Biology of Coastal Management and Enhancement

Alison MacDiarmid

This presentation will briefly cover:

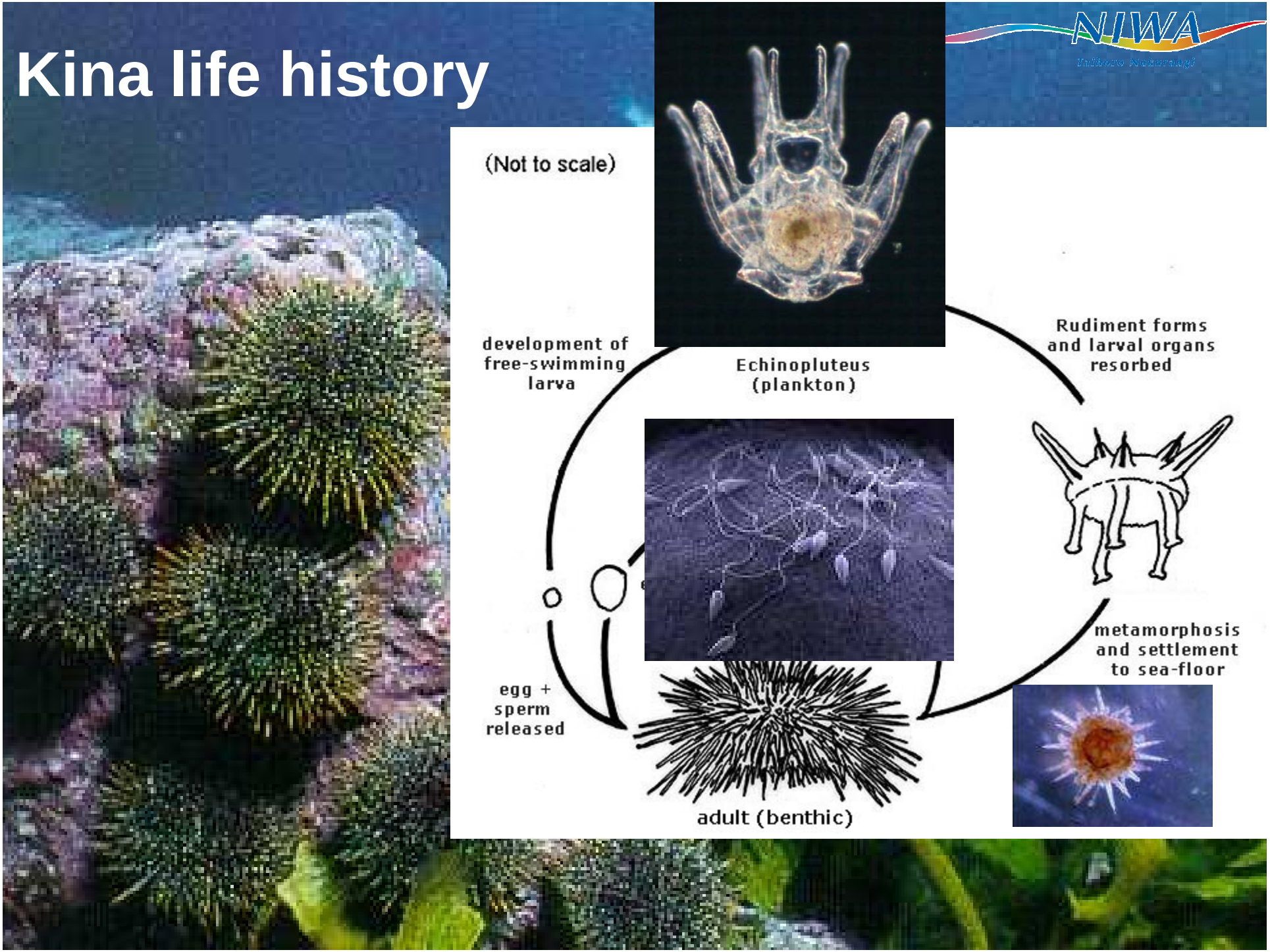
- Life history
- Environment
- Scales of connection among populations
- Interactions among species
- Population variability
- Effects of fishing
- Population rebuilding

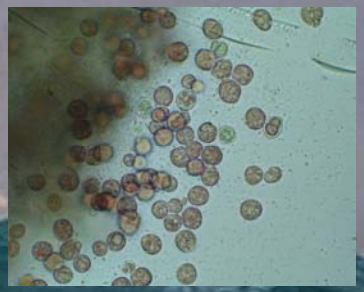
Fundamental differences in the life history of harvested marine and land species

- Land species have simple life cycles with a few young that are cared for by the mother. Usually good survival.

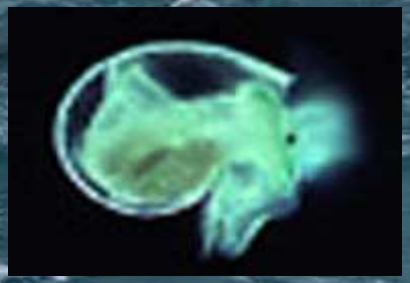
- Most marine species (with notable exceptions) have complex life cycles. Broadcast spawn thousands of eggs and sperm, larvae disperse, no parental care, massive larval mortality.

