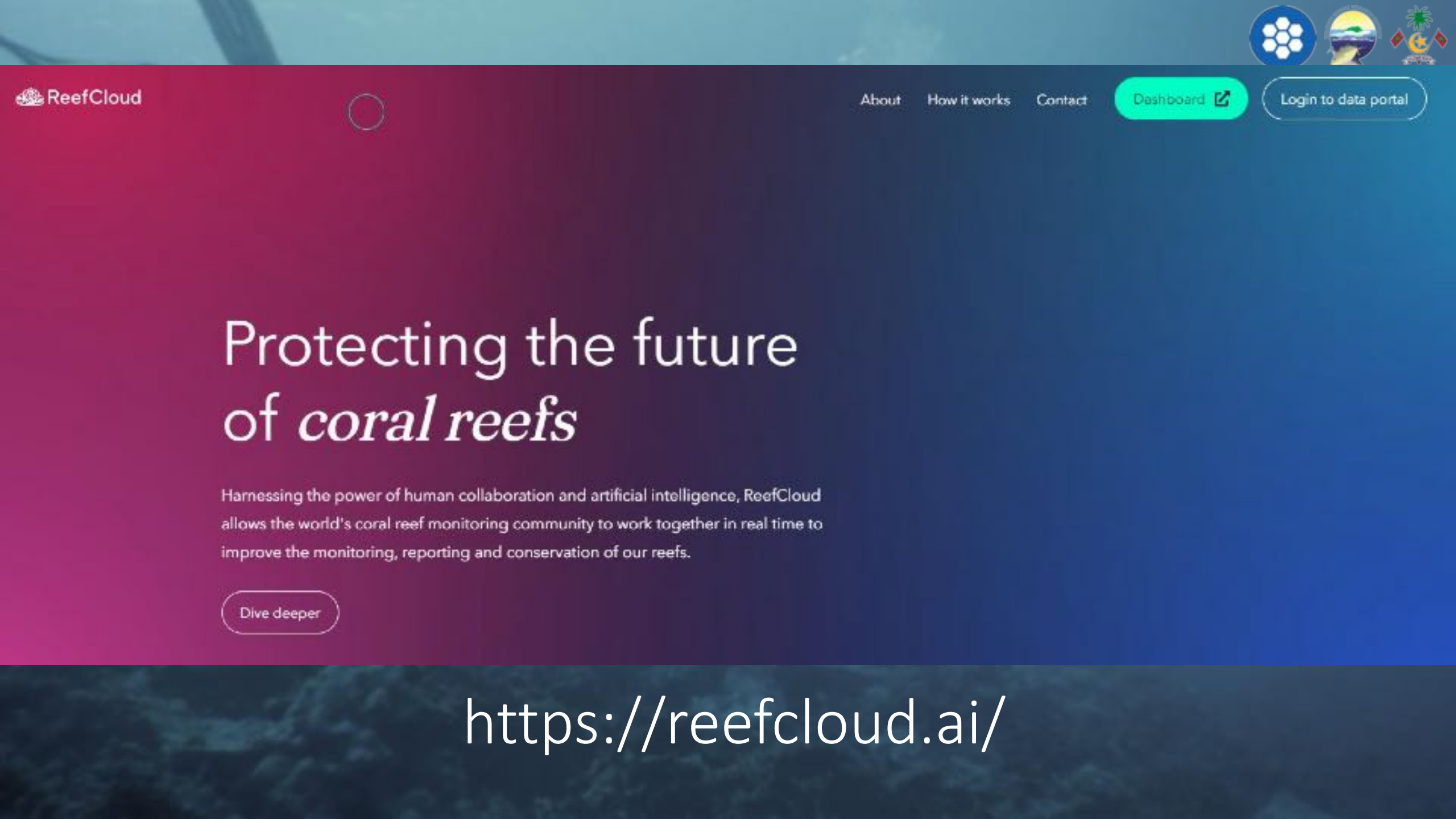
Label set

- Complex
  - 146 labels
  - Genus focused
  - Genus and morphology combinations

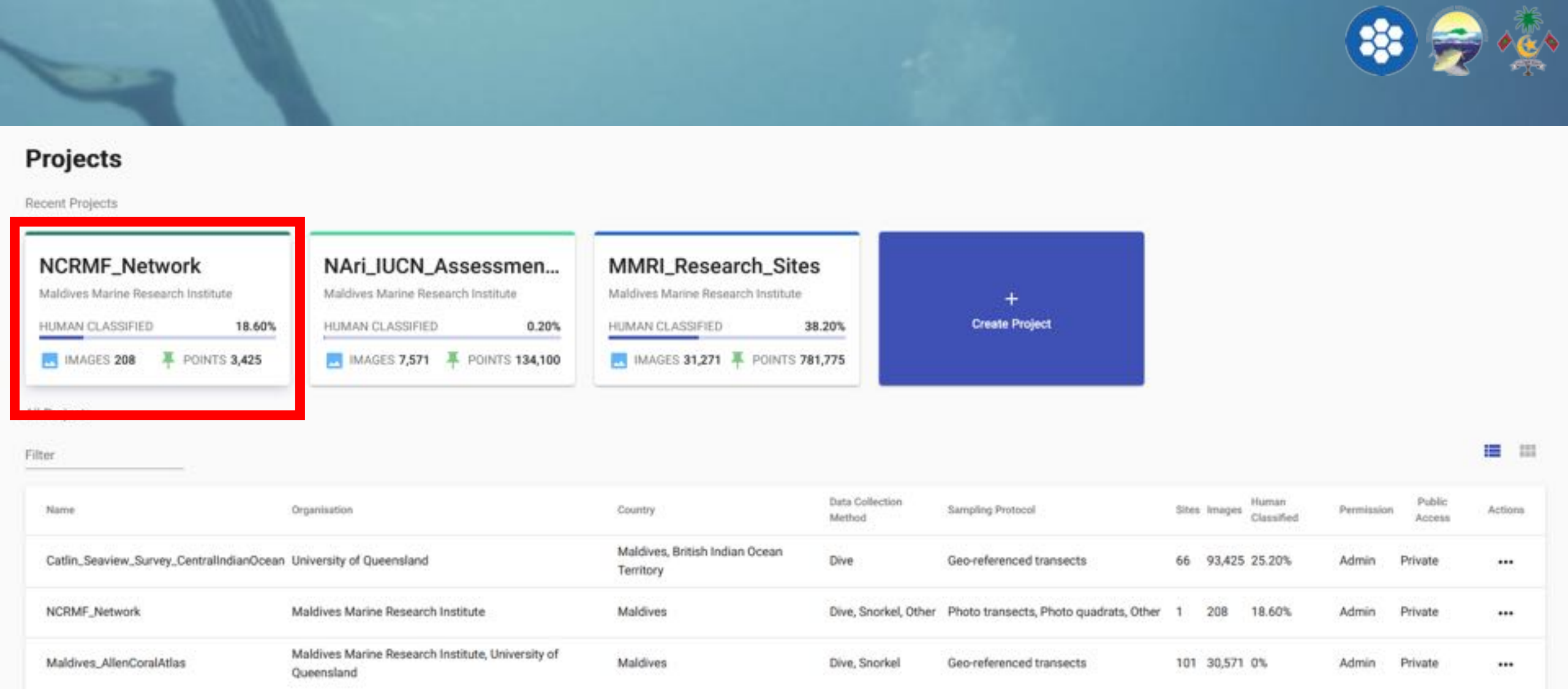
- Simple
  - 60 labels
  - Morphology focused
  - Selected genera
    - *Porites, Acropora, Pocillopora*

Manual vs Semi automated

Fully manual – e.g., CPCe – > Humans annotate all the points, can be very time consuming
Semi automated/automated – e.g., coralnet and reef cloud -> train an AI that uses machine learning to annotate images. The more training we give the system, the better AI and the results it produces



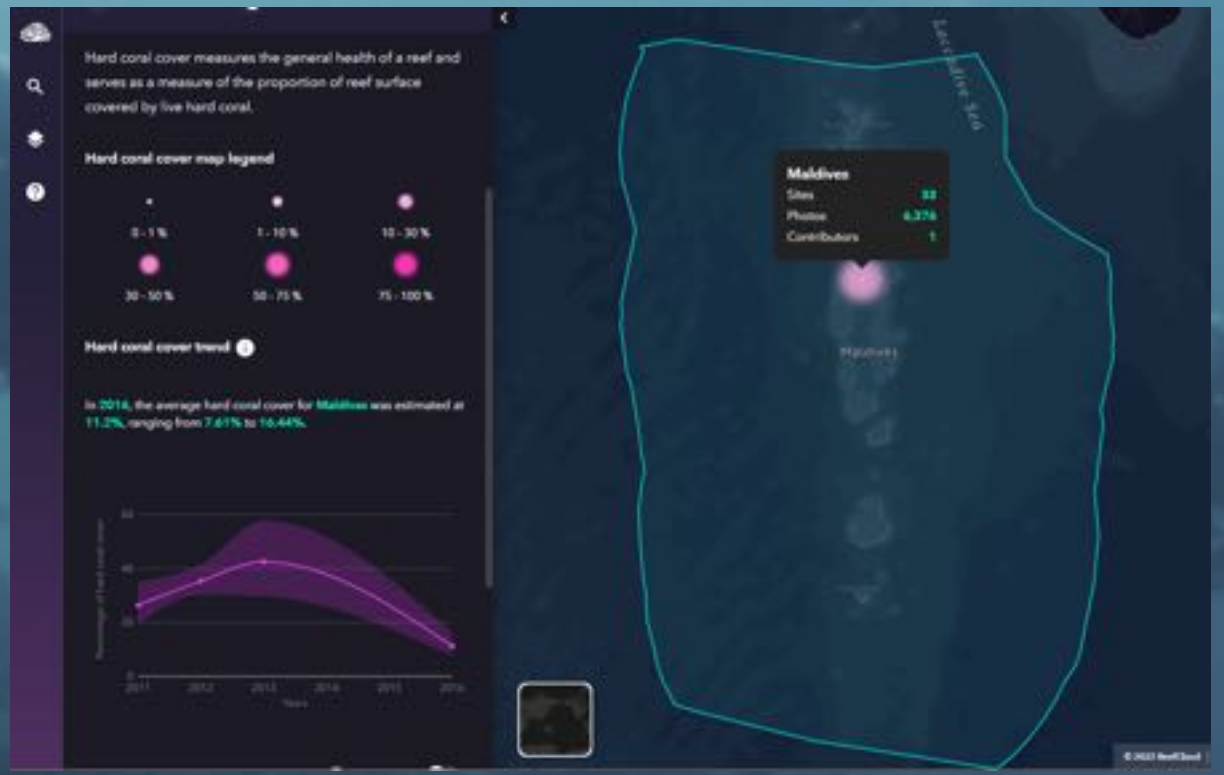
https://reefcloud.ai/



- Reasons for choosing ReefCloud by MMRI
  - Ease of management of large amounts of data:
  - Ease of collaboration:
  - Reliability of AI annotations:
  - Data back up:
- Each user and organization has to make own decision based on their objectives, requirements and constraints

