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Previous viewpoints have criticized the apparent inability of the coral reef scientific and management communities to coordinate efforts in filling information gaps that strengthen management and policy (e.g. Risk 1999; Knowlton, 1998). For the first time in history a global, coral reef targeted research initiative is being funded to address priority gaps in knowledge that have the potential to increase management capacity and to support policy internationally.

The purpose of the targeted research is to establish an investigative framework to test specific hypotheses related to major human and natural factors threatening coral reef quality and to better communicate and apply results. The program has been developed based on international scoping of investigative priorities following the 1998 ENSO, and is being designed for implementation over 15 years. It has three main components: 1) Filling Key Knowledge Gaps, 2) Promoting Scientific Learning and Capacity Building, and 3) Linking Scientific Knowledge to Management. Four main locations around the world have been selected for the first phase of the program (Fig. 1), and will serve as Centers of Excellence where international working groups will collaborate with regional and local scientists and managers.

The program structure involves six main working groups investigating bleaching and local ecological responses, spatial connectivity, disease, restoration and remediation, remote sensing and modeling and decision support.

More than 70 scientists are participating in the targeted research. The research results are coordinated by a synthesis panel and a system of peer review within an adaptive, iterative operational structure (Fig. 2). The program is supported by the Global Environment Facility, the World Bank, the University of Queensland and Intergovernmental Oceanographic Commission/UNESCO, and the U.S. National Oceanic and Atmospheric Administration.



## References:

Risk, M. 1999. Paradise lost: how marine science failed the world's coral reefs. *Mar. Freshwater Res.* 1999, 50, 831-7.

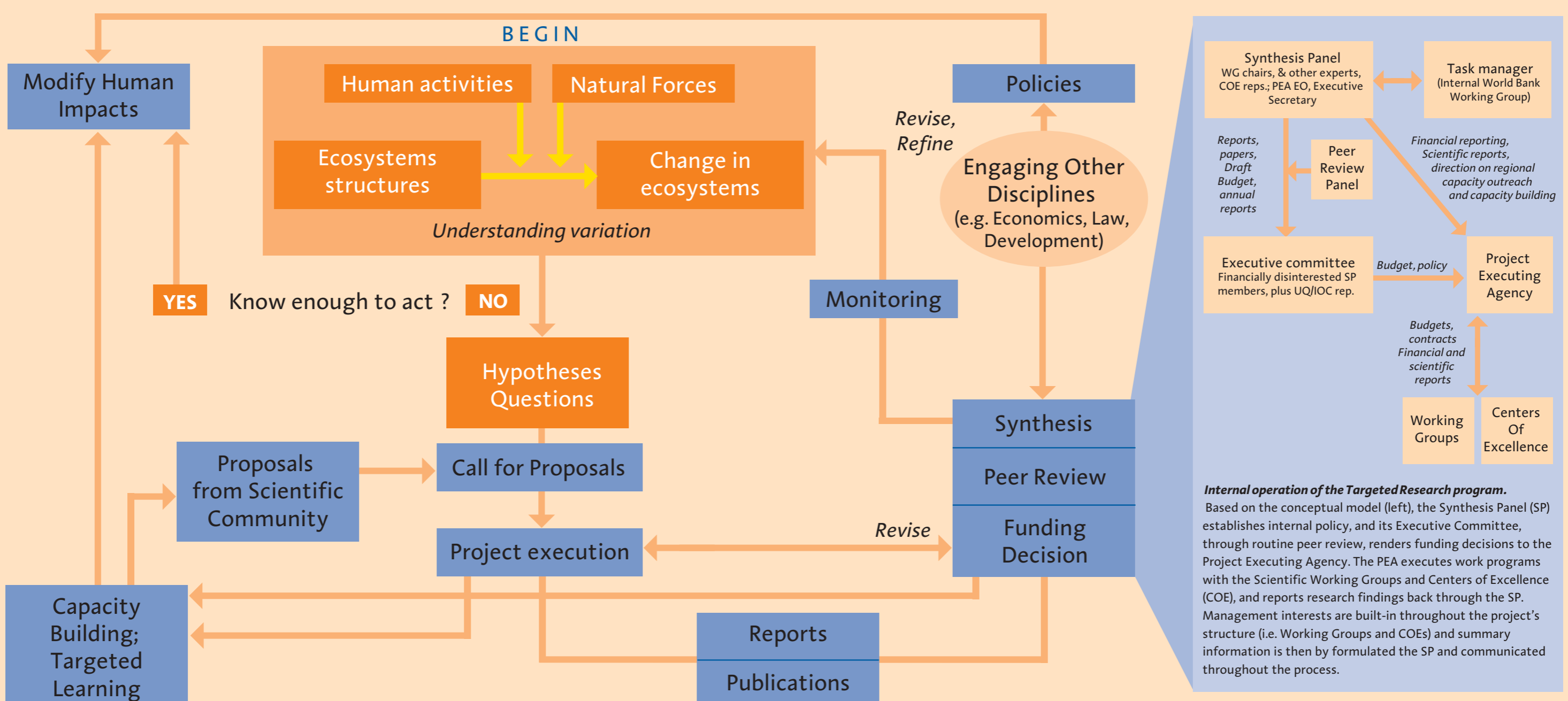
Knowlton, N. 1998. Hard Decisions and Hard Science: research needs for coral reef management. In: *Coral Reefs – Challenges and Opportunities for Sustainable Management*. The World Bank. 1998. ISBN 0-8213-4235-5. 224 pp.

