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**BC Perspective on Shellfish Aquaculture
Regulation and Related Environmental
Experience with Particular Emphasis
on Geoduck**

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Cultured Shellfish species



A collage of four images showing different cultured shellfish species: oysters, clams, mussels, and scallops.

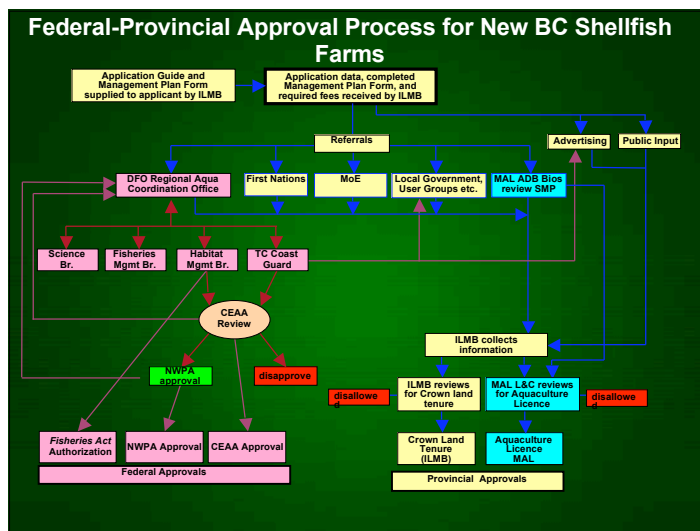


Oyster farming



A collage of four images related to oyster farming: a worker handling oysters in a bin, workers with oyster racks in the water, a worker on a boat, and a person on a beach.

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- Shellfish Management Plan (SMP) is completed by applicant to specify the “What, Where, When and How” of the proposed farm operation.
- The SMP is reviewed by MAL Shellfish Biologist for biological and technical feasibility & suitability of culture activities & facilities at the proposed site.



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- Following review, the Shellfish Biologist makes a recommendation (+ or -) on the proposed Shellfish Management Plan to ILMB and MAL Aquaculture Licensing units.
- Further considerations by MAL Aquaculture Licensing include First Nations consultation, public input and Risk Management analysis prior to a Licensing decision

Geoduck Policy Documents

- The result of 15 years of collaborative fed/prov. research and policy development
- Can be found at:
<http://www.agf.gov.bc.ca/fisheries/shellfish/geoduck/main.htm>
- Three separate documents for:
 - Existing Intertidal Tenures
 - Existing Subtidal Tenures
 - New Subtidal Tenures
- Not accepting applications for new geoduck intertidal tenures at present

Existing Intertidal Sites

Applications to amend the aquaculture licence of existing intertidal aquaculture sites, (where the existing site is defined as the boundary of the tenure issued before June 28, 2005), are limited to those in the Strait of Georgia transfer zone (DFO Areas 13 to 19-4, inclusive and areas 28 and 29).

Conditions to address fish habitat, navigation & genetic concerns are specified (http://www.agf.gov.bc.ca/fisheries/Shellfish/geoduck/existing_intertidal.htm)

DFO Intertidal Operational Statement

- On and Near-Bottom Intertidal culture:
http://www-heb.pac.dfo-mpo.gc.ca/decisionsupport/os/os-shellfish-on_e.htm
- Applies to new projects & amendments with oysters and clams other than geoducks
- Describes conditions & measures to be incorporated in order to avoid negative impacts to fish habitat.

Operational Statement for Off-Bottom Deepwater Shellfish And Kelp Aquaculture

Applies to shellfish related activities including but not limited to:

- raft or longline culture of oysters in trays, PVC pipes, or rope strings;
 - raft culture of mussels on droppers (single or continuous);
 - submerged or surface longline culture of scallops or other shellfish;
 - floating culture of kelps.
- NB: Doesn't apply to subtidal geoduck culture

Similar conditions to intertidal OS, but also:

A minimum of 10 m water depth at low tide (i.e. chart datum) will be maintained beneath all floating structures

Raft & Longline Culture –Oysters, Mussels



Conditions for Use of OS:

To proceed with a shellfish aquaculture project without a DFO Habitat review, you must meet the following conditions:

- Provincial government approval of shellfish management plan (SMP);
- Substrate modification, construction of berms or altering freshwater stream channels does not occur;
- Overlap of development activities on, or physical disruption of, **Important Fish Habitat** does not occur;
- Not conducting geoduck aquaculture;
- Incorporate the *Measures to Protect Fish and Fish Habitat : 13 steps*
- File a Shellfish Notification Form with local DFO office

Other Approvals

The OS doesn't release the applicant from complying with other legislation:

- municipal (e.g. local zoning by-laws),
- provincial (e.g. Aquaculture Regulation) and
- federal (e.g., the *Navigable Waters Protection Act*)

DFO Fish Habitat Review

- Applies to projects for geoduck & other shellfish (when OS conditions not met).
- Protocol described at:
- http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/shellfish_checklist.pdf



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Fisheries and Aquaculture Licencing and Compliance Branch

- Compliance and Monitoring Unit
 - 8 Inspectors province wide
 - » 6 Courtenay
 - » 1 Campbell River
 - » 1 Prince Rupert
- Conduct regular inspections of shellfish farms for compliance with SMP



BC Geoduck Culture Licences

- 4 Hatcheries
- 7 Off-bottom (nurseries)
- 24 Intertidal bottom
- 6 Subtidal bottom (5 existing, 1 new)
 - Only 1 hatchery is active with geoduck, thus seed availability is limited

New Subtidal Tenure Policy

- Pre-selection of eligible application areas by government (currently all in Strait of Georgia)
- Additional criteria for applicant qualification
- Fish habitat assessment of application areas required
- Tenure boundary marking required
- Pre-seeding harvest opportunity for displaced geoduck fishers

New Subtidal Tenure Policy (con't)

- Residual animals can be harvested along with cultured stock as by-catch
- One-time genetic sampling of stock from site required
- Seed and broodstock to originate from within transplant zone (Str of Georgia).
- Special harvest reporting requirements to maintain chain of custody

New Subtidal Process

- In cooperation with UHA and DFO, 55 possible sites in Strait were initially identified



New Subtidal Process (con't)

- Applications received on 10 areas by the February 10, 2006, deadline
- Applications reviewed and assessed through interagency referrals, First Nations' consultation, public advertising and open houses.

Status: New Subtidal

- Of the ten new subtidal sites offered:
 - 3 tenures and 1 related Aquaculture Licence have been issued
 - 1 application disallowed
 - 6 tenure and 8 Aquaculture Licence applications awaiting adjudication
- Judicial review of the tenure decisions has been launched by Sliammon First Nation
- Considerable public opposition to new farms in several coastal communities
–**environmental concerns**

Environmental Experience with Geoduck Culture in BC

1. Subtidal Bottom: 5 sites on 82 ha (198 ac) since 1995
 - Consultant reports on substrate, fauna/flora
 - Govt biologist and contractor dive/video audits of culture plots, predator exclusion and tenure marking
 - Qualitative observations indicated that environmental effects appeared to be very limited
 - PSARC review (Hand and Marcus 2004) on potential effects on wild geoduck populations and harvestable TAC of fishery (http://www.dfo-mpo.gc.ca/csas/Csas/publications/ResDocs-DocRech/2004/2004_131_e.htm)

Summary of Research on Benthic Effects of Geoduck Culture in BC

C.M. Pearce, Y.X. An, J.M. Blackburn, L.J. Keddy, D.L. Paltzat, S.W. Williams

**Fisheries and Oceans Canada
Pacific Biological Station**

Project Objectives

Intertidal and Subtidal Research Experiments

- (1) To assess the effect of different forms of predator protection on survivorship and growth of juvenile clams
- (2) To assess the potential effects of geoduck culture on the benthic environment
- (3) To assess the potential effects of harvesting the clams with a high-powered water pump (*i.e.* stinger) on the benthic environment

Project Progress

Intertidal Experiment

- Clams harvested July 2006 after one year grow-out
- All field sampling completed
- Sample processing of 4 and 6 month post-harvest samples ongoing (to be completed 2007)