Public data management & sharing

- Transparency with public with published data
- Rapid analysis of data at various resolutions
- Immediate access to summaries



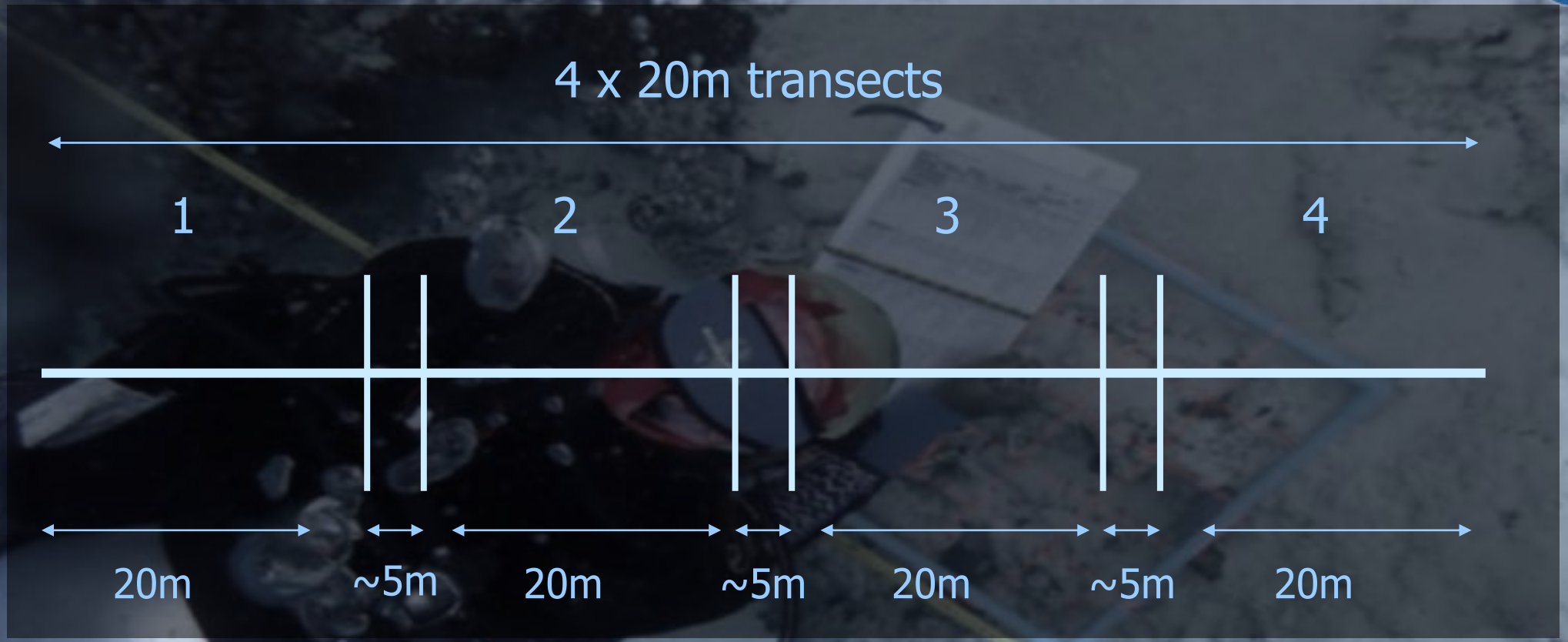
Monitoring Benthic Communities: Coral Recruitment

NCRMF Workshop: 8th to 10th May

Maldives Marine Research Institute

Coral Recruitment

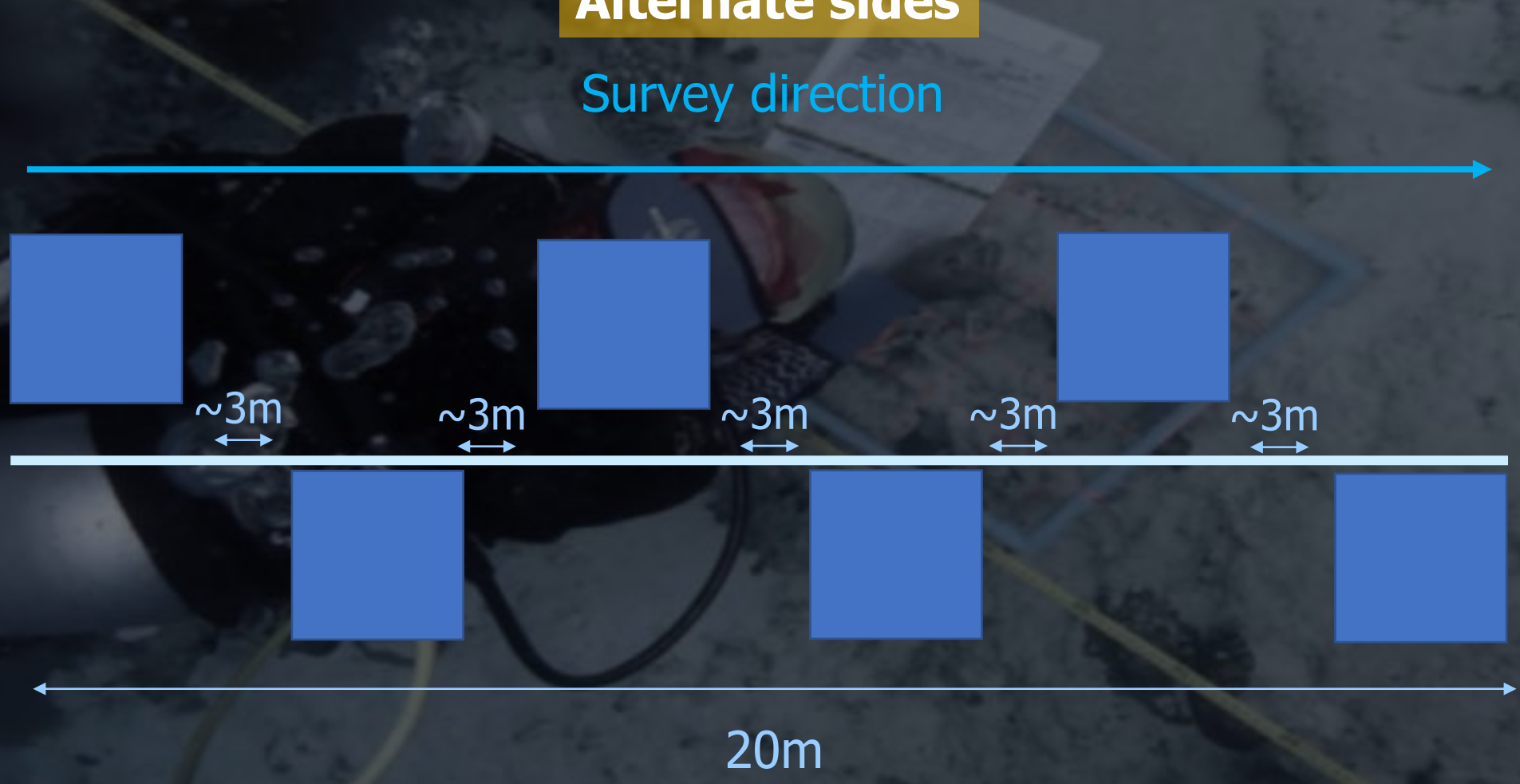
- Survey carried out to assess a coral reef's recovery potential
- Transect based quadrats
  - 6 quadrats per transect
- 50cm x 50cm quadrats
- Recording juveniles between 0-10 cm



6 quadrats per transect

24 quadrats per depth

Alternate sides



Skill Level

Record genera OR hard coral

Exact measure OR binned size class

HARD CORAL RECRUITS v1 - 2022

National Coral Reef Monitoring Framework

50 CM X 50CM QUADRATS

ORGANISATION:		**SURVEYOR:**		**LOCATION:**		**SITE:**					
DATE:		**START TIME:**	:	**END TIME:**	:	**SURVEY DIRECTION:**		**SURVEY (m):**	**L**	**W**	**H**
MAX DEPTH (m):		**MIN DEPTH (m):**		**EST VIZ (m):**		**TEMP (°c):**		**COMMENTS:**			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

QUADRAT % COMPOSITON:	Hard coral	*HC*	Dead hard coral	*DHC*	Rock	*RK*	Rubble	*RB*	Sand	*SD*	Algae	*AL*	Sponge	SP	CCA	*CCA*
RECRUIT MEASURES:	Exact measures to 0.01mm of corals between 0cm and 10cm using vernier calipers **OR** Binned as follows: 0 - 2.5cm *B* 2.6-5cm *R* 5.01-10cm *J*															

TRANSECT 1	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**
% Comp:	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*

TRANSECT 2	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**
% Comp:	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*

HARD CORAL RECRUITS v1 - 2022

National Coral Reef Monitoring Framework

50 CM X 50CM QUADRATS

ORGANISATION:		**SURVEYOR:**		**LOCATION:**		**SITE:**					
DATE:		**START TIME:**	:	**END TIME:**	:	**SURVEY DIRECTION:**		**SURVEY (m):**	**L**	**W**	**H**
MAX DEPTH (m):		**MIN DEPTH (m):**		**EST VIZ (m):**		**TEMP (°c):**		**COMMENTS:**			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

QUADRAT % COMPOSITON:	Hard coral	*HC*	Dead hard coral	*DHC*	Rock	*RK*	Rubble	*RB*	Sand	*SD*	Algae *AL*	Sponge *SP*	CCA	*CCA*

RECRUIT MEASURES:	Exact measures to 0.01mm of corals between 0cm and 10cm using vernier calipers					
	OR					
	Binned as follows:	0 - 2.5cm	*B*	2.6-5cm	*R*	5.01-10cm *J*

TRANSECT 1	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	Q2	Q3	Q4	Q5	Q6
% Comp:	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*

TRANSECT 2	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	Q2	Q3	Q4	Q5	Q6
% Comp:	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*	*% Comp:*

Meta data

HARD CORAL RECRUITS v1 - 2022

National Coral Reef Monitoring Framework

50 CM X 50CM QUADRATS

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

QUADRAT % COMPOSITON:	Hard coral	*HC*	Dead hard coral	*DHC*	Rock	*RK*	Rubble	*RB*	Sand *SD*	Algae *AL*	Sponge SP	CCA	*CCA*
RECRUIT MEASURES:	Exact measures to 0.01mm of corals between 0cm and 10cm using vernier calipers OR Binned as follows: 0 - 2.5cm *B* 2.6-5cm *R* 5.01-10cm *J*												