Kina life history





hours



7 days

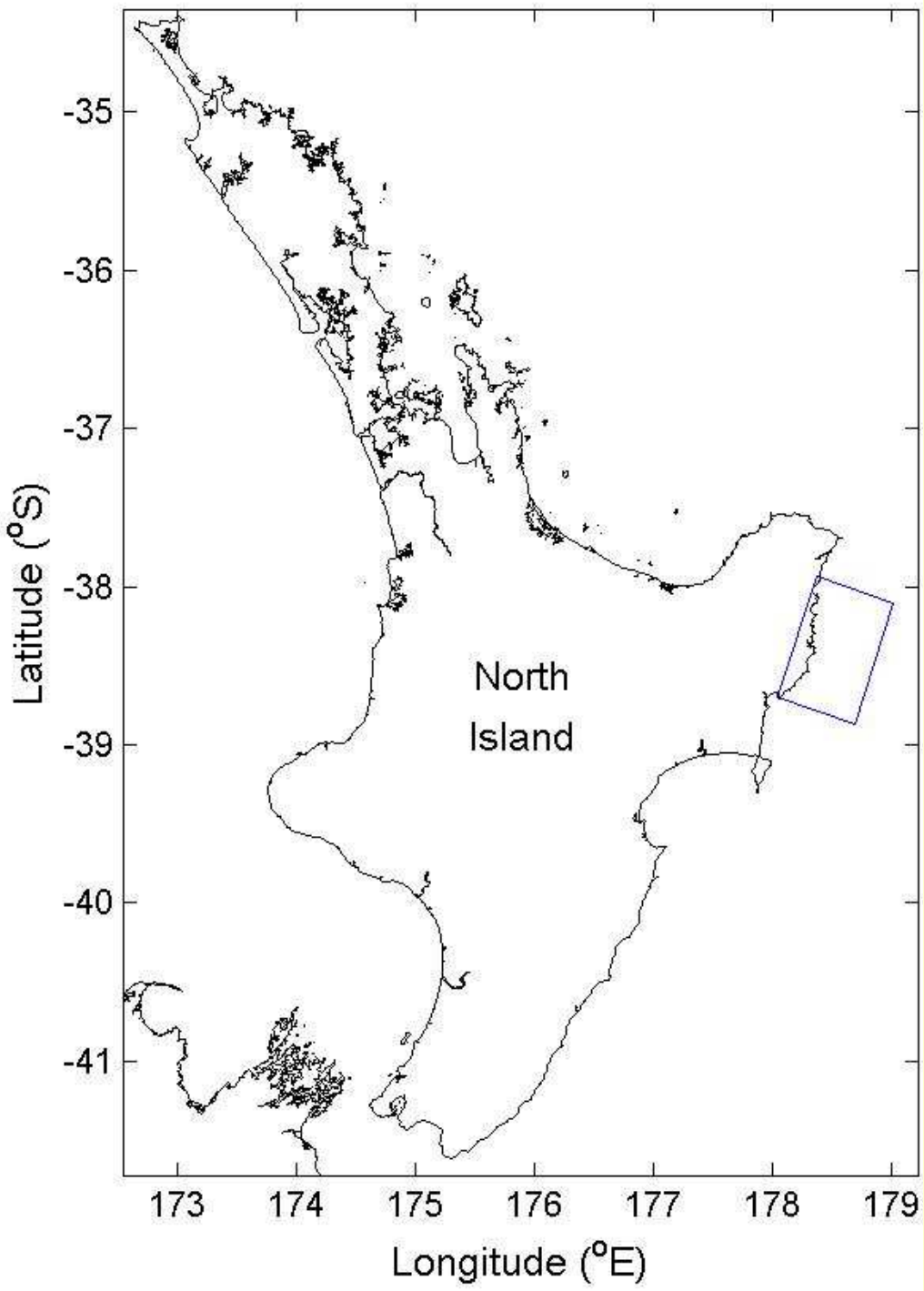
20-30 days

12-18 months

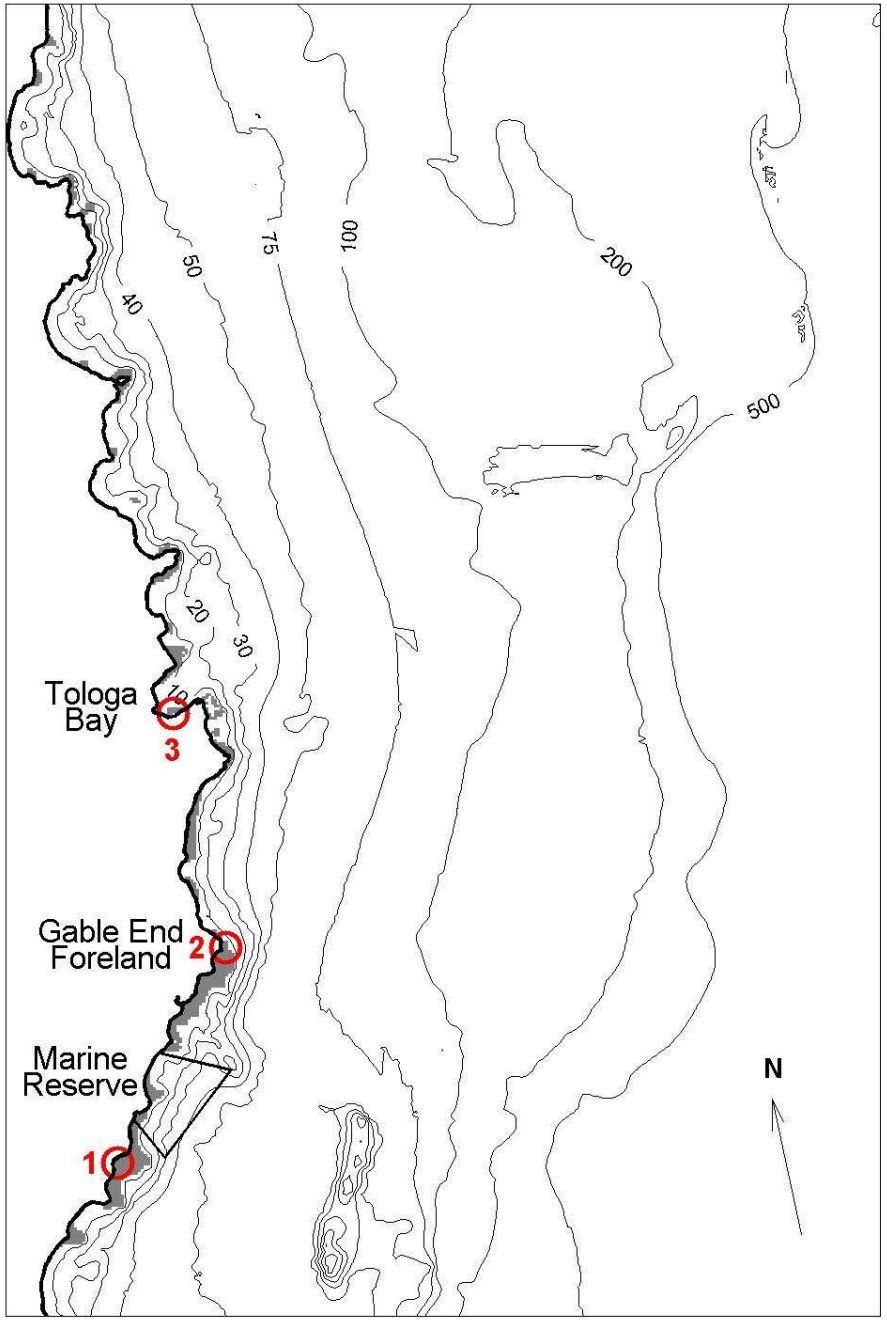
Effects of the environment on the scale of larval dispersal

