Overview of Field Data for the Allen Coral Atlas

Summary:
In an effort to map the world's coral reefs and connect people to help save reefs, we need eyes in the water to create and verify maps. Volunteer photo data contributes georeferenced photo quadrat data for map development:

1. Photo quadrats are collected at 0-3 m depth (snorkeling) or 3-10 m depth (SCUBA diving), by a person towing a GPS recording the position that can be linked to each photo.
2. Photo quadrats are analysed for benthic composition through machine learning and provide a quantitative benthic value for a known position on the satellite image.
3. Benthic composition can be used to calibrate and validate the maps and photos, and provide additional qualitative reference that could reanalyzed.

Key Highlights

- To understand each reef zone we aim to collect information from different reef habitats. The Atlas engineers are interested in capturing a large area with a variety of bottom types including: seagrass, algae, sand, rubble, rock next to corals themselves over time.
- Transects are positioned to transverse a range of reef zones and ecological areas such as the reef flat, lagoon, crest and slope. The ACA team will provide you with an ideal transect locations. the transects won't only cover coral rich areas.
- Every pixel of the satellite imagery contains important data that can be used to generate accurate habitat maps. Field data is useful to interpret what the pixels or groups of pixels represent in the satellite images.
- Georeferenced photos linked to the map can help train the algorithm, and check the map accuracy after its generated. Over time georeferenced photos can also be used to help map changes in reef health. They also serve as a permanent record.

How to do it:

Minimum requirements:

- People who can swim.
- Gear: camera that can go underwater, GPS that can be downloaded, float and dry bag and some rope.
- Software provided by Allen Coral Atlas team

Preparation:

- Discuss your intended sites and transect placement with the ACA team.
- Set up your gear with the necessary settings (as per the full manual) - In particular make sure your camera is in local time for the survey site, GPS is set on automatic time zone, recording track whenever switched on, shows time in seconds and pings for location every 2 seconds.
- Load the supplied linking software (GPSphoto) to your field laptop.
- If possible, do a dry run (small test transect on land) with your camera and GPS by following the full manual, to check that your photos can be linked to the GPS tracks. You can get support from the ACA team if anything is not working before your trip.

Snorkelling Survey Protocol (in shallow waters)

- Turn on your GPS and camera, then photograph the time (in seconds) of the GPS before you put it in the drybag (this is what is needed to link the photos later). Also photograph your slate with the date, starting time and site. Use a landmark – like a tree on an island if you are swimming towards shore, or an anchored boat if you are swimming transect away from shore for direction and to swim in a straight line, – or you can give your buddy a compass to keep you straight. Or you can do a "V" shaped transect out to the reef crest and back.
- Attach the GPS float to the snorkeler with the camera, keep the GPS float as close as comfortable to the camera, then begin swimming.
- Make sure the camera is facing downwards (landscape view, no portraits), and use the plumb bob to position it so that it is taking a 1 x 1 m photo – in shallow water you won't be able to look through the viewfinder, so you may have to hold the camera out in front.
- Take a photograph every 2 - 4 kick-cycles (3m). For distance set a time, or finish at known point. At the end photograph your slate with site name, date, and finish time
- Swim with a buddy to help you navigate safely – duck diving down to position the camera can be tiring

Diving Survey Protocol (Diving along reef slopes; surveys average 5 m depth, max 10 m.)

- Turn on your GPS and camera, then photograph the time (in seconds) of the GPS before you put it in the drybag (this is what is needed to link the photos later). Attach the GPS float and reel to the diver with the camera, keep the GPS float as close as comfortable to the camera
- Photograph your slate with the date, starting time and site, then descend to 5 m depth and set the reel to keep this depth. For direction use a compass or depth contour, for distance set a dive time
- Use the plumb bob to position the camera above the substrate
- With the camera facing down, make a photo every 2 - 4 kick cycles (3 m)
- At the end photograph your slate with site name, date, and finish time

Downloading and georeferencing the photoquadrats

Follow the post-processing protocol to care for your data
Step 1: Download photos and rename with the unique transect name (site, date and team)
Step 2: Download and save the GPS tracks
Step 3: Link photos and GPS based on time synchronization using GPSPhoto software
Step 4: Backup data and get ready for next days of survey