TRANSECT 1	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):	
Q1	Q2	Q3	Q4	Q5	Q6	
% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	

TRANSECT 2	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):	
Q1	Q2	Q3	Q4	Q5	Q6	
% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	

Transect meta

HARD CORAL RECRUITS v1 - 2022

National Coral Reef Monitoring Framework

50 CM X 50CM QUADRATS

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

QUADRAT % COMPOSITON:	Hard coral	*HC*	Dead hard coral	*DHC*	Rock	*RK*	Rubble	*RB*	Sand	*SD*	Algae	*AL*	Sponge	SP	CCA	*CCA*

RECRUIT MEASURES:	Exact measures to 0.01mm of corals between 0cm and 10cm using vernier calipers OR Binned as follows: 0 - 2.5cm *B* 2.6-5cm *R* 5.01-10cm *J*

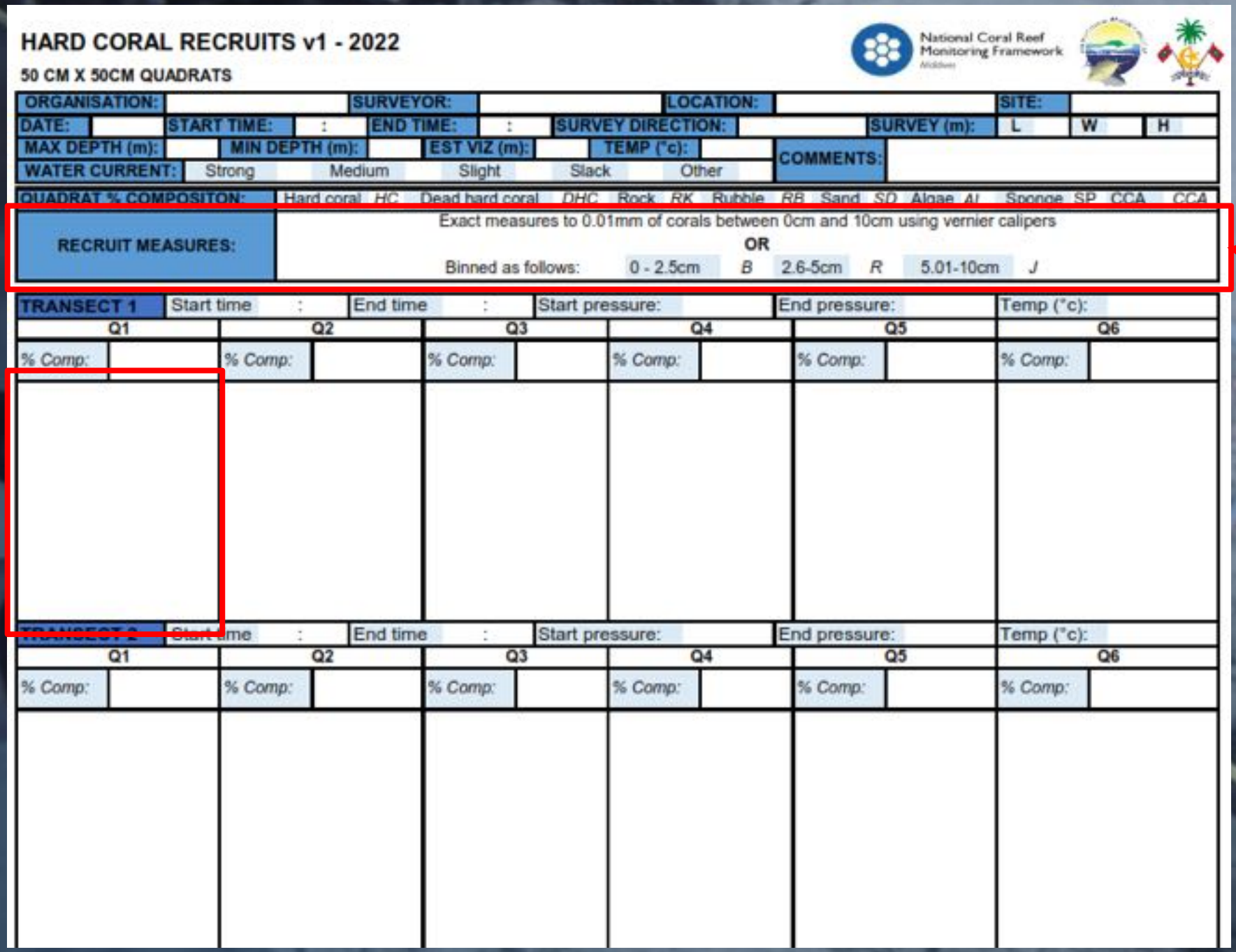
TRANSECT 1	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	Q2	Q3	Q4	Q5	Q6
% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	% Comp:

TRANSECT 2	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	Q2	Q3	Q4	Q5	Q6
% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	% Comp:

Quadrat composition



HARD CORAL RECRUITS v1 - 2022

50 CM X 50CM QUADRATS

National Coral Reef Monitoring Framework

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						
QUADRAT % COMPOSITON:	Hard coral HC	Dead hard coral DHC	Rock RK	Rubble RB	Sand SD	Algae AL	Sponge SP	CCA	CCA		
RECRUIT MEASURES:	Exact measures to 0.01mm of corals between 0cm and 10cm using vernier calipers OR Binned as follows: 0 - 2.5cm B 2.6-5cm R 5.01-10cm J										

TRANSECT 1	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	Q2	Q3	Q4	Q5	Q6
% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	% Comp:

TRANSECT 2	Start time :	End time :	Start pressure:	End pressure:	Temp (°c):

Q1	Q2	Q3	Q4	Q5	Q6
% Comp:	% Comp:	% Comp:	% Comp:	% Comp:	% Comp:

Recruitment data

- Genus and exact measures*
- Hard coral and exact measures
- Genus and size bins
- Hard coral and size bins

Monitoring Invertebrates and Coral Disease

NCRMF Workshop: 8th to 10th May 2023

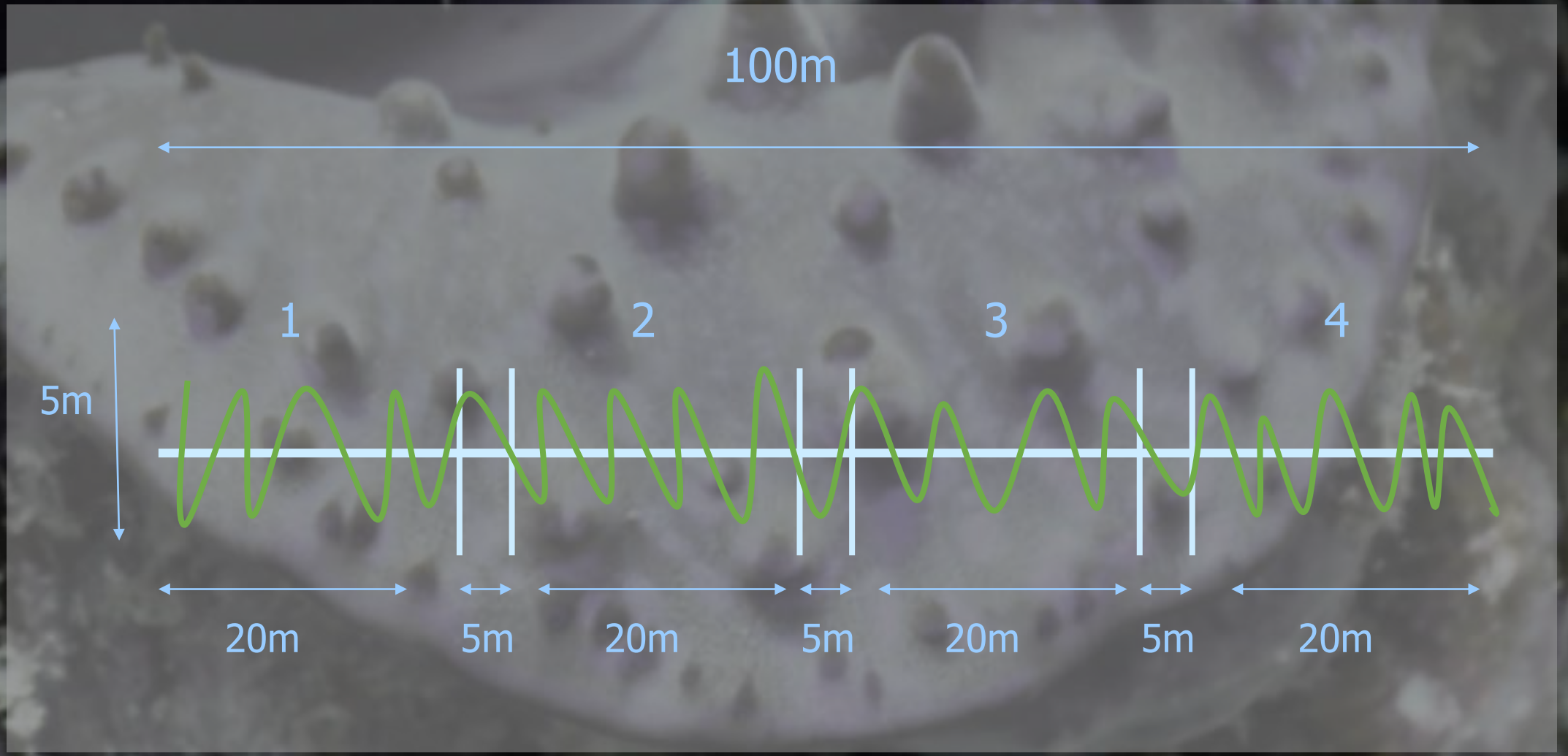
Why do we count invertebrates?

Why do we count invertebrates?

