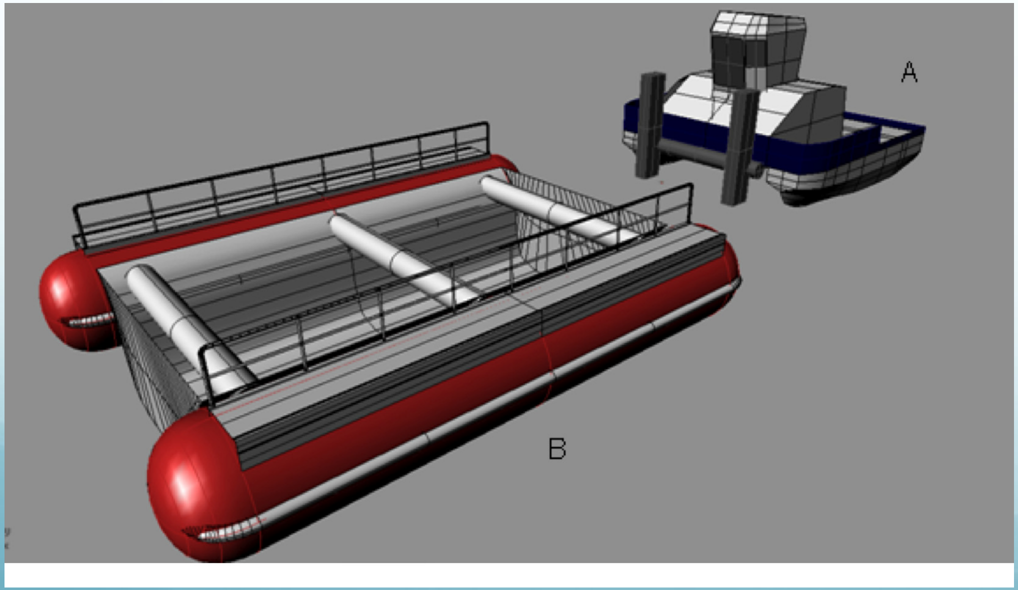
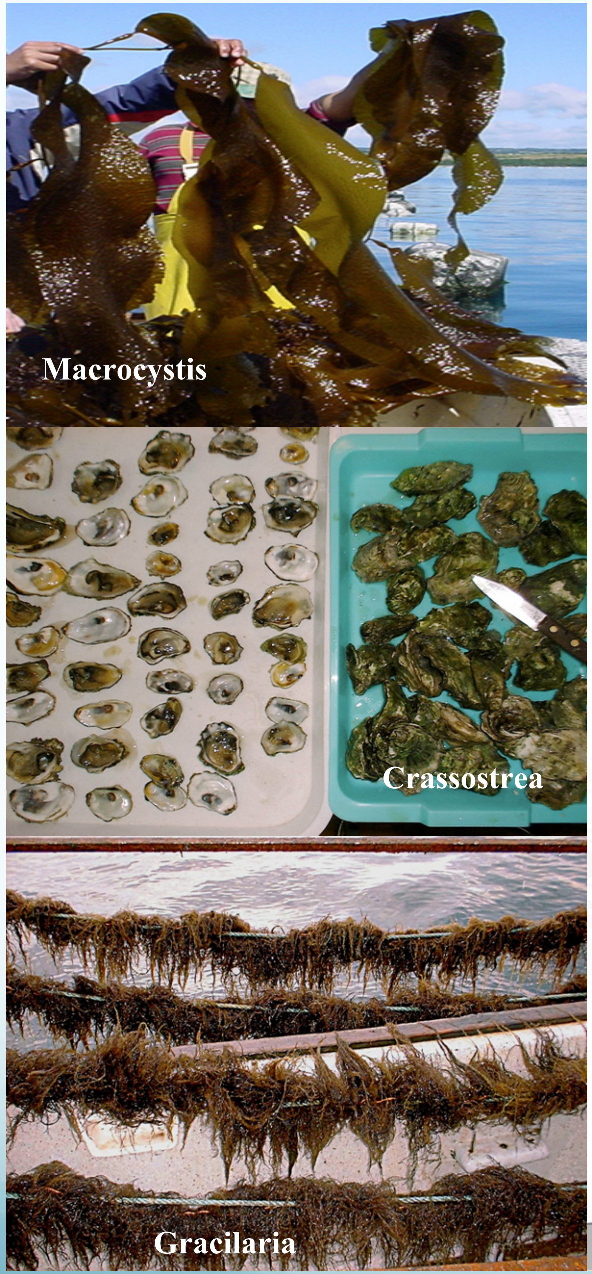
Culture Challenges