An example with paua larvae

Based on work by Scott Stephens & Niall Broekhuizen, partly funded by DoC

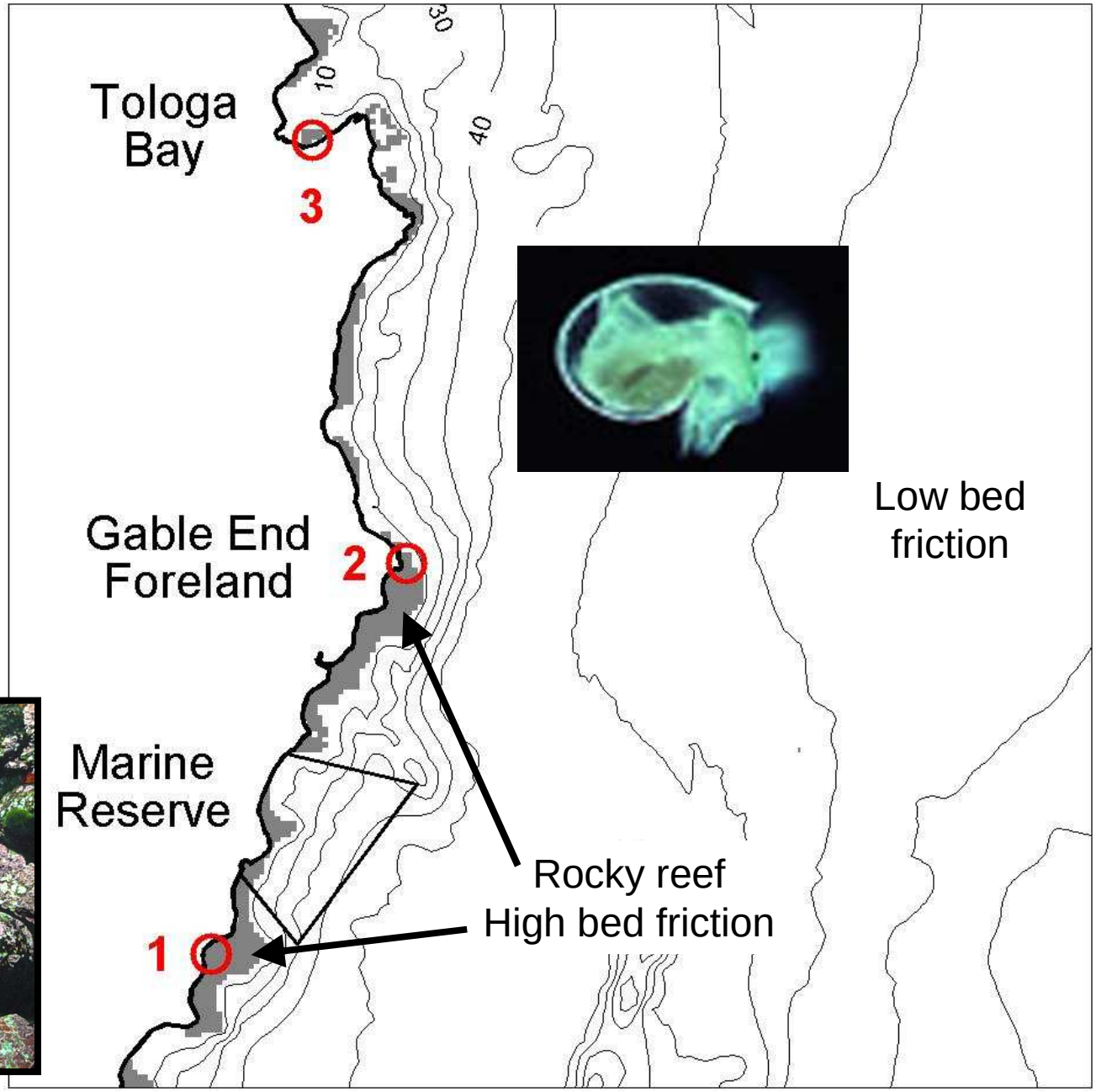


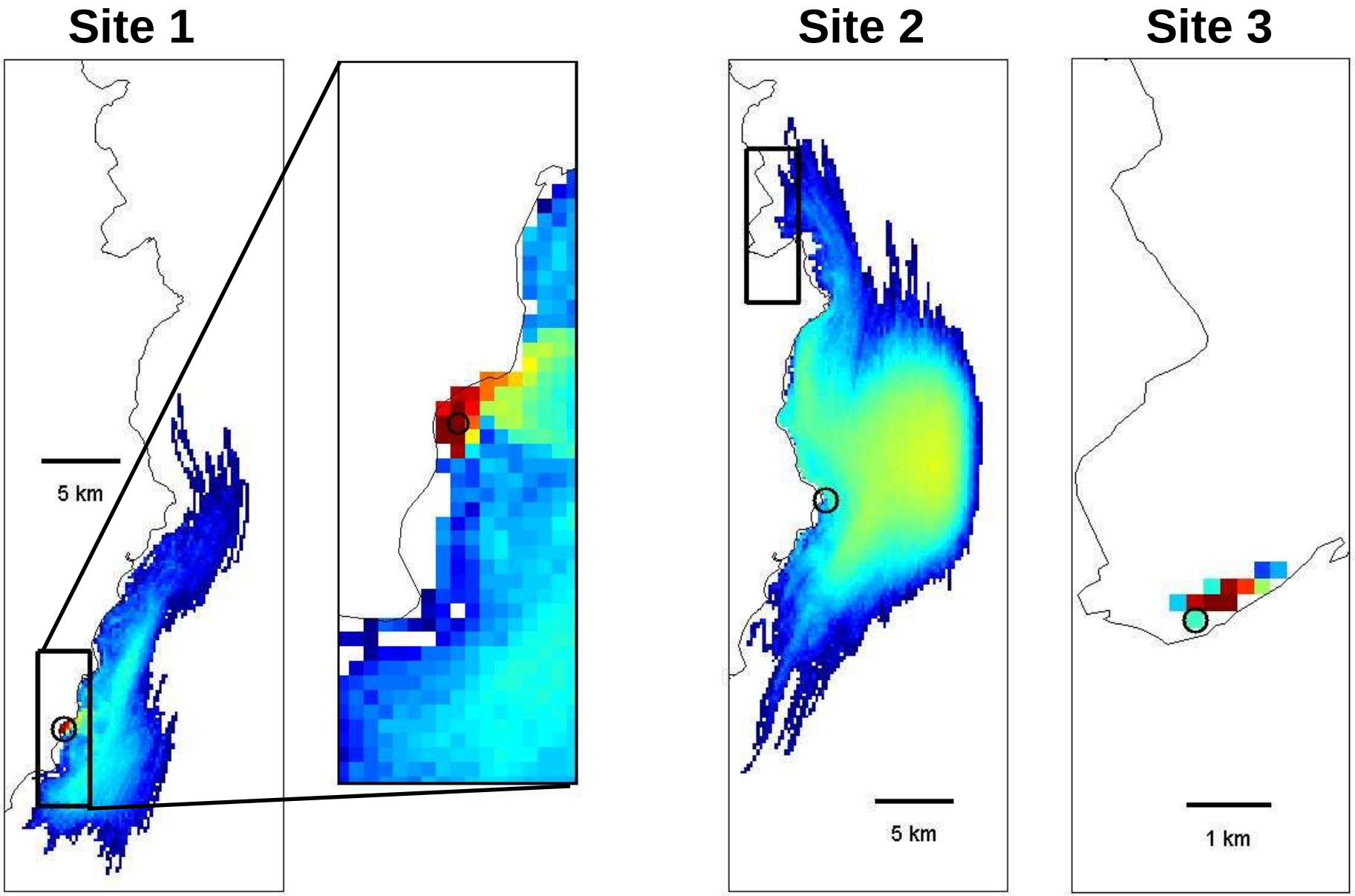
Scott & Niall constructed a 2-dimensional hydrodynamic model to predict current flow off an area of coast north of Gisborne