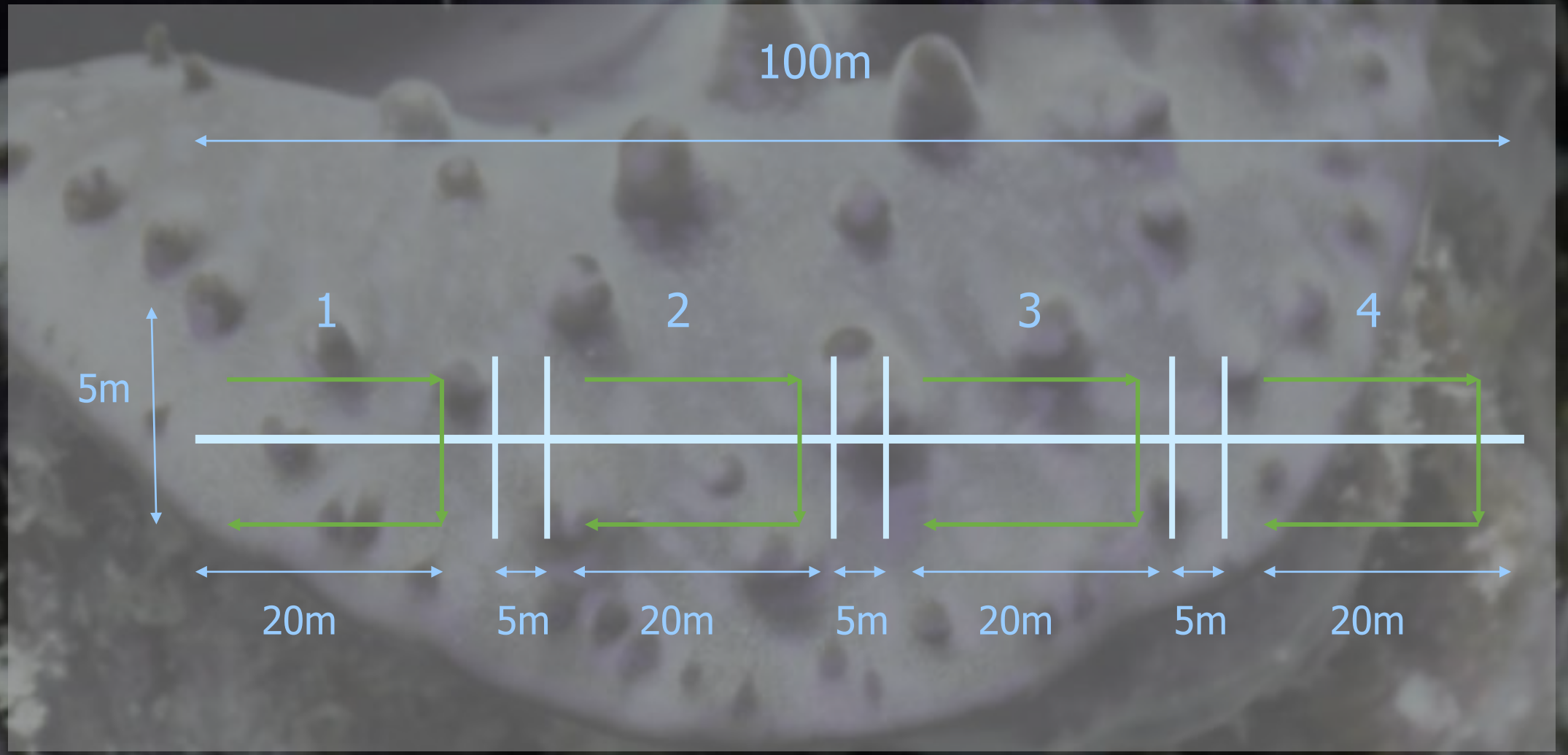
- Ecological functions
- Indicator species
- Economic value

The Survey

- Abundance counts
- Belt transect transect
- 4 x 20m x 5m transects



Can carry out survey moving in a zig zag pattern. Can be useful when there is a lot of swell



Can carry out survey covering one half of the belt a time. Can be useful when there is a lot to count and to focus on one area

The Survey

- 20-30 minutes
- After the fish surveyor
  - Double up with fish surveys

MARINE SEABED MOBILE LIFEFORM & DISEASE V2 - 2022

National Coral Reef Monitoring Framework

BELT TRANSECT | INVERTEBRATES & CORAL DISEASE

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

CONDITIONS	Ripe *RI* Damaged *DM* Dead *DD* Disease *DI* Male *MA* Female *FE* Other *OT* No Record *NR*
BEHAVIOURS	Courtship *CT* Hunting *HU* Feeding *FD* Cleaning *CI* Aggregation *AG* Aggression *AR* Approach *AP* Avoidance *AV* Resting *RE* Spawning *SP* Other *OT* No Record *NR*

INVERTEBRATE	Transect 1 Time :		Transect 2 Time :		Transect 3 Time :		Transect 4 Time :	
	Abundance	*CND/BHV*	*Abundance*	*CND/BHV*	*Abundance*	*CND/BHV*	*Abundance*	*CND/BHV*
T. squamosa								
T. maxima								
Tridacna spp.								
Triton								
Spider Conch *Lambis* spp.								
Drupella								
Banded Coral Shrimp								

Meta data

MARINE SEABED MOBILE LIFEFORM & DISEASE V2 - 2022

BELT TRANSECT | INVERTEBRATES & CORAL DISEASE

National Coral Reef Monitoring Framework

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:	
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:	
SURVEY (m):	L	W	H				
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):	
COMMENTS:							
WATER CURRENT:	Strong	Medium	Slight	Slack	Other		

CONDITIONS	Ripe *RI*	Damaged *DM*	Dead *DD*	Disease *DI*	Male *MA*	Female *FE*	Other *OT*	No Record *NR*
BEHAVIOURS	Courtship *CT*	Hunting *HU*	Feeding *FD*	Cleaning *CI*	Aggregation *AG*	Aggression *AR*	Approach *AP*	Avoidance *AV*
	Resting *RE*	Spawning *SP*	Other *OT*	No Record *NR*				

INVERTEBRATE	Transect 1 Time :		Transect 2 Time :		Transect 3 Time :		Transect 4 Time :	
	Abundance	*CND/BHV*	*Abundance*	*CND/BHV*	*Abundance*	*CND/BHV*	*Abundance*	*CND/BHV*
T. squamosa								
T. maxima								
Tridacna spp.								
Triton								
Spider Conch *Lambis* spp.								
Drupella								
Banded Coral Shrimp								

Conditions and behavior

MARINE SEABED MOBILE LIFEFORM & DISEASE V2 - 2022

National Coral Reef Monitoring Framework

BELT TRANSECT | INVERTEBRATES & CORAL DISEASE

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:			
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:	
WATER CURRENT:	Strong	Medium	Slight	Slack	Other				

CONDITIONS	Ripe *RI* Damaged *DM* Dead *DD* Disease *DI* Male *MA* Female *FE* Other *OT* No Record *NR*
BEHAVIOURS	Courtship *CT* Hunting *HU* Feeding *FD* Cleaning *CI* Aggregation *AG* Aggression *AR* Approach *AP* Avoidance *AV* Resting *RE* Spawning *SP* Other *OT* No Record *NR*

INVERTEBRATE	Transect 1 Time :		Transect 2 Time :		Transect 3 Time :		Transect 4 Time :	
	Abundance	*CND/BHV*	*Abundance*	*CND/BHV*	*Abundance*	*CND/BHV*	*Abundance*	*CND/BHV*
T. squamosa								
T. maxima								
Tridacna spp.								
Triton								
Spider Conch *Lambis* spp.								
Drupella								
Banded Coral Shrimp								

