


Best Management Practices for Offshore Aquaculture

A decorative graphic consisting of two white, wavy lines that sweep across the middle of the slide, resembling ocean waves.

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Marine Cage Culture

Ecological Effects on Marine Environment



Nutrient Enrichment — Water Column
Sediment Accumulation — Anoxia
Wildlife Interactions — Biodiversity
Fish Health

ECOLOGICAL EFFECTS TO WATER QUALITY



*Excessive nutrient loads —
Nitrogen and Phosphorus*

Increased BOD — Biological Oxygen Demand

*Toxicity from net cleaning agents,
boat fuel, and equipment*

Best Management Practices for Water Quality

- *Site in deep, well-flushed waters*
- *Avoid excessive net fouling*
- *Establish nutrient and water quality thresholds*
- *Tailor monitoring plan(s) to take into account impacts to sensitive marine habitats — threshold concentrations*
- *Discourage the use of chemical anti-foulants and, when possible, employ mechanical cleaning methods*
- *Quickly remove and properly dispose of fish mortalities*
- *Consider the use of integrated multi-trophic aquaculture (IMTA), when practicable*

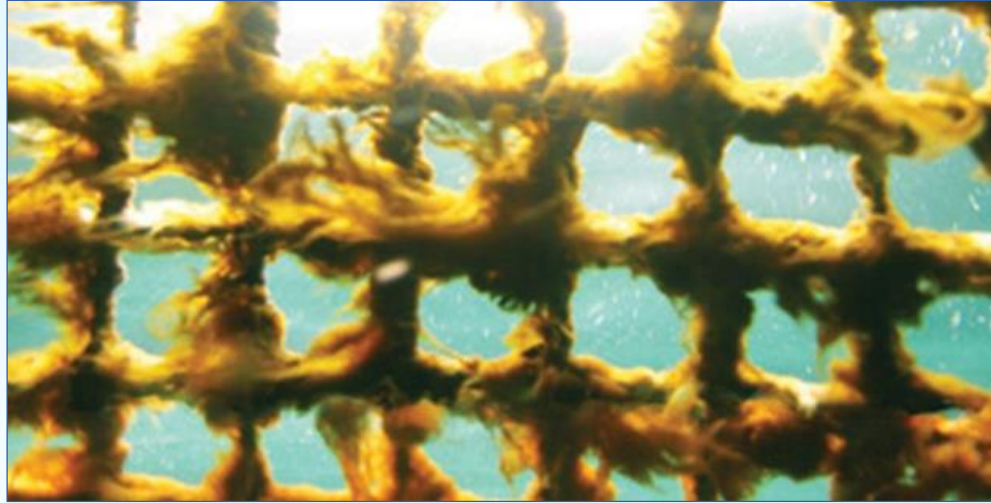


Best Management Practices for Water Quality



- *Encourage clean harvest methods and off-site processing*
- *Collect operational and human waste for off-site disposal*
- *Take measures to prevent discharge of contaminants from farm and develop a chemical spill response plan*
- *Properly maintain and operate farm vessels and equipment to minimize leaks, spills, or waste loss*
- *Provide employees with approved marine sanitation devices aboard vessels or working platforms*

ECOLOGICAL EFFECTS TO SEDIMENT



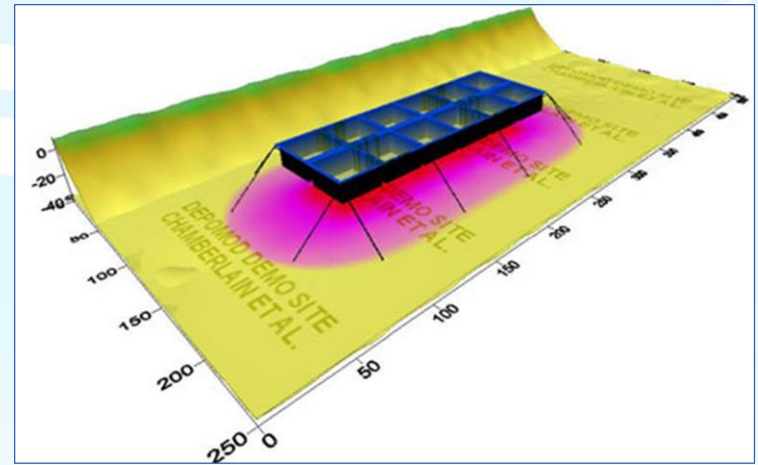
*Sediment accumulation under farms
creating anoxic benthos*

