

ANNEX 4 - Coral Reef Responses to Global Change

SCOR WG 104 - Coral Reef Responses to Global Change: the Role of Adaptation

Report to SCOR Executive Committee – September 1997

Submitted by R. W. Buddemeier, chair, 4 August 1997

Activities since the previous report may be divided into two major categories.

Symposium organization: During late 1996 and early 1997, considerable effort was expended obtaining approval and co-sponsorship for the scientific symposium that will precede the final meeting of WG-104. Those efforts were successful; Appendix A of this report is a copy of the description of arrangements and solicitation of participation that was distributed via the NOAA coral reef list-server and other avenues.

Development of scientific content of the symposium has been the primary focus of activities for the past six months. Invitations to participate in the symposium were initially structured to address all of the terms of reference of WG-104, where necessary drawing on expertise from outside the membership of the group. Since that time substantial effort has gone into coordinating the topics and approaches of the various authors to ensure the maximum possible conceptual and terminological consistency and mutual relevance among the various presentations. This has been accomplished largely by e-mail, augmented by meetings of opportunity among various participants. Appendix B of this report give the current status of the program for the symposium.

American Zoologist will publish the refereed proceedings of the symposium. As indicated in the previous report, a final (see comments below) WG-104 meeting will be held in Boston for approximately three days immediately following the SICB meeting and symposium. The primary focus of this meeting will be the internal review and coordination of the draft symposium papers to produce a coherent and well-integrated overview of the topic rather than a collection of disparate papers. I have invited non-WG symposium participants to contribute to the meeting at their own expense, and I continue to seek additional funding to support those participants who are making major contributions.

Notes and Comments: We have continued the efforts initiated early in the existence of the WG to include and appeal to the broader community of those interested. Not only by drawing other invited speakers into the symposium, but also by achieving a high visibility, co-sponsorship by several organizations, and providing opportunities for contributed paper and poster sessions on related themes, we expect to make the meeting (and proceedings) a milestone in reef research.

I also note that our overall approach and products will fit extremely well with the SCOR initiative to develop a greater presence in policy-oriented matters. This meeting will occur at the conclusion of the International Year of the Reef, and the topics addressed, although very fundamental science, will be clearly and specifically relevant to the concerns of policy makers at all levels. As an example of the context for our contribution, see the recent publication in *Science* (Pennisi, 1997).

I have previously reported on the co-sponsorship of WG-104 by the LOICZ core project of IGBP. This has included a commitment of funds without which the Symposium could not have been organized. Overlapping interests are also demonstrated by the fact that a number of symposium participants will be attending and presenting talks at the LOICZ Open Science Meeting to be held this October.

Further testimony to the success of this collaboration may be found in the proposal for joint sponsorship of a working group on coastal groundwater effects. In a recent development, Prof. H. Faure of INQUA has contacted me and WG-104 member Jean-Pierre Gattuso with a request to organize a Working Group of the "INQUA Commission on Terrestrial Carbon" devoted to "Reef Carbon". Although this effort will have only marginal overlap in time with the SCOR-LOICZ WG, it will provide an opportunity for continued development of some of

the ideas and findings arising from our present work (the significance of which the invitation tacitly acknowledges).

Scientific progress: It is premature to detail our accomplishments while they are still in the abstract stage, but I am confident that we are in the process of producing an unprecedented synthesis which will include specific formulations that will alter fundamental paradigms.

Corresponding member S. V. Smith recently circulated a review and summary of draft abstract submissions that sums up both our challenge and our probable contribution: "Most of what we know (or think we know) about coral reefs is based on studies of well-developed coral reef communities. These features are probably atypical over geological time, in that the communities being studied have developed in habitats created by a rapid rise of sea level over about 10,000 years, followed by about 3,000 years of relatively stable conditions. There is further reason to suggest that the geographic and environmental distributions of many (perhaps most) reef organisms extend well beyond the environmental limits which encompass most reefs which have been studied. Furthermore, most ecological and physiological studies of reef organisms have involved a relatively limited range of reef organisms--most prominently the scleractinian corals and their contained endosymbiotic algae. We must therefore view our knowledge of reefs as being remarkably biased. An encouraging aspect of the present session is the recognition of these various biases and the attempts to 'see beyond them'. As two examples, let me cite the reflection about modern reef ecology within the context of the geological record, and the use of environmental models to define the "hyperspace" occupied by coral reefs. Another point I would like to raise at the outset is the recognition that ecologists increasingly recognize that "change" includes measures of frequency and variance, as well as mean."