Abundance counts of inverts

FLUTES

Tridacna

Triton

Drupella

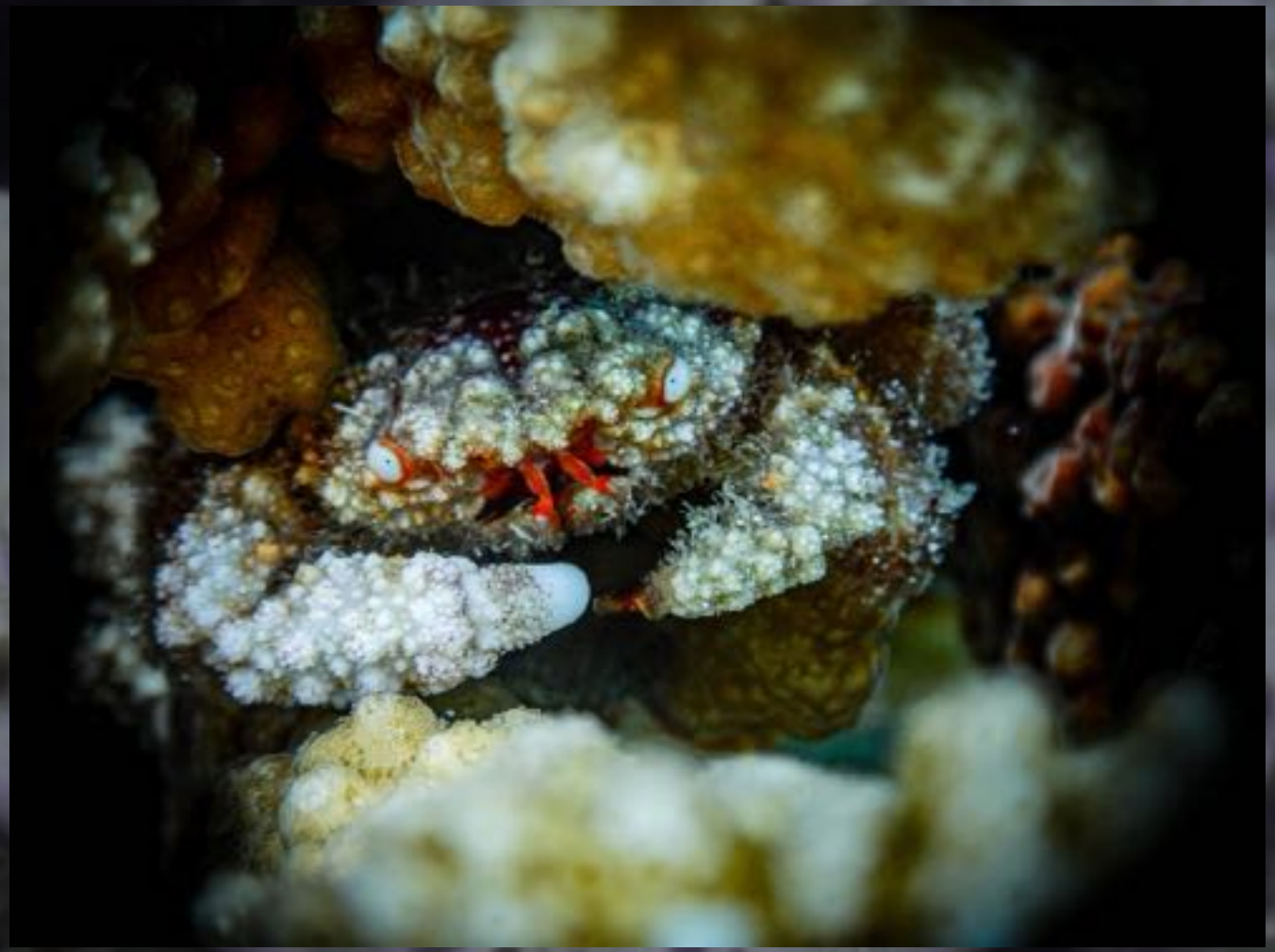
Banded coral shrimp


P. femorstriga


P. versicolor


Slipper lobster

Lobsters



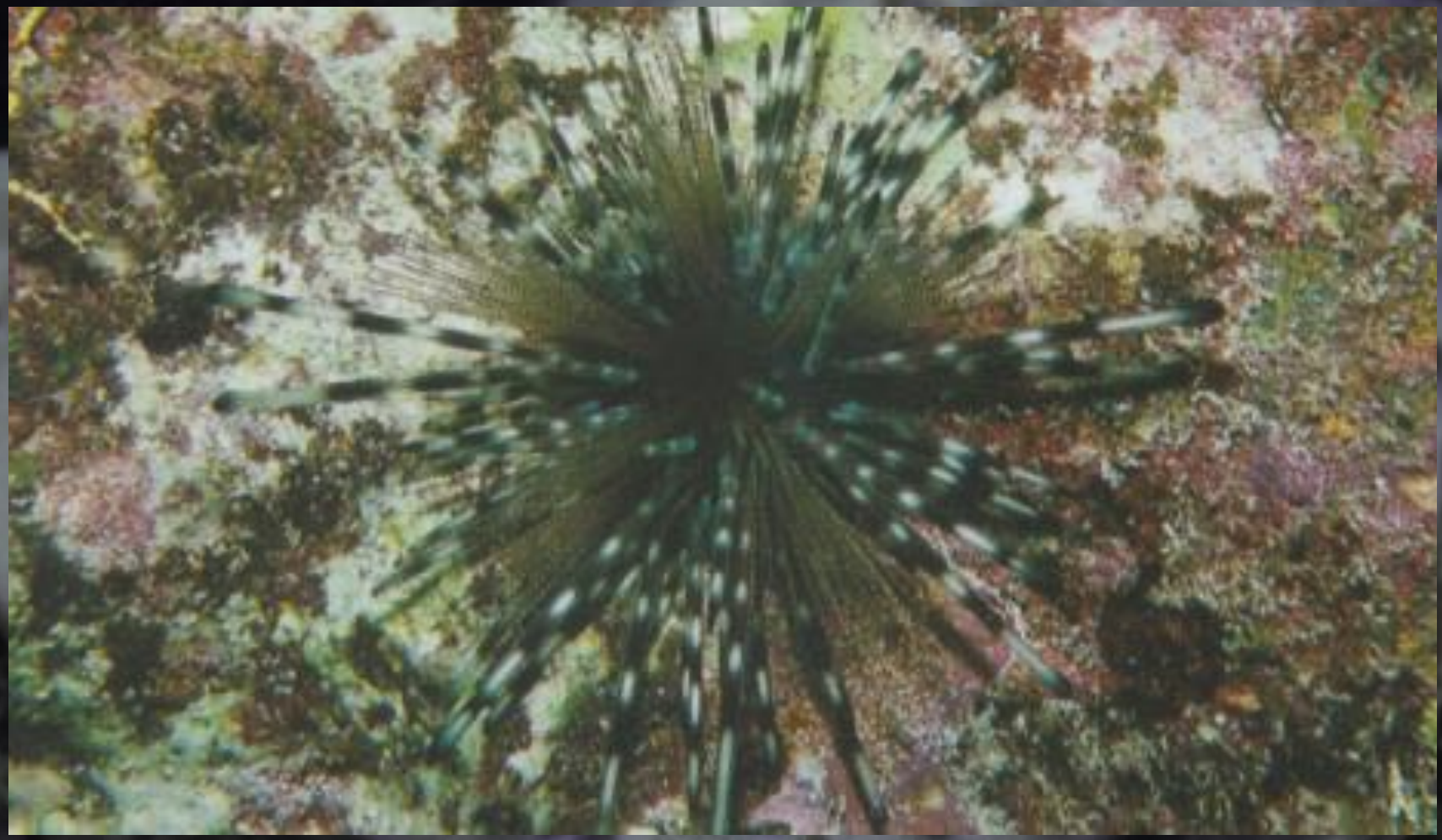
Crabs

Other crustacea

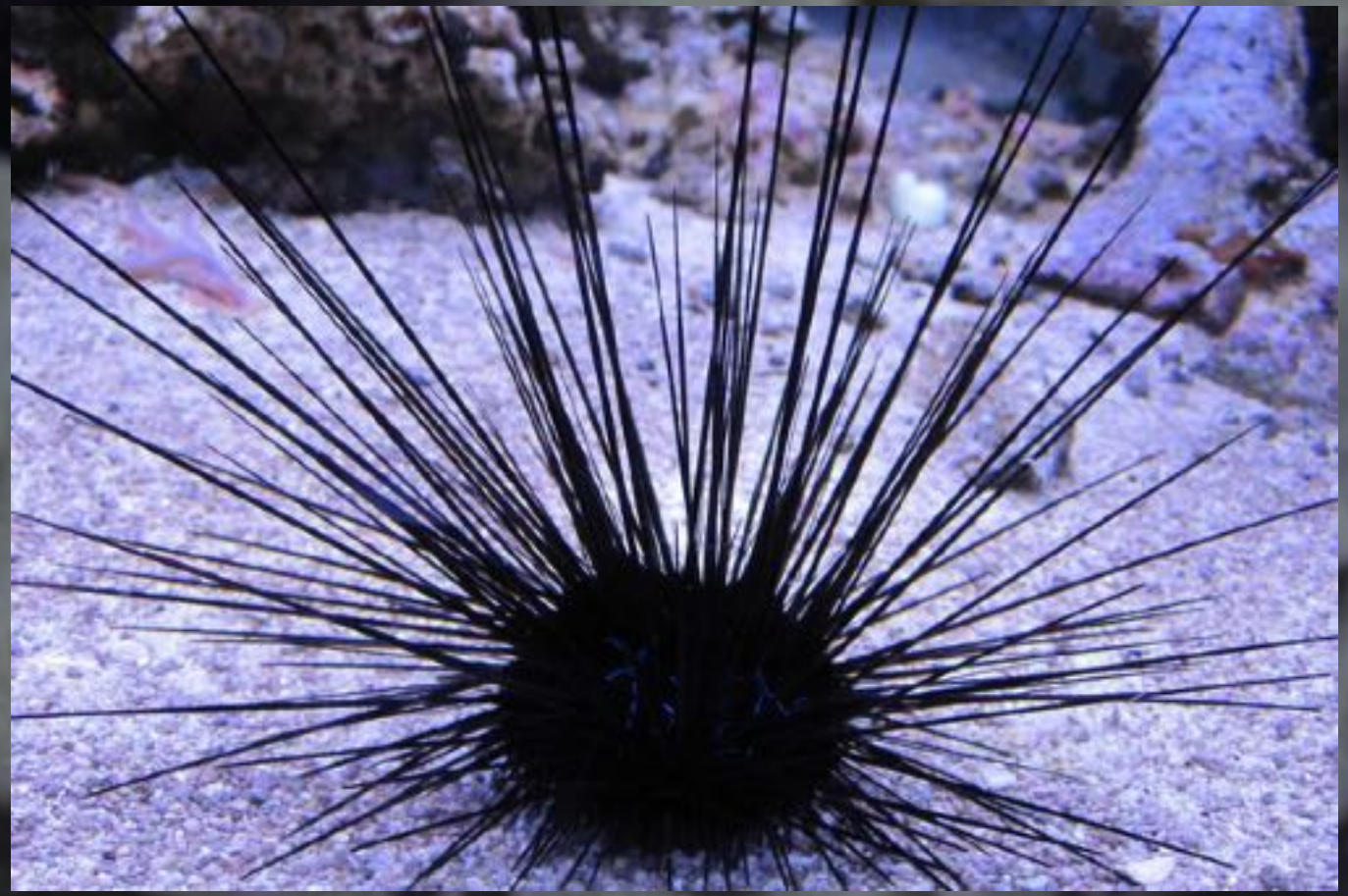
Sea cucumbers

COTS

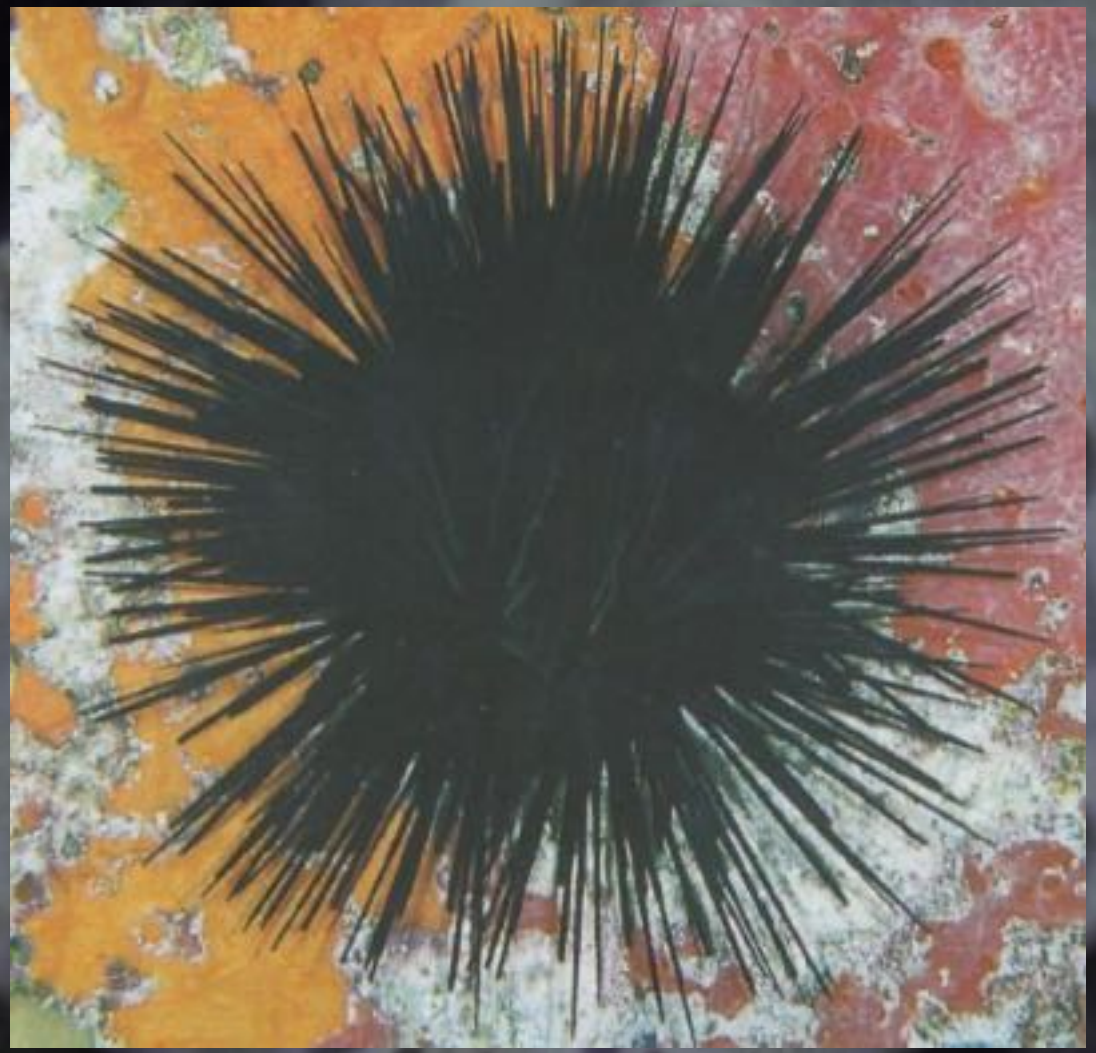
Cushion Star



Banded Urchin



Long spine urchin



Blue black urchin

Other urchins

Octopus

Coral Disease

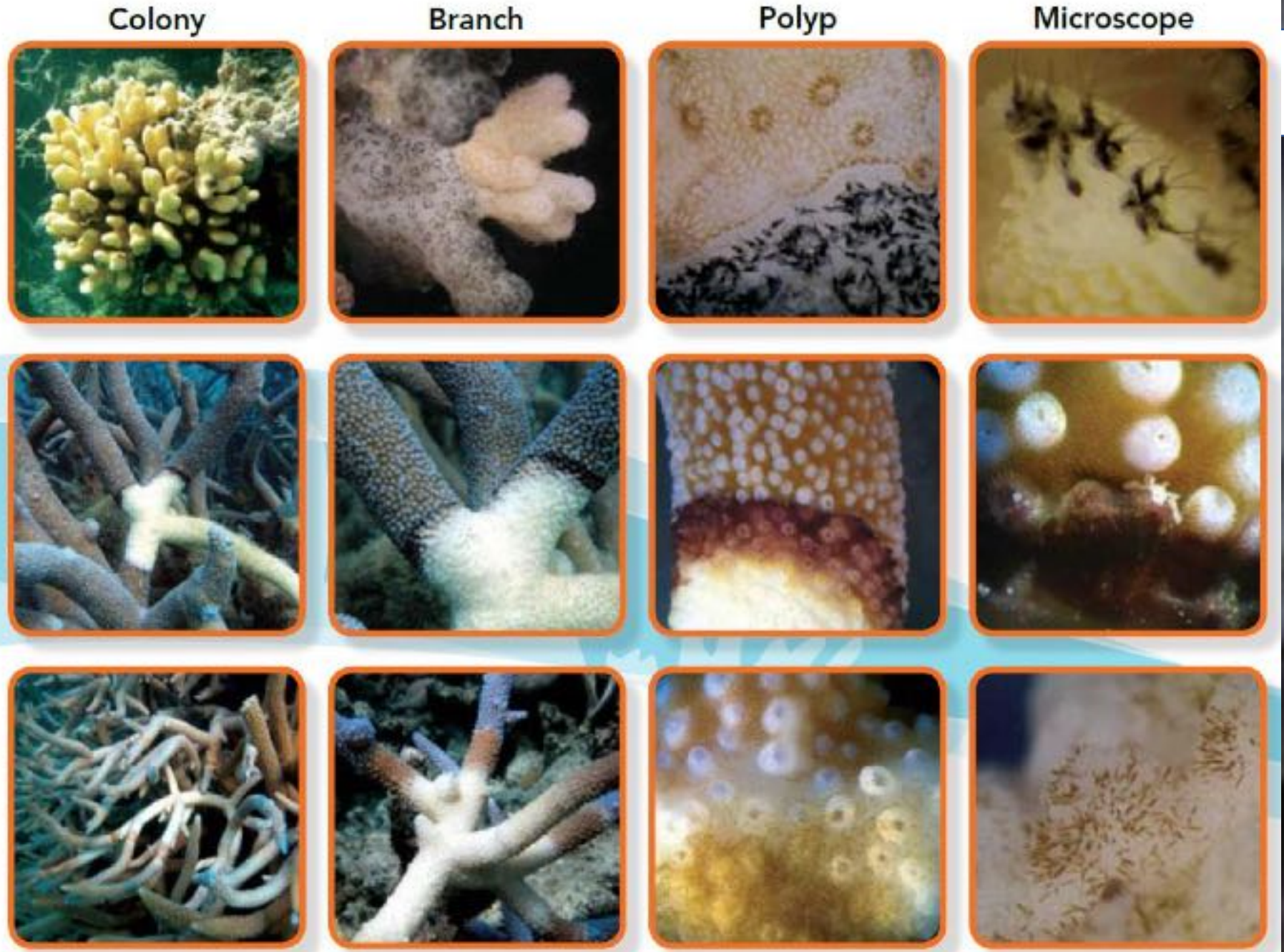
Coral Disease survey

