

1995 Annual Report of SCOR Working Group 104: Coral Reef Responses to Climate Change: The Role of Adaptation

Submitted by Robert W. Buddemeier, Chair, 13 October 1995

Background:

The formation of WG-104 was approved by the SCOR Executive Committee at its meeting in November, 1994. Following action on the Committee's recommendations concerning membership and Terms of Reference, invitations were issued by the Executive Director, and the Working Groups was essentially constituted and operational by March, 1995. Initial discussions lead to the conclusion that the title of the working group should be understood to include the role of physiological acclimation as well as adaptation in the genetic sense.

Membership and areas of interest:

Initial correspondence with members and corresponding members established their areas of interest and proposed contribution to the overall topic as follows:

Members:

- R. Bak, Coral reef ecology; organism stress, damage, and recovery.
- R. W. Buddemeier (Chair), Climate change characteristics and effects, coral growth, terrestrial and marine system interactions.
- T. Done, Coral reef ecology; community health, stress, and recovery.
- R. Gates, Symbiosis - algal specificity, bleaching, physiology, biochemistry, and internal nutrition.
- J.-P. Gattuso, Metabolic responses and acclimation of corals and reef communities; past, present and future CO2 budgets of reef systems; ecosystem structure and function.
- B. Hatcher, Non-linear responses of benthic community structures; relations of adaptation to hydrodynamics, production and trophodynamics.
- J. Pandolfi, Paleobiology - ecosystem dynamics and community structure of Quaternary reefs.
- A. B. Pittock, Climate models, global climate change, and regional (including tropical and marine) climate scenarios.

Corresponding members:

- S. V. Smith, Community metabolism, carbon and nutrient fluxes, biogeochemistry.
- C. B. Castro, Comparison of changes of different reef areas; responses to environmental change, primary production, and coral reproduction
- R. Rowan, Molecular genetics, evolution, systematics and ecology of symbiotic algae.
- B. Opdyke, Carbonate geology and geochemistry in relation to global CO2 cycles and climate change.
- J. Pätzold, Climate reconstruction from coral skeletal records.
- D. Yellowlees, Biochemistry and physiology of nutrient utilization and symbiosis.

In addition to individual commitments, Rowan, Gates and Yellowlees have agreed to attempt to review available information on intrinsic physiological limits to adaptation and acclimation (limits and thresholds).

Organization and communication:

Because of the interdisciplinary breadth of the topic, the strategic approach to the terms of reference is to establish the members and corresponding members as a scientific cadre that will stimulate, assemble and review contributions from colleagues as well producing individual contributions. In order to inform the larger scientific community of WG-104 activities, notices have been published in Reef Encounter (No.17, pp. 19-21,

1995) and *Wallaceana* (74:17-20,1995), an information and discussion meeting was led by Buddemeier and Gattuso at the 5th International Conference on Coelenterate Biology (The Netherlands, June, 1995), and a World Wide Web home page has been established (<http://ghsun1.kgs.ukans.edu/welcome.html>).

Electronic mail has proven to be an extremely effective means of communication among those members with reliable Internet access, and the home page, although still under development, serves as a general document and information repository for both members and interested non-members. Unfortunately, easy Internet and WWW access are not yet uniformly available to all members, so periodic mailings and telephone conversations have also been used to communicate. Other travel and meetings have provided opportunities for the Chair to meet personally with Bak, Done, Gattuso, Smith, and Yellowlees over the past year. In addition, arrangements have been made for both an open workshop and the first formal Working Group meeting in association with the 8th International Coral Reef Symposium (Panama, June, 1996).

Scientific progress:

Although much of the initial activity has been concerned with the logistics of organization and communication, significant scientific progress has also occurred.

Recent publications (see home page for background information) have focused attention on the role of corals and reefs in the global carbon cycle and their interactions with atmospheric CO₂ levels. Relating to this activity, S. V. Smith has prepared an informal review of the subject (Reflections on the Measurement and Significance of Carbon Metabolism on Coral Reefs) as a working paper for the group (which is being circulated and will be posted on the home page). R. W. Buddemeier and J.-P. Gattuso are invited to participate in an international workshop on Carbon Cycling and Coral Reef Metabolism in Miyakojima, Japan, Oct 16-25 1995; Buddemeier's workshop paper (Coral Reef Carbon Cycle Research: Conceptual and Experimental Design) will also be circulated as a WG-104 working paper. Gattuso and colleagues in Monaco have initiated experimental studies of the response of coral calcification to the aragonite saturation state of the water.

Although the work was completed prior to formation of the Working Group, a recent publication by corresponding member R. Rowan (Rowan R. and Knowlton N. (1995) Intraspecific diversity and ecological zonation in coral-algal symbiosis. *Proc. Natl. Acad. Sci. USA* 92, 2850-2853.) represents a significant advance in our understanding of the possible role of variable symbiotic partnerships in coral adaptation and acclimation.

External developments:

In addition to the resurgence of interest in the question of coral reef and the CO₂ cycle, there are other developments relevant to the task of the Working Group. Draft copies of the forthcoming report of the Intergovernmental Panel on Climate Change (IPCC) suggest that there is a majority opinion that global warming and climate change due to the anthropogenically enhanced greenhouse effect can be considered demonstrated reality rather than a probability. If this is adopted as the official position of the IPCC, we can expect a significant upsurge in interest in impact assessments and ecosystem responses, which are the practical outcomes of the subjects under consideration by WG-104.

Planned activities:

An open scientific workshop is scheduled for at the 8th International Coral Reef Symposium (Panama, June 1996). Brief summary reports by the attending WG-104 members and corresponding members will be presented to stimulate discussion and general contributions.

Following the workshop and Symposium, a meeting of the Working Group will be convened. The proposed work plan for the meeting is: (1) Review and summarize progress to date, including external contributions. (2) Identify scientific areas relevant to

the terms of reference that require particular attention in to order to achieve the objectives of the WG. (3) Adopt a publication plan, including specification of the forms of and schedules for both intermediate and final publication of the Working Group products. (4) Identify individual responsibilities for preparation, review, and integration of material for the products. (4) Develop plans for the next (presumably final) working group meeting.

At present, it is expected that the working group will have a final meeting to review and integrate its products prior to final publication, and that this will occur in 1998 or possibly late 1997. It is hoped that members will be able to take advantage of opportunities to meet and collaborate prior to that, and a list of possible opportunities (meetings, etc.) will be prepared.

Actions Requested:

The SCOR Executive Committee is requested to approve the proposed 1996 meeting described above, and to allocate funds in the amount of the attached budget.

Proposed Budget, 1996:

Support is requested to ensure the attendance of all members at the WG-104 meeting in association with the 8th International Coral Reef Symposium. Several members have full or partial travel support, and a number of corresponding members will also be able to attend with other support. We request financial support (in US\$) as follows:

Registration @ 450: Bak, Pandolfi, Gates, Buddemeier, Pittock
Lodging, 7 nights @65: Bak, Gates, Buddemeier, Pittock
Perdiem, 7 days @32: Bak, Gates, Buddemeier, Pittock,

Travel costs (round trip to Panama from home institution) estimated as follows:
Bak, 1100; Buddemeier, 950; Gates, 940; Pittock, 2700.

Incidental costs associated with meeting (room rental, projection equipment and supplies, etc.) \$200.

Note: Gattuso expects to be able to fund his attendance from other sources, but will not be sure until January.

Total: \$10,856

This amount is necessarily an estimate, and every effort will be made to minimize actual costs.