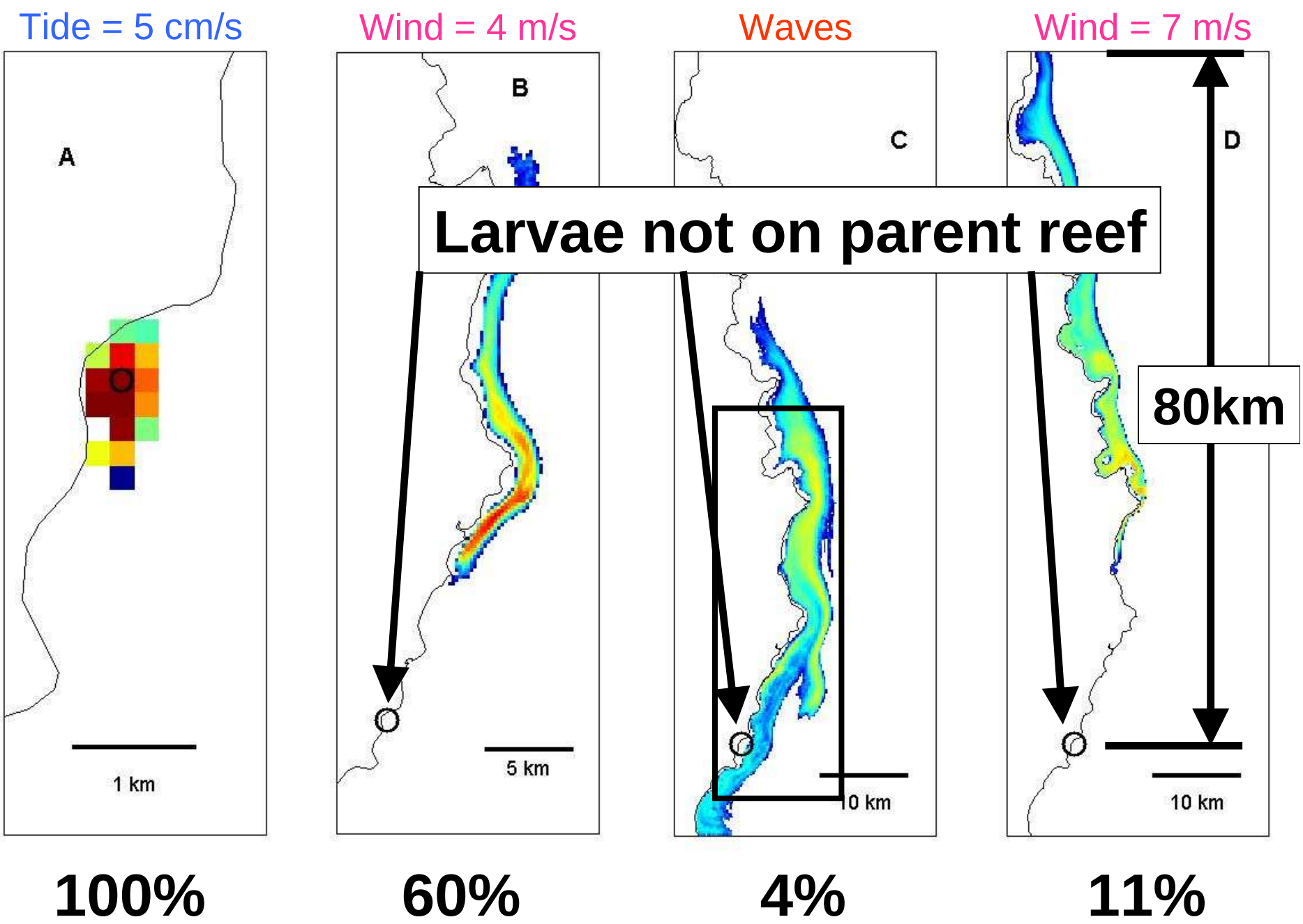
Included bottom shape and texture

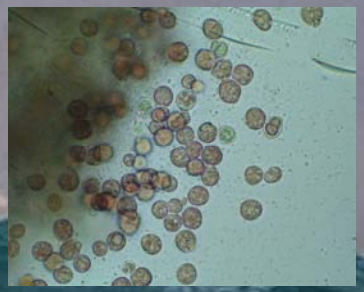
Tracked larval dispersal from shallow paua spawning sites



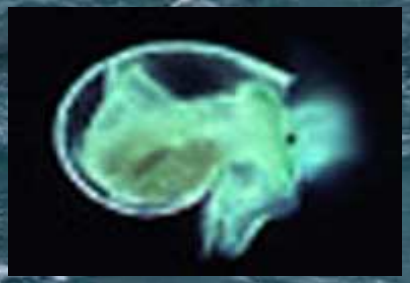


Tide = 0.3 m/s


Tide = 5 cm/s
Wind = 4 m/s
Waves
Wind = 7 m/s
A
B
C
D
Larvae not on parent reef
80km
1 km
5 km
0 km
10 km
100%
60%
4%
11%



