INDONESIA DISSERTATION/THESIS PROJECT

IN36 Long-term changes in the community ecology of coral reefs

Dr Dan Exton | Head of Research | dan.exton@opwall.ac.uk

Studying how ecosystems change over time is vital to understanding how they respond to environmental change and anthropogenic stressors, and is a crucial tool for conservation managers in identifying sites under particular threat and assessing the performance of management efforts. This is true now more than ever, with the ever-increasing impacts of human induced climate change and local impacts such as overexploitation, pollution and habitat loss. Coral reefs are particularly vulnerable to these impacts due to the high degree of sensitivity and extremely slow growth rates of scleractinian (hard) corals; the ecosystem architects which underpin the hyperdiverse communities found there. However, long-term data sets monitoring coral reefs over extended time periods are surprisingly rare, likely due to the logistical and financial requirements of running such programmes. Operation Wallacea are in a unique position thanks to their volunteer-led model, and our long-term monitoring programme of coral reefs around Hoga island in the Wakatobi National Park is one of the longest anywhere in Indonesia. The programme is based around a combination of benthic surveys of reef health and coral community structure, and surveys of associated fish communities.

One of the most widely used ways to assess the health of a coral reef is to determine the percentage of the reef surface which is made up of healthy live corals; as ecosystem architects corals are the most important organisms on the reef. By expanding this further to look at the percentage cover of other benthic categories (e.g. macroalgae, sponge, soft coral) we can gain a better understanding of the status of a reef and what factors might be impacting it. The same data can be used to look at corals of particular interest, such as the highly threatened but ecologically important Acroporids, or to measure the diversity of the coral community. Traditionally, line transects have been used to conduct benthic surveys. A single transect tape is laid horizontally along the reef at a given depth, and what lies under the tape recorded either continuously along the transect (line intercept method) or at set intervals along the transect (point intercept method). Line intercept gives a more accurate data set but is much slower to complete, whereas point intercept allows more replicates to be completed and so increases the spatial coverage of data collection. For our monitoring programme we use point intercept method from video transects, which increases the speed at which transects can be completed underwater and moves the actual data collection to back on land where more time and care can be taken ensuring accuracy.

Coral reef fish are important both economically for local small-scale fisheries and ecologically because of their ecosystem roles. For example, herbivorous fish are crucial in reducing macroalgal growth and allowing corals to thrive. Surveys of reef fish tend to be conducted by Underwater Visual Census (UVC), where a researcher swims along a transect and records every fish they see a set distance either side of, and above, the transect to give a pre-determined total area of reef surveyed. Generally, both the total number (abundance) and the species of each fish will be recorded, although more experienced researchers may also estimate the length of each fish, although this is notoriously difficult to achieve with any accuracy due to the difficulties with estimating sizes

underwater. However, the reason length is so important is that it can be used to estimate biomass, which in many ways is a much more useful measurement than simple abundance. For example, one large herbivore could consume more macroalgae than several smaller ones of the same species; abundance and biomass would lead to opposite conclusions being reached. The concept of stereo-video has been around for some time, but in recent years it has been applied to underwater surveys of fish. Two cameras mounted on a precision engineered chassis essentially function like a pair of human eyes. If the exact angle between the cameras is calibrated, the contrasting views from each camera can be used to locate exact points in three dimensions. By placing one point on the nose and one on the tail of a fish, the distance between the two points can be estimated to >95% accuracy. Divers swim along a transect filming using the stereo-video system and analyse the footage back on land. Specialist software allows only those fish within a pre-determined distance to be recorded, the species to be noted, and the length of each fish to be measured. This allows accurate biomass estimates to be made, as well as providing a permanent record of the transect for future re-analysis.

Operation Wallacea's coral reef monitoring programme around Hoga island has been running for over 15 years at the same study sites (n = 6) and depth zones (reef flat, reef crest and reef slope). Projects could focus on a single year or a small number of years and explore patterns between benthic reef health and fish community structure in greater detail. Alternatively, they could look at long-term temporal trends and incorporate the full historical data set. Please note that fish surveys used UVC originally, but switched to SVS from 2013 onwards as the technology became available; temporal trends between the two methods can still be explored, but the change will need to be factored into the interpretation of results. This project is entirely diving based, with extensive analysis required back on land.

Recommended Reading

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