

NEW DIRECTIONS IN SUSTAINABLE MARICULTURE AND FISHERIES HABITAT RESTORATION

**SUSTAINABLE MARICULTURE CONFERENCE
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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