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DINOFLAGELLATE DENSITY AND CIGUATERA INCIDENCES ON CHRISTMAS, FANNING, AND CIGUATERA INCIDENCES ON WASHINGTON ISLANDS, LINE GROUP, KIRIBATI

by

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CIGUATERA FISH POISONING

PROGRESS REPORT

Dinoflagellate density and ciguatera incidences on Christmas, Fanning, and Ciguatera incidences on Washington Islands,Line Group, KIRIBATI.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The most evident factors triggering the onset of ciguatera outbreaks are disturbances in the ecology of coral reefs, natural events such as storms and hurricanes, or human activities, such as dredging and reef blasting (Tebano and McCarthy (1984), Tebano (1984), Ruff (1989) and Kaly & Jones (1994)). Outbreaks following military related activities have also been documented (Ruff, 1989) from the Marshall Islands, French Polynesia and Line Islands, Kiribati.

Ciguatoxication was first reported from the Line Island Group in the late 1930s. The first case reported from Christmas (Kiritimati) Island was about 1943 and in Fanning (Tabuaeran) about 1945. In the 1950s a series of fish species including surgeon fishes, carangids, butterfly fishes, snappers, moray eels and seabass were tested for ciguatoxicity (Halstead, 1967). Several species tested were proven to contain high levels of ciguatoxin. The last known records of ciguatoxicity level testing from Christmas and Fanning islands was in 1960. Washington (Teraina) was the only island which reported no ciguatoxications in those years.

The survey done in the Line Group was part of a project which monitors ciguatera fish poisoning levels in Kiribati. The report present some progress on the project as of mid-1994 to end of 1994.

The objectives of the project are;

(a) To monitor and establish a database on the impact of the Nippon Causeway on the level of ciaguatoxin in reef fish in the surrounding area

(b) To monitor the impact of reef blasting in the Gilbert and Linnix groups.

(c) Safeguard the public from eating toxic species, and

(d) Safeguard fish quality standards of the domestic fish market on Tarawa, outer islands and the Line Group by identifying ciguatoxic fishes and potentially toxic areas.

In this report, the population densities of the dinoflagellate *G.toxicus* are repoted and household interviews on the problem and ciguatera cases are discussed.

2. METHODS and MATERIALS

The survey in the Line Group was made between the 28th June and 20th July 1994. The visit to Fanning Island lasted three days (8/7/94 - 11/7/94).

2.1 **Interview**.

Old residents and fishermen were the main target during the interview. The questionaires were designed to identify toxic fishes, potentially toxic areas, and probable factors related to the problem. The local fish names given were cross checked with existing references for English and scientific names.

2.2 **Ciguatera Fish Poisoning cases**.

Christmas Island fish poisoning cases were provided by the London clinic. The cases were verified by cross checking symptoms and information provided with the symptoms of ciguatera fish poisoning.

Washington and Fanning Island cases were kindly provided by the Statistics Unit of the Tungaru Central Hospital, Nawerewere.

2.3 **Assay method used for the field survey on the population density count of *G.toxicus* and related dinoflagellates**.

Algal specimens were collected by SCUBA diving. The algae were sieved through different sieve sizes; 500μm, 125μm, and 38μm. The residue retained on the 38um sieve was transfered to a 25ml plastic vial and preserved in 5 % formalin. These subsample were used for dinoflagellates identification and count using a microscope. The population density was calculated per gram of algae. Other dinoflagellates identified were *Ostreopsis siamensis, Ostreopsis.sp., Coolia monotis, Prorocentrum lima,* and *Amphidinium spp.*

Seven sites were selected from Christmas Island (Figure 3) and four sites from Fanning Island (Figure 4). For each site selected, five replicates were obtained.

3. RESULTS

3a. **Christmas Island**

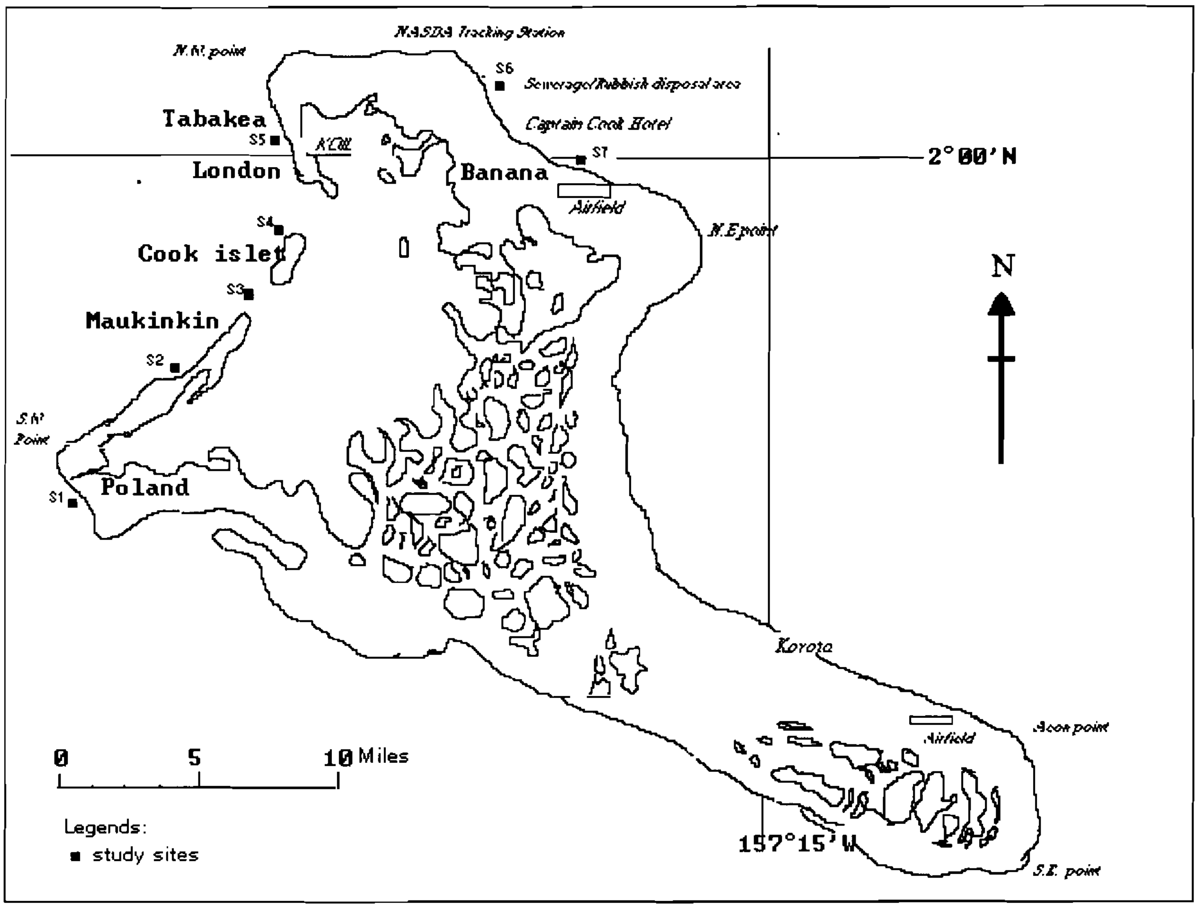


Figure 1. Map of Christmas Island showing study sites and potentially toxic areas

3a.1. **Interview**

Knowledge of ciguatera fish poisoning history and the factors triggering it is very limited. Most interviewees could only tentatively identify potentially toxic areas and some toxic fish species. Coastal areas north and south of Cook islet, London, Koil to Nasda and Hotel to Korota (Figure 1) were classified as potentially toxic areas. Te ingo *(Lutjanus bohar)* and te rabono *(Gymnothorax sp.)* were the only species reported to be toxic and were considered moderate in toxicity. Te ingo is the species common to all potentially toxic areas mentioned above.

3a.2. **Ciguatera fish poisoning cases**

Except for 1989, 1992 and 1993 the number of fish poisoning were very low (Table1). In the 1993 cases, Banana and London recorded the highest incidences (Table 2).

Table 1.Fish poisoning cases from 1987 to 1993 obtain from the Tungaru Central Hospital, Nawerewere.

	Years						
	1987	1988	1989	1990	1991	1992	1993
Christmas Is	1	0	12	0	-	2	26
Fanning Is (Tabuaeran)	7	0	0	1	-	39	31
Washington Is (Teraina	4	7	26	0	-	41	4

Table 2.Verified fish poisoning cases, cases obtain from London Clinic, Christmas island

	Years			
Village	1991	1992	1993	1994
London	4	2	14	4
Banana	0	0	10	0
Tabakea	0	0	0	0
Poland	1	0	0	0

3a.3. **Dinoflagellate densities**

G.toxicus occured at 3 sites in very low abundance, less than 3 counts per gram algae. *P.lima* was a predominant species at all study sites. The highest density was found at Poland followed by the sewerage disposal area (Figure 1, 3 & Appendix 1). Other dinoflagellates were also found (Figure 3) at the same study sites.

3b. **Tabuaeran**

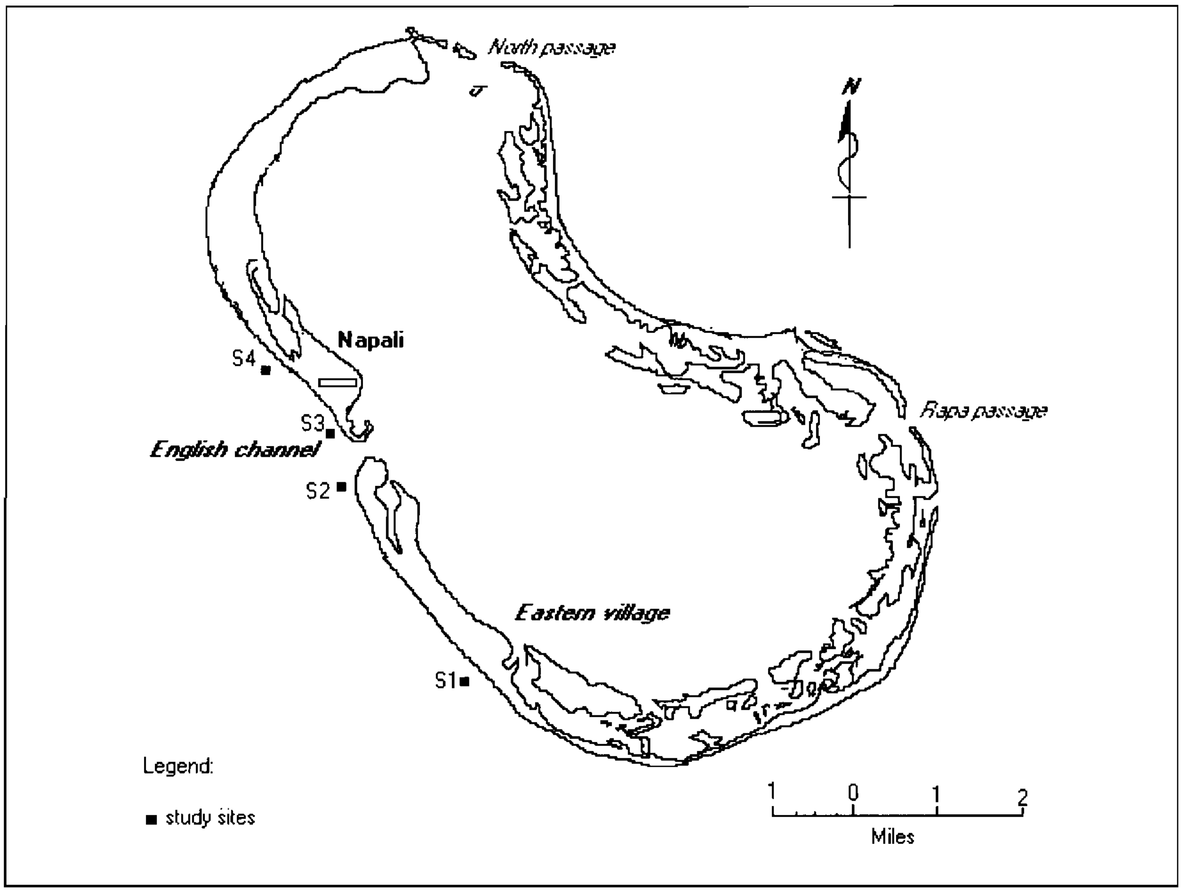


Figure 2. Map of Tabuaeran (Fanning Island) showing study sites

3b.1 **Interviews**

3b.1.1. **General view of interviewees on Ciguatera**

Interviewees indicated that ciguatera fish poisoning had been there long before I-Kiribati were allowed to settle on the island, that is, before 1930. Reasons behind the existence of fish poisoning are unknown to most inhabitants, but shipwreck was suspected to have worsen the problem.

Fishermen who had spent most of their life on the island had observed fluctuations in ciguatoxic level. The level reached its peak between the 1930s and 1950s. A decline in ciguatoxic level was noticed in 1960, mostly in herbivorous fish species such as te riba (*Acanthurus gahham*), te mako (*Acanthurus xanthopterus*) and te nnokunoku. An increase was notice again in 1973 and 1975 following two shipwrecks both at the western side of the channel. Since the early 1980s a decline in ciguatoxin level was noticed.

3b.1.2. **Toxic areas and fish species.**

The potentially toxic areas identified by most interviewees are confined to areas between the two furthest villages, Napali and the furthest eastern village (Figure 2), a newly founded village. The area between the eastern village and the English channel is populated by less toxic fish species, whereas from the channel to Napali accomodate the most highly toxic species. The area considered less toxic still holds highly toxic species even though the ciguatoxin level in the area was noticed to have declined since the early 1980s.

Table 3 shows toxic species known to most inhabitants.te maneku (*Cephalopholis sp*), te ingo (*Lutjanus bohar*), te karon (*Cheilinus miniatus*) and te nimwanang (*Cephalopholis argus*) were considered highly toxic.

Table 3.List of ciguatoxic fish species on Fanning Island.

Kiribati Name	Englsh Name	Scietific name.
Te maneku	Grouper	*Cephalopholis sp*
Te ingo	Redbass	*Lutjanus bohar*
Te Karon	Humpheaded wrasses	*Cheilinus miniatus*
Bukitakeiau??		
Te riba	Black berred	*Acanthurus gahhm*
Te mako	Surgeonfish	*A. xanthopterus*
Te nnokunoku		
Te rabono	Eel	*Gymnothorax sp*
Te nimwanang	Peacock rockcod	*Cephalopholis argus*

3b.2. **Ciguatera fish poisoning case**

Fish poisoning cases on Tabuaeran (Table 1) showed a very low number of cases between the years 1987 and 1990. A dramatic increase happened in 1992 when there were 39 cases and again in 1993 when there were 31 cases.

3b.3. **Dinoflagellates densities**

Gambierdiscus toxicus was present at all four studied sites. The highest density was found at both sides of the English channel. Other dinoflagellates were also found at high densities (figure 4). Napali and the eastern village have a low density of dinoflagellates compared with the high densities found at the channel.

Table 4. Population census result for Fanning, Washington and Christmas islands.

