THE SOUTH PACIFIC REGIONAL MARINE POLLUTION ASSESSMENT AND CONTROL PROGRAMME (SPREP POL)

An Integral Part of the 1991-2 Work Programme
of the South Pacific Regional Environment Programme (SPREP)

PROGRESS REPORT PRESENTED TO THE

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prepared by

R.J. Morrison
Scientific Coordinator, SPREP POL

and

Laisiasa C. Tulega
SPREP Environmental Contaminants Officer

Résumé Français

SPREP POL est une évaluation régionale intégrée de la pollution marine et un projet de contrôle du PROE. Il comprend toute une gamme d'activités réalisées dans la plupart des pays de la région du Pacifique Sud et y participent au moins 15 institutions et organisations gouvernementales. Le but principal de ce projet est de fournir aux gouvernements et aux administrations, une information scientifique et technique nécessaires pour entreprendre une action de protection de l'environnement marin contre la pollution. De plus les renseignements transmis donnent la possibilité aux gouvernements de déterminer les changements qui surviennent au niveau régional dans l'environnement marin.

Au cours de l'année 1991-92, la majorité des activités a consisté en l'élaboration d'un inventaire de produits polluants non-marins (qui fera la liste des types et quand cela sera possible, des quantités de produits polluants rejetés dans l'océan Pacifique Sud), d'un inventaire de sédiments transportés par les rivières jusque dans l'océan du Pacifique Sud, d'un nombre d'études d'emplacements connus pour leur pollution afin de déterminer les sources et les quantités de contamination, de plusieurs études aux endroits soupçonnés de pollution afin de déterminer la gravité du problème, et d'une ou deux études sur des lieux non pollués susceptibles de fournir des renseignements pour la surveillance des changements à long terme dans l'environnement marin de la région.

Ce travail a été en partie fondé par l'UNEP mais a aussi été subventionné de manière importante par les programmes nationaux français de recherches marines (par l'entremise de l'ORSTOM), australiens (grâce à l'AIMS et au GBRMPA) et Néo Zélandais (avec le NIWAR). Les agences gouvernementales des petits pays comme Palau, Tonga et Vanuatu ont aussi participé au programme, en particulier en qualité d'agences coopérantes aux projets organisés par les institutions de recherches régionales.

Les conclusions principales indiquent à ce jour, que malgré que l'environnement de l'océan Pacifique Sud change peu au large, dans les régions côtières proches des centres principaux de population, la situation se détériore continuellement. Pratiquement tous les endroits de cette catégorie, où des recherches ont eu lieu, montrent qu'ils existent des problèmes sérieux de contamination crées pour la plupart par les déchets domestiques et l'évacuation des eaux usées, mais aussi dans certains endroits par les déchets industriels. Par exemple, le niveau de TBT dans le port de Suva, est l'un des plus élevés, enregistré dans le monde et ce problème apparaîtra certainement ailleurs dans la région. De plus la gestion des déchets est inadéquate et nous montre que les gouvernements et les différentes administrations devraient prendre des mesures urgentes pour réduire les quantités de déchets produits et en améliorer sérieusement la gestion.

L'impact de la pollution marine sur le nombre de poissons et la santé des insulaires du Pacifique qui dépendent de ces ressources pour leur survie, n'a pas encore été évalué, mais à l'évidence ces effets se développeront de plus en plus si on n'entreprend pas une action plus importante pour protéger l'environnement marin.

INTRODUCTION/BACKGROUND

Marine pollution-related problems in the South Pacific islands can be summarised under 4 headings (SPREP, 1990):

Destruction of coastal ecosystems
Lowering of water quality
Changing ocean properties and processes
Climate change and sea level rise

The marine pollution component of the South Pacific Regional Environment Programme (SPREP POL) addresses the first three of these issues.