Members of the Working Group and the other Symposium participants have continued to publish relevant papers; one commentary that was derived from and inspired by WG-104 discussions and goals was that by Buddemeier, 1997 (note that because of Nature's stringent format and space limitations I wasn't able to use the standard acknowledgment, but did succeed in citing SCOR as reference 2).

Acknowledgments: I particularly want to recognize the very substantial contributions of two people who are not members of WG-104. One is Dr. Howard Lasker, co-organizer of the symposium; it is no exaggeration to say that this could not have happened without him. The other is Dr. John Benzie of the Australian Institute of Marine Science. In addition to bringing to our efforts an area of expertise (evolutionary genetics) that was badly needed and not originally represented, he has consistently taken a leadership role in helping to organize people and ideas, both at the original meetings and workshop in Panama, and in preparation for the symposium. I think it is appropriate to recognize his contributions by designating him a corresponding member of WG-104.

On a related issue, the Proceedings will meet the basic commitment of WG-104. It seems clear that one further stage of integration and publication is both possible and desirable -- development of the individual papers into a single, integrated book or monograph. This would presumably involve a smaller subset of key authors/editors, at least one more writing/editorial workshop, and a publishing outlet. I am not requesting support for this from SCOR, but I do ask for any comments, suggestions, or possible assistance in developing the necessary support for this additional product that would further extend the impact and recognition of the results.

References

- Buddemeier, R. W., 1997, Symbiosis: Making light work of adaptation: *Nature*, v. 388, no. 6639, p. 229-230.
Pennisi, E., 1997, Brighter prospects for the world's coral reefs?: *Science*, v. 277, no. 5325, p. 491-493.

Appendix A, WG-104 Report: Announcement/release materials

CORAL REEF SYMPOSIUM AND MEETINGS

Coral reef issues and programs will be a major focus of the joint annual meeting of the Society for Integrative and Comparative Biology (SICB) and its associated societies*, the International Society for Reef Studies (ISRS), and

the Ecological Society of America (ESA), which will be held at the Boston Marriott Hotel -- Copley Place, January 3-7, 1998. SICB is organizing both meeting and program.

The scientific meeting will feature a major emphasis on coral reef science, including an invited Symposium Jan. 6-7 on CORAL REEFS AND ENVIRONMENTAL CHANGE -- ADAPTATION, ACCLIMATION, OR EXTINCTION? Contributed paper and poster sessions, special events, and society meetings will also take place. Invited Symposium speakers include: A.B. Pittock, B. N. Opdyke, J. Pandolfi, R. A. Kinzie III, R. Gates, K. Yamazato, B. Carlson, H. Lasker, J. Benzie, D. Potts, R. Rowan, R. P. M. Bak, T. Done, R. Karlson, J. Kleypas, T. Done, J.-P. Gattuso, B. Hatcher, S. V. Smith, and R. W. Buddemeier.

Included in the presentations will be the initial versions of the final report of Scientific Committee on Oceanic Research (SCOR) Working Group 104. This group, co-sponsored by the Land-Ocean Interactions in the Coastal Zone (LOICZ) Core Project of the International Geosphere-Biosphere Programme (IGBP), has as its charge a review and report on the topic Coral Reef Responses to Global Change: The Role of Adaptation. In addition to SCOR and LOICZ, the symposium is being sponsored by SICB, ISRS, ESA, and the New England Aquarium.

Robert W. Buddemeier and Howard R. Lasker, Symposium organizers.