Settlement of feces and uneaten food

*Detachment of fouling debris from nets or
sloughing of antifouling materials.*

SEDIMENT MANAGEMENT

- *Establish “allowable benthic impacts using the chemical sediment properties as indicators (DO, sulfides, organic carbon)*
- *Benthic Enrichment Index (BEI) – forming anoxia*
- *Site in well-flushed area to disperse nutrients and suspended solids — hydrographic study*
- *Monitoring protocols for “footprint of deposition” or “sediment impact zone”*
- *Cage rotation or fallowing plan*
- *Monitor and mitigate net fouling debris*



ECOLOGICAL AND GENETIC RISKS OF ESCAPES



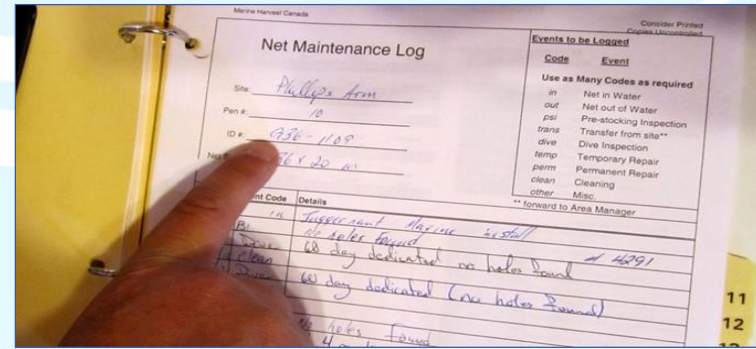
*Interbreeding to the alteration of the gene pools
of local crustacean or fish populations*

Release of fertilized eggs and larvae

Disease transmission by escapees to wild fish

Establishment of exotic species

Best Management Practices for Fish Escapes



- *Culture local (native or naturalized) species and discourage or prohibit the culture of non-native species*
- *Conduct a risk assessment for non-local species*
- *Develop a broodstock program that conserves genetic diversity (integrated approach) or selects for low wild fitness (segregated approach)*
- *Avoid unintended releases of cultured gametes, eggs, and larvae — harvest prior to sexual maturation*
- *Consider stocking sterile fish, when practicable*

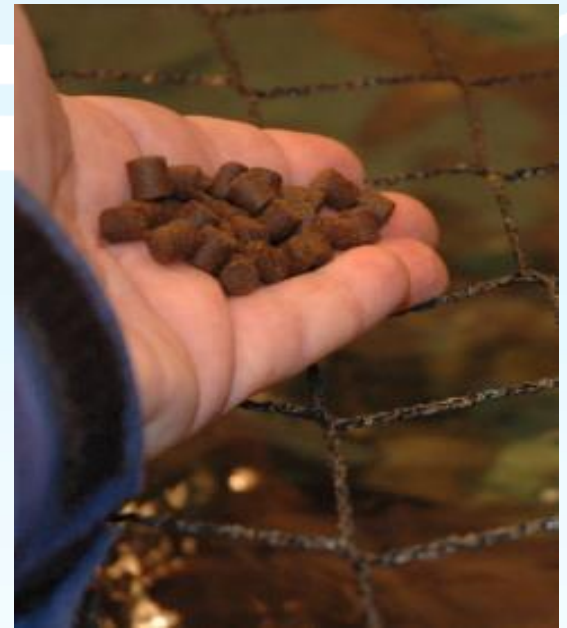
Best Management Practices for Fish Escapes

- *Develop and regularly update an escapes reduction and mitigation plan for each farm*
- *Use cage designs which minimize the possibility of escape — properly engineered*
- *Routinely monitor cages for escapement and properly maintain cage equipment and boat propellers*
- *Establish predator deterrence procedures*
- *Coast Guard approved warning for non-farm traffic*



Best Management Practices for Fish Feeds

- *Eliminate raw feed ingredients including small fish, fish processing waste, squid, and animal slaughter waste*
- *Provide feed companies with desired composition, performance and practical feeding requirements (sinking rate, fines, pellet hardness, etc.) for each cultured species*
- *Promote techniques to improve feed conversion ratio and minimize excess feed input*
- *Maintain and analyze records of fish growth, survival, feed used, feeding times, and ration amounts*