The primary causes of the problems are the disposal of domestic waste (sewage included), the disposal and management of non-domestic waste (e.g., agricultural chemicals, oil, tyres), increased sedimentation (resulting from changing land use, forestry and mining), coastal development (tourism, port construction), over-exploitation of living marine resources (reef fish, shellfish, mangroves) and natural disasters including volcanoes, earthquakes, cyclones (Brodie and Morrison, 1984; Brodie et al., 1990; Morrison 1991).

Secondary causes include inadequate waste disposal facilities, inadequate legislation or effectiveness of existing legislation, lack of awareness of the seriousness of the problems, the sectoral nature of many national planning activities and the lack of adequate data for the preparation of legislation and other mitigating action.

The knowledge gaps that have been identified include the following:

(a) A lack of long-term data to facilitate the recognition of temporal and spatial trends.
(b) A knowledge of the behaviour of toxic contaminants (e.g., pesticides) in critical environments is unavailable.
(c) There is no basis for estimating the health impacts of the microbiological contamination caused by uncontrolled sewage discharges.
(d) Few baselines exist for the development of programmes studying ecosystem changes as pollution indicators.
(e) Apart from certain fish species, information on the extent of use of marine resources is lacking.

Existing assessment and control activities include limited research carried out by national, regional and international agencies, localized but often overloaded waste treatment and disposal facilities, varying levels of environmental management planning, suitable environmental legislation in many countries, and a rapidly expanding programme of environmental education.

Resources to carry out marine pollution assessment and control activities are very limited. Trained manpower is lacking, plus there is a general trend of out-migration or transfer (within government) of such specialists. Equipment, facilities and funding for these activities are often less than adequate, out of service (due to poor servicing) or underutilized due to the lack of supporting services (electricity breakdowns, poor water supply). Even the use of low level technology or community monitoring is restricted because of the lack of staff to provide training and compile/analyse the data produced.

The overall goal of the SPREP POL project is to assess the extent of pollution and to provide a basis for recommendations to control such pollution. The objectives include

(a) the provision of information on types of pollutants
(b) generation of time series of data
(c) analysis of the causes of pollution
(d) contribution to GEMS programme of UNEP
(e) enhancement of indigenous capability in assessment and control of marine pollution

These objectives are being addressed by a combination of monitoring programmes, baseline studies and research activities as summarised in Table 1.

A funding proposal was developed on the basis of requests submitted to SPREP by governments and institutions and submitted to UNEP. This document reports on progress made in the period June 1991 (when the funds first became available) and June 1992 using the funds provided by UNEP.

TABLE 1 SPREP POL Monitoring and Research Activities

MONITORING ACTIVITIES

1. Ocean Processes and Properties
   of particular importance are variability in circulation patterns, thermal structure, salinity distributions, plankton productivity, nutrient fluxes, larval distribution patterns.

2. Trace (Heavy) Metals
   Activities in this sector will concentrate on mercury, cadmium, lead and tin but other metals may be included.

3. Pesticides
   Particular emphasis will be placed on organochlorine pesticides.

4. Sewage related parameters
   This sector will study the problems of increased nutrients and microbiological contamination.

5. Others including hydrocarbons and detergents.

N.B. Monitoring activities will include areas of known or suspected pollution and reference sites with no likely pollutant sources. Studies at these latter sites will provide data for studying long-term changes in the South Pacific marine environment. At all other sites the purpose of the monitoring is to determine the type and extent of pollution so that recommendations on the required remedial action can be prepared for governments.

RESEARCH ACTIVITIES

1. Preparation of a regional status report on land-based pollutants entering the marine environment.

2. Study of the role of sedimentation in marine pollution including the transport of pollutants.

3. Development of circulation model for the main South West New Caledonia lagoon as a potential model system (for other Pacific island coastal areas).

4. Review of the Guam EPA coastal water monitoring program 1978-88 to assess the appropriateness of site selection parameters determined and sampling strategy in meeting the needs of coastal area management decision makers. The results of this review will be made available to other governments planning monitoring programmes.