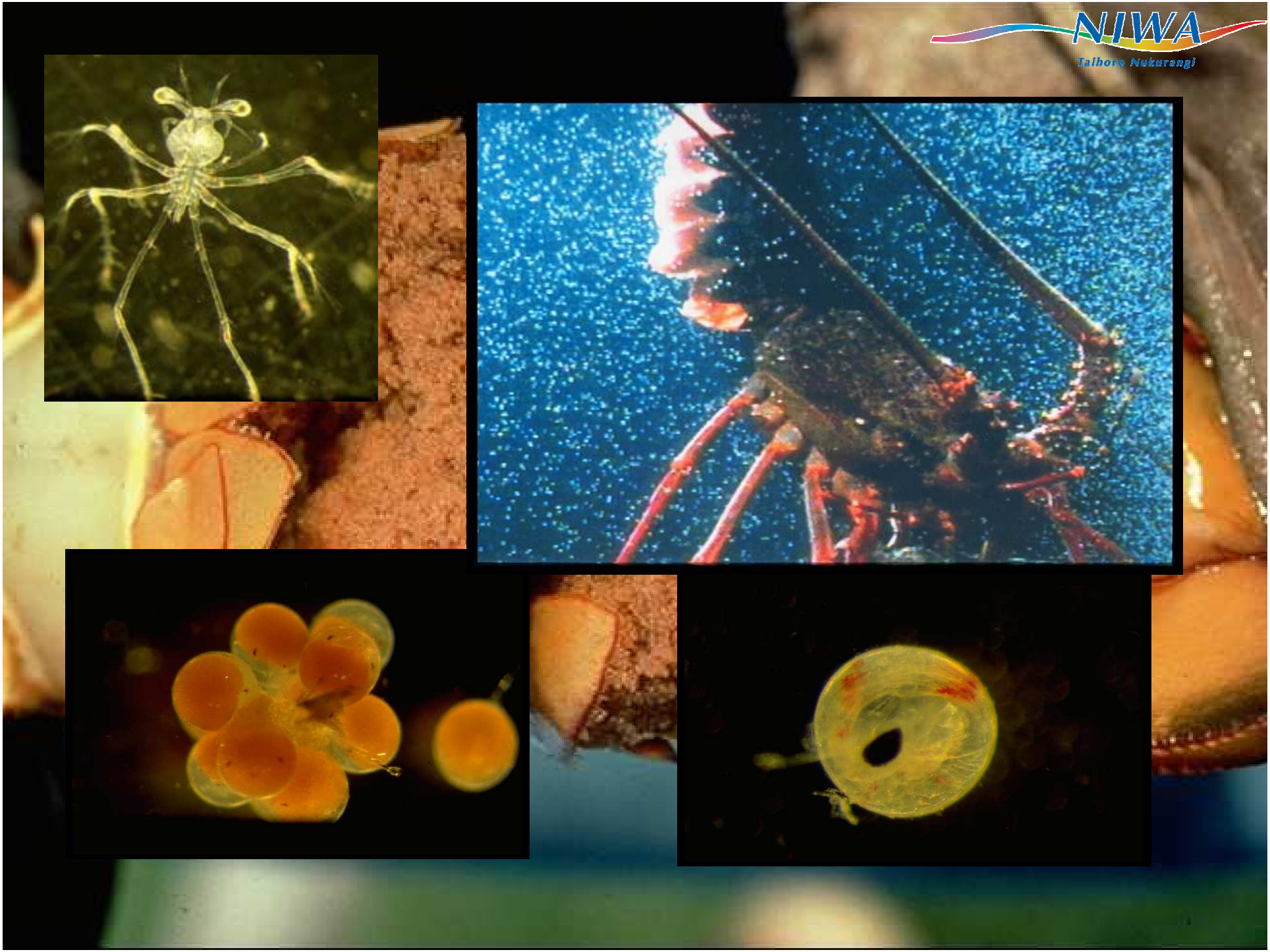
hours

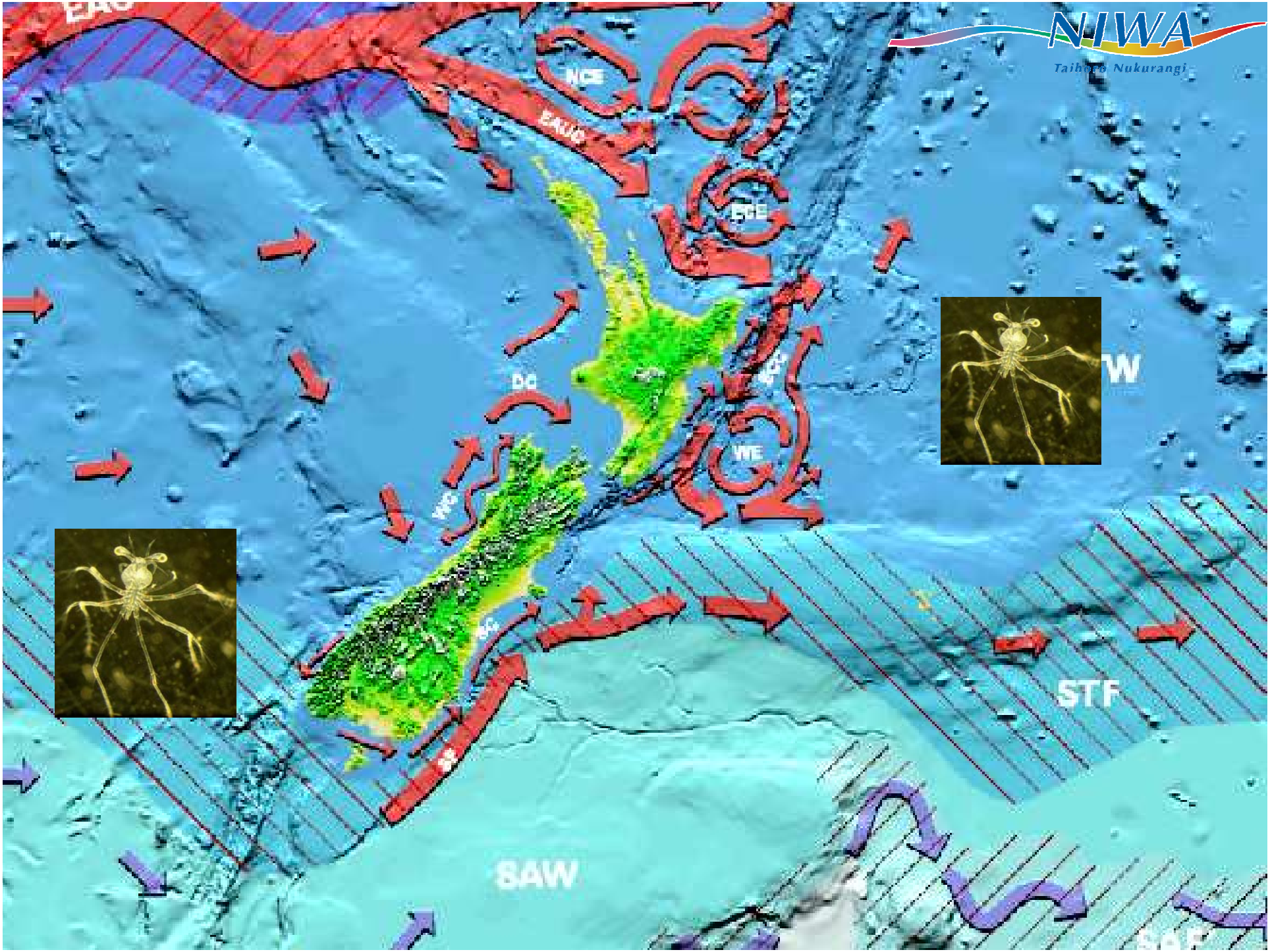


7 days

20-30 days

12-18 months


NIWA
Taihoro Nukurangi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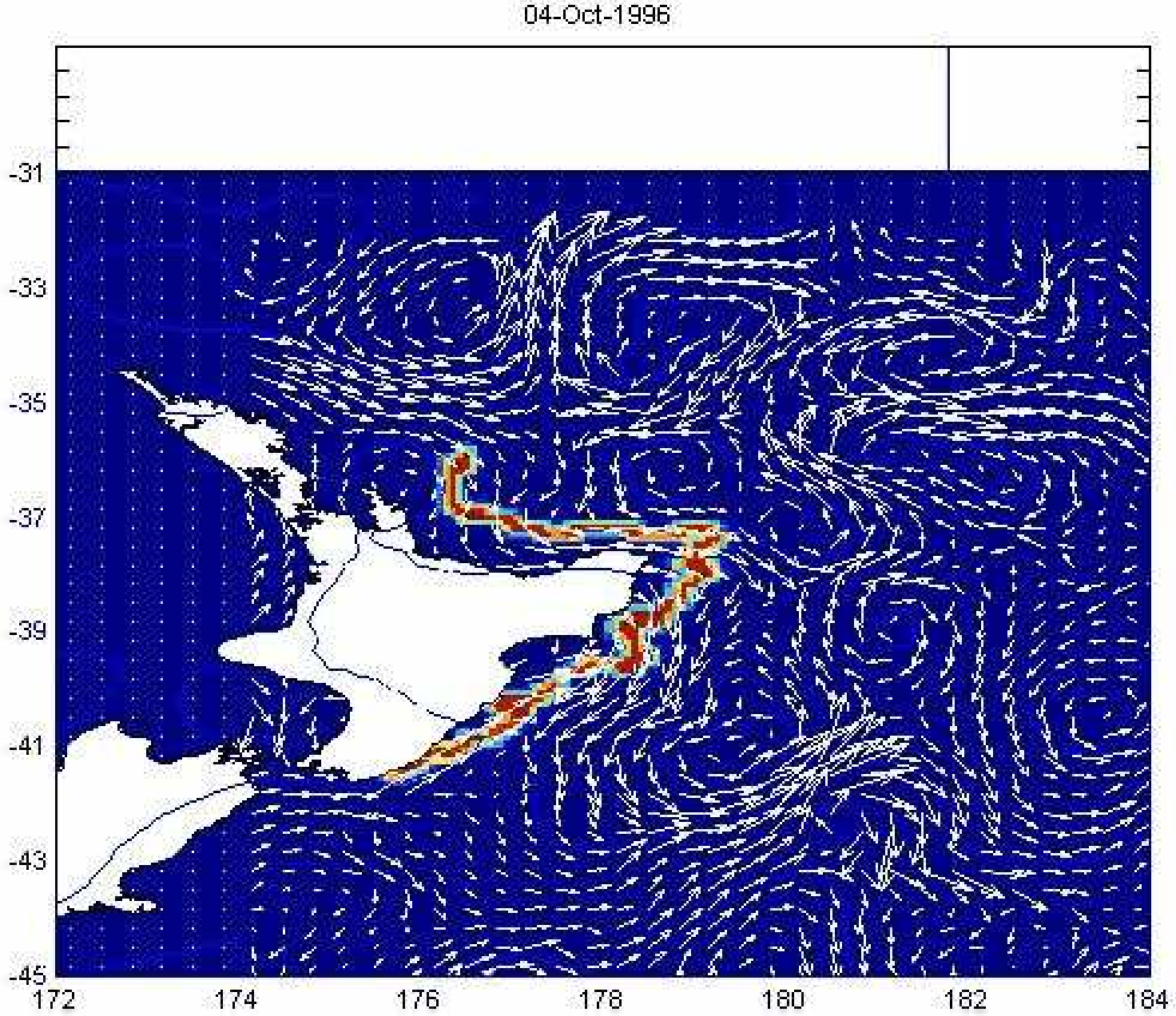
04-Oct-1996
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-33
-35
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-41
-43
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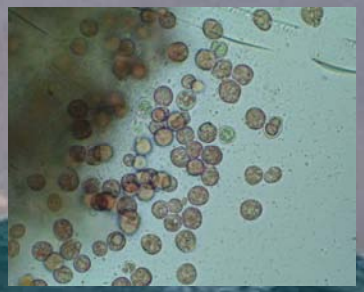
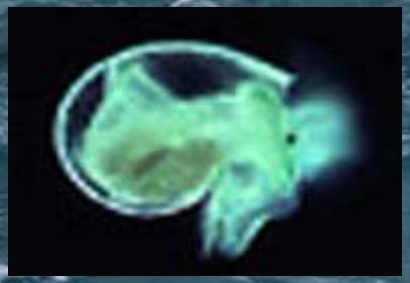


