Coral Reef Targeted Research & Capacity Building for Management

Over one-half of the world's population lives within **100 kilometres of the sea.**





Connectivity and Large-Scale Ecological Processes Working Group

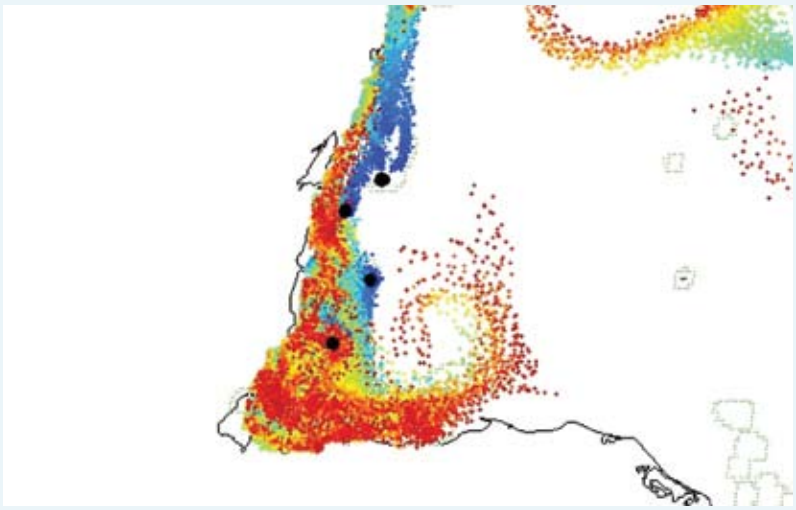
Connectivity: What is it? How is it measured? Why is it important for management?

Implications for Coral Reef Management

Until now, management of coral reefs, where it exists, has been reactive rather than proactive. With coral reefs entering a time of even greater stress, it is mandatory that managers develop more proactive approaches, strongly embedded in science.

The use of connectivity information to accurately assess linkages among locations, and local demographic capabilities is going to be essential if we are to have management programs that are capable of sustaining coral reefs. The CRTR Connectivity program is providing and testing new methods for building the connectivity database that effective management will use.

Marine Protected Areas (MPAs) are a management tool holding great promise. Realizing that promise requires Connectivity science as an essential tool for guiding the design and implementation of MPAs.



Model run showing possible pattern of dispersal of larval snapper from known spawning sites in Belize during May 2004. Red represents greatest number of of larvae while blue represents fewest Belizean larvae arriving at that location after 30 days of larval life. An example of the modelling done in Project 7

Goals:

The Coral Reef Targeted Research and Capacity Building for Management (CRTR) Connectivity Working Group is undertaking *demonstration projects* in the Mesoamerican region that will *develop tools* and apply them to determine *connectivity patterns for selected species in that region.* Work is being done in *collaboration with local management agency* personnel, *students* from the region are receiving advanced education, and efforts are being made to use the projects and results to *inform local communities* and show how connectivity data can be obtained, and *used effectively in management planning.*

What?

Marine populations are interconnected, exchanging individuals mainly through larval dispersal and thereby influencing the dynamics of each population.

Most reef species have pelagic larval stages. The dispersal during larval life means that neighboring populations are connected by the exchange of lavae. This connection is termed *connectivity.*

How?

Measuring connectivity is technically difficult for several reasons, including:

- *Long* larval lives
- Larvae *too small* to be tagged
- Dispersal a complex product of *passive transport and* active *movement.*

Many species are larval for many days or weeks and potentially able to travel large distances

The Coral Reef Targeted Research and Capacity Building for Management Program (CRTR) is a leading international coral reef research initiative that provides a coordinated approach to credible, factual and scientifically-proven knowledge for improved coral reef management.

The CRTR Program is a proactive research and capacity building partnership that aims to lay the foundation in filling crucial knowledge gaps in the core research areas of Coral Bleaching, Connectivity, Coral Diseases, Coral Restoration and Remediation, Remote Sensing and Modeling and Decision Support

Each of these research areas are facilitated by Working Groups underpinned by the skills of many of the world's leading coral reef researchers. The CRTR also supports four Centers of Excellence in priority regions, serving as important regional centers for building confidence and skills in research, training and capacity building.