Years	1985*	1990*	1995**
Fanning	445	1051	(+2/3 of 488)
Washington	451	889	(+1/3 of 488)
Christmas	1737	2447	?

* *1985,1990 census*

*** figure obtained from the Ministry of Lines and Phoenix Groups*

The population is growing rapidly in the Line Group (Table 4). Four hundred and eighty eight (488) new recruits are expected this year, two thirds of whom will be settled in Fanning and the rest in Washington.

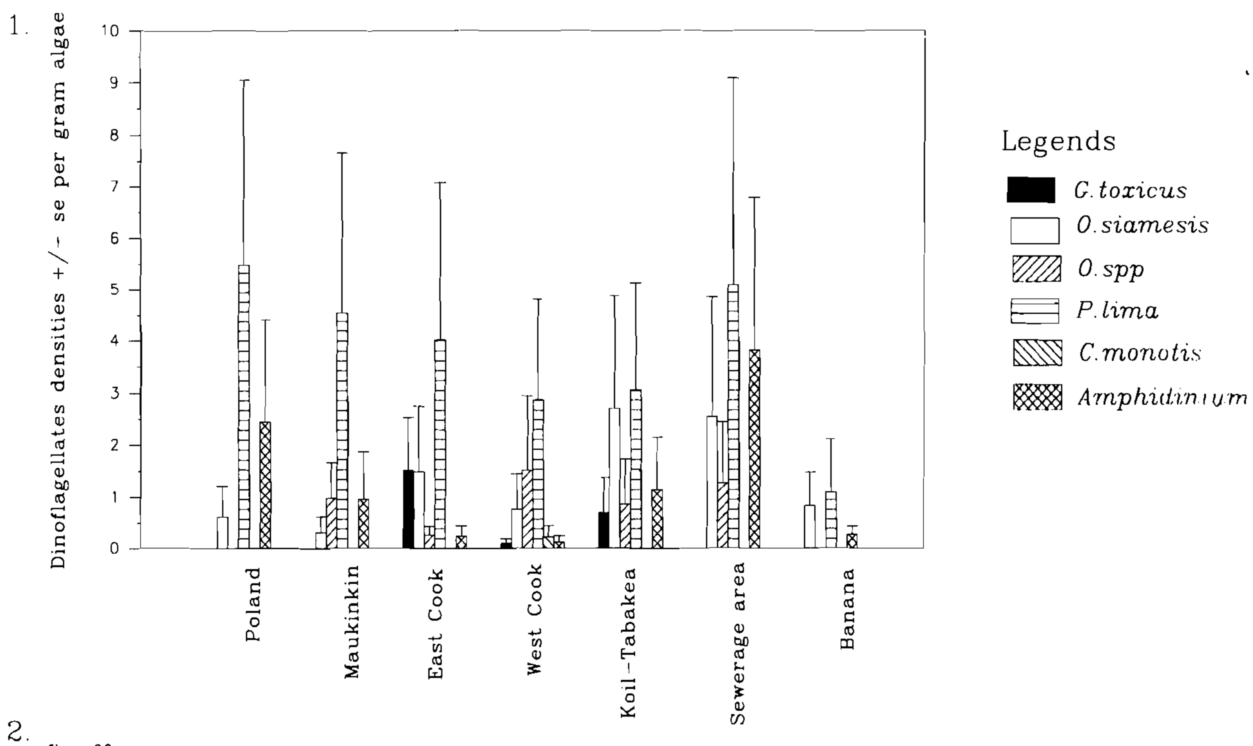
The dramatic increase in fish poisoning cases between 1989 and 1993 (Table 1), and the human population growth in the Line Islands, that is Christmas, Fanning, and Washington islands were positively correlated. Inversely, the significant decline in ciguatoxin especially on Fanning Island noticed by the locals is negatively correlated with the high number of fish poisoning cases reported.