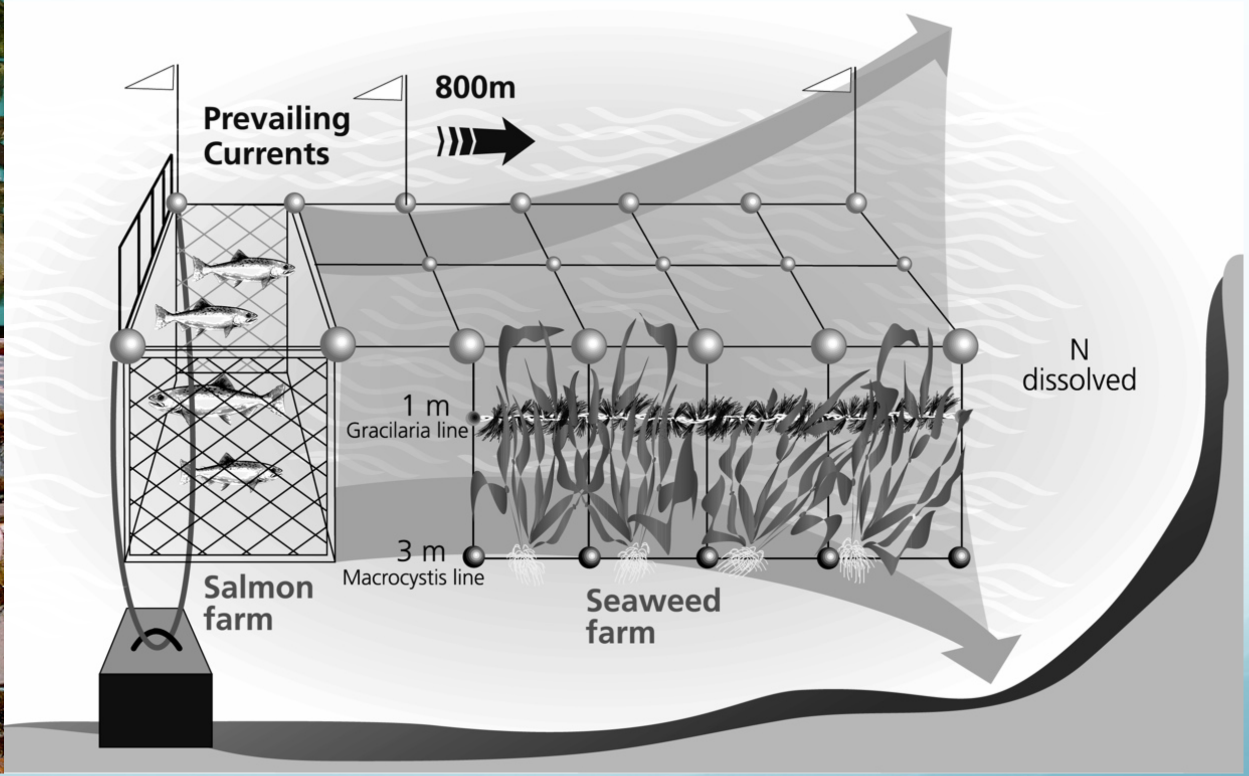
1. Engineering Cost Optimization
2. Production Optimization
1. Genetic Improvement
2. Seaweed Diseases
3. Industrialization of large-scale operations