RESPONSE TO REGIONAL MARINE POLLUTION EMERGENCIES

PROGRESS REPORT 1991-2.

1. Land Based Sources of Pollutants Inventory

This is a region-wide activity covering all the island territories of the region except Australia and New Zealand. Since most of the pollutants found in the South Pacific are land-derived, this will provide the data necessary for determining what pollutants are likely to be found in any given locality. Atmospheric transport of pollutants may be important in certain parts of the world, but recent studies have shown that the South Pacific atmosphere (apart from certain industrial areas) is the cleanest so far studied (Riley et al., 1989). Negotiations are nearing completion with IMO to undertake a complementary inventory of ship-based pollutant sources for the region.

The consultant carrying out this activity (Ms Nancy Convard of EnviroSearch, Ltd, Honolulu) began work in February 1992 and has visited about 8 countries in the region. Limited travel funds have prevented her from visiting any other countries. Provisional lists of pollutants by type, together with assessments of quantities and sources where appropriate data are available, have been prepared for each country. These have been circulated to national focal points and other interested individuals for comment and addition/correction before they are compiled into a region-wide report which will be available at the end of 1992. The study is also looking at current waste disposal practices. The data from this part of the study will also provide information needed to develop appropriate waste management strategies for regional countries.

The major conclusions to date indicate that domestic wastes still constitute the major portion of land-based pollutants entering the South Pacific Ocean. Wastes from industrial and commercial activities, however, also contribute significant quantities of pollutants. In addition it has been noted that "smaller" quantities of certain contaminants from industrial wastes may have more deleterious effects than "larger" quantities of domestic waste. Industrial wastes generally enter the marine environment with little or no treatment.

The lack of appropriate data on industrial production and industrial waste disposal makes it difficult to accurately determine pollutant quantities. Improved data collection on industrial activities and the provision/recording of industrial production activity in terms of units produced rather than monetary value would allow a rapid assessment of pollutant quantities and types. Other data that would allow for an improved assessment of land-based pollutants are:

current pesticide imports
current fertilizer use
details on type and number of manufacturing facilities
chemical use by industry.

This has led to problems being encountered not only the identification of types and sources of pollutants, but also in identifying the data collection requirements for more accurate quantification of these pollutants.

One of the major problems identified is that of waste management. Whereas there is a trend toward improved domestic waste treatment and disposal, non-point source pollution from urban runoff has also been identified as a significant contributor to pollution of coastal waters. Sediment discharge, via rivers or direct runoff, to the marine environment from ongoing activities, such as agriculture, construction of unpaved roads, timber harvesting, is seen a major problem and is being addressed in a separate SPREP POL activity (see below).

Recommendations for improved waste management will be included in the final report. Implementation of pollution prevention practices has been identified as one option for improved waste management that is appropriate for the South Pacific Region.

2. The Role of Sedimentation in Pollution in the South Pacific

A section of the land based pollution survey is focussing on sediment inputs to the South Pacific ocean via rivers. This will provide a valuable baseline for assessing the impact of future land use changes (including logging and mining).

The region-wide project is being undertaken at the University of the South Pacific under the overall guidance of Professor J. Morrison. The work is being carried out by 2 research assistants, Mark Asquith and Fiona Kooge, and is divided into a number of parts.

Firstly, there is an assessment of the total sediment load to the South Pacific Ocean by rivers. As a physical survey was not possible, and the existing sediment load data were too scarce to be of any practical use, empirical modelling was investigated. A number of models were evaluated for their applicability to the region given the available data. The Fournier method was found to estimate the amount of suspended sediment discharged from catchments using mean monthly and annual rainfall and relief data. Since rainfall data is probably the most widely collected environmental data in the region and is also probably the most accessible data this method has many attractions. More complex models such as the Uniuversal Soil Loss Equation (USLE) and Soil Loss Estimation Method for Southern Africa (SLEMSA) were found to be unworkable on a regional scale as the data requirements (e.g., rainfall erosivity and soil erodability) are unavailable except for a few isolated locations.

