The CORAMM (Coral Risk Assessment, Monitoring and Modelling) project


INTRODUCTION

CORAMM aims to improve our knowledge of the impacts of high suspended sediment loads and drift cuttings on cold water coral communities. The project is multidisciplinary in approach, with sedimentologists, biologists, modellers and representatives from StatoilHydro all involved in furthering the current understanding of these ecosystems. CORAMM has 4 workpackages: WP1 concentrates on the development of novel video and image analysis tools to enable a better and faster evaluation of Lophelia pertusa coral community structure and health. WP2 assembles and further develops sensor systems for environmental monitoring with special emphasis on particle dynamics. These systems can be used as autonomous stand-alone units or can be linked to the internet. WP3 carries out specific experiments with live coral colonies to elucidate and predict the effect of different particle size and microbial composition. WP4 will build advanced ecosystem models for cold water corals and use a physiology-based approach to predict the effect of different sediment loads on the performance of cold water corals. Here we present the outcome of the first 18 months of research.

Workpackage 1

WP 1 aims to develop innovative video and image analysis techniques to improve assessments of coral community structure and health. Our work has focused on:

1) Developing methods to mosaic video and still images from coral reefs (from ROV, submersible, video still) and import these mosaics into GIS maps.
2) Developing automated classification tools to assess reef health and distribution from still images (incl. still frames extracted from a video stream).

1) Automated estimation of coral coverage

The Alfred Wegener Institute and Bielefeld University have developed computer algorithms that can be trained to detect corals, otherb iota or substrate images extracted from a video stream. In summary the system relies on experts to identify areas of a set of images covered by a particular organism or substrate. Given a sufficiently high number of expert-identified features, the computer system can learn how this feature is distinguished from the rest of the image. Once trained, a larger set of images can be fed to the system, which can undertake an automated analysis of areas of each image covered by the features that it has previously learnt (Figs 1-4).

Processing stages

1) Computer learns from expert to identify image data with various features.
2) Experts identify features (e.g. coral, sponges).
3) Algorithms automatically identify features on all images.
4) User can then undertake an automated analysis of areas of each image covered by the features that it has previously learnt (Figs 1-4).

Workpackage 3

This WP focuses on developing and running experiments in the laboratory to better understand the functioning of L. pertusa. We assess how particles from the water column affect L. pertusa. All experimental work thus far has been done at the Sven Loven Centre for Marine Research. The work is co-ordinated by University of Gothenburg with researchers from the Max Planck Institute of Marine Microbiology and Jacobs University also contributing. Lophelia polyps collected from the observation site were maintained in temperature-controlled laboratories supplied with running seawater from Korsfjord.

3.1 The effect of particles on growth rates

In the first 18 months, we investigated how bacteria from marine particles affect coral health, or damage coral tissue following exposure to particles of various composition. Our data suggests that a single dose (even at moderate concentration) causes a build-up of anoxia over time within the smothering sediments (Fig.11). This allows us to better understand how reef ecosystem performance is affected by changes in key parameters (Fig 13).

3.2 Ecosystem models

We are developing a model for cold-water corals. The Centre for Marine & Estuarine Ecology lead this WP, but the interconnected nature of CORAMM encourages input from the other WPs. Model stage 1, for example, requires input from WP 2, whereas WP 3 feeds into modelling stages 2 and 3 (Fig. 14). Models interact regularly with other WPs who later test models that provide exactly the data they need.

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References


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Fig. 1) Experts identify features (e.g. coral, sponges) on selection of images.

Fig. 2) Computer learns from expert to identify image data with various features.

Fig. 3) ‘Train’ed computer examines other images in dataset and assigns identification names to features.

Fig. 4) Coral images can be produced (thin line) showing the percentage of images covered by coral over a transect. Coral coverage estimates from auto analysis and a manual 15-point methods (thin line) (Guinan et al., 2009) were similar.

Fig. 5) ROV used in collection of video data from Tiller reef mosaicking.

Fig. 6) The mosaic gained shows the variation in – particle density across – Off of the reef.

Fig. 7) Map of the Tiller reef and details of deployments. The reef has been damaged by trawling in the past, which was banned 5 years ago.

Fig. 8) Temperature, salinity and turbidity of bottom waters at the Tisler basin (°C), moving average: 1.

Fig. 9) Custom-built long-term deployment basket fitted with a particle trap. Designed for the study by the AWI, basket equipped with RVs for recovery.

Fig. 10) 3 assessments of polyp activity. A) Extended polyps, B) visible polyps, C) retracted polyps.

Fig. 11) O2 concentrations in the boundary waters of coral fragments in situ (µmol/g tissue dry weight and h) (inset: controlled growth chamber) during periods of constant exposure to particles a build-up of anoxia over time within the smothering sediments (Fig.11).