SICB/SCOR CORAL REEF SYMPOSIUM -- Revision/update as of 03 August 1997

Note -- some titles and the exact order of presentations are preliminary and subject to change.

Tuesday, 6 January 1998 -- am, chair: H. Lasker, co-chair: D. Potts

- 8:00. BUDDEMEIER, R.W.* , Univ. of Kansas, Lawrence. A most ingenious paradox -- Introduction and overview.
- 8:40. HATCHER, B.* , A. HATCHER. Dalhousie Univ., Halifax, Canada. Scaling coral reef responses to global change: Can we identify the key processes a priori?
- 9:20. PITTOCK, A. B.* , CSIRO Division of Atmospheric Research, Aspendale, Victoria, Australia. Coral reefs and environmental change: Adaptation to what?
- 10:20. OPDYKE, B.N.* , Australian National University, Canberra, J.KLEYPAS, Nat. Center for Atmos. Research, Boulder. Climatic, bathymetric and geochemical constraints on the distribution and relative accumulation rates of coral-algal communities for the last 150,000 years.
- 11:00. PANDOLFI, J. M.* , National Museum of Natural History, Washington, D. C. Understanding ecosystem response to environmental change in modern coral reefs: clues from the Pleistocene fossil record.

Tues pm -- chair: T. Done, co-chair: S. Smith

- 1:00. KINZIE, R.A. III* , Univ. of Hawaii, Honolulu. Reproduction, symbiosis, and the fossil record: do geologists care about sex?
- 1:40. GATES, R.* , P. J. EDMUNDS, Univ. of California, Los Angeles, and Calif State Univ., Northridge. The physiological mechanisms of acclimatization in tropical reef corals
- 2:20. YAMAZATO, K.* Mejo University, Okinawa, Japan. Coral and reef responses in marginal environments: effects on reproduction.
- 3:20. CARLSON, B.* , Waikiki Aquarium, Honolulu. Organism responses to rapid change: what aquaria tell us about nature.
- 4:00. LASKER, H.R.* , SUNY, Univ. at Buffalo. Life history traits of corals and their resilience to environmental perturbation.
- 4:40. BENZIE, J.* , Australian Inst. of Marine Science, Townsville. Genetic structure of coral reef organisms: Ghosts of dispersal past.

Wednesday January 7 -- am, chair: J. Benzie, cochair: J. Pandolfi

- 8:00. POTTS, D.* , Univ. of California, Santa Cruz. Environment and ecology -- the Porites perspective.

- 8:40. ROWAN, R.* Marine Lab., Univ. of Guam, Mangilao. Endosymbiotic algae as adaptive agents.
- 9:20. BAK, R.P.M*, E.H. MEESTERS, Netherlands Inst. of Sea Research, Texel. Population structure as adaptive response of coral communities to global change.
- 10:20. DONE, T.*, L.M. DEVANTIER, K.E. FABRICIUS, L. MCCOOK, and E. TURAK Australian Inst. of Marine Science, Townsville. Coral reef community adaptability to environmental change at the scales of regions, reefs and reef zones.
- 11:00. KARLSON, R.* H.V. CORNELL. Univ. of Delaware, Newark. Integration of local and regional perspectives on the species richness of coral assemblages.

Wed. pm -- Chair: J. Ware, co-chair: D. Fautin

- 1:00. KLEYPAS, J.* Nat. Center for Atmos. Research, Boulder. Habitat and habitat change -- a global model.
- 1:40. GATTUSO, J.P.* D. ALLEMAND and M. FRANKIGNOULLE. European Oceanologic Observatory, Monaco, and University of Liege, Belgium: Interactions between the carbon and carbonate cycles at organism and community levels in coral reefs.
- 2:20. SMITH, S.V.* Univ. of Hawaii, Honolulu. Large-scale implications of coral reef structure and function to global environmental change.
- 3:20. BUDDEMEIER, R.W.* ET AL. Univ. of Kansas, Lawrence. Overview, summary, and products.
- 4:00. SYMPOSIUM PARTICIPANTS and AUDIENCE. Moderated discussion on synthesis and implications of symposium results.