

MARINE CHEMISTRY

11 Accumulation and Transfer of Naturally Occurring Heavy Metals in Coral Reef Food Webs

PERIOD: 1979
ORGANIZATION: Griffith University,
School of Australian Environmental Studies
PROJECT LEADER: Mr T. Pear
PROJECT OFFICER: Dr W. Craik
SUPERVISORS: Dr D. Connell, Dr G. Miller
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$542

OBJECTIVES

To measure the levels of mercury and zinc in a coral reef fish community at Heron Island Reef to test the 'trophic level theory' for the behaviour of pollutants in food webs.

IMPLICATIONS/MANAGEMENT NEEDS

Various theories have examined the behaviour of pollutants in food webs. One widely accepted theory is the trophic level theory. This theory implicates the food chain as being responsible for increasing pollutant concentrations in successively higher trophic levels. This research will examine the trophic behaviour of zinc and mercury in a coral reef fish community.

METHODOLOGY

Fish from 30 species were collected by spearing and hook and line fishing in April 1979. The species were categorised into trophic levels by relating the findings from analysis of the gut cavity with data in the literature. Samples of tissue were removed from the fish and analysed for mercury and zinc by atomic absorption methods.

STATUS

The project has been completed.

Levels of mercury and zinc found in fish of the Heron Island/Wistari Reef community were generally low but variable.

Conclusions were made regarding the possible effects of a number of ecological, physiological and biochemical variables on the trophic behaviour of mercury and zinc:

Habitat and feeding behaviour may influence levels of mercury in benthic dwelling species (*Chaetodonts*, *Scarus* sp. and herbivores). Weight influenced mercury concentrations. However this variable could not account for total variation in mercury content between species and trophic level.

Trophic level had only a limited influence upon mercury content and none upon zinc content.

Biochemical regulation is suggested as the major control mechanism for zinc concentrations.

Since the total variation of mercury content could not be attributed to any one variable and because the nature of the pathway for mercury uptake is complicated an alternative theory to the trophic level theory was proposed. It is likely the alternative approach will still provide only part of the answer to mercury food web behaviour.

Pear, A.G. 1979. Mercury and zinc in a coral reef fish community from Heron Island, Great Barrier Reef, Queensland. Honours dissertation, Griffith University.

LOCALITY: Capricornia Section - Heron Island, Wistari Reefs

Hydrocarbons in Heron Island Boat Harbour

PERIOD: 1981

ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Mr P. Bishop

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr D. Connell, Dr G. Miller

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$683

OBJECTIVES

To establish the background concentrations of hydrocarbons in the Heron Island boat harbour and the surrounding reef flats. To investigate the use of a holothurian species (*Holothuria atra*) as a biological indicator of petroleum hydrocarbons.

IMPLICATIONS/MANAGEMENT NEEDS

The background concentrations of hydrocarbons in Great Barrier Reef waters is essential information for monitoring and assessing impacts.

METHODOLOGY

To determine the distribution and concentration of hydrocarbons, samples of sediments and holothurians were collected from two sites on the reef flat and from three sites in the boat harbour. Hydrocarbons were extracted from the sediments and holothurians using techniques developed at Griffith University. The extracts were analysed using gas chromatography and gravimetric techniques.

An uptake experiment was conducted at another site on the reef flat where holothurians were not present. An experimental group of holothurians (in a cage) and a control group were transferred to the site. Dry sediment contaminated with light diesel oil was spread over the floor of the cage. Holothurians and sediment samples were collected from the treated cage and from the control area and all samples were analysed for hydrocarbon content using the methods of the baseline study.

STATUS

The project has been completed.

Sediment samples contained no trace of oil contamination, although petroleum hydrocarbons were tentatively identified in sediments from one site sampled in the boat harbour.

H. atra sampled from the boat harbour and one site on the reef flat contained an array of hydrocarbons with characteristics similar to those of degraded diesel oil. *H. atra* sampled at the site furthest from the boat harbour contained hydrocarbons which displayed no characteristics of petroleum, and were thus assumed to represent ambient hydrocarbons.

Baseline levels of hydrocarbons in sediments and *H. atra* from this site on the reef flat were 100 ug/kg (wet wt) and 3,390 ug/kg (wet wt) respectively. These results compared favourably with other baseline studies.

Results from the baseline study indicated that *H. atra* may possibly bioaccumulate petroleum hydrocarbons, suggesting their use as a possible indicator of oil pollution. However, *H. atra* did not take up petroleum hydrocarbons during the uptake study. Further investigation is therefore required to demonstrate the usefulness of *H. atra* as a biological indicator.

Bishop, P.J. 1982. Hydrocarbons in holothurians, *Holothuria atra*, and surface sediments from Heron Island boat harbour and reef flat. Honours dissertation, Griffith University.

LOCALITY: Capricornia Section - Heron Island Reef

Evaluation of the Gastropod *Strombus luhuanus* as an Indicator for Petroleum Hydrocarbons in a Coral Reef System

PERIOD: 1982

ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Ms H. Chapman

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr D. Connell, Dr C. Catterall

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$460

OBJECTIVES

To test the suitability of *Strombus luhuanus* as a bio-indicator for petroleum hydrocarbons in coral reef systems.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to test the suitability of a biological parameter to monitor background levels in the entire Great Barrier Reef and to measure the impacts of a spill.

METHODOLOGY

In situ tests will be made of the rate of uptake, retention and depuration of petroleum hydrocarbons. Low levels of a range of hydrocarbons will be used.

Compounds will be analysed by gas chromatography and gas chromatograph mass spectrometry. Fieldwork will be undertaken in May 1982.

STATUS

Report to GBRMPA due June, 1983.

LOCALITY: Capricornia Section - Heron Island Reef

Lipids in sediments and Holothurian Grazing

PERIOD: 1982

ORGANIZATION: University of Melbourne,
Department of Organic Chemistry

PROJECT LEADER: Ms M. Peters

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr R. Johns

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$757

OBJECTIVES

To undertake a baseline study of lipids in sediments.

To determine marker compounds to identify different types of micro-organisms in sediment.

To assess the effect of holothurian grazing on micro-organisms in sediment.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide reference data for comparison of lipids in sediment in the future and to provide baseline data for the evaluation of possible future effects on holothurians.

METHODOLOGY

The lipids being studied are pigments, fatty acids, sterols, alcohols and hydrocarbons.

A baseline lipid study carried out at Lizard Island Reef will provide data for later comparisons.

The detrimental effects on bacteria and other micro-organisms from e.g. hydrocarbons derived from other than natural sources will have an effect on the whole system.

STATUS

The project has been completed.

With respect to micro-organisms in the sediment, it was found that bacteria, meiofauna, and algae are all grazed by holothurians and few survive the passage through the gut intact. However, the algae and bacteria grow faster in the heavily grazed areas. This suggests that the holothurians assist in the release and recycling of nutrients from within the sediment. Meiofauna populations are continuously decreased by holothurian grazing, but there was a greater decrease in meiofaunal numbers in the sediments from which holothurians were excluded. Holothurians therefore appear to be providing nutrients for the growth of other components of the coral reef, including their own food, and ensuring that the bacteria can continue in their role as the primary decomposers of dead and detrital material on the reef.

The techniques used in this study can define base line levels of natural biogeolipids and thereby allow changes in the natural components of the reef to be determined and to distinguish allochthonous inputs.

LOCALITY: Cairns Section - Lizard Island Reef