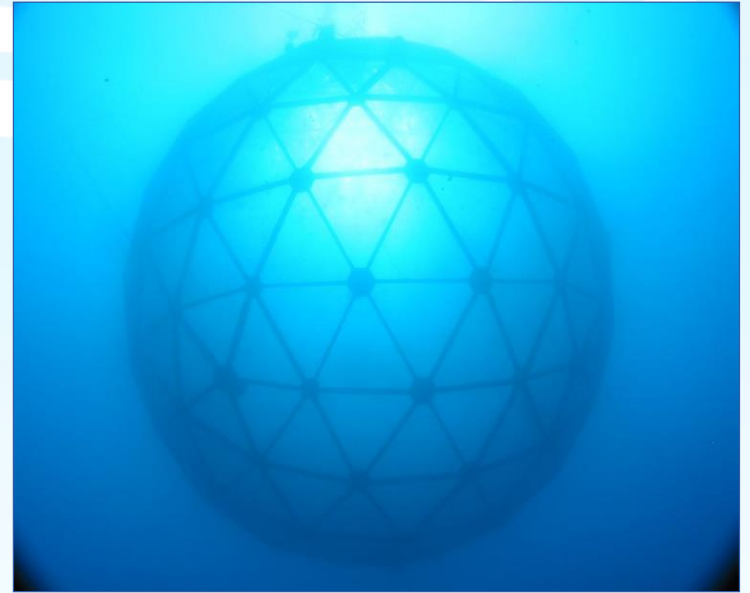


Best Management Practices for Fish Feeds



- *Encourage feed companies to use feedstuffs from environmentally responsible sources and practice continuous improvement in all aspects of feed formulation and manufacture*
- *Procure feed with an adequate amount of long chain omega-3 fatty acids to produce a final product with equal or greater levels of these fatty acids compared to that of the same species from the wild*
- *Handle and store food appropriately to maintain quality*

ECOLOGICAL EFFECTS TO FISH HEALTH



- *Without a healthy, clean cage environment fish can soon become stressed or sick, resulting in poor health, impaired growth, and possibly death.*
- *Buildup of biofouling organisms impede water flow and potentially cause fish abrasions*
- *Inappropriate stocking density can create stress, reduce feeding activity, and impede growth*

Best Management Practices for Fish Health

- *Develop a health monitoring plan and protocols*
- *Consult with an aquatic animal health expert or veterinarian at various levels of operation*
- *Develop and employ biosecurity practices and quarantine protocols*
- *Use appropriate stocking densities and employ techniques to minimize physiological stress to cultured organisms*



Best Management Practices for Fish Health

- *Vaccinate fish prior to stocking into cages, if available and necessary — prophylaxis*
- *Use only FDA-approved drugs*
- *Minimize the use of antimicrobials*
- *Cooperate with animal health regulators*
- *Coordinate with veterinary, husbandry, and fish pathology researchers, when possible*

Best Management Practices for Ecological Effects — Wildlife Interaction



- *Avoid disruption to native biodiversity, especially protected species*
- *Prevent predator interactions and use non-lethal predator deterrents, when necessary*
- *Use proper cage design to minimize entanglement with marine animals and other protected species*
- *Site farms away from corals, seagrass, mangroves, and other sensitive habitats*
- *Exercise caution when operating vessels to avoid collisions with sea turtles and marine mammals*

Best Management Practices for Ecological Effects Summary



- *Minimize nutrient accumulation at the site*
- *Optimize feeding protocols*
- *Implement cage rotation or fallowing if nutrient loading exceeds ecological threshold*
- *Employ methods to minimize physical disturbance to habitat and biodiversity*
- *Utilize responsible cage cleaning methods*

THE HUMAN DIMENSION

- *Carry out public input process prior to permit issuance*
- *Conduct economic/market analysis to project local economic effects*
- *Identify potential or perceived conflicts with wild harvest*
- *Hold informational meetings in local area*
- *Identify potential or perceived conflicts with wild harvest market, tourism, recreational use, aesthetic value, cultural activities, or navigation*
- *Provide educational materials and work on outreach issues with local community*



THE HUMAN DIMENSION

- *Meet community needs when possible/practical (e.g., jobs)
Train/employ local workforce*
- *Consider including tourism and recreational fishing in operations*
- *Avoid traditional fishing areas and areas of aesthetic importance*
- *Avoid flooding local market(s) with cultured fish*
- *Work with local community to market cultured fish when/where possible*



OFFSHORE AQUACULTURE CERTIFICATION

BEST AQUACULTURE PRACTICES

Global Aquaculture Alliance

<https://www.aquaculturealliance.org/>

THANK YOU!

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