20 Hectare Pilot Farm

Salmon-Oyster-Seaweed Model





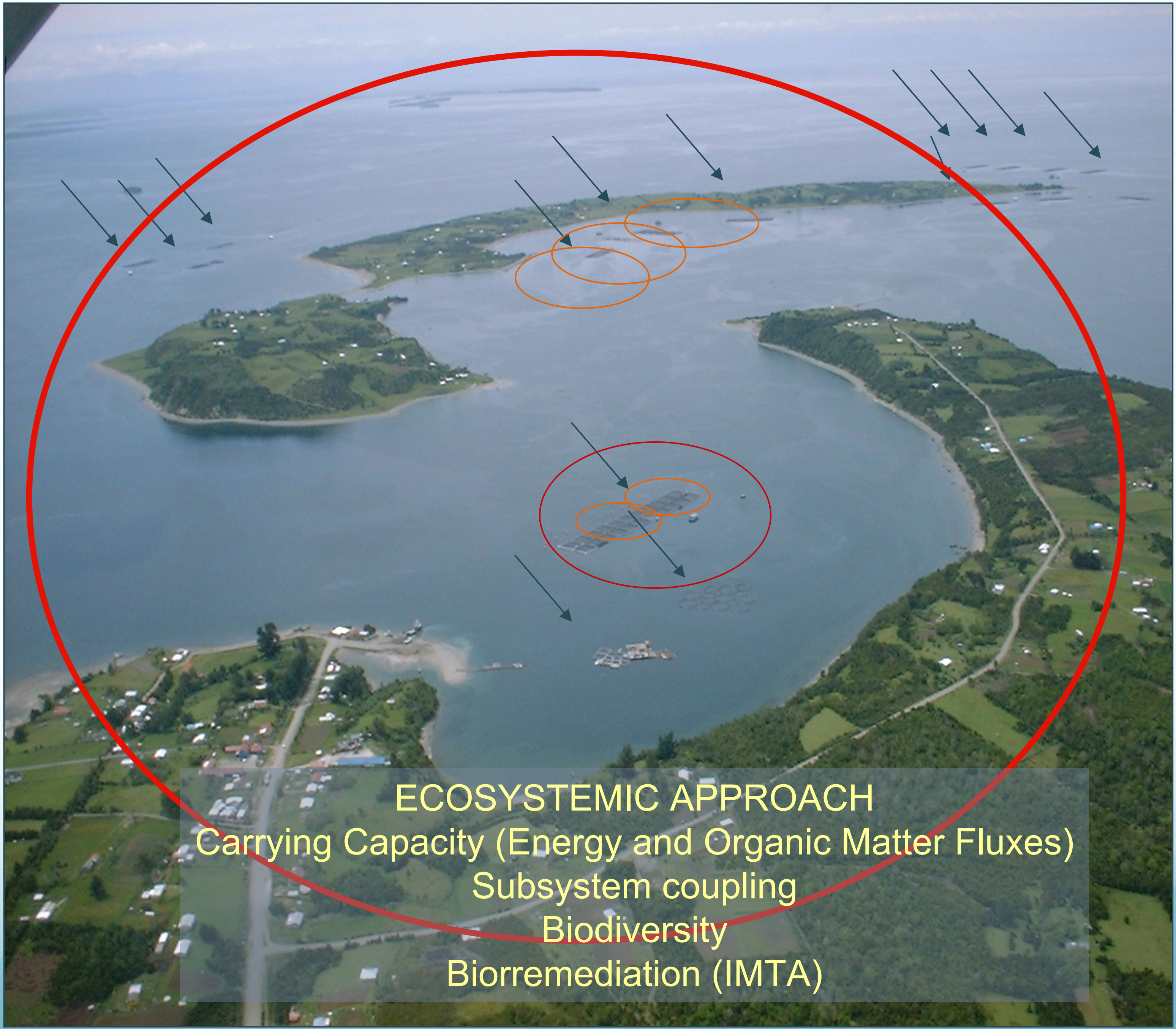
Buschmann et al. 2008. J. Appl. Phycol.
Buschmann et al. 2009. Ocean & Coastal Management

Table 4. Estimation of the *Macrocystis* and *Gracilaria* biofiltering efficiency and the seaweed scaling to achieve 80% effectiveness for removing the dissolved nitrogen wastes of a 1000 ton salmon farm in southern Chile.

	Gracilaria	*Macrocystis*
Productivity (DW kg/100 m)	240	250
Tissue N (g DW/100 g)	4.6	2.42
N uptake (kg/ ha (25 culture lines))	276	151
Bioremediation of a 1000 ton Salmon Production		
Estimated N load into the water column by fish farming 36900 kg)		
Ha of algae for a 80% N removal	143.5	262.3

Buschmann et al. 2008. Journal applied Phycology
Abreu et al. 2009. Aquaculture

Intensive use of Coastal Zones


ECOSYSTEMIC APPROACH
Carrying Capacity (Energy and Organic Matter Fluxes)
Subsystem coupling
Biodiversity
Biorremediation (IMTA)