DISCUSSION

The high number of fish poisoning cases on Fanning and Washington islands show that people are still at risk eating fishes caught from potentially toxic areas. Although, a significant decline has been analytically proven since 1960 (Halstead, 1967) ciguatera will still be a problem on these islands since fish is a dietary staple.

People from the Gilbert islands are being recruited to the Line Islands and hopefully other islands in the Phoenix Group under the Government programme known as '*Te kamaeka i mainiku*' or recruiting people to the Line Group. Fanning and Washington islands are the only two outstanding islands. The Government initiated the programme in 1988, which falls into two phases. The first phase confirmed the people who had been living there for years the right of landownership. The second phase 1989 and 1990, recruited families from the Gilbert Group to Fanning and Washington islands. This second phase still continues and will probably be finished at the beginning of 1995.

The newly settled recruits face various problems one of which is ciguatera fish poisoning. This is probably happening as a result of limited knowledge and lack of advice on



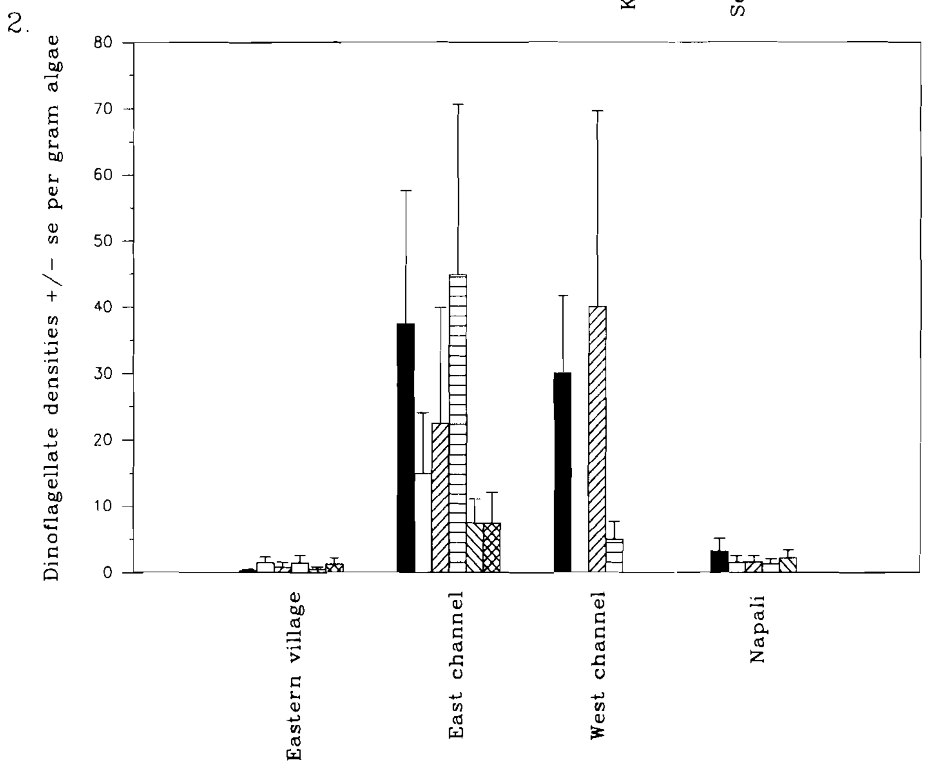


Figure 1. Dinoflagellate densities at seven study sites on Christmas Island

Figure 2. Dinoflagellate densities at four study sites on Fanning Island

fish poisoning in the Group. It is therefore recommended that the Government advises people intending to move to these islands about ciguatoxic fish species and the potentially toxic areas.

Christmas Island is known to have some of the highly ciguatoxic fish species (Halstead (1967)). The survey, however, shows lower fish poisoning cases compared to the other two islands, Fanning and Washington. Christmas Island has a huge landmass area compared to the latter two islands, providing alternative food sources beside fish. Therefore the chances of eating and thus identifying ciguatoxic fish species is very small. More cases will probably emerge as the poupulation increases in the years to come.

