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KINA SAMPLING AND MARINE RESERVE MONITORING

(Short Answers in Conservation Science)

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KINA SAMPLING AND MARINE RESERVE MONITORING

Report prepared for the Department of Conservation Rotorua Conservancy

Dear Mr Garrick,

Herein is our advice on the following questions:

1. Kina size frequency investigations.
Advice on sampling design is required to enable a Department of Conservation initiated programme to be implemented by Bay of Plenty Polytechnic marine biology students, the objective of which is to quantitatively compare the size frequencies of kina at three locations within the Bay of Plenty.

2. Establishment of baselines for a subtidal monitoring programme at Te Whanganui a Hei Marine Reserve.
Advice is required on what biota should be monitored within the marine reserve, how this should be undertaken in terms of sampling design and where reserve and control sites could be located.

Our advice is as follows:

1. Kina investigations

a. Kina abundance: as per attached sheet except that 12 25 x 1 m transects be substituted for the 3 100m x lm transects.

b. Kina size frequency: The patchy distribution of kina can make the unbiased estimation of size difficult if kina inside and outside aggregations differ in mean size. Different methods of selecting individuals to be measured vary in their ease of use and degree of bias. There are several ways of doing this:-

(i) Measure all kina counted in each transect. The estimate of mean size will be unbiased but the process could be very time-consuming if many kina are present. Sub-sampling is usually necessary to reduce the numbers measured. The trick is to ensure random selection of individuals to be measured.

(ii) The best way is to keep a running tally of the numbers of kina counted in a transect and to measure only those kina previously chosen by random numbers eg. numbers 2, 7, 9, 15, 26, 27, 32 etc. This method is often slow because of changes in attention from counting numbers to measuring sizes but should yield an unbiased estimate of size.

(iii) Another method is to break the larger transect up into smaller units and to measure all kina in a randomly chosen subsample of these smaller units. For example in a 25m x lm transect three lm x lm areas could be randomly chosen and all kina within them measured. If this was repeated for all transects within an area then the degree of bias in estimating size would probably be small.

(iv) Measure the first 100 or 200 kina encountered in an area while swimming through. This method is fastest but will be the most biased if kina inside and outside aggregations differ in mean size.

Bulk harvesting of kina probably targets individuals within large aggregations as these often give the greatest return per unit of effort. In this case abundance and size within aggregations may be of most interest to compare among heavily fished and lightly fished localities.

2. Establishment of baselines for a subtidal monitoring programme at Te Whanganui a Hei Marine Reserve:

Background

There are two reports giving background information on the marine environment in the Hahei Marine Reserve which can be utilised to help plan a monitoring programme. A report by Coffey and Associates (1990) provides a preliminary species list of macrofauna and flora, a general description of the underwater habitats and a limited amount of quantitative data. A second report by the Bay of Plenty Polytechnic Marine Studies Course (1991) provides habitat descriptions and quantitative data on a range of species at sites inside and outside the then proposed reserve area.

Species to be monitored

We assume that the monitoring programme is required to document the probable recovery of species previously exploited in the reserve area (restoration) and later to monitor the continuation of this state.

Because of excessive time and cost it is usually impossible to monitor every species in a marine reserve. Many species are too small, too rare, or too transient to adequately monitor. Unexploited species are of limited interest as they are unlikely to show a response to protection in a marine reserve. For these species documentation of their presence/absence in the reserve and control areas at the start of protection is adequate. The key species to be monitored in a marine reserve fall into two groups:

-the habitat formers such as sea urchins, macro-algae, sponges (in sponge garden habitats) etc.
-the exploited species such as cray-fish, large reef fish, sea urchins and edible shellfish.

The two previous studies of the Hahei area adequately document the presence/absence of species, and identify the key habitat formers and exploited species.

Habitat Formers

-kina *Evechinus chloroticus*

-Macro-algae *Ecklonia radiata, Lessonia variegata, Carpophyllum spp.* (4 species), *Sargassum sinclarii.*

-Sponges (a variety of erect and massive species in the deep reef edge sponge garden habitat)

Exploited species
-crayfish *Jasus edwardsii*
-paua *Haliotis iris*
-kina *Evechinus chloroticus*
-large reef fishes
- red moki
- leather jacket
- blue cod
- goatfish
- hiwihiwi
- butterfish
- banded wrasse

Sample Design

Habitat description

Both previous studies in the Hahei area identified subtidal habitats commonly found in northeast NZ. Four of these warrant inclusion in a subtidal monitoring design. They are (with the habitat identifier used by Coffey and Associates (1990) and Bay of Plenty Polytechnic Marine Studies Course (1991) respectively); shallow mixed weeds (M & A), kina grazed areas (K & C), *Ecklonia* forest (E & D) and deep reef edge (D & not given). Both previous studies noted the need for habitat maps of the reserve as an aid to placing replicate transects within habitat strata. Habitat mapping can undertaken by intensive dive transect description such as occurred to produce the habitat map for the Leigh Marine Reserve or by swath mapping by acoustic devices linked to differential GPS.