Optional: Analyzing benthic cover data (see CoralNet section below)

Checklist/Material Prep

- Print survey manual for mapping reef project (including instructions for downloading photos and linking to GPS)
- GPSphoto downloaded onto your machine (if you are in a place with limited internet)
- A special log-in and password for CoralNet
- Underwater cameras (GoPro's fine but need a viewer)
- Plumb line (fishing weight on a line to tie to camera)
- GPS + dry bag
- Float with a reel (to attach to divers) or short rope (for snorkelers)
- Compass, Pencil and slate
- Somewhere to store photos and output GPX files (hard drive or laptop)

What happens to your data? (You are contributing to a global effort to map coral reefs!)

- After photo quadrates are analysed for benthic composition in CoralNet it will be extracted from CoralNet by the Atlas engineers
- This benthic data will be matched, using photo name and its GPS position
- The mappers will use the geo-referenced data to train the mapping algorithm
- As maps are created they will become available for download at allencoralatlas.org

Deriving benthic composition from photoquadrats: Advances in automated image recognition (i.e. facial recognition technology used by Facebook) can speed up the process to automatically determine benthic organisms in photos. In our study we use CoralNet.

The Atlas team can assist you with setting up CoralNet.

CORAL NET (NB: ONLY WORKS ONLINE - If you don't have internet access at the site you will have to complete this step later.) If you get stuck during this process you can email your Atlas contact for support.

- Use the printed CoralNet Annotation instructions to analyse your photos. The benthic class categories are what is needed for the Atlas – but might be more simple than what you learned in coral reef ecology studies. If you want to analyse your own photos in more detail you can set up your own label sets (e.g. Acropora, Orbicella, Diploria, Halimeda) – just make sure they can be pooled into the 10 benthic classes for map training (e.g. Live Hard Coral, Macroalgae).
- CoralNet will place 50 random points across your 1 m2 photo
- Take a look at what's under each point and decide what the benthic class is.
- After you have analysed about 10% of the photos, the machine learning can start to determine what's in other photos. The more photos you train, the better the accuracy gets. The goal is ~80% accuracy.
- Data will remain in CoralNet and the Atlas engineers can download it. At the end of the field season, the only other information they need is the output GPS file which has the photo names and tracks.

Resources for further study

Detailed methods are available from the Atlas team:

Roelfsema C.M. K. Markey, E. Kennedy, E. Kovacs, R. Borrego, H. Fox, B.Bambic, B.Free, K. Rice and S.R. Phinn (2019). Protocol for Georeferenced Benthic Photoquadrat Surveys. Remote Sensing and Research Centre, School of Earth And Environmental Sciences, University of Queensland, Brisbane, Australia.

Other sources on: https://www.rsrc.org.au/coastal-mapping-and-monitoring

Georeferenced Photo Quadrat Methods:

•Roelfsema, C.M., Joyce, K. E., Phinn, S.R.(2006) Evaluation of Benthic Survey Techniques for Validating Remotely Sensed Images of Coral Reefs. Proceedings 10th International Coral Reef Symposium Okinawa.
•Roelfsema, C.M., and S.R. Phinn (2010) Calibration and Validation of Coral Reef Benthic Community Maps: Integration of Field Data with High Spatial Resolution Multi Spectral Satellite Imagery. Journal of Applied Remote Sensing, DOI:10.1117/1.3430107.
•Roelfsema, C, M. Lyons, M. Dunbabin, E. M. Kovacs & S. Phinn (2015) Integrating field survey data with satellite image data to improve shallow water seagrass maps: the role of AUV and snorkeller surveys? Remote Sensing Letters, DOI:10.1080/2150704X.2015.1013643

Mapping Approach:

•Roelfsema C.M., E.M. Kovacs, J.C. Ortiz, S.R. Phinn, P.J. Mumby, D. Callaghan, M. Ronan, N. Wolf, S. Hamylton and M. Wettle (2018) Characterise Geomorphic Zonation And Benthic Habitat Type in the Southern Great Barrier Reef (GBR) through Ecological Modelling And Remote Sensing" Remote Sensing of the Environment, DOI:10.1016/j.rse.2018.02.005