Subtidal Experiment

- Clams to be harvested Feb. 2007 (delayed due to weather)
- Field sampling ongoing (to be completed Summer 2007)
- Sample processing ongoing

Study Site

Location: Head of Nanoose Bay, BC
Intertidal plot (~0.5 m chart datum)
Plot size: 20 m x 3 m

Objectives

Experiment set up to address:

- (1) Effect of predator protection method on survivorship and growth of juvenile geoduck clams planted in the intertidal
- (2) Effect of intertidal culture process and clam harvesting on benthic environment

Experimental Treatments

Predator Protection

- PVC tube protection methodology as used in WA
- Examining 3 factors:
 - (1) PVC tube diameter (10.2 vs. 15.2 cm)
 - (2) PVC tube length (25.4 vs. 30.5 cm)
 - (3) Size of mesh screen on the PVC tubes (6 vs. 12 mm)
- 8 treatments with 30 replicates per treatment (240 tubes total)



Research Plot



Experimental Protocols

Assessing Impacts on Benthic Environment

- Benthic sediment samples collected at each sample period within culture plot (0 m) and at 5, 10, 25, and 50 m distance from plot along 3 transects (3 replicates)
 - (1) Parallel to shore line at same tidal height as plot
 - (2) Perpendicular to shore line towards ocean
 - (3) Perpendicular to shore line towards beach

Collection of Sediment Samples



Environmental Data Caveats

- Infaunal species data not yet ready
- Results somewhat complicated due to 3-way analysis (date, transect, distance)
- Talk will focus on the effect of date
 - post-seeding versus pre-seeding comparison
 - post-harvesting versus pre-harvesting comparison
- Talk will focus on specific results within the seeded plot (0 m data) and on general results within the experimental area (0-50 m)

Conclusions

Growth

- (1) Significantly better in the larger diameter (15 cm) pipes than in the smaller diameter (10 cm) pipes
- (2) Significantly better in the shorter (25 cm) pipes than in the longer (30 cm) pipes
- (3) Significantly better in the larger mesh (12 mm) pipes than in the smaller mesh (6 mm) pipes

Survivorship

- (1) Not significantly affected by pipe diameter, pipe length, or mesh size

Conclusions

Variable	Pre-seed vs Post-seed		Pre-harvest vs Post-harvest	
	Seeded Plot	Research Plot	Seeded Plot	Research Plot
	(0 m)	(0-50 m)	(0 m)	(0-50 m)
Percent Organics	NS	NS	S, reduction	NS
[Sulphide] at 2 cm	S, reduction	S, reduction	NS	NS
[Sulphide] at 4 cm	S, reduction	S, reduction	NS	NS
ORP at 2 cm	NS	NS	NS	S, reduction
ORP at 4 cm	NS	NS	NS	S, reduction
Total Organic Carbon	NS	NS	NS	NS
Total Nitrogen	NS	NS	NS	NS

Conclusions

Variable	Pre-seed vs Post-seed		Pre-harvest vs Post-harvest	
	Seeded Plot (0 m)	Research Plot (0-50 m)	Seeded Plot (0 m)	Research Plot (0-50 m)
Grain Size				
>2 mm	NS	NS	S, reduction	NS
1-2 mm	NS	NS	NS	NS
500 µm-1 mm	NS	NS	NS	NS
250-500 µm	NS	NS	NS	NS
125-250 µm	NS	NS	S, increase	NS
63-125 µm	NS	NS	S, increase	NS
45-63 µm	NS	NS	S, increase	NS
<45 µm	NS	NS	NS	NS

Conclusions/Recommendations

Effects on Environment

- (1) Outplanting of tubes and clams had no significant negative impacts on % organics, [sulphide], ORP, or sediment grain size
- (2) Further sample and data analysis required to assess potential impact on infaunal diversity and TOC/TN
- (3) Further sample and data analysis required to assess potential impact of clam harvesting on environmental variables

Summary

- BC has a relatively small, but diverse shellfish farming industry on tenured land
- Shellfish regulatory and compliance inspection systems are comprehensive
- Studies of environmental impacts of shellfish culture in BC are providing a base of knowledge for improving environmental practices and public acceptance of shellfish farming.