

# Integrated Multi-Trophic Aquaculture (Polyculture)

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# IMTA or Monoculture in Open Containers

- Pro
  - Increased value of multiple products
  - Decreased release of waste products by conversion to useable biomass rather than released to environment
  - Early sentinels of environmental change
- Con
  - Potential for transfer of unacceptable components from one product to another
  - Greater impact on surrounding natural community by release of antibiotics or resistant microbes exposed to multiple cultured species

# Aquaculture Chemical and Drug Use

- Types of Aquaculture Chemicals (Chemicals Of Potential Ecological or Human Health Concerns = COPEHHC)
  - Removal, exchange, or addition of COPEHHC
    - **Removal** of dissolved and particulate nutrients from natural planktonic system to support aquaculture products
    - Nutrients – excess foods added to aquaculture species
    - Nutrients - shift in nutrient types (ammonia to nitrates or reverse)
    - Nutrients – unutilized waste materials (solids)
    - Unutilized product (aquaculture product but not used)
    - Unutilized secondary production on aquaculture containers
    - Anti-fouling materials on nets (Tars, chemicals)
    - Antibiotics (disease control)

# Aquaculture Chemical/Drug Use Concerns

- ‘Adverse’ biological effects of Potential Concern
  - Shifting from ‘natural’ environments to production of selected populations or products
  - Toxicity
  - Local eutrophication (water/sediments);
  - Community shifts (filter and deposit feeding communities);
  - Aquatic vegetation changes – (plankton, nuisance algae, )
  - Cross Transfer of antibiotic resistance to local microbial populations
  - Bioaccumulation of background or specialized chemicals
  - Chemical or taste “tainting” of products

## Assessment Methods

- Models of community shifts and balancing of nutrients – Prediction based on historical understanding
- Monitoring to evaluate modeling predictions and establish the area and types of change occurring as a result of the release of chemicals – increasing present understanding
- Filter feeding sentinels of early change (Mussel Watch)

# Models and Perception

- Water column changes in nutrient dynamics and effects on planktonic communities
- Prediction of effects of change in nutrient dynamics on higher indigenous trophic levels
- Mass dynamics of settling wastes and area of bottom impacts to benthic communities
- Prediction of bioaccumulation of COPEHHC into local food webs and into product (background and introduced materials)
- Evaluation of the potential adverse effect to the local food webs or the product to ecological and human health endpoints

# Monitoring

- **Nutrients**
  - Water column changes (increases or change in nutrient components or water quality characteristics in time and space)
    - Chemical Assessments of particulate and dissolved nutrient quantity and quality (e.g., carbon, nitrogen, phosphorus, BOD, COD)
    - Water Quality Changes (dissolved oxygen, turbidity)
    - Biologically assess effects of components (phytoplankton community dominance in time and space)
- **Sediment**
  - Chemically assess changes in nutrients in sediment (TOC, volatile solids, BOD, COD, sulfide and nitrogen species) – chemical fingerprint of waste materials from farm?
  - Biologically assess effects of nutrient changes in sediment – benthic community assessments and analysis of impacts on structure and function of community members.
  - Evaluate next trophic levels associated with the water column or sediment changes.

## Chemicals and Antibiotics

- Inventory the types of materials and chemicals that are used on the site.
  - Cleansers, antibiotics, anti-fouling materials,
  - Contaminants in food materials that are either added during culturing or that are the background levels for COPEHHC on particles and/or dissolved in background waters
  - Evaluate potential ecological or human health impacts from COPEC's

# Monitoring Product Quality

- Chemical assessments
- Histopathology
- Health of Product
- Body burdens and association or lack of association with aquaculture activities
- Taste and 'Tainting' Assessments of Product and Indigenous Community Members
- Indigenous Community Health and Reproductive Potential

## Assessment Methods

- Models predict extent of potential change
- Monitoring methods – validate or modify
  - Water column – Nutrient dynamics, particle loads, current meters, drogues and pelagic community shifts near and far field
  - Sediment – benthic community change, sediment organics (quantity and quality), natural and introduced COPEC assessments, where necessary forensic chemistry for source ID.
  - Tissues – Aquawatch - improvement on mussel watch, ‘health’ of cultured species, ‘tainting – flavor assessments.

Questions?