0-100 m



0-40 km

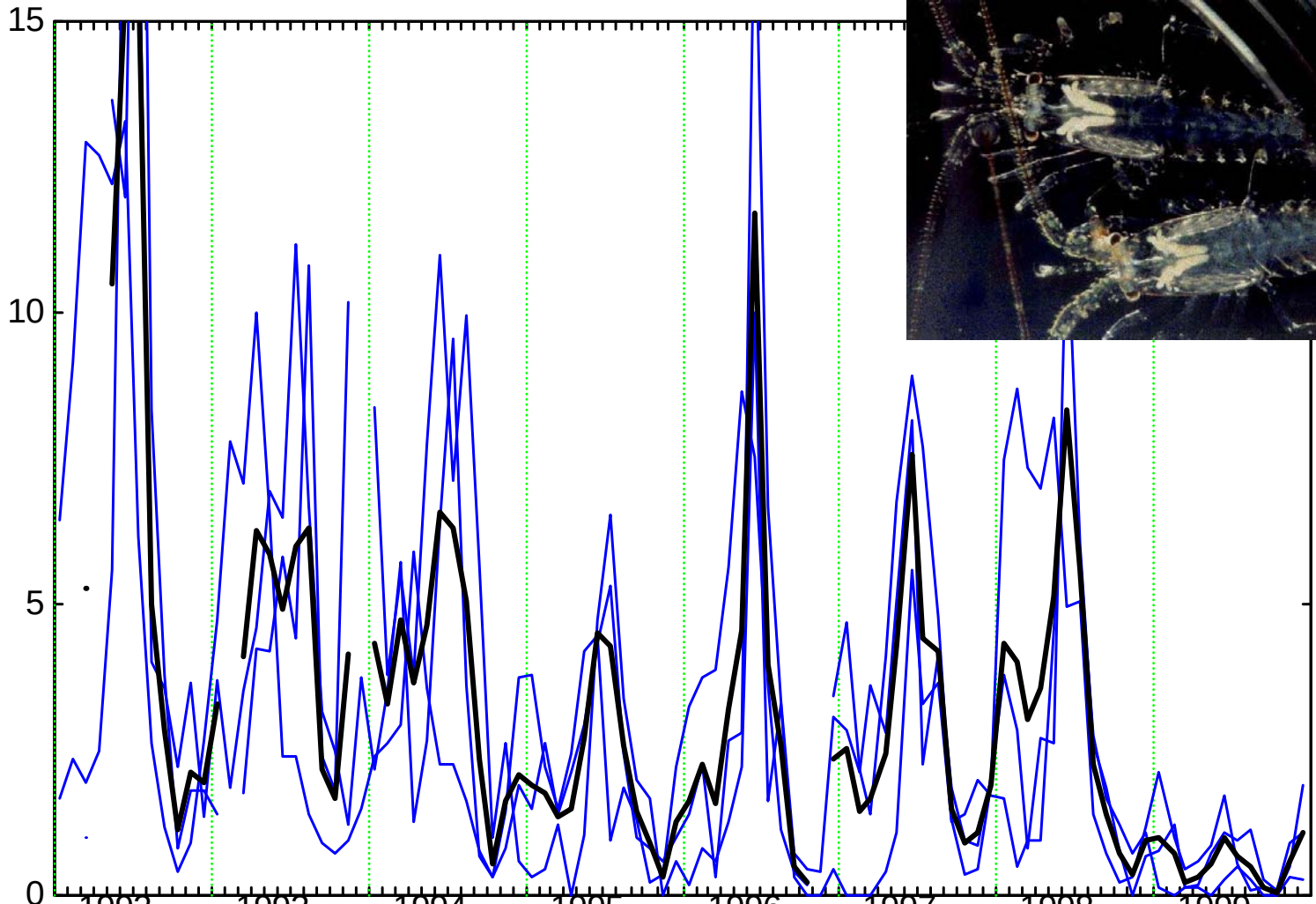
10-200km

500-1000km

Implications of larval dispersal

- Settlement of juveniles on your stretch of coastline is generally dependent on the wise governance of breeding stocks elsewhere
- Your wise management of breeding stock will principally be for someone else's benefit
- A particular stock of kaimoana needs to be collaboratively managed at a large spatial scale as well as a local scale
- The appropriate scales will vary among kaimaoana

Puerulus settlement 1992-1999



Interactions among species

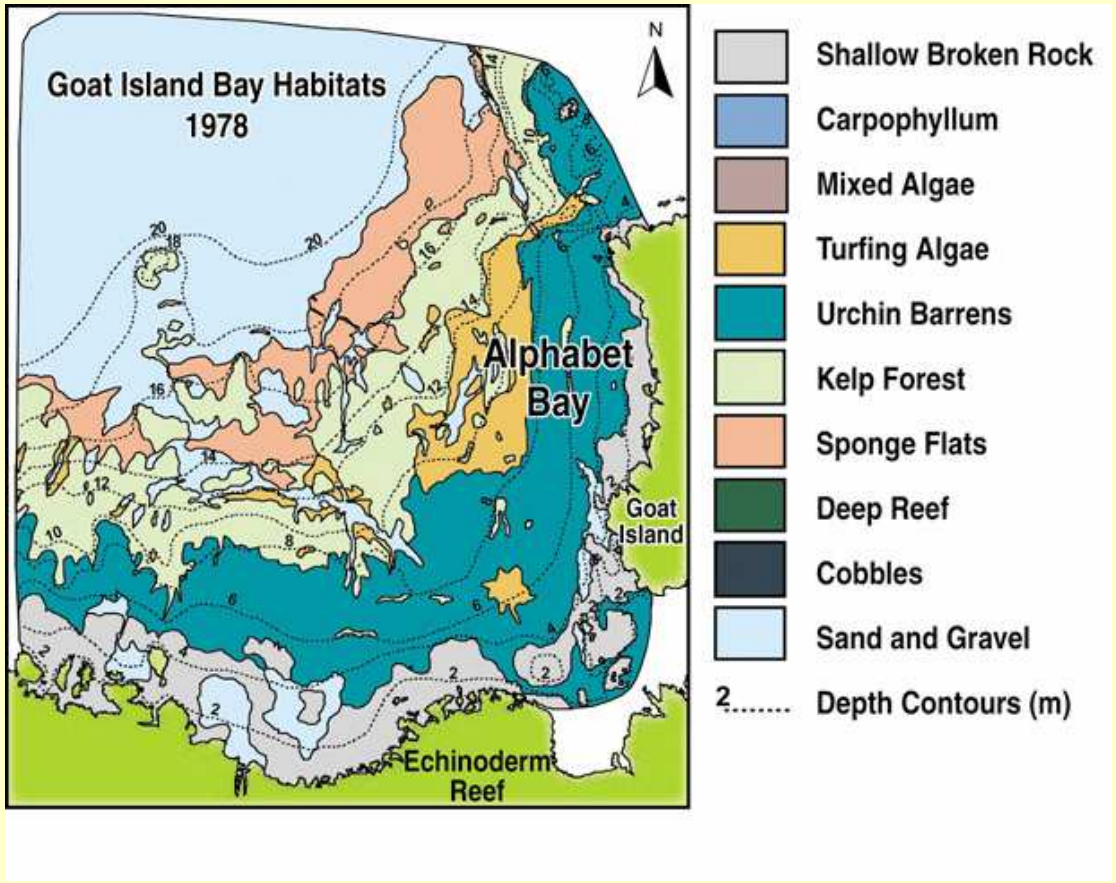
Kaimoana range from:

- **Primary producers such karengo**
- **Filter feeders such as mussels**
- **Grazers such as kina and pupu**
- **Predators such as snapper and crayfish**

Potential for interactions among these species that can cause depressed abundance and cyclical changes

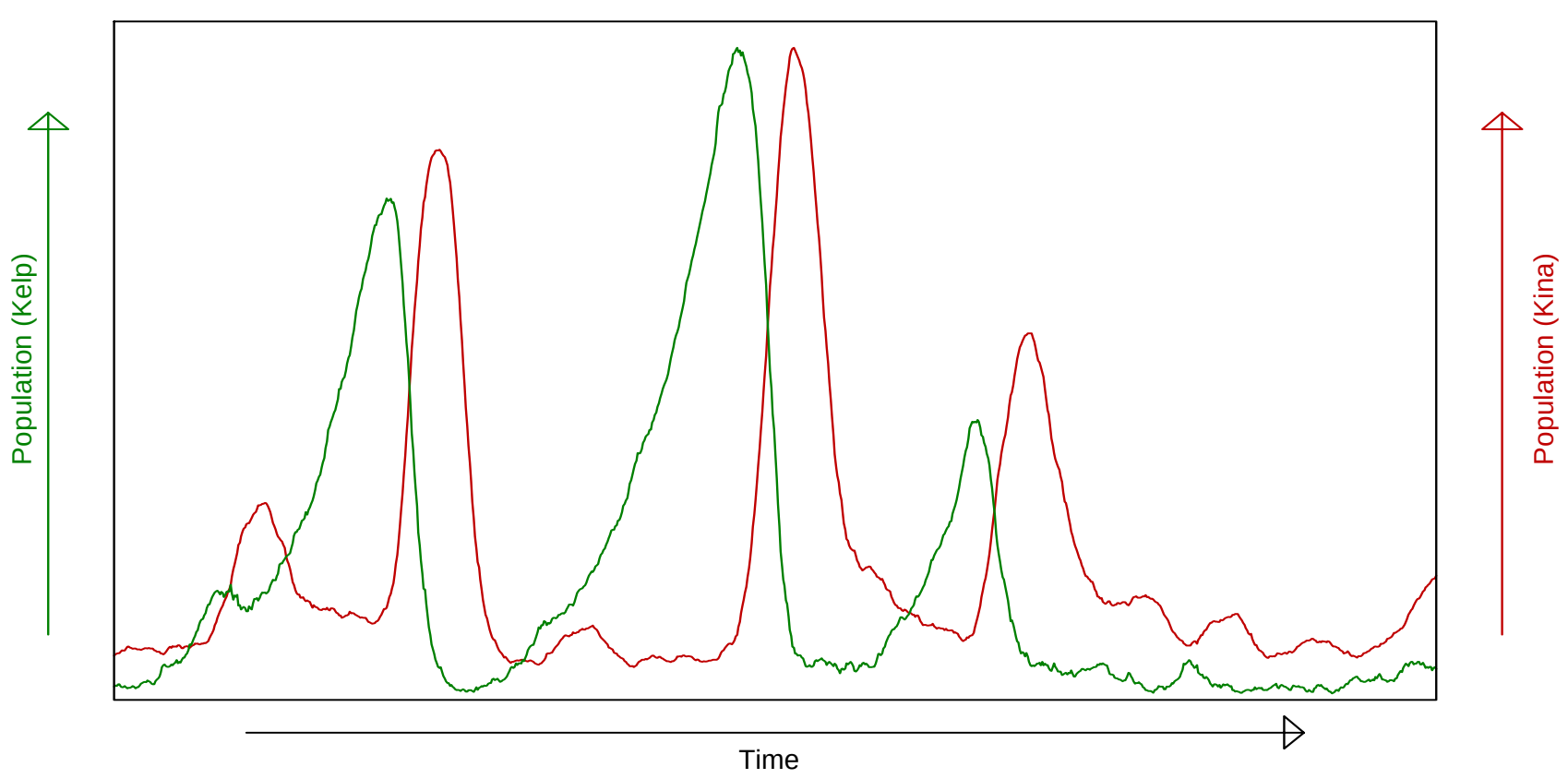
Kina grazed rock platforms common in areas of low predator abundance in Leigh Marine Reserve in 1978

Urchin barrens formed extensive areas, but kina predators, snapper and koura, also started to increase