Sources of variation

Previous work in north-east NZ indicates that variation in abundance of reef organisms within a general area occur among reef habitats, among localities, and among sites within localities. Estimates of abundance and size should therefore be made in each habitat using replicated transects within replicated sites, at several localities within the area of interest.

Our suggested design for surveys in each habitat type is as follows:

RESERVE						CONTROL					
LOCALITIES						LOCALITIES					
1	2	3	4	5	6	1	2	3	4	5	6
SITES						SITES					
1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
REPLICATES (N)						REPLICATES (N)					
5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5

In summary;	Treatment	Reserve/Control	t=2
	Localities (treatment)	6 localities	1=6
	Sites (locality)	2 sites	s=2
	Replicate counts	5 transects	n=5

There are no good preliminary data on densities of target organisms within the Hahei reserve and adjacent area. Thus the number of localities, sites (within localities) and number of replicates we suggest should be used in the initial survey are based on the experience of ourselves and others in undertaking similar surveys. The results of this survey should be used to refine the methods used in later surveys. Thus, it may be possible to reduce the numbers of replicates per site without major loss of statistical power.

Location of Reserve and control sites.

To enable valid comparisons between reserve and control areas to be made for each habitat type, localities in reserve and control areas should cover, as far as possible, the same range of aspect and exposure. For example localities R1 and C1 in Fig. 1 are both in coves on the south-eastern side of Mahurangi Island while R4 and C4 are on the exposed outer sides of two smaller islands and so on for the remaining localities. Other localities could be chosen but the guiding principal should be to ensure that natural sources of variation are equally represented in both the reserve and control localities. The reason for this is clear. If, for example, all macroalgae localities in the reserve area were on the exposed side of islands but the control localities were sheltered significant differences might be expected on the basis of degree of exposure alone. Based on information in Coffey and Associates (1990) and Bay of Plenty Polytechnic Marine Studies Course (1991) we suggest in Fig. 1 some likely localities in the reserve and control areas for placement of survey sites. However, we have no local knowledge and final decisions on choice of localities must be made in the field by someone with appropriate experience of the area and survey design. For the deep reef edge habitat it may not be possible to locate 6 localities in both reserve and control area where this habitat occurs. In this case a smaller but equal number of localities in each area should be surveyed.

Transect size

We suggest that reef fishes and cray fish be counted in replicate 50 x 5 m transects. This is twice the length used in the Bay of Plenty Polytechnic Marine Studies Course (1991) because of the low densities they encountered. The size of reef fish and crayfish should be estimated visually. Carapace length is a better measure of size than total length in crayfish as they frequently curl their tail beneath their body. These estimation techniques need to be practised underwater. This can be done using fish models and for crayfish by estimating size and then capturing the animal to measure carapace length. The error for each diver should be noted. Enclosed is a published paper in which visual estimates of carapace length in crayfish have been successfully used.

A portion of the tape laid out for the fish and cray counts can be used for the counts of large brown algae, sponges, kina and paua. We suspect that the kina abundance exercise outlined in section 1 will show that a 25 x 1 m transect is robust for counts of kina. It may also suffice for paua and sponges in shallow and deep habitats respectively. If in Ecklonia forest too many algae are encountered a shorter transect maybe required. The final decision on this

must be made in the field. The decision on where to start the counts for urchins etc should be made prior to the dive. Estimates of paua size frequency should also be made. For this species measurement of every individual encountered is probably feasible.
An estimate of the height of the macro algae canopy should be made. Size of sponges need not be recorded.

Survey conduct

Because crayfish and reef fish require different search image and technique we suggest that most reef fish species are counted as the tape is swum out and crayfish are counted on the return swim. Because of the more cryptic nature of hiwihiwi they may be better counted along with crayfish. In our experience an efficient way of conducting the counts is for the reel end of the tape to be attached to some convenient point and both divers swim out the end of the tape counting fish as they go, searching one side of the tape each. On the return swim one diver searches for crayfish and hiwihiwi while the other starts the counts of kina, macro-algae etc.

