THE GREENHOUSE EFFECT: ITS IMPACT ON MARINE AND COASTAL ENVIRONMENTS

A Position Statement by the Australian Marine Sciences Association, December 1988

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Background

It is generally accepted that the Greenhouse Effect is a global climatic change occurring as a consequence of increased levels of CO_2 and other gases in the atmosphere. This is primarily due to the burning of fossil fuels since the start of the Industrial Revolution The consequnces of fuel burned today will continue to be manifest into the future. The problem has been compounded by the reduction in global vegetation, which plays a major role in absorbing CO_2 from the atmosphere.

Predicted initial changes include an atmospheric temperature increase of 2°–4°C over the next fifty years. The rate of temperature increase is predicted to accelerate over time.

Other predicted effects of significance to the marine environment include a sea-level rise of 0.8±0.6 m by about the year 2040, and changes in wind and wave regimes, oceanic currents and sea-surface temperatures. Change in rainfall patterns will influence river discharge and hence flooding and sediment yield. The magnitude and rate of such changes are critical in determining the impact on the coastal zone, including its biological communities.

At its 1988 conference, the Australian Marine Sciences Association prepared the following statement identifying impacts on marine and coastal areas. The anticipated impacts will require a coordinated multidisciplinary and national response. The statement has been prepared to provide decision makers with a framework for responsible planning.

As the resolution of predictive models is improved, more detailed estimates of impacts will be possible. Current Greenhouse predictions are tentative, and responses must be considered as interim and subject to review; at the same time, in view of present trends, they may simply be regarded as moderate, prudent measures to respond to present indications.

Major Impacts on the Australian Marine and Coastal Environment

Predicted climate changes and the associated sea-level rise of 0.8 m (±0.6 m) will have several significant impacts on marine and coastal environments, which include:

- Shoreline changes, which will result from permanent inundation of low-lying areas, increased flooding and erosion, and disruption of sediment transport patterns.
- Increased salt-water intrusion into wetlands, estuaries, deltas and floodplains, affecting salinity, flushing, freshwater aquifers and related soils and vegetation.
- Modified coastal and estuarine habitats; some will be lost while others will be created or expanded. Many coastal wetlands, which are important fish nursery areas, could be lost due to lack of sufficient landward areas into which they could retreat.
- Changing wind, weather and wave patterns, which may affect maritime safety, increase the risk of storm damage, and alter coastal morphology. The southward shift in the limit of tropical cyclones by 200–400 km, and an increase in their intensity, would pose obvious risks to more southern coastal developments, as well as to marine and estuarine biota and their habitats.
- Altered ocean circulation patterns and increased sea-surface temperatures as a result of the changed weather patterns. This would affect the productivity of the oceans and the dispersal of the larvae of marine species, including those that are commercially important.
- Alteration to the distribution and abundance of marine organisms in both space and time.

Information Needed to Answer Key Questions

To better assess the impact of future climatic trends on the marine environment, two types of data re required from the marine science community: (1) the monitoring of basic environmental data, needed to measure the rate of any sea-level rise, temperature increase and secondary effect, and (2) information on processes, which would help assess the degree of impact and the response of marine ecosystems.

The precision and distribution of sea-level, tide and wave recording needs to be upgraded. The problems of regional tidal variation due to climatic and tectonic (land movement) differences requires the selection of onshore and offshore measuring stations at representative locations. This will assist in distinguishing between regional and global sea-level changes. The work of the Permanent Committee on Tides and Mean Sea-level should be supported.

Information is required on the temporal and spatial variation in the distribution and abundance of marine organisms, possibly using key species as indicators. Coastal zonation patterns of animals and plants, open-water larval dispersal patterns, and new organism distribution records could provide important clues to changes in sea-level, circulation, temperature and marine processes.

Water-quality data from selected river mouths in representative regions around Australia are necessary to assess the implications of water-quality changes in estuaries and deltas due to changes in freshwater runoff and salt-water intrusion,. A set of indicative parameters monitored at appropriate frequencies should be established.

Detailed mapping of the habitats, landforms and land-uses of the coastline should be carried out, in relation to a predicted median sea-level rise of about 1.0 m, showing the extent of coastal area, including estuarine and wetland habitat, that would be lost or modified. This would assist in identifying whether sufficient suitable areas remain for the coastal communities to retreat landward. Buffer zones must be provided against development in such areas. The 1.0 m contour will provide an indication of the magnitude of the problem.

Detailed monitoring of shoreline movements is necessary to document the rate of change as it occurs and to aid in formulating and implementing future preventative measures. Monitoring sites should be expanded around Australia to allow for local variability in shoreline movements.

Research is required to better understand the ecological requirements of organisms important to fisheries. Although research of this type has been undertaken in the past, greater emphasis needs to be placed on determining the likely response of these organisms to Greenhouse-induced changes.

Studies are required to determine the sites of the best and most representative coastal habitats/environments within major geographic regions for detailed long-term monitoring.

There is a need for better understanding of the likely changes in ocean current patterns that impinge on or affect Australia, including the El Nino–Southern Oscillation phenomenon.

Recommendations

The Australian Marine Sciences Association, at its 1988 Annual Conference, adopted the following recommendations to be communicated to appropriate people and organisations in government and the wider community:

- to encourage measures to reduce the production of all Greenhouse gases
- to encourage prompt attention by all levels of government to the potential for climatic change, in order to ameliorate the social, economic and biological impacts
- to support and participate in research into global and regional climatic change (e.g. such international cooperative programs as GOFS/WOCE/IGBP)
- to recommend the formation of a national committee, on which AMSA is represented, to coordinate research on the Greenhouse effect
- to identify and reserve sufficient buffer zones behind coastal habitats
- to promote the long-term monitoring of chemical, physical and biological changes
- to support *special* funding of Greenhouse-related research
- to focus attention on assessing the risks associated with extreme events, rather than average increases, and to develop contingency plans for such events
- to require coastal development proposals (including Environmental Impact Statements) to contain an assessment of Greenhouse Effects
- to require local and regional environmental plans to provide zonings of land use that take account of the Greenhouse Effect.