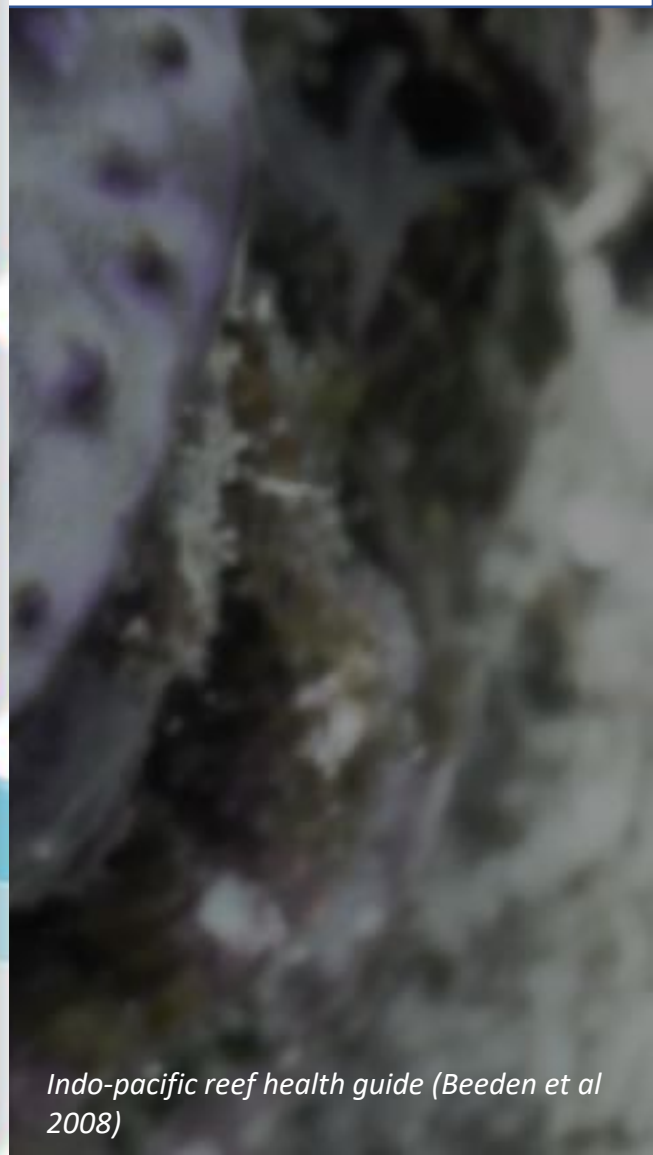
- Part of the invertebrate survey
  - Same data collection sheet
- Abundance
- Recording the basics

Coral Disease survey

CORAL DISEASE	Transect 1	Transect 2	Transect 3	Transect 4
	Time :	Time :	Time :	Time :
Black Band				
Brown Band				
SEBD				
Growth anomalies				
Other				
Observations				

Coloured Band Diseases





Indo-pacific reef health guide (Beeden et al 2008)

Coral Disease survey

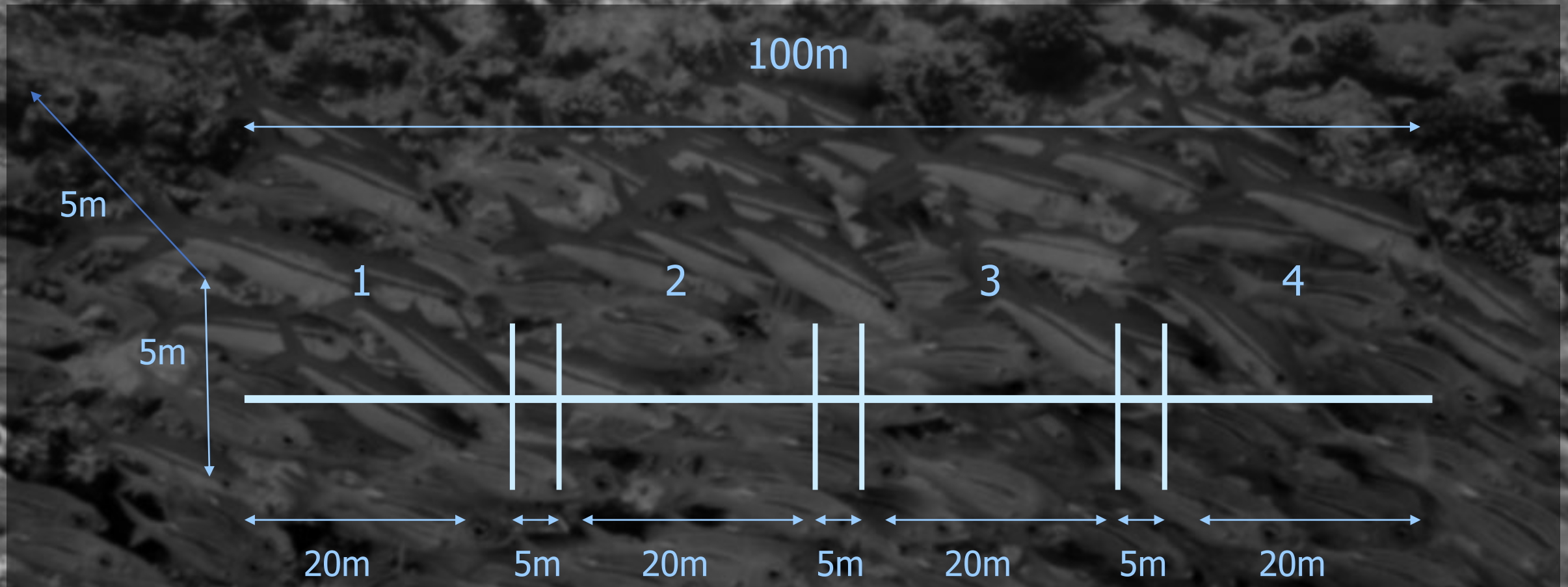
Indo-pacific reef health guide (Beeden et al 2008)

