Kai Moana Enhancement

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What is enhancement?

Manipulating the environment or introducing new or additional stock to increase the abundance, availability and or quality of the plant or animal being harvested

Enhancement and aquaculture ?

Enhancement may involve:

- Habitat restoration
- Encosystem modification
  - Control of predators or competitors
  - fertilisation
- Habitat construction

Enhancement and aquaculture ?

Enhancement may involve:

- collecting wild juveniles and retaining them for on-growing to harvest
- producing juveniles in intensive culture for stocking into intensive environments
- producing juveniles in intensive culture for stocking into extensive environments for later harvest

Enhancement or aquaculture ?

Regardless of the methods used

- If something was done to increase production and there are exclusive harvest rights, this is aquaculture
- If ownership is not retained to harvest, this is enhancement

Enhancement or aquaculture ?

Eastern Canadian example: The oyster Crassostrea virginica

Seed is caught from wild spawning oysters and transferred to public areas or private leases where it is scattered on the bottom. (more than 80% of the leases are for bottom culture)

Enhancement or aquaculture ?

Regardless of location, additional manipulations including lifting oysters out of the sediments or removal of predators (starfish) may occur

- Where the seed has been transferred to private bottom leases then the activity is aquaculture

- Where the seed has been placed in a public area where there is non-exclusive harvesting rights, this is enhancement

An enhancement success ?

Lake Enrichment for sockeye salmon in western Canada

- Before commercial fishing, adult salmon returned to freshwater in very large numbers
- Pacific salmon spawn and die and the carcasses of the adults fertilised the lakes
- Without the added nutrients the lakes do not produce sufficient food to support the next generation of salmon fry
- Lake fertilisation programs restore the nutrients that would otherwise be provided by returning adult fish

An enhancement failure ?

Salmon Enhancement on the Columbia River

Following WW2, several hydroelectric dams were constructed on the Columbia River

Loss of natural salmon runs was accepted on the presumption that the loss could be mitigated by constructing of approximately 20 hatcheries

An enhancement failure ?

The success of the hatchery program was evaluated in the 1960's by asking two questions:

- Do hatcheries contribute to the fisheries?
- Is the economic value of the catch derived from hatcheries greater than the cost of producing the fish?

Intensive monitoring demonstrated that 14% of Chinook salmon caught on the US Pacific coast were hatchery reared fish and the value of the catch exceeded the hatchery cost by seven fold

An enhancement failure ?

The question they didn't ask was did the hatcheries compensate for the loss of natural production due to the dam construction

- Today, hatchery production accounts for 80% of the salmon from the Columbia

but

- Total production from the Columbia is less than 5% of its historical abundance

Enhancement risks

Enhancement efforts can cause harm

- Propagation of disease
- Loss of genetic diversity
- Competition with natural production
- Diversion of resources into ineffective programs
- Justification but not a remedy for other resource extraction activities

What is the Goal

- Production for direct commercial gain
  - Enhance / harvest / sell
- Improved production for indirect commercial gain
  - increased abundance of fish for sport catches (gains realised through tourist receipts (fishing guides and other tourist services to recreational fishers)
- Improved production for a specific social goal
  - Improved access, quality or quantity for customary harvest

Enhancement Potential in New Zealand

Scallops (*P. novaezelandiae*)

- The Challenger Scallop Enhancement Company

Dredge oyster (*T. chilensis*)

- The Bluff Oyster Management Company

Pipi (*P. australis*) and cockles (*A. stutchburyi*)

Pāua (*Haliotis iris*)

Tuna (*A. australis, A. dieffenbachii*)

Rock lobster (*J. edwardsii*)

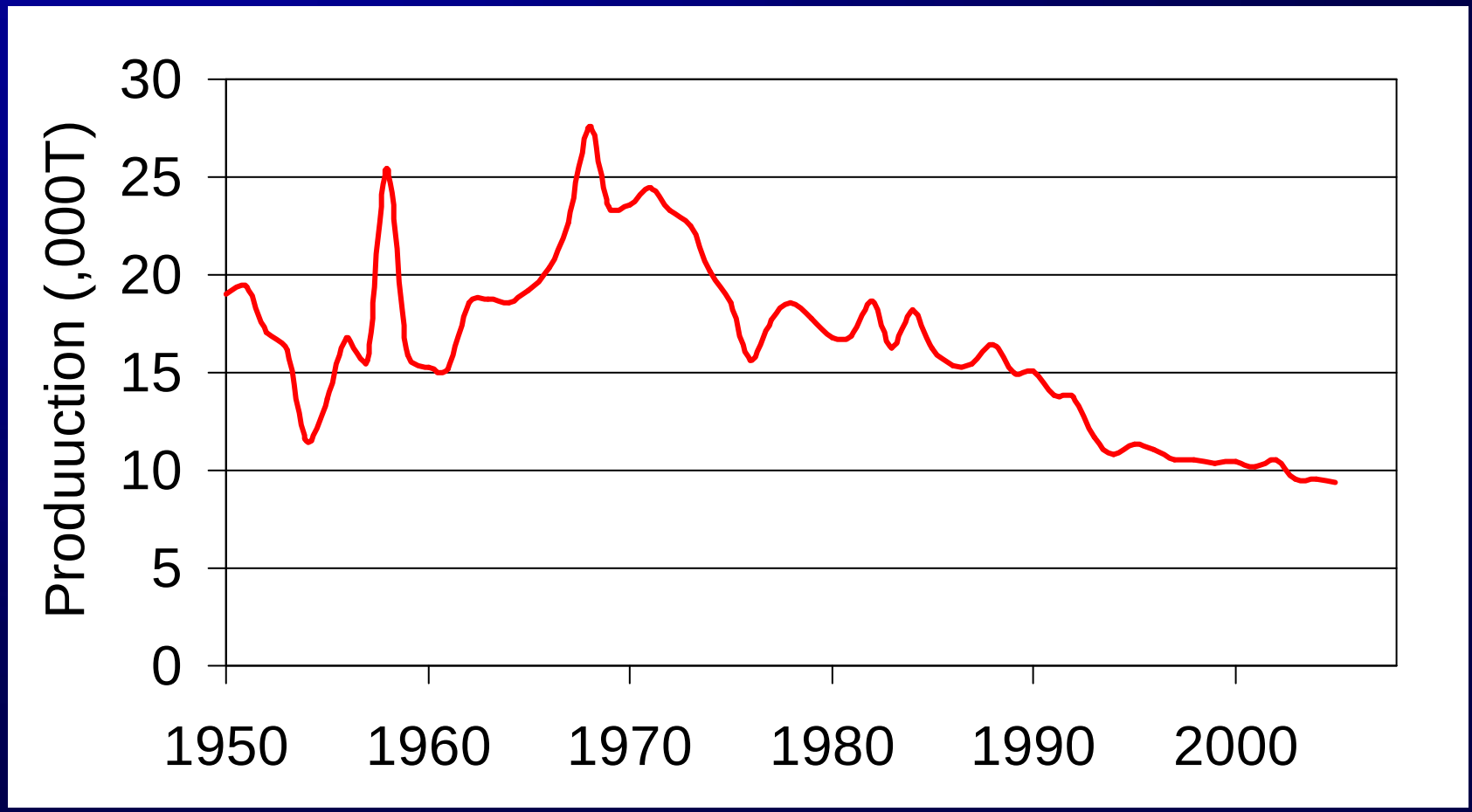
Enhancement Potential in New Zealand

- Yellowtail kingfish (*S. lalandi lalandi)*
- Snapper (*P. auratus*)
- Kina (*E. chloroticus*)
- Seaweeds – Karengo (*Porphyra spp.)*

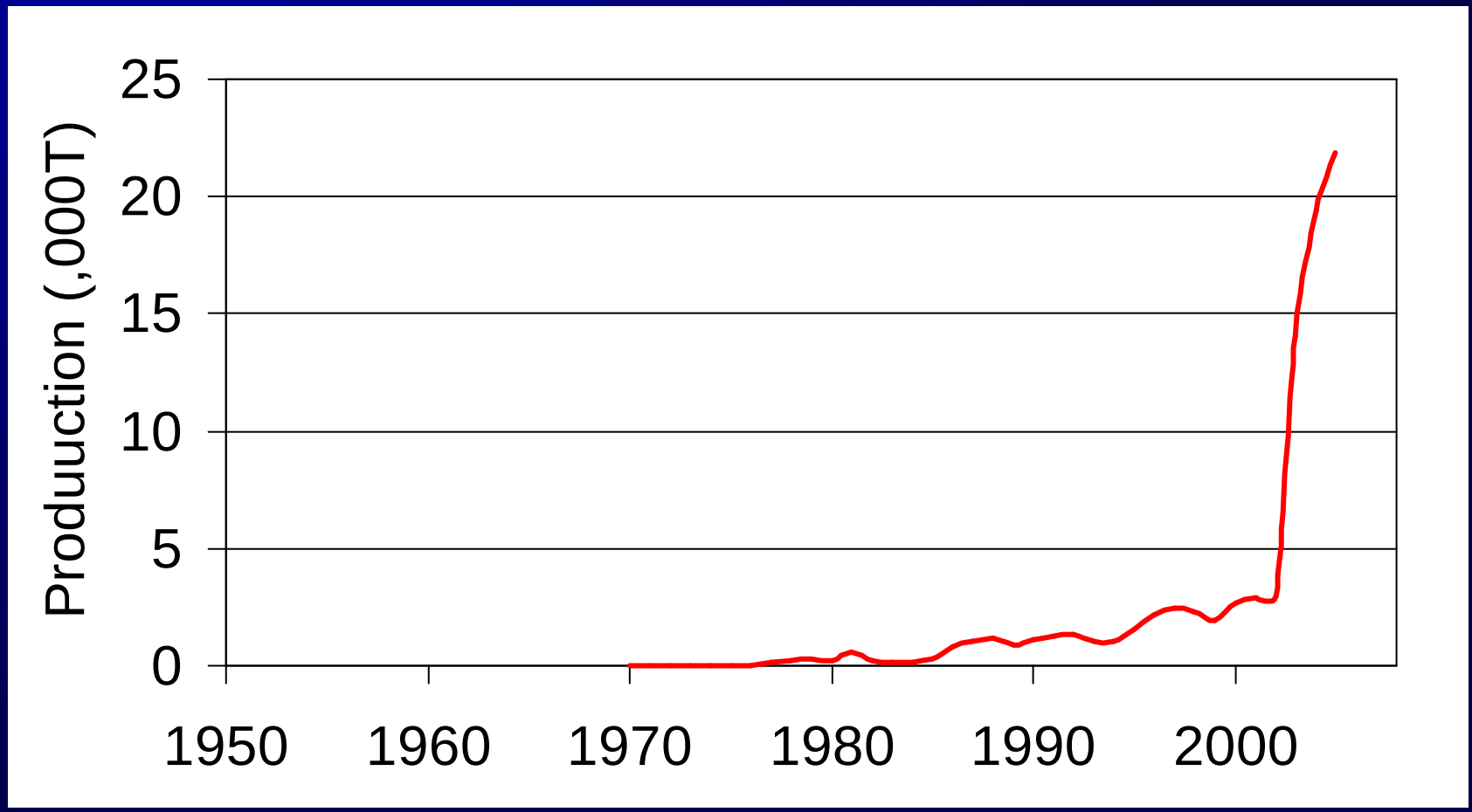
Black foot paua (*Haliotis iris)*

- **Max length: 140mm**
- **Habitat: Rocky reefs**
- **Distribution: NZ**

World paua fishery



World paua production

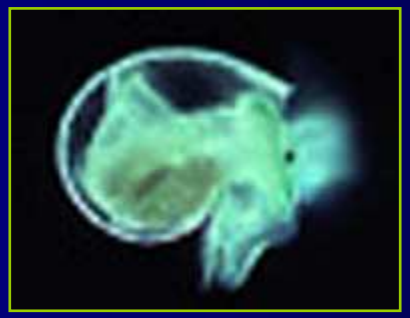


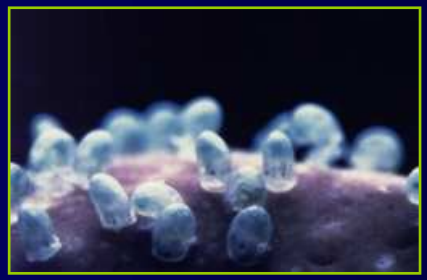
Paua Enhancement

- Relocate dislodged paua
- Transplanting crowded or stunted wild stocks to better locations
- Transplant broodstock
- Out-planting of hatchery reared juveniles in rocky habitats
- Artificial reefs
- Removal of competitors (kina)

Paua hatchery

- Short (<10d) non-feeding larval phase
- Settled onto surfaces “conditioned” with diatoms
- Weaned on to manufactured feed





Paua Enhancement

Hatchery production of paua

- Cost of production to 10 mm: $.50 per animal
- At 5% survival to harvest = $10 per harvested animal
- At 2% survival to harvest = $25 per harvested animal

Paua life history

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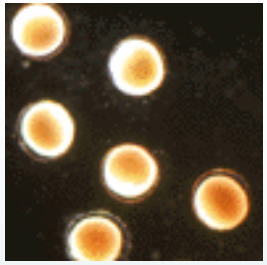
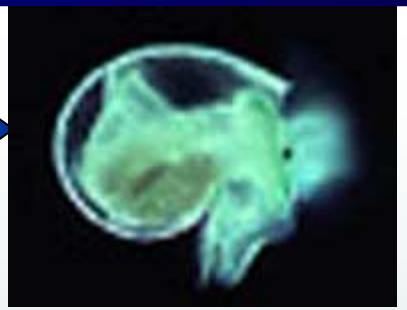
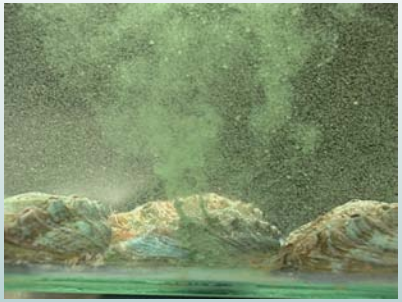


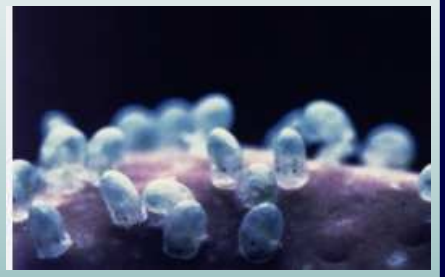
Paua eggs



Paua larvae (2d)

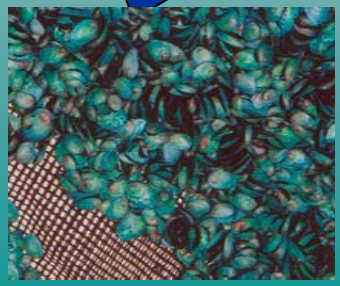


Broodstock Spawning



Settled larvae (5-10d)

10mm spat
(4-6 months)



MARINE

Rock Lobster

Red Rock Lobster (J. edwardsii)

- Very long larval life, the phyllosoma spends many months at sea
- The post-larvae (or puerulus) stage lasts days to weeks. The animal is a strong swimmer and moves shoreward
- Pueruli grasp onto substrates (natural or artificial), settle and moult into juveniles
- Survival at settlement is estimated to be 1 – 4 %
- Settlement is not uniform along the coast

Rock Lobster

Pueruli are commonly found on mussel lines

- By providing shelter during the day, mussel farms may enhance shoreward migration and settlement success

Or

- By providing shelter over unfavourable bottom, the mussel farms may have a negative effect
- Juvenile collection and relocation
- Enhancement of habitat (artificial reef construction) under or near mussel farms

Opportunities

Paua

- Out-planting of hatchery reared paua juveniles in specific areas
- Habitat development

Rock lobster

- Construction or improvement of existing habitats
- Potential relocation of pueruli to natural reefs or constructed habitats

Next Steps

Determine:

- Your interest
- The regional opportunity
- The investment required (time, money, training)
- The economic, social and environmental benefits
- The economic, social and environmental risks

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