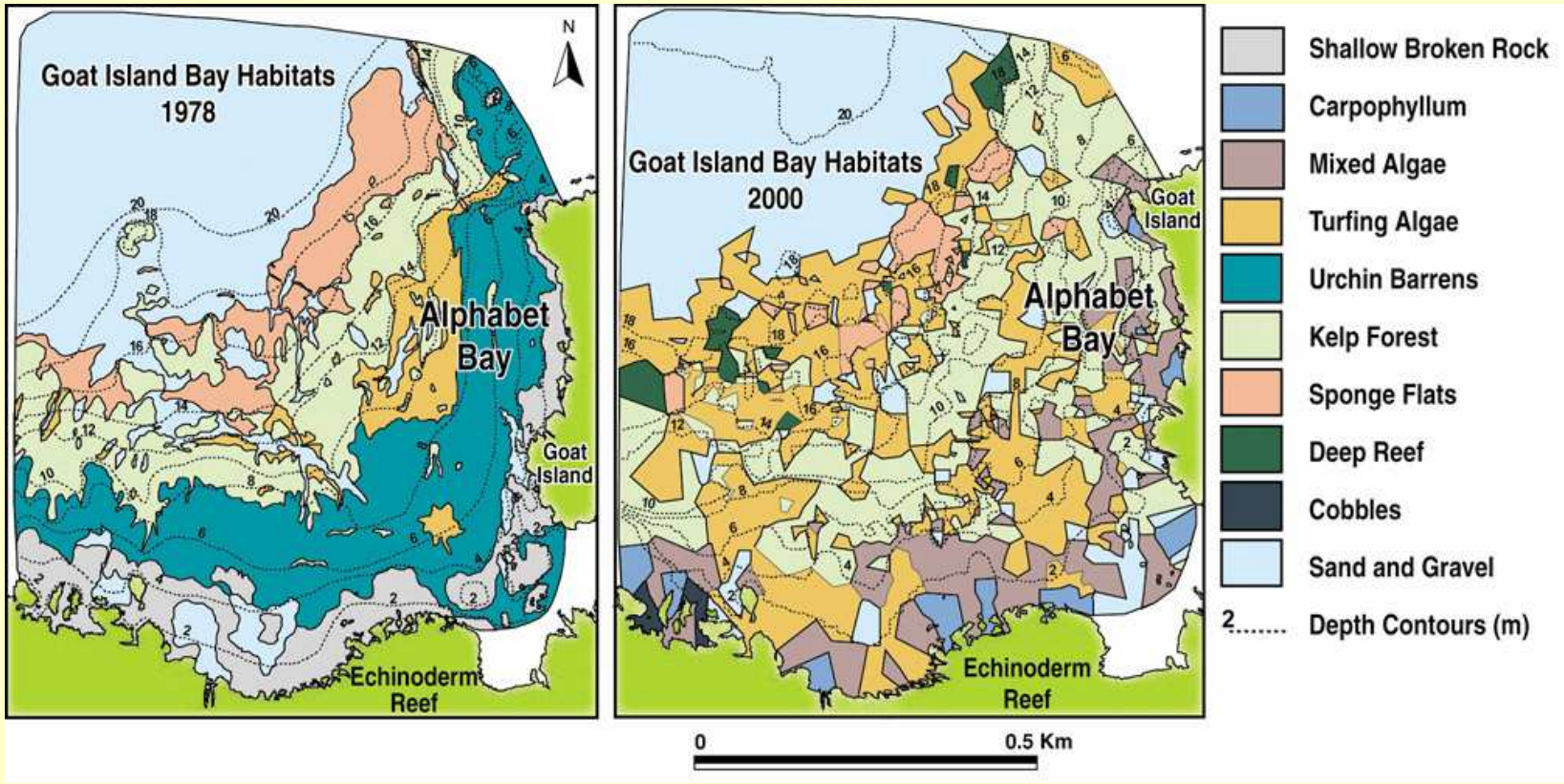


After 20 years these eventually reduced kina abundance and kelp forest and turfing algal species increased in extent

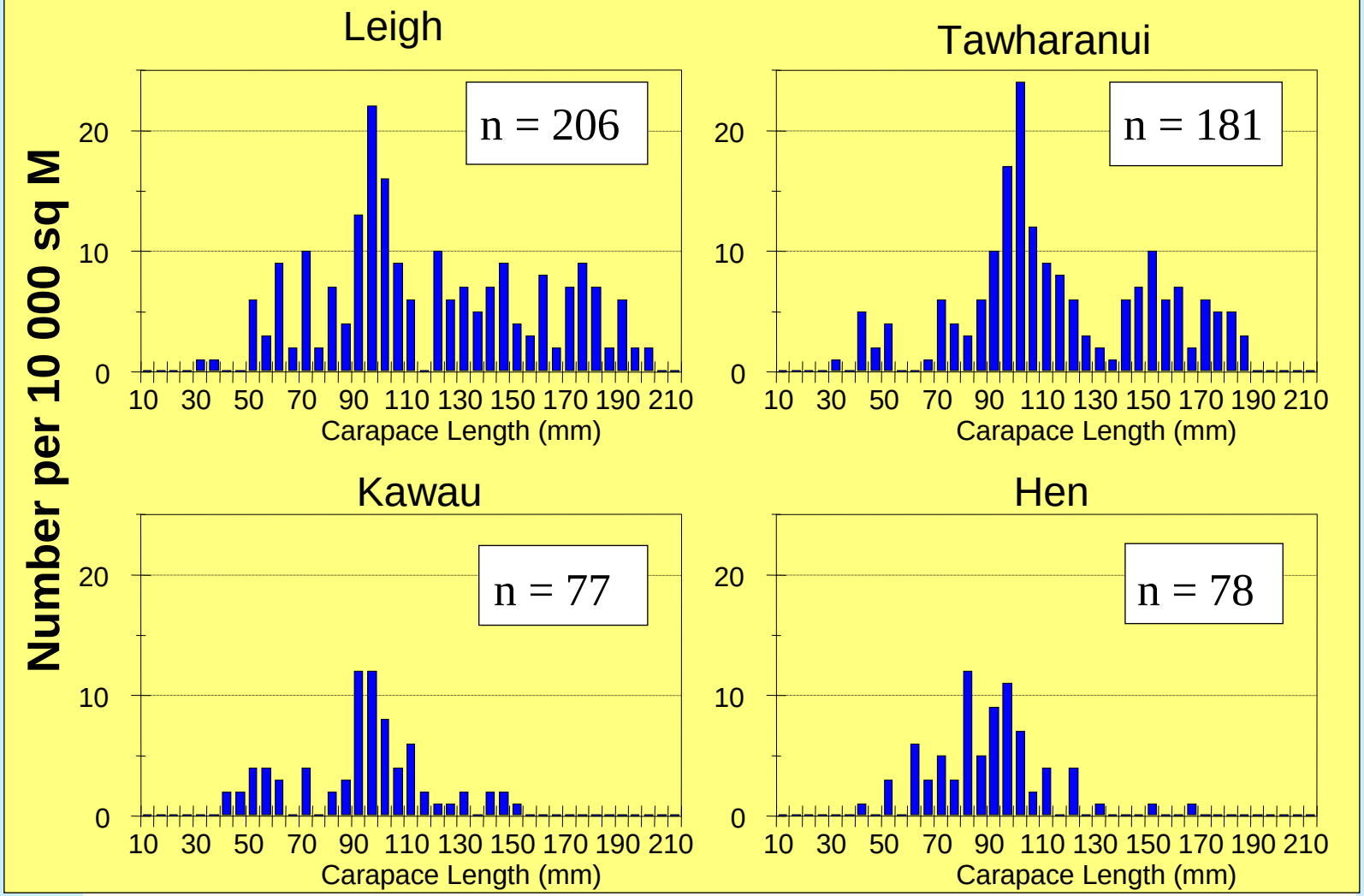
Model of cyclical change in kina and kelp abundance: 20 year cycle



Changing the distribution of habitats and associated species

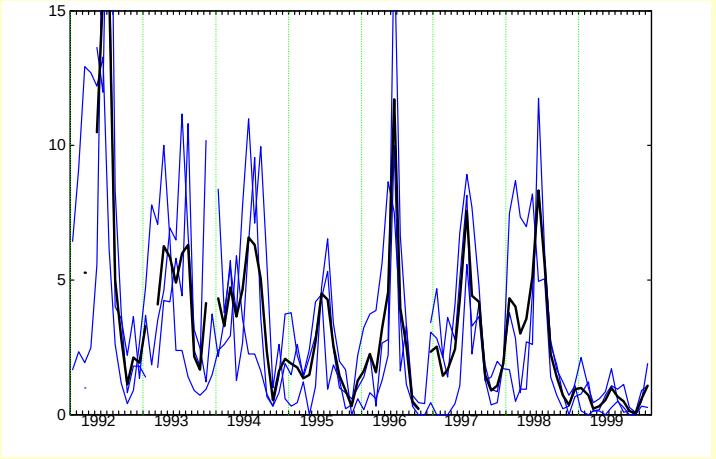


Effects of fishing on male koura



Effects of fishing

- Decreases abundance
- Removes the oldest / largest size classes from the population
- This removes the buffer that helps to dampen the effects of variable numbers of juveniles entering the population each year
- Makes all the fisheries much more dependent on the strength on the incoming year class
- May decrease the availability of a prey species
- Can dampen growth by repeated capture and measurement



Our common aim is Population Rebuilding

Changing the pattern of fishing, restoring habitat or reseeding a population in order to:

- Increase the stock of larger older kaimoana
- Buffer the stock from the effects of variable numbers of juveniles entering the population
- Eventually allow the same or higher catch than today's to be taken with more certainty, less effort and less risk to the stock

NIWA
Taihoro Nukurangi

M2 Tide

1 m/s