USE OF AN EDIBLE RED SEAWEED TO IMPROVE EFFLUENT FROM SHRIMP FARMS

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Research location - Moloka’i
Molokai Aquaculture Project

- Seaweed production
- Seaweed nursery
- Fish culture
- Integrated seaweed-shrimp culture
Gracilaria parvispora

- Introduced from Japan
- Commonly called long ogo or long limu
- Wild harvest in Hawaii by Japanese, Filipinos and Native Hawaiians
Goals of the Moloka’i Project

- Cottage industry for Native Hawaiians in rural Hawaii.
- Re-introduce a traditional food to the Hawaiian diet.
- Market to chefs producing native dishes for tourist trade.
- Provide economic incentive to protect ancient Hawaiian Fish Ponds.
Cages stocked in Uahaulapue Fish Pond
Simple cage construction

LIMU CAGE OF PVC PIPE AND NETTING

2" PVC Pipe

String splits net into two compartments

3/8"x3/4" Plastic Aquaculture Netting

Cover of same net material keeps Limu in cage.

Concrete Block anchor

MATERIALS COST:

Pipe and Elbows $30.00

Netting @$0.03/sq.ft.
  Top - 72 sq.ft.
  Sides - 90 sq.ft.
  Bottom - 72 sq.ft.

234 sq.ft. $7.00

Anchor Block $3.00

$5.55/m² Total = $40.00 ea.
Gracilaria being washed in cage
Rinsing *Gracilaria* at harvest
Packing *Gracilaria* for off-island markets
Seaweed market outlet

TROPIC FISH & VEGETABLE CENTER
w/ Tuna w/ Octopus Kimchi
Blanched w/ cucumber and oil w/ Ono
Environmental impacts from conventional shrimp culture

- Effluents and nutrient enrichment.
- Destruction of mangroves.
- Diseases, exotic species, genetic contamination.
- Changes in estuarine flow patterns.

Green Peace says
Ohia shrimp farm pond
Ohia shrimp farm

- Slightly inland - behind mangroves (which are not native to Hawaii)
- Effluent goes to through drain channel to leach channel.
- Effluent filters through porous soil and coral rubble, into ocean.
Drain channel and leach channel
**Gracilaria** was stocked into effluent drain and leach pond

- *Gracilaria* was removed from cages in ponds.
- Individual thalli were weighed and stocked into effluent channel at 4 kg/m$^3$.
- Thalli were weighed weekly.
- Samples were taken for C:N determination.
- Water samples analyzed for NH$_4$, NO$_3$, PO$_4$ and turbidity.
Ave. water quality in effluent channel

\[ \text{NH}_4 = 62 \text{ mmol m}^3 \ (1.1 \text{ mg/l}) \]
\[ \text{NO}_3 = 2.9 \text{ mmol m}^3 \ (0.2 \text{ mg/l}) \]
\[ \text{PO}_4 = 3.7 \text{ mmol m}^3 \ (0.35 \text{ mg/l}) \]
\[ \text{Turbidity} = 4.0 \text{ NTU} \]
Nitrogen content increase in thalli (% N)

% N in thallus

Day 0 Day 5 Day 10 Day 15

Day 0: 1.5
Day 5: 2.5
Day 10: 3.5
Day 15: 3.0
G. parvispora growth in effluent channel

- 4.7% daily relative growth rate
- Nitrogen content increased from 1.3% to 3.1%
- C:N ratio decreased from 30:1 to 10:1
G. parvispora returned to cages in ponds

- Treatment 1: Thalli from effluent channel stocked into cages stocked in pond
- Treatment 2: Thalli fertilized in on shore tanks with commercial fertilizers, stocked into pond
- Treatment 3: Thalli placed in tanks, no fertilizer, returned to cages in pond
Cages stocked in pond after soaking in shrimp farm effluent
Relative daily growth rates over 4 weeks

- In effluent channel
- Transferred to ocean
- Chemical fertilizer
- Not fertilized
Results

- Thalli in effluent channel removed (fixed) 3 kg of N per every 100 kg of seaweed placed in channel.
- *G. parvispora* in channel grew 4.7% per day.
- *G. parvispora* fertilized in channel and stocked back into cages in pond, grew 9.7% per day for first week.
Conclusions

- *G. parvispora* can grow in effluent channels and remove large amounts of nitrogen.
- The seaweed probably also removes significant amounts of other pollutants (nutrients).
- *G. parvispora* can be fertilized in channel and placed in cages in ponds for rapid growth.
Conclusions

- *Gracilaria* can also be used at salmon farms to reduce wastes, algae yield of 49 kg m$^2$ per year (Buschmann et al., 2001).
- We are also testing at experimental farms in Mexico and Eritrea.
- Shrimp and fish farms integrated with seaweed production should be economically and ecologically sustainable.
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