- Challenges -

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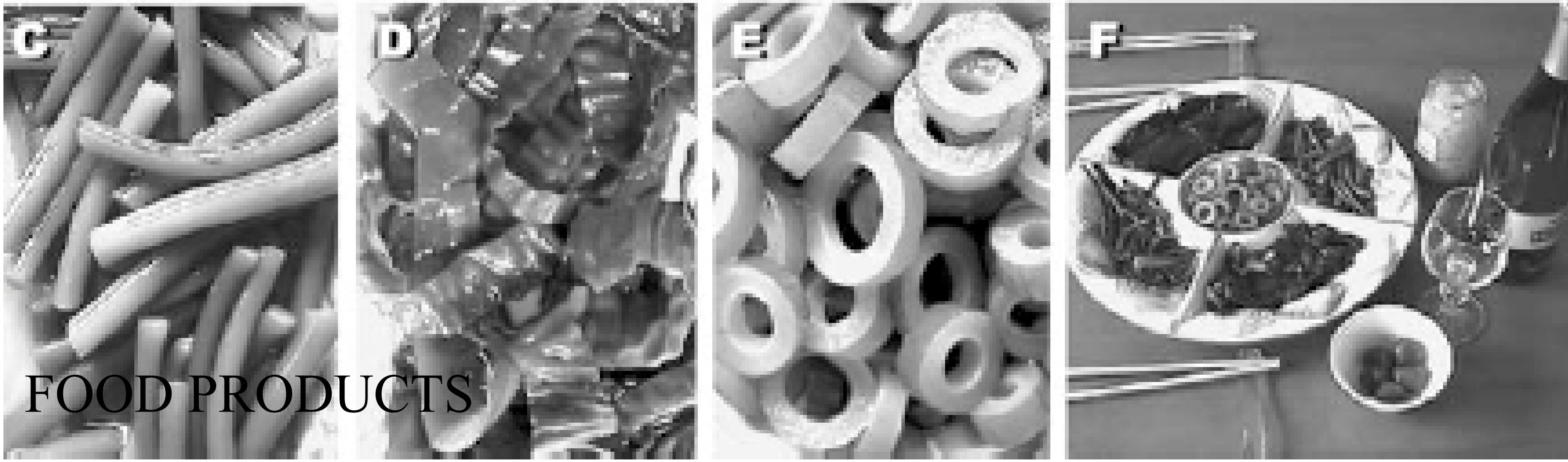
1. Adding Value to Seaweeds
2. Cost Internalization of Waste Reductions
3. Knowledge

Adding Value to Seaweeds



Environmental Cost

Traditional Economic Analysis

TABLE 2. Profitability analysis using the net present value (NPV in US$) and internal rate of return (IRR in %) of a culture system simulating three different net salmon productions (200, 400, and 600 tons) and four different fish stock densities (15, 30, 45, and 60 $kg \cdot m^{-3}$) without internalizing the total environmental costs.

		Profitability indicators	
Fish net production	Stocking density	NPV	IRR
200	15	n.p.	n.p.
	30	n.p.	n.p.
	45	455,692	24.1
	60	685,939	30.0
400	15	n.p.	n.p.
	30	814,882	21.9
	45	1,965,197	34.3
	60	2,498,356	42.2
600	15	n.p.	n.p.
	30	2,065,330	26.2
	45	3,743,201	40.0
	60	4,569,269	47.8

n.p., no profit.

Chopin et al. 2001 J. Phycology

Internalization of Environmental Costs

TABLE 3. Profitability analysis using the net present value (NPV in US$) and internal rate of return (IRR in %) of a culture system simulating three different net salmon productions (200, 400, and 600 tons) and four different fish stock densities (15, 30, 45, and 60 $kg \cdot m^{-3}$), considering the internalization of the total environmental costs.

		Profitability indicators	
Fish net production	Stocking density	NPV	IRR
200	15	n.p.	n.p.
	30	n.p.	n.p.
	45	n.p.	n.p.
	60	n.p	n.p.
400	15	n.p.	n.p.
	30	n.p.	n.p.
	45	n.p.	n.p.
	60	339,186	19.2
600	15	n.p.	n.p.
	30	n.p.	n.p.
	45	505,167	18.6
	60	1,330,517	25.4

n.p., no profit.

Chopin et al. 2001 J. Phycology

Internalization of environmental Cost
+
IