



NEW DIRECTIONS IN SUSTAINABLE MARICULTURE AND FISHERIES HABITAT RESTORATION

**UNITED NATIONS COMMISSION ON
SUSTAINABLE DEVELOPMENT
PARTNERSHIP IN NEW TECHNOLOGIES FOR
SMALL ISLAND DEVELOPING STATES**

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GLOBAL FISHERIES CRISIS

- **Almost all fisheries are overexploited and crashing**
- **This applies to both shallow and deep water fisheries**
- **As a result aquaculture production is rapidly increasing, and is already surpassing wild capture fisheries**

PROBLEMS OF CONVENTIONAL MARICULTURE

- **Monocultures, usually of a single clone**
- **Escapees contaminate and erode genetic diversity of wild populations**
- **Dense populations promote disease and parasites**
- **When one gets sick, all die**
- **Diseases and parasites infect wild populations**
- **Feedlot operations, intensively fed, antibiotic use**
- **Cause intense pollution of surrounding habitats from rotting food and excrement**

UNSUSTAINABLE MARICULTURE

- **Impoverishes biodiversity**
- **Promotes disease, parasites, and pollution**
- **Relies on heavy external food additions**
- **Energy intensive**
- **Damages surrounding habitats**
- **Mangrove destruction**
- **Often capital intensive**
- **Food for export not local consumption**

EXAMPLES

- **Salmon in Norway, Scotland, British Columbia, Nova Scotia, Alaska**
- **Shrimp in Southeast Asia and Latin America**
- **Feedlot fish ranching of tuna and cobia**
- **Exotic oyster introductions**

ALGAE: EUCHEUMA

- **Most widespread in Indonesia and Philippines**
- **Problems with exotic species invasiveness, monoculture**
- **Intrinsically low value**
- **Processing not done locally**
- **Overproduction has caused price collapse**

ALGAE: GRACILARIA

- Range of agar products from low to high value, many diverse species
- Carrageenan cannot substitute for high value Agar uses
- Can be processed locally
- Wide range of genetic diversity for growth, agar gel strength, nutrient response, and herbivore resistance that can be selected with more research
- Habitat for juvenile lobsters and conch

HOLOTHURIANS, SEA CUCUMBERS, TREPANG, BECHE DE LA MER

- Many species
- High value, high demand
- Pharmaceutical uses
- Wild harvest, overexploitation worldwide
- Can be propagated
- Pacific Aquaculture Cooperatives in Republic of the Marshall Islands, Solomon Islands, possible expansion to other areas
- Whole atoll farming with local partnership

MARINE PROTECTED AREAS VERSUS HABITAT RESTORATION

- **MPAs work only where overfishing is the prime cause of fisheries decline, and where prime habitat can be protected**
- **Don't work where habitat quality is degraded, as in almost all reefs**
- **Only habitat restoration will work in degraded areas**
- **Habitat restoration requires a framework of bottom-up community-based management to work**

CUBA LOBSTER CASITAS

- **Create habitat for lobster, especially in seagrass habitats where lobster have no place to hide from predators**
- **Have greatly increased standing stocks, sustainable production and exports**
- **Require cooperative management to succeed**

FISH AGGREGATION DEVICES

- Based on natural aggregation of tuna under floating logs
- Made from Bamboo and coconut palm fronds
- Greatly increase pelagic fish catches
- Long artisanal tradition in Philippines and now being widely applied in Indonesia, Pacific and Caribbean
- Sometimes blamed for depleting reef fish, but this is exaggerated, creates new habitat
- Can be overharvested, need management
- Rock piles, Indonesia, Philippines, Palau

JUVENILE FISH HABITAT

- Most reef fish and lobster juveniles prefer shallow areas, mangroves, or algae mariculture
- Usually thought that shallow water, distance from reef, or structural complexity is key
- Experiments by Ivan Nagelkerken with artificial mangrove roots show highest juvenile fish recruitment in reef slope habitats
- Therefore increasing structural complexity is the most important factor

BIOROCK FISHERIES HABITAT RESTORATION

- **Greatly enhances coral growth and survival from environmental stress**
- **Speeds up growth of all attached organisms**
- **Greatly increases recruitment of attached and free swimming organisms, such as fishes, both adult and juvenile**
- **Promotes highly diverse ecosystem**
- **No external food inputs**
- **Can be built in any size or shape**

BIOROCK IN FISHERIES MANAGEMENT

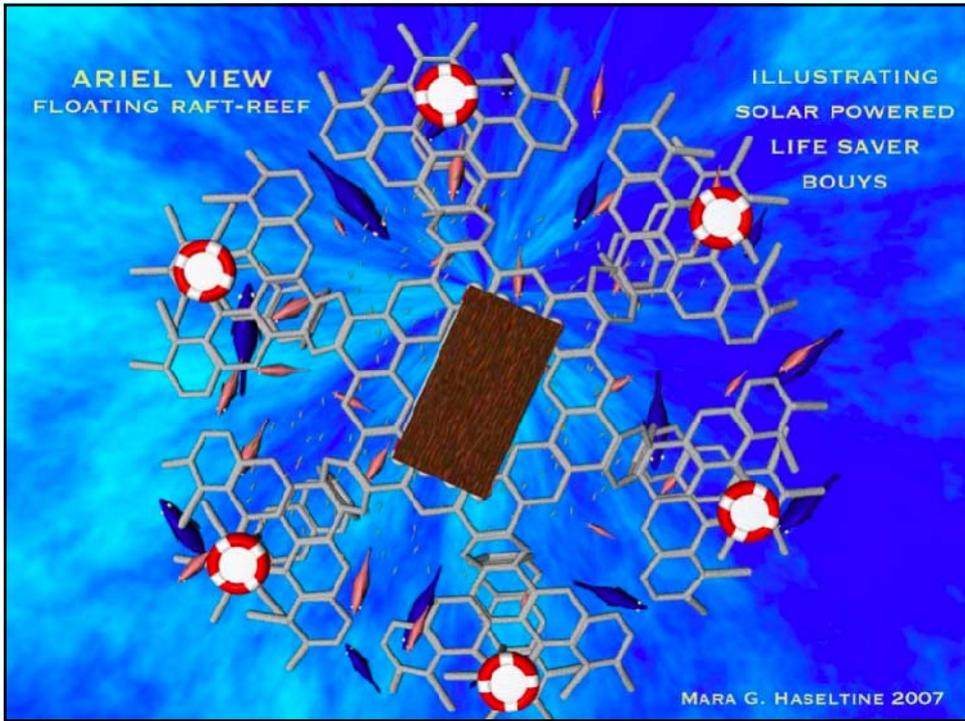
- **Fishermen can restore habitat quality and greatly increase sustainable harvestable standing stocks of fish, lobsters, oysters, and many other reef organisms**
- **Floating reefs can be built to increase pelagic fish catches**
- **Require management**
- **Require large scale investment in fishermen's knowledge and microloans**

ENHANCING RECRUITMENT AND HABITAT

- **Release of juvenile groupers into Biorock habitat by the Gondol Research Institute for Mariculture, Gerokgak, Bali**
- **Capture of pre-metamorphosis juvenile fish, coral, and invertebrates and transfer to Biorock habitat can greatly reduce juvenile mortality and increase standing stocks**

FUTURE FISHERIES

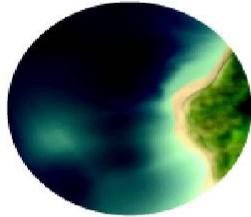
- **FARMING, NOT HUNTING**
- **LARGE-SCALE RESTORATION OF DEGRADED HABITAT**
- **FLOATING REEFS TO EXPAND PRODUCTION TO SHELF WATERS AND OPEN OCEAN**
- **INVESTMENT IN ARTISANAL COMMUNITY-BASED FISHERIES MANAGEMENT RATHER THAN SUBSIDIZING INDUSTRIAL FLEETS TO INCREASE OVEREXPLOITATION**
- **CHANGES IN POLICIES AND FUNDING**
- **NEED TO LINK TO CLIMATE CHANGE**



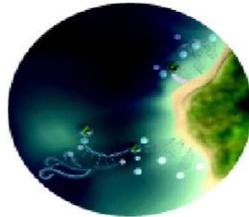
ARTIST CONCEPT BOARD: Mare G. Haseltine

Geotherapy: Restorative solutions utilizing existing technologies in new and innovative ways that harmonize with nature.

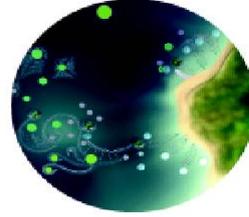
SUSTAINABLE FLOATING ISLANDS



phase one

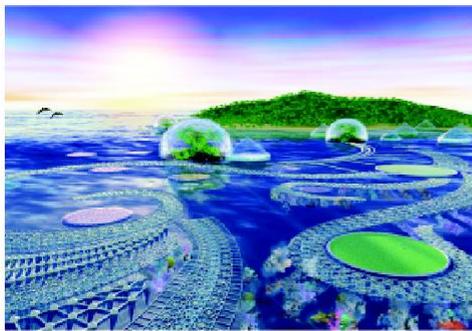


phase two



phase three

What does a healthy future look like?



SUSTAINABLE DESIGNS FOR TROPICAL ISLANDS:

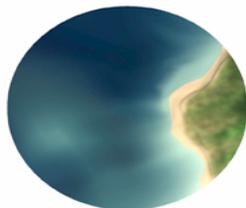
- Self repairing reefs which offer Shore Protection
- Reef Restoration which enhances Biodiversity
- Mariculture
- Maritime Agriculture for food and fuel (seaweed)
- Carbon Sequestration
- Eco Tourism
- Water Desalinization
- Renewable Energy Sources:
 - Solar
 - Algae-Lipid Biofuel
 - Tidal
 - Wind
 - Wave
 - Hydrogen

To See more of the artist's work go to www.calemara.com
Mare G. Haseltine is a member of the Global Coral Reef Alliance
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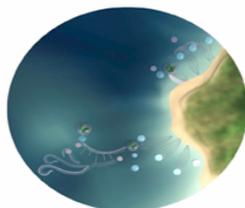
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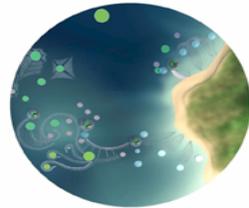
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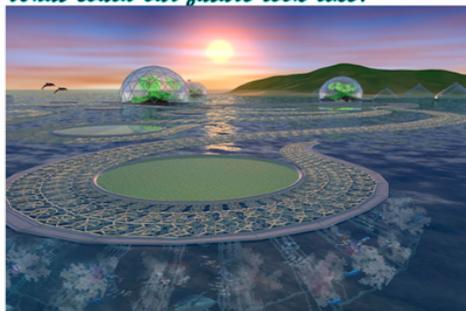


phase two



phase three

What could our future look like?



SUSTAINABLE DESIGNS FOR TROPICAL ISLANDS:

- Self repairing reefs which offer Shore Protection
- Reef Restoration and biodiversity
- Mariculture
- Maritime Agriculture for food and fuel
- Carbon Sequestration
- Eco Tourism
- Renewable Energy Sources:
 - Solar
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