OPTIMUM CO-CULTURE PROPORTION OF FISH-MACROALAGE FOR REDUCING SELF-POLLUTION IN MARINE CAGE CULTURE AREAS

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Introduction

- With the development of marine fish cage culture, the extreme enrichment of nitrogen and phosphorus loadings in the water column deriving from fish farm activities becomes a source of water self-pollution and eutrophication.

- Integrating seaweeds into fish aquaculture
  - ✓ Remove nutrition elements such as N and P
  - ✓ Photosynthesis: Absorb CO_2 , release O_2
  - ✓ Economic benefit
- Co-culture proportion

- Nitrogen was selected as the parameter to balance the seaweed absorption and fish making
- Nitrogen entered into water was composed of three parts: nitrogen excretion , feed residue, faeces.
- The nitrogen balance equation can be represented as follows:

$$N\text{（seaweed）} = N\text{（fish excretion）} + N\text{（feed residue）} + N\text{（fish dead）}$$

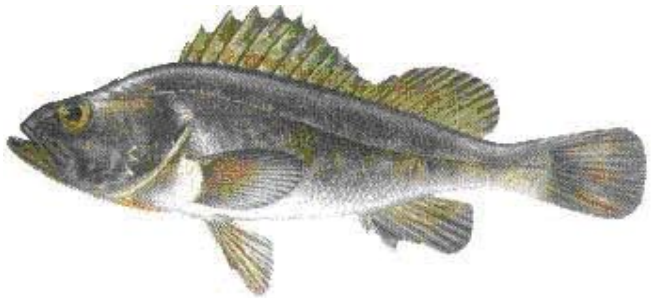
Study Area

- Ailian Bay , Yellow Sea
- Water depth: 20~25m
- Total 26 cages
- Annual yields about 130 t
- Main species :

  Sea bass *Lateolabrax japonicus (*71.82%)

  Black rock fish *Sebastodes fuscescens (*28.18%)

Sea bass
Lateolabrax japonicus



Black rock fish
Sebastodes fuscescens

Nitrogen Excretion Rate

- *Lateolabrax japonicus*

$\ln N = 1.9778 + 0.0132 T^2 - 3.6396 \ln W + 0.2979 T \ln W - 0.0084 T^2 \ln W$ *(Ge,2006)*

- *Sebastodes fuscescens*

$N = 1.774 + 9.551 F + 0.012 T^2 - 1.300 F \ln W + 0.134 FT \ln W - 0.003 FT^2 \ln W$ *(Xie,2001)*

W : Weight

T: Temperature

F: Food Consumption Rate

S: Special Growth Rate

Food Consumption Rate

- *Lateolabrax japonicus*

  $\ln(R+1)=(S+0.307+0.018T)/0.778$ (*Xie,2001*)

  $F=RW/100$

- *Sebastodes fuscescens*

  $\ln F=-13.3031+1.3380T-0.0237T^2+2.25701\ln W+0.0042T$

  $T^2\ln W$*(Ning,2001)*

Total nitrogen quantities

- If Nitrogen excretion was considered as 1, feed residue was 150％, and faeces were about 10％.

Table 1 The nitrogen quantities generated by *Lateolabra Ljaponicus* and *Sebastodes fuscescens* in different season (kg)

Species / Season	*Lateolabrax japonicus*			*Sebastodes fuscescens*		
	Nitrogen excretion	Feed residue	Faeces	Nitrogen excretion	Feed residue	Faeces
Spring	1.57	2.36	0.16	58	87	5.8
Summer	21	31.5	2.1	107	160.5	10.7
Autumn	269	403.5	26.9	197	295.5	19.7
Winter	89	133.5	8.9	79	118.5	7.9

Bioremediation species

Laminaria

Laminaria Harvest

Gracilaria lemaneiformis

Gracilaria lemaneiformis

Biological characteristic

- December~May (Winter & Spring): *Laminaria*
- June~November (Summer & Autumn): *Gracilaria lemaneiformis*
- The conversion factor between dry and wet weight was 1:7.

- *Laminaria*

✓ Nitrogen content: 1.34％(dry weight),

✓ Yield : 56 t (wet weight)/ha

- *Gracilaria lemaneiformis*

✓ Nitrogen content : 2.70％(dry weight),

✓ Yield : 30 t(wet weight)/ha

Optimum co-culture proportion

- Total nitrogen quantity of **Winter & Spring**： 591.68 kg
- 591.68×7/ (0.0134*56* 1000)＝5.52 ha.
- Optimum co-culture proportion of fish cage and *Laminaria* in Winter & Spring was 1(cage):0.212(ha).

- Total nitrogen quantity of **Summer & Autumn**：1544.4 kg
- 1544.4×7/ (0.027*30*1000) ＝13.35 ha
- Optimum co-culture proportion of fish cage and *Gracilaria* in Summer & Autumn was 1(cage):0.513(ha).

- Just a reference value based on the farmer scale
- Deepgoing research based on the research scale

✓ Model calculation

✓ Parameters: Boundary condition; Water exchange; Sediment-water interface fluxes;

Thanks for your attention