The CRTR Program is a partnership between the Global Environment Facility, the World Bank, The University of Queensland (Australia), the United States National Oceanic and Atmospheric Administration (NOAA) and approximately 40 research institutes & other third parties around the world.

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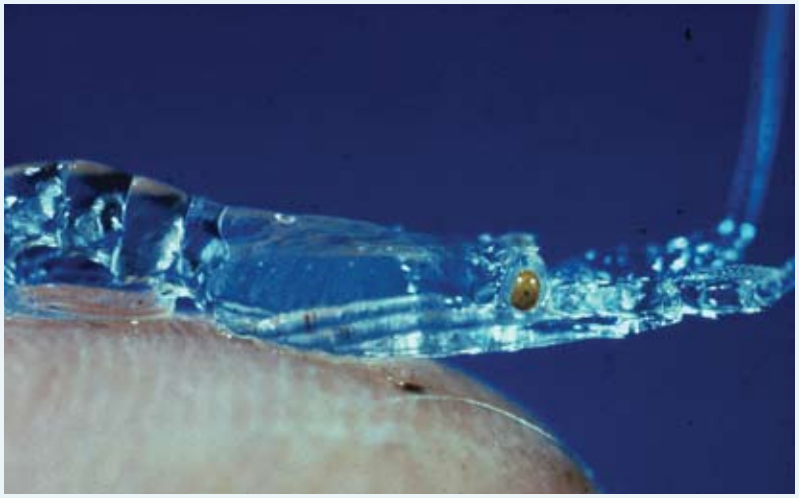
- RESEARCH UPDATE



At present there is very little information on levels of connectivity in coral reef regions, and MPA management depends too much on good luck and 'guesstimates'.

If we are to be successful in maintaining coral reefs into the future, we must incorporate much more information on connectivity into our management plans and procedures. The first step is to develop the tools to collect that information.

during this time. Their dispersal is strongly influenced by patterns of water movement, but larvae can sense their surroundings, respond to them, and swim, sometimes surprisingly well. Larval behavior also changes as the larvae develop and grow.

The movement of water around complex coral reef topography is itself far from simple.

Measuring connectivity requires field observations that are:

1) *Over large regions* to encompass the potential extent of larval movement
2) *Timed* to coincide with critical biological events such as spawning pulses, and
3) By people with *a broad range of skills* – physical oceanographers, ecologists, behavioral scientists and others.

It also benefits from use of sophisticated laboratory-based sciences including *molecular genetics, trace-element chemistry,* and advanced *computer modeling.* This is not routine monitoring.

Why?

Management of coral reefs, for conservation and/or for sustainable fisheries requires that we manage human impacts to levels that are sustainable by the populations of reef organisms. This depends on the ability of the local (impacted) population to grow, and population growth depends upon connectivity

IA tiny postlarval stage of the Caribbean spiny lobster sitting on a finger. This is the larval stage that enters reef habitat, and the stage that recruits to collectors used in project 6.

as well as on local reproductive potential. Design and management of Marine Protected Areas, in particular, depends on knowledge of the connectivity relationships of the local populations of targeted species.

Progress to date

The Connectivity program has commenced several distinct, but interrelated projects in the Mesoamerican region. They are intended to advance the science, and demonstrate its effectiveness in measuring connectivity for particular kinds of species. We work closely with local management agencies to build a database of recruitment of particular species at sites through the region, because recruitment data can inform us of the demographic rates of local populations, and can provide basic data needed for determining connectivity patterns.

Studies of fish concern one typical species that does not aggregate over large distances to spawn, and one species that aggregates for spawning once a year. Quite different methods are required for these different kinds of species. Studies of corals center on technique development for tracking dispersing planula larvae and for identifying them to species. Genetic studies of coral populations are being used to discern likely connectivity patterns in the past. Studies of coral settlement and early survival are being done because this early benthic phase may be a critical bottleneck to coral success.

The spiny lobster has one of the longest larval lives of any reef species, so determining is connectivity patterns may be very difficult. We are collecting data on lobster recruitment, and on lobster larval biology for use in building models of larval dispersal. Validated models can provide information on connectivity among locations.

Belizean student, Nataniel Alvarado, attaching settlement plates to monitor recruitment of coral larvae for Project 3.

Further Information

Connectivity and Large-Scale Ecological Processes Working Group

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