PROPOSAL FOR KINA SAMPLING AT MOTITI ISLAND, BAY OF PLENTY

Background:

Kina populations are highly clumped within the habitats generally known as urchin barrens. Traditional sampling using square-sided quadrats may not necessarily be the best way to estimate the size of the population because samples often contain either very few or large numbers of individual kina, depending on whether a patch was encountered or not. For instance, recent sampling within and outside the Tuhua Is Marine Reserve appears not to have produced results that we can rely upon should the population change as a result of protection. This sampling was undertaken using 3 replicate 10x10 m quadrats within each habitat, but based on the results, we would have needed to sample over 25 replicates to detect a 50% change in the population.

Proposal:

It is proposed to use several methods to sample the same total size of habitat to estimate the population of kina at Motiti Is. Four different methods could be used, a team of students each using a different method. The results from each can be compared to allow the most effective method to be chosen for future work.

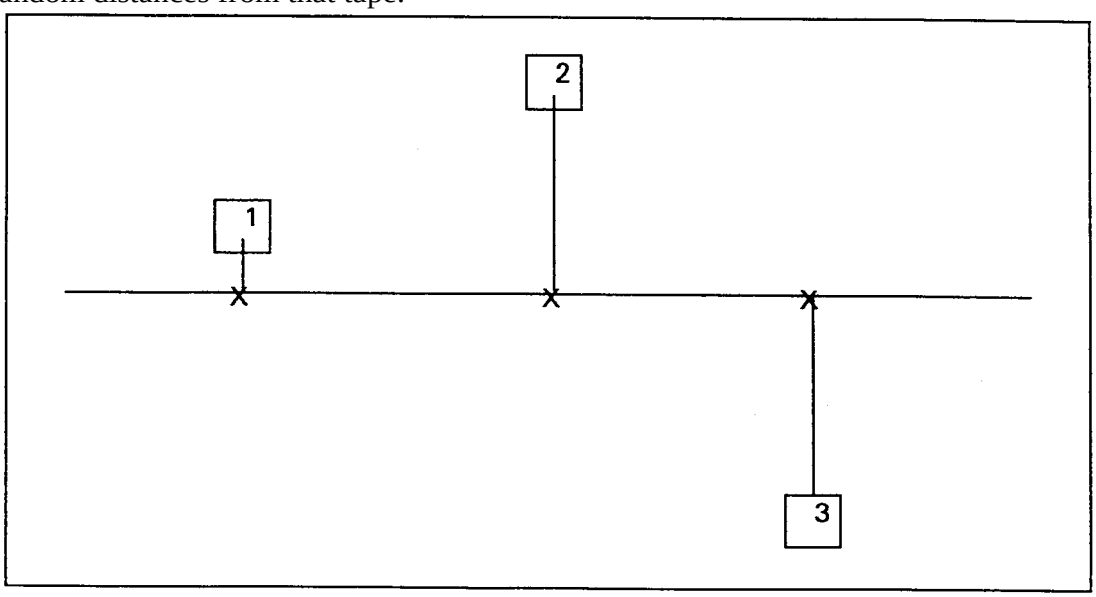
Three aspects require information to be gathered:

1. An estimate of the population size and its variance.
2. An estimate of the sizes of individuals within the population.
3. An estimate of the time taken to sample each method (a cost-benefit analysis).

Methods:

It is proposed to sample a total area of 300 m^2 in each method. All samples must be taken within the same habitat, eg urchin barrens between 5 and 10 m depth.

1. Random 10x10 m quadrats, with 3 replicates. The position of each quadrat could be determined by dropping 3 markers from the boat within the habitat. Each marker would then form the mid point of each quadrat. Alternatively a tape could be run out through the habitat, with 3 random points marked on it. Quadrats would then be placed at random distances from that tape.



2. Random lxl m quadrats, with 300 random replicates. The position of each quadrat could be determined by having 100 random marks along a 200 m tape. Repeat with two other marked tapes.

3. Random 100 x 1 m transects, with 3 replicates. These transects should be along a depth gradient to avoid crossing habitat boundaries as much as possible.

4. Count the number of kina patches along a transect 150 m long by 2 m wide. A patch for this purpose is defined as >10 urchins in 1 m^2. Measure the size of the patch, count the number of urchins within the patch, estimate the sizes of the individuals making up the patch. A patch should be included if some portion of it is within the 2 m wide band.

In addition to all this, the habitat should be described - depth, substrate, dominant algae, etc, and how big the total area of habitat is. This is required to give an estimate of the total kina population.

The time taken to complete each method should be recorded for time-benefit analysis.

The exercises above can be repeated as often as is wished, depending on personnel available.

Figure 1. Sketch Map of marine reserve, Hahei, showing suggested localities for monitoring in reserve and control areas