Te baneawa (*Chanos chanos*), a species which can survive in both the marine and brackish aquatic environment is abundant on Christmas island. The high population density of this species (personal observation) would not last long if the present unmanaged intense harvest from non-Government fish ponds still continues. The decline will probably force people to both lagoon and reef species for protein supplement. This could also alter the current ciguatera status. As more lagoon and reef fishes are consumed more ciguatoxic cases may be expected. Ciguatera will still persist for many years to come. Other dinoflagellates identified apart from *G.toxicus* also posses a toxin found in ciguatera (Juranovic and Park (1991)).

An overview of potentially toxic areas on Fanning island is limited to village vicinities which cover less than half of the island. Expansion or formation of new villages by new settlers will probably reveal more toxic areas as their population increases in number.

G.toxicus high population density still persists at the English harbour, the general area in which poisonous fishes were reported to have been abundant since the mid-1940s (Halstead, 1969). Previous ecological researchers have not yet been able to assess the triggering factors which cause the onset of ciguatera. However shipwrecks, war waste dumping, reef blasting for boat channel and other disturbances on coral communities were claimed to have contributed and link to ciguatera. On Fanning Island in particular, shipwrecks have increased ciguatoxin level. In another study (Kaly and Jones ,1994) the outbreak caused alone by physical disturbances such as shipwrecks or boat channel blasting is most unlikely, but interactions of disturbances with other factors is most likely.

Despite these, the seriousness of ciguatera in the Line Group can not be underated as more people will probably be moving to these islands. To match the influx of people to these islands more development will be made to meet the demands of a growing population. Some of the developments will of course be marine related, and these could act as contributing factors to ciguatera.

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Thank you goes to the Assistant Fisheries Officer, Michael Tekanene and his staff both on Christmas and Fanning Islands for arranging transport and accomodation.

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APPENDIX

1.***Mean density of each dinoflagellate species for each study sites on Christmas island***

Sites	*C.monotis*	*P.lima*	*Amphidinium*	*O.siamensis*	*O.sp*	*G.toxicus*
S1	0	5.4 (3.5)	2.4 (1.4)	0.6 (0.2)	0	0
S2	0	4.5 (3.1)	1.0 (0.6)	0.3 (0.1)	0.9 (0.4)	0
S3	0	4.0 (2.9)	0.2 (0.06)	1.4 (1.0)	0.3 (0.1)	1.5 (1.0)
S4	0.3 (0.2)	2.9 (1.6)	0.1 (0.06)	0.8 (0.6)	1.5 (1.0)	0.1 (0.04)
S5	0	3.1 (2.0)	1.1 (0.8)	2.7 (1.9)	0.9 (0.7)	0.7 (0.3)
S6	0	5.1 (3.9)	3.8 (2.1)	2.5 (2.0)	1.3 (0.9)	0
S7	0	1.1 (0.5)	0.3 (0.1)	0.8 (0.2)	0	0

(#)-the standard error of the mean

2. ***Mean density of each dinoflagellate species for each study sites on Fanning island***

Site	*O.siamesis*	*O.sp.*	*Amphidinium*	*P.lima*	*C.monotis*	*G.toxicus*
S1	1.5 (0.8)	0.8 (0.5)	1.2 (0.8)	1.5 (0.9)	0.5 (0.3)	0.3 (0.1)
S2	15.0 (9.1)	22.4 (17.4)	7.5 (4.7)	44.9 (25.8)	7.5 (3.7)	37.4 (20.2)
S3	0	40 (29.6)	0	5 (2.4)	0	30 (11.7)
S4	1.5 (0.8)	1.5 (1.0)	0	1.3 (0.7)	2.2 (1.2)	3.2 (1.9)

(#)- the standard error of the mean