Monitoring Reef and Reef Associated Fauna

NCRMF Workshop: 8th to 10th May 2023

Fauna surveys

- Belt survey
- 3 dimensions -> 5m x 5m x 20m transects
  - 4 transects per depth
- First surveyor
  - After transect has been laid
  - Also lays the transect
- Abundance and size class
- 30 – 40 mins


100m
5m
5m
1
2
3
4
20m
5m
20m
5m
20m
5m
20m

Meta data

MARINE WATER COLUMN LIFEFORMS V2 - 2022

National Coral Reef Monitoring Framework

BELT TRANSECT | FISH

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

CONDITIONS	Live	LI	Damaged	DM	Dead	DD	Disease	DI	Male	MA	Female	FE	Other	OT	No Record	NR
BEHAVIOURS	Courtship	CT	Hunting	HU	Feeding	FD	Cleaning	CI	Aggregation	AG	Aggression	AR	Approach	AP	Avoidance	AV
	Resting	RE	Spawning	SP	Nesting	NE	Other	OT	No Record	NR						

TRANSECT 1 START TIME : END TIME :	<5cm	5-10 cm	10-20 cm	20-30 cm	>30 cm
BUTTERFLY FISH					
GROUPERS					
GRUNTS					
MORAY EELS					
PARROT FISH					
SNAPPERS					
SURGEON FISH					
ANGEL FISH					
TRIGGER FISH					
RABBIT FISH					
WRASSES					
HUMPHEAD WRASSE					
SHARKS					
RAYS					
MANTA RAYS					
TURTLES					

TRANSECT 2 START TIME : END TIME :	<5cm	5-10 cm	10-20 cm	20-30 cm	>30 cm
BUTTERFLY FISH					
GROUPERS					
GRUNTS					
MORAY EELS					
PARROT FISH					
SNAPPERS					
SURGEON FISH					
ANGEL FISH					
TRIGGER FISH					
RABBIT FISH					
WRASSES					
HUMPHEAD WRASSE					
SHARKS					
RAYS					
MANTA RAYS					
TURTLES					

Conditions and behaviors

MARINE WATER COLUMN LIFEFORMS V2 - 2022

National Coral Reef Monitoring Framework

BELT TRANSECT | FISH

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

CONDITIONS	Live	LI	Damaged	DM	Dead	DD	Disease	DI	Male	MA	Female	FE	Other	OT	No Record	NR
BEHAVIOURS	Courtship	CT	Hunting	HU	Feeding	FD	Cleaning	CI	Aggregation	AG	Aggression	AR	Approach	AP	Avoidance	AV
	Resting	RE	Spawning	SP	Nesting	NE	Other	OT	No Record	NR						

TRANSECT 1 START TIME : END TIME :	<5cm	5-10 cm	10-20 cm	20-30 cm	>30 cm
BUTTERFLY FISH					
GROUPERS					
GRUNTS					
MORAY EELS					
PARROT FISH					
SNAPPERS					
SURGEON FISH					
ANGEL FISH					
TRIGGER FISH					
RABBIT FISH					
WRASSES					
HUMPHEAD WRASSE					
SHARKS					
RAYS					
MANTA RAYS					
TURTLES					

TRANSECT 2 START TIME : END TIME :	<5cm	5-10 cm	10-20 cm	20-30 cm	>30 cm
BUTTERFLY FISH					
GROUPERS					
GRUNTS					
MORAY EELS					
PARROT FISH					
SNAPPERS					
SURGEON FISH					
ANGEL FISH					
TRIGGER FISH					
RABBIT FISH					
WRASSES					
HUMPHEAD WRASSE					
SHARKS					
RAYS					
MANTA RAYS					
TURTLES					

Type of fauna, abundance and size class

MARINE WATER COLUMN LIFEFORMS V2 - 2022

National Coral Reef Monitoring Framework

BELT TRANSECT | FISH

ORGANISATION:		SURVEYOR:		LOCATION:		SITE:					
DATE:		START TIME:	:	END TIME:	:	SURVEY DIRECTION:		SURVEY (m):	L	W	H
MAX DEPTH (m):		MIN DEPTH (m):		EST VIZ (m):		TEMP (°c):		COMMENTS:			
WATER CURRENT:	Strong	Medium	Slight	Slack	Other						

CONDITIONS	Live	LI	Damaged	DM	Dead	DD	Disease	DI	Male	MA	Female	FE	Other	OT	No Record	NR
BEHAVIOURS	Courtship	CT	Hunting	HU	Feeding	FD	Cleaning	CI	Aggregation	AG	Aggression	AR	Approach	AP	Avoidance	AV
	Resting	RE	Spawning	SP	Nesting	NE	Other	OT	No Record	NR						

TRANSECT 1 START TIME : END TIME :	<5cm	5-10 cm	10-20 cm	20-30 cm	>30 cm
BUTTERFLY FISH					
GROUPERS					
GRUNTS					
MORAY EELS					
PARROT FISH					
SNAPPERS					
SURGEON FISH					
ANGEL FISH					
TRIGGER FISH					
RABBIT FISH					
WRASSES					
HUMPHEAD WRASSE					
SHARKS					
RAYS					
MANTA RAYS					
TURTLES					

TRANSECT 2 START TIME : END TIME :	<5cm	5-10 cm	10-20 cm	20-30 cm	>30 cm
BUTTERFLY FISH					
GROUPERS					
GRUNTS					
MORAY EELS					
PARROT FISH					
SNAPPERS					
SURGEON FISH					
ANGEL FISH					
TRIGGER FISH					
RABBIT FISH					
WRASSES					
HUMPHEAD WRASSE					
SHARKS					
RAYS					
MANTA RAYS					
TURTLES					

BUTTERFLY FISH

Moorish Idol – not a butterfly fish

ANGEL FISH

GROUPERS

GRUNTS

MORAY EELS

PARROT FISH

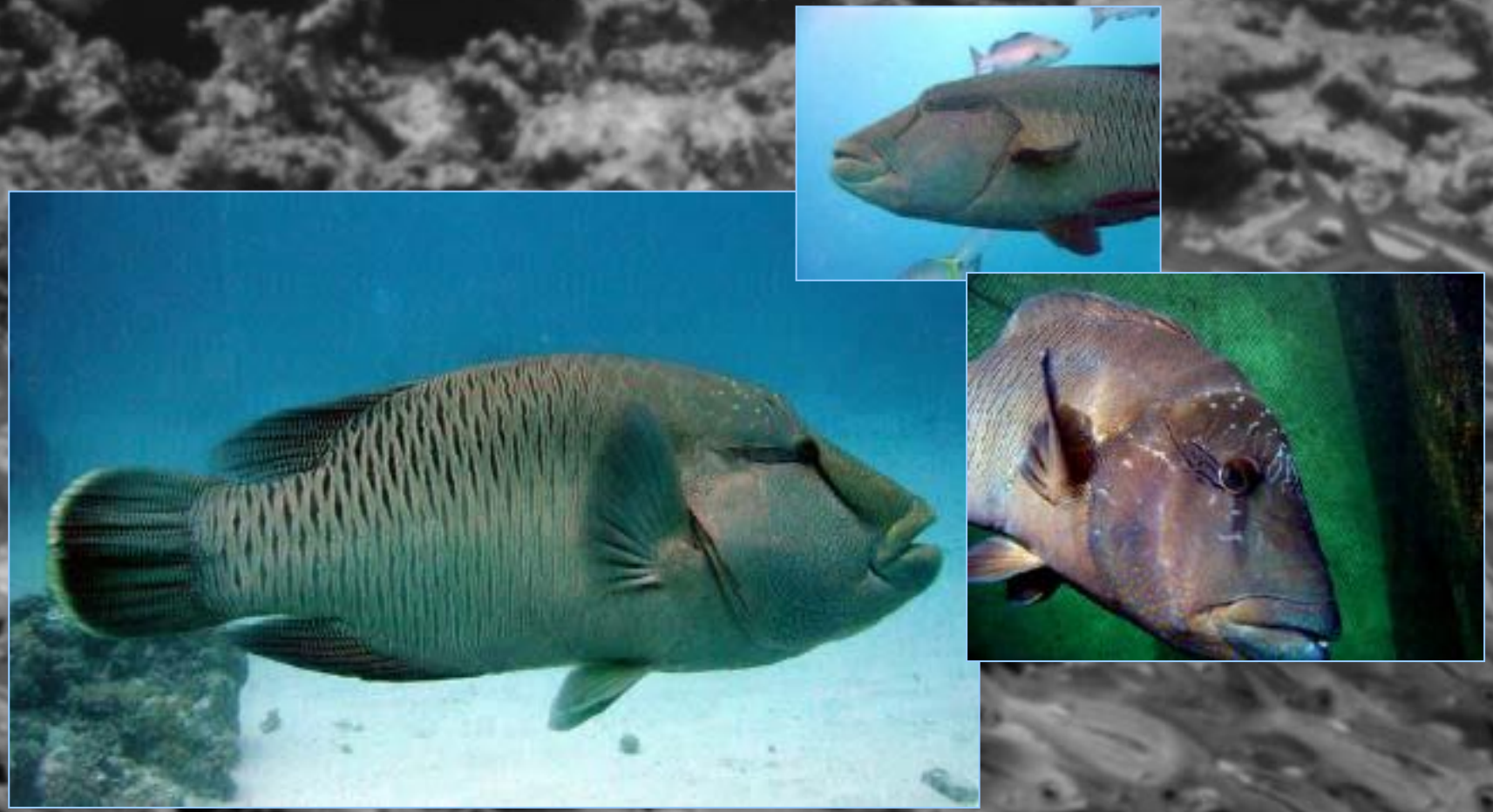
SNAPPERS

SURGEON FISH

TRIGGER FISH

RABBIT FISH

WRASSES



HUMPHEAD WRASSE

SHARKS

RAYS

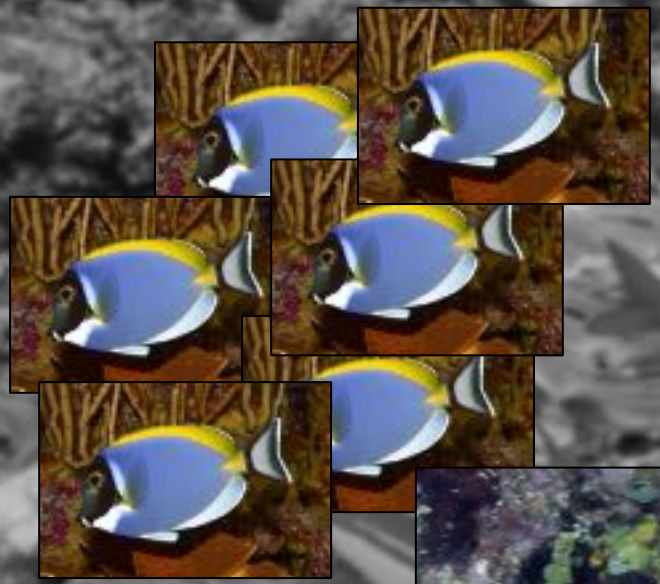
MANTA RAY

TURTLES

Size class exercise

- Data is being recorded to different size classes
  - Same size can appear to different at different distances
  - Different people may see the same size as a different size
  - Sizes can be tricky to determine when there is motion
- Important to calibrate how size classes are seen among surveyors
  - Comparability of data
  - Reliability of data





Monitoring Reef Complexity

NCRMF Workshop: 8th to 10th May 2023

Maldives Marine Research Institute

What is reef complexity?