The Fournier method was tested for three catchments on Viti Levu, Fiji, and the results compared to available estimates and measurements. There was favourable agreement between prediction and measurement. The method has been applied to approximately 75 islands in the South Pacific that sustain significant and perennial surface drainage. As a result, a preliminary estimation of the total suspended sediment load via rivers to the South Pacific Ocean is now complete and the data are available on request.

For a significant number of islands, however, even rainfall data is scarce, and has been collected at a few sites or for short time periods. This problem is particularly acute for Papua New Guinea and Vanuatu.

In addition to the above, a substantial body of literature covering the causes and impacts of increasing sediment loads has been collected and reviewed. A Bibliography has been prepared and is available on request. The literature covers changes in the sediment regime due to changes in vegetative cover and land use, the reasons for the changes, the downstream impacts on biota and geomorphology, marine and estuarine impacts, and touches on the social and economic factors relating to both the causes and effects of the changes. A review of these issues in now being prepared.

Finally, the development of common procedures and techniques for the expansion of the regional suspended sediment data base is in progress and will be completed for inclusion in the final project report to be submitted before the end of 1992.

3. Preparation of a Lagoonal Circulation Model

This project supported the development (by ORSTOM) of a computer simulation circulation model for coastal lagoons. This is important as many major population and industrial centres in the region are located on or near lagoons. Knowledge of the behaviour of pollutants discharged into these zones of limited mixing and/or fishing is important in planning pollution control programmes.

The South-west lagoon of New Caledonia was used for the development of the model and on-site data were collected from 1988-90. Using this data two models have been developed and this work has now progressed to the stage where realistic results about the currents can be determined. The two-dimensional model is now fully operational. With this model tidal currents and sea level can be calculated from tidal amplitude and phase. The three-dimensional model is still being tested, but it is hoped that it will be fully operational before the end of 1992. This will allow the calculation of the currents created by the wind and its combination with the tides.

The work on the two-dimensional model is now being written up for publication and copies will be distributed to relevant government and research agencies once the publication is available.

4. Evaluation of Long-term Coastal Monitoring - Guam

The aim of this activity is to utilize data from the major long-term coastal marine monitoring programme in the region - that of the Guam Environmental Protection Agency. The Agency has been asked to review its 12 year data set and consider the selection of sites and parameters in the light of the original objectives. From this exercise it is hoped that other regional governments will be able to design better monitoring programmes, avoiding mistakes that might otherwise waste limited resources.

The Guam Environmental Protection Agency has been unable to proceed with this activity.

5. Completion of Monitoring Studies and Development of Pollution Control Recommendations

a. PORT MORESBY, PAPUA NEW GUINEA

No report available

b. HUON GULF, PAPUA NEW GUINEA

No report available

c. SUVA, FIJI

The University of the South Pacific Marine Pollution Research Group has been continuing the study of Laucala Bay and Suva Harbour with data being collected in September-October 1991 and from February-August 1992. The results show that particular areas in both water bodies are contaminated with either or both of sewage and industry derived pollutants. There appears to be little change since 1987-8 monitoring.This work has included the first study of organochlorine contaminants in Fiji and has shown that the levels in sediments around Suva are low to very low, with only one site showing any real evidence of contamination.

In addition to the above monitoring, arrangements were made under the CIDA sponsored USP/University of Victoria Twinning Porject on Marine pollution to have a student work with the Ports Authority of Fiji to prepare a report on sources of pollutants entering the greater Suva harbour area. This report will be invaluable in trying to implememnt the effluent water quality standards recently decreed for Fiji's harbours.