Figure 1: GEF-World Bank Coral Reef Targeted Research Capacity Building Centers of Excellence



Locations include Puerto Morelos Marine Laboratory, Universidad Autónoma de México (UNAM); Heron Island Research Station, University of Queensland Center for Marine Studies, Queensland, Australia; Bolinao Marine Laboratory, University of the Philippines Marine Science Institute; Institute of Marine Science, Zanzibar; and University of Dar Es Salaam, Tanzania.

Figure 2: Conceptual Model for Coral Reef Targeted Research



This process begins at the top of the diagram with the intent to first characterize the environment, examine the state of current knowledge, and whether sufficient information already exists to perform some management action. If no, then clear orientation of hypotheses and major questions are formulated for targeted investigations. Peer review is factored in at all levels, and synthesis of scientific findings occurs regularly. Research projects are modified annually if necessary through a transparent evaluation / funding decision process. Research projects are accompanied by standardized ecosystem monitoring at all of the research locations. Engaging other disciplines at the appropriate points within the process can help inform and affect interventions, policy and human impacts. Thus, management actions are informed by science and are adaptive.

## Major research questions for...

### Bleaching and local ecological responses

What is the molecular basis of thermal stress? What is the environmental history and correlates of coral reef stress? Identify and develop biomarkers for use in detecting impacts of stress and climate change on corals reefs at a physiological, organismic, community, and ecosystems level. Develop models and scenario testing instruments for the examination of potential future impacts of climate change on coral reefs and the socio-economic ramifications these impacts may have.

### Connectivity

Can connectivity be measured for groupers or snappers using traditional spawning aggregation sites? Can mass spawnings be used to follow and model dispersal of coral propagules from a source population? Do local and regional differences in reef 'condition' that affect settlement & post-settlement survivorship override patterns of dispersal potential and limit connectivity? Are larval or postlarval biology or behavior important in modeling pelagic dispersal?

### Disease

What environmental factors influence the distribution and prevalence of the different coral diseases? What are the causes, reservoirs and modes of transmission of coral disease? What are the effects of climate and environmental factors on the surface muco-polysaccharide layers of coral? What are the effects of climate and environmental stress on coral immunity? How does disease change population dynamics and reproduction of corals? How does disease change coral biodiversity and community structure of reefs?

### Restoration & Remediation

What is the long-term efficacy and cost-effectiveness of restoration interventions? Is artificial substrate composition an important consideration in restoring physically damaged reefs over a 5-10 year time-scale? Does enhancement of coral larval recruitment significantly enhance coral reef recovery on a 5-10 year timescale and is it cost effective? Can transplantation of corals and other reef species be effectively used in restoration?

### Remote Sensing

Can remote sensing be used to monitor coral cover and algal cover? Can remote sensing be used to: map reef communities? - detect change in coral reefs? - predict thermal stress? - enhance use of habitat maps to manage biodiversity?