Reef complexity -> Structural complexity

- Indicator of coral reef health
  - E.g., complexity has a strong negative relationship with algal cover and strong positive relationship with coral cover
- Ecosystems services
  - E.g. Wave protection
- Micro habitats
  - Higher density and diversity of fish
- Higher complexity -> higher potential for recovery

Reef rugosity

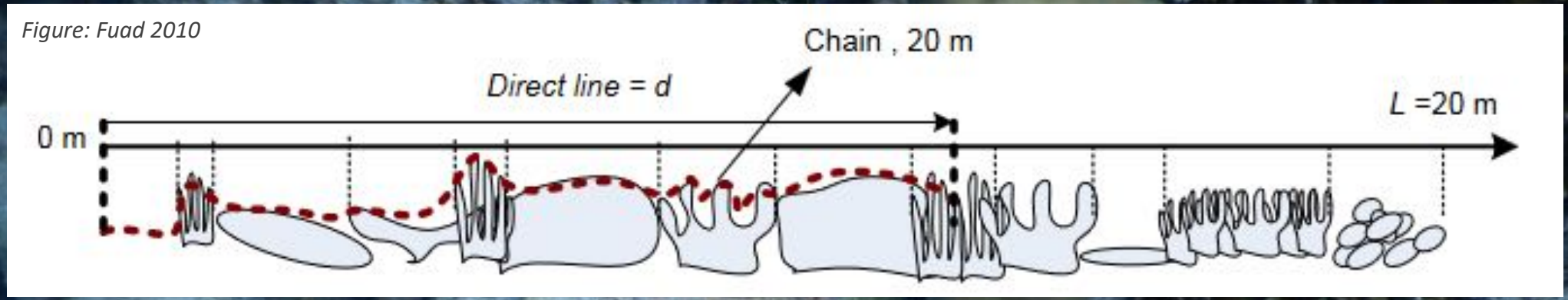
- Chain intercept transect
- Chain of known length
  - MMRI uses 5m chain lengths for 20m transects
- 1 measurement per transect
  - 4 replicates per depth

Location:		Site:		Chain Length:	

Date	Surveyor	Depth (m)	Transect	Int1 (m)	Int2 (m)

Comments:

Figure: Fuad 2010



Intercept 1

Intercept 2

20 m Transect

Survey direction

Reef rugosity -> reef complexity

$$Rugosity\ index = 1 - \frac{horizontal\ distance}{linear\ distance}$$

$$Rugosity\ index = 1 - \frac{|intercept\ 2\ - intercept\ 1|}{chain\ length}$$

$$Rugosity = ratio\ between\ 0\ and\ 1$$

Values closer 0 means low complexity and values closer to 1 is higher complexity

Complex reef

Simple reef

NCRMF Workshop:
8th to 10th May

Maldives Marine Research Institute

Other NCRMF surveys and reports

AERIAL GUIDANCE

For bleaching & coral spawn

- Spot captures
- Using drones or other similar devices
- Zoomed in or wide shots – ideally both
- Ideally at an attitude between 5m and 30m
- Horizontal speed < 1.0m/a

For bleaching & coral spawn

- Date and time
- GPS coordinates
- Atoll and Island
- Altitude
- Drone specific
- Flight path and flight time

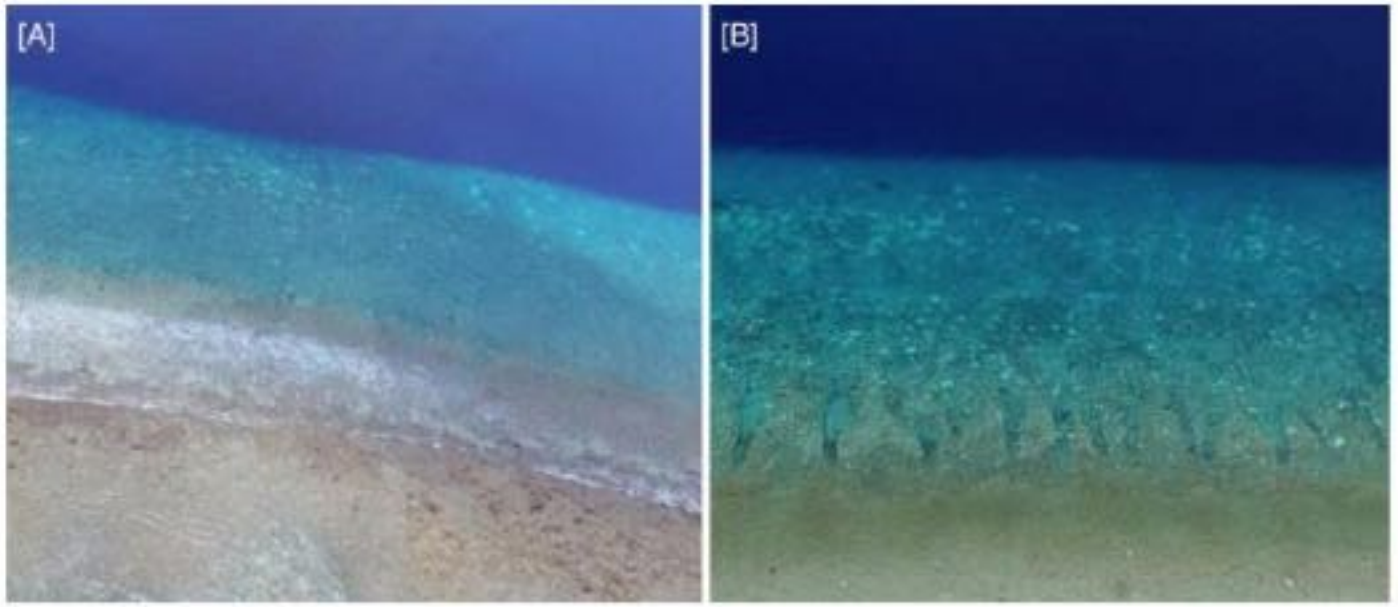


Plate 1. Aerial imagery captured by flight pilots in 2016 in [A] North Ari atoll and [B] Thaa atoll. White specks on imagery are bleached coral colonies

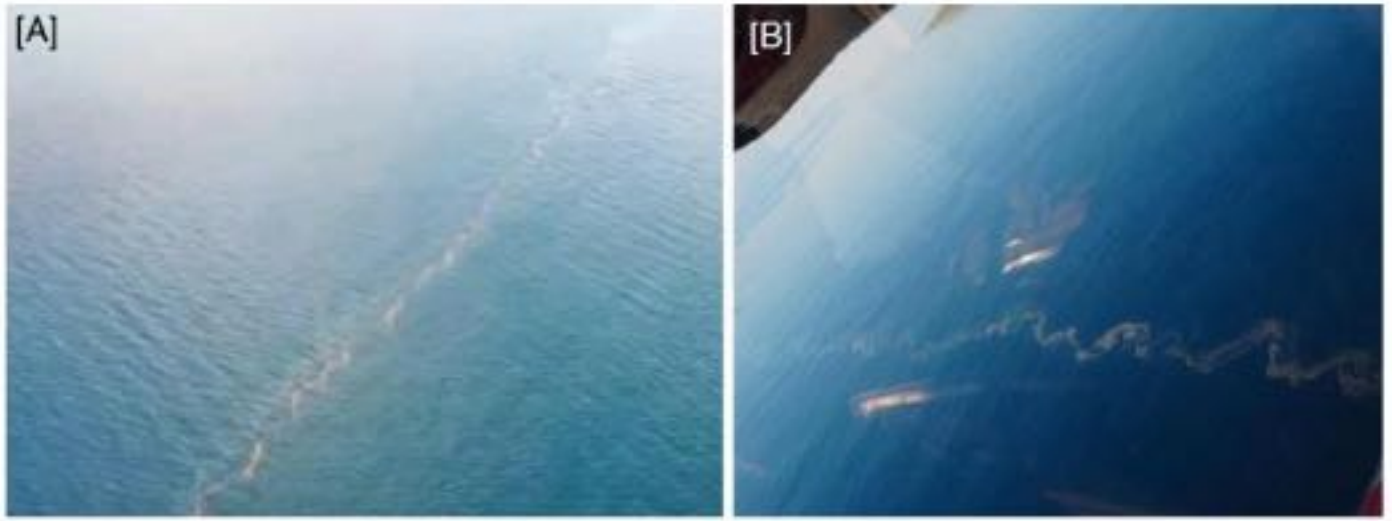


Plate 2. Aerial imagery captured by data contributors in 2020 and 2021 capturing coral spawn slick. [A] is a screen grab from a video taken from a plane. [B] is an image taken from a seaplane.

NEXT Week: Quiz and small mock survey design

Details

- MCQ type short quiz
- Mock Survey Planning
  - Objectives
  - Select your site(s)
  - Choose your protocols – explain why you chose them
  - Detail what gear and logistics you would need
  - Survey plan and organization
  - Data management and entry plan

CORAL DATABASE

NCRMF Workshop: 8th to 10th May 2023

Maldives Marine Research Institute

CORAL DATABASE

Collaborative monitoring of coastal, oceanic, reef and other ecosystems

What is the coral database

- Web enabled database supporting the Maldives National Monitoring Framework
- Hosted by the Maldives Marine Research Institute
- Monitor, collect, host, share, assess environmental information such that it could help decision making
- Multi sectoral targeted database
- Multi ecosystem approach

Components

WEBSITE

PUBLIC DASHBOARD

DATA PORTAL

Organization management – user levels

ORGANIZATION ADMIN

DATA MANAGER

USERS

READ ONLY USER

Data management

Summary data

Private

Public

Data access

Public

On-request

Unavailblae

Purpose

Contribute data collection networks

https://www.coraldatabase.gov.mv/