One other activity has produced some quite alarming results that may have significance elsewhere in the region. A joint USP/University of Victoria/University of Auckland project has been looking at the levels of tributyl tin (TBT) residues around Suva. The analytical results show that parts of Suva harbour have the highest levels of TBT in sediments so far recorded anywhere. In addition, examination of neogastropods has shown wide evidence of imposex (females developing male sexual organs and thus markedly impacting the reproductive cycle). The possible impact of such high TBT levels on human health has yet to be investigated. The preliminary results of this activity are sufficiently serious that regional governments should immediately look into the situation in their own country, particularly in any areas where boat-building or repair facilities are located.

RECOMMENDATON

Regional governments and administrations should immediately investigate the use of TBT based marine fouling paints to determine whether or not a potential environmental problem exists. If it appears that a problem may exist, SPREP should be asked to provide assistance to determine the extent of the problem and to recommend action to mitigate the problem.

d. PORT VILA

Mr. M. Maata and Mr. W. Peter from the USP Marine Pollution Research Group visited Vila in February to carry out an investigation of water quality in collaboration with the Vanuatu Environment Unit. The results showed that the pattern observed in 1987 of high nutrient and coliform levels in Emten and Ekasuvat Lagoons relative to Vila harbour still exists, but there was no evidence of increasing eutrophication. The levels of organochlorine contaminants in sediments were very low.

e. FANGA'UTA LAGOON, TONGA

Dr. W. Aalbersberg and Mr. R. Odense from the USP Marine Pollution Research Group visited Tonga in March 1992 to carry out a water quality monitoring programme in collaboration with the Environment Unit and the Health Department of the Tonga Government. The chemical data indicated a healthy lagoon with low nutrient levels. A potential problem due to shellfish contamination by human and animal wastes was noted. This was due to latrines being built close to the water and piggeries built on the water's edge such that lagoon water flushed through them at every high tide. This is a particular problem as shellfish are widely consumed locally and they can concentrate contaminants including pathogenic organisms.

Examination of sediments for organochlorine contaminants showed low values at most sites but high levels of DDT were found for one site and this requires urgent investigation (to determine if it is due to dumping or heavy local agricultural use).

There is considerable concern about the clearance of mangroves and landfill activities along the shoreline in the Pe'a sector and also sedimentation in this sector. The layer of mud has increased in dèpth in recent years and it is likely this is a consequence of landfill and agriculture activities. It is possible that this marked increase in sediment and turbidity is responsible for the serious decline in shellfish in the lagoon.

RECOMMENDATION

If it has not already done so, the Tonga Government should initiate a study into the effects of increased sedimenataion and turbidity on shellfish ecology. This activity would not only be useful in Tonga, but would also be of major benefit to other regional countries where shellfish resources are of significant social or economic importance. This project could be carried out as a cooperative activity with USP or other regional institutions.

f. TAHITI, FRENCH POLYNESIA

No report received

g. GUAM

No report received

6. Initiation and Continuation of Studies at Reference Sites

Studies at reference sites where little or no contamination is suspected are being initiated to provide data for monitoring long-term changes in the South Pacific marine environment.

a. MOTOPURE ISLAND

No report received

b. ASTROLABE LAGOON, FIJI

Work at the Astrolabe Lagoon has been carried out by the USP Marine Pollution Research Group since 1988. This work has shown that the Lagoon is virtually free from pollution apart from minor problems close to the population centres (three) on the islands within the lagoon. A visit to the Lagoon in April 1992 indicated that no change had occurred since the last visit (in December 1990) and the levels of nutrients and other water

quality indicators showed values close to those for open ocean water. Sediments have been analysed for trace metals and organochlorines and the results confirm that no contamination can be detected. Shellfish are available for collection on a regular basis at only one site. Trace metal contents show no evidence of contamination, but coliform contamination has been detected. The source of this contamination is uncertain, but may be related to a nearby school. This problem is currently under investigation, but is not seen as a major health risk.

c. TIKEHAU, FRENCH POLYNESIA

No report received

d. BABELDAOB, PALAU

This activity is being undertaken by the Palau Environmental Protection Board. The Letter of Understanding setting out the terms of the project and the funding was only signed in late April and the funds delivered in May, 1992. As a consequence there has been little time to generate any data. The sampling sites have been selected and the monitoring began in June 1992.

7. Completion of Baseline Studies and Recommendation for Future Action

a. FLY RIVER DELTA, PAPUA NEW GUINEA

No report received

b. POHNPEI, FEDERATED STATES OF MICRONESIA

This activity is being coordinated by the Community College of Micronesia (CCM). To date several activities have been completed. Using funds provided by SPREP/UNEP, equipment required for the completion of the project has been ordered. As of June 30, 1992, this equipment had not arrived.

Using funds available from the project, Prof.J. Morrison and Mr Spensin James (CCM) organised a training workshop in coastal marine pollution monitoring in Pohnepi in June 1992. Eleven participants attended the workshop which involved a series of theory and practical sessions. As part of the workshop the participants investigated water quality at 12 coastal sites around Pohnpei. These studies showed that sewage contamination is a serious problem at virtually every site and is particularly bad in two or three locations. There appears to be no concerted local plan of action to deal with the situation which represents a major health risk to the local community, particularly for children who frequently use the coast for recreation.

The monitoring programme is continuing as a collaborative exercise between CCM and the Pohnpei Department of Health.

c. KOROR, PALAU

As with the Babeldaob activity discussed above, this activity only got under way as a SPREP POL exercise in May 1992. Some monitoring has been initiated by the Palau Environmental Quality Board, and selected sites from that programme will be studied in more detail as a contribution to SPREP POL. It is expected that a reasonable amount of data will be available by the end of 1992 to provide an assessment of the quality of the marine environment around Koror.

d. OTHER POLLUTANTS INCLUDING HYDROCARBONS AND DETERGENTS

No new data on hydrocarbons or detergents has been produced in the project to date. One other area of major concern has been identified - this is the level of plastic waste in the marine environment of the South Pacific. This has been reviewed by Dr. Murray Gregory of the University of Auckland and Dr. Nigel Wace of the Australian National University has produced interesting data for the areas around Australia, particularly the south and west coasts. As is well known, such plastic waste represents a major hazard to marine life, including seabirds, and it is quite obvious that the problem is getting worse with much of the material entering the ocean locally in addition to that transported from further afield.

RECOMMENDATION

It is recommended that SPREP include plastic waste as a marine pollutant and draw the attention of governments and administrations to the problems caused by such waste and the increasing levels of such materials in South Pacific waters. Governments and administrations should be urged to take the necessary action to reduce or eliminate the dumping of such waste in the marine environment.

8. Continuation/Completion of Ocean Processes and Properties in the South West Pacific

a. EFFECTS OF HYDROCLIMATIC VARIATIONS ON PLANKTON PRODUCTION
b. LONG-TERM OCEAN/CLIMATE STUDY
c. VARIATIONS IN SURFACE HALINE AND VERTICAL THERMAL STRUCTURES

The above three activities are being carried out by ORSTOM through its Survey of the Tropical Pacific (SURTROPAC) and Oceanic Fluxes in the Pacific (FLUPAC, formerly PROPPAC) projects which represent part of the French contribution to the Tropical Ocean Global Atmosphere (TOGA) project (which is itself part of the World Climate Resaearch Programme (WCRP)) and the Joint Global Ocean Flux Study (JGOFS) project.

The required data is generated during cruises (two per year) along a transect at 165°E between 20°S and 10°N. These transects have been made on a biannual basis since January 1984, as part of a monitoring study of environmental parameters made in the open ocean of the West Pacific. Together with meteorlogical parameters and zooplankton net hauls, vertical profiles of the following parameters are obtained at least at every degree of latitude: sea temperature, salinity, oxygen, nitrate, nitrite, phosphate, chlorophyll and pheopigments. Continuous current profiles are also recorded during both the outward and return passages.

During the March 1991 cruise westerly winds were found between 10°S and 2°N on the outward leg, generating eastward surface currents, an abnormal situation at the Equator. During the return leg, the situation had gone back to normal with westward currents and easterly winds, showing a short term variability in the western Pacific. Related to the current variations, the hydrographical structure showed an equatorial convergence with deep nutrients at 0° and significant surface concentrations at the northern and southern boundaries (4°S and 4°N). Surface chlorophyll maxima were observed at 2-3°N and zooplankton biomass reached a peak at 1°N. The southern part of the transect showed a deep and rather marked chlorophyll maximum.

During the July-August transect, oceanographic conditions were clearly thoise of an El Nino situation, with westerly winds and eastward currents in the equatorial; area. As a result, an equatorial; convergence with no surface nutrients was observed together with warm (>30°C vs 29°C in march) waters flowing from the western Pacific. Chlorophyll values along the transect were low and deep, consistent with thew hydrographical situation.

The overall conclusion from the 1991 cruises is that the March 1991 conditions could be indicative of an impending El Nino situation, while the July-August data showed a settled El Nino situation. The consequences of such conditions are important for temperature, salinity, nutrient distribution and primary production.

Preliminary results from the Jan-Feb 1992 transect showed that oceanographic conditions at that time were similar to those prevailing in Jul-Aug 1991 and may be considered as an on-going El Nino Southern Oscillation (ENSO) event. The major feature was a lack of upwelling in the western Pacific.

d. WATER COLUMN NUTRIENT BUDGETS FOR NE QUEENSLAND SHELF
e. MESOSCALE VARIABILITY OF CURRENT CIRCULATION IN THE CORAL SEA AND GREAT BARRIER REEF LAGOON
f. PHYTOPLANKTON BIOMASS AND PRODUCTIVITY ALONG MARGINS OF THE CORAL SEA

The above three activities are being carried out as contributions by the Australian Institute of Marine Sciences

(AIMS) to the SPREP POL Project. The contributions by SPREP to the overall budget are very small, as the full project costs are of the order of hundreds of thousands of dollars.

No separate report has yet been prepared for SPREP POL on these activities.

g. COASTAL MARINE CLIMATE SURVEY IN NEW ZEALAND

This study is an ongoing baseline programme monitoring sea surface temperatures around New Zealand. Full details of the objectives, procedures, etc., are given in Grieg et al (1988). During the early part of this programme, voluntary observers used hand-held thermometers to record sea surface temperatures once a day. Over the last 2 years, moves have been made to automate the collection of sea temperature data by installing internally recording temperatue loggers. Funds from SPREP have been used to support the purchase and installation of these loggers and to prepare computer software to recover and archive the data.

Because of the long-term and ongoing nature of the programme, no separate detailed data analysis has been completed for the period covered by this report. Eight data loggers are now in place around the New Zealand coast and one is installed in the Chatham Islands (establishment of this latter station was assisted by funds from SPREP).

h. BIORESOURCE PRODUCTIVITY AROUND NEW ZEALAND COASTS

The production of important marine biological resources in most waters is considered to be food limited. Observations on the mass reproductive failure of fish dependent birds and mammals in recent times has been associated with the rapid decline in their food resource, and provide striking evidence that marine trophic relationships are both dynamic and precariously balanced, depending on both natural and human related processes.

This project uses a multidisciplinary approach designed to better understand the open ocean - coastal ecosystem functioning of the marine environment off the west coast, South Island, where a large commercial fishery now exists. It is designded to distinguish between and predict the effects of human activities and natural events on the structure and dynamics of the marine environment of the area. It is hoped that these findings will ultimately be applied to the marine environment in other parts of New Zealand. The studies focus on physical oceanographic features, especilally those important to mixed layer dynamics and upwelling, the influence these have on productivity at the base of the food web, and involve the development of mathematical models that integrate laboratory and field work conducted using the most up-to-date techniques.

This on-going programme has made considerable progress towards meeting its major aim and studies continue to build on the results from past work. Specific achievements within the programme to date include:

- identification of wind generated coastal trapped waves as a major part of shelf current variability at sub-tidal frequencies
- identification of the dynamics and processes associated with upwelling off different regions along the Westland coast, and hindcasting the local current regime
- observation of a number of new circulation features - coastal jets, offshore eddies, counter currents/under-currents
- knowledge of the optical properties of coastal and offshore waters
- identification of the microbial loop as an important component of the food web (findings at variance with similar overseas studies)
- establishment of the relative importance of ciliated protozoa and flagellates as links in the food web
- identification of a prey of hoki larvae, and aspects of prey selectively by larvae
- description of horizontal and vertical distributions of planktonic organisms in relation to hydrographic features
- construction of the first numerical models for a New Zealand oceanic system that explain the mixed layer dynamics, and the relationships between nutrients and plankton in the pelagic food web
- establishing the importance of mixed layer dynamics and upwelling to the pelagic food web; phytoplankton biomass and production decrease with increasing depth of the mixed layer
- establishing the relative importance of 'new' or upwelled nitrogen versus recyced nitrogen and its importance to phytoplankton growth, and the role of zooplankton in the nitrogen cycle
- description and qualification of the meio/macro benthic fauna and sedimentary environment, and energy transfer through the shelf benthos.

9. Marine Pollution Incident Regional Response Effort

To date no requests have been submitted to utilise the funds available for this activity. The only report of such an incident to reach the Scientific Coordinator of SPREP POL came from the Petroleum Officer of the Forum Secretariat who reported on an oil spill in Kosrae resulting from the rupture of the fuel tanks on a sunken barge. It was hoped that the Coordinator could visit Kosrae while enroute to the Pohnpei

Training workshop described above, but this proved impossible. Advice was forwarded to the Kosrae Public Works Department, but to date no response has been received. This particular problem should have received the attention of the US Coast Guard who have agreed to look into such incidents in the Federated States of Micronesia. It is likely that the Coast Guard response was slow in this case as a formal request for assistance has to be made before action can be initiated.

ADDITIONAL WORK

In addition national marine pollution programmes are producing supporting data. For many countries this work is extremely limited but Australia, New Zealand, Guam and French Polynesia are producing valuable local information. Some bilateral projects (e.g., USAID project in Tarawa lagoon, Kiribati) will also generate useful information. International programmes such as JGOFS and WOCE are providing valuable support in the study of ocean processes and properties.

Training activities are a constituent and continuing component of SPREP POL. This will facilitate the enhancement of indigenous capability essential for long-term marine pollution control.

CONCLUSIONS

On the basis of the information generated in the SPREP POL project activities in 1991-2, the major conclusions are that while the state of the open ocean environment in the South Pacific is changing little, in the coastal areas close to major population centres, the situation is continually deteriorating. Almost every site of this type where investigations have been carried out shows serious contamination problems mostly associated with the management of domestic waste and sewage but in some locations with industrial wastes also. In addition the management of waste is poor indicating that governments and administrations should be taking urgent action to reduce the quantities produced and to markedly improve the management of such materials.

The impacts of the marine pollution on fish populations and on the health of Pacific Islanders who are highly dependent on such resources for food have not yet been quantified, but the present evidence is that these effects will become increasingly important if greater action to protect the marine environment is not taken.

Marine pollution problems in the South Pacific have expanded significantly in the last decade. An efficient, effective programme of assessment and control is essential to prevent the situation becoming even more serious. SPREP POL represents an

integrated, multi-faceted, multi-agency attempt to reduce these problems and maintain or improve the quality of the marine environment for the benefit of the peoples of the region. In the absence of such a coordinated programme of activies, the state of the marine environment will continue to deteriorate and the impacts of the pollution may cause serious problems before authotities have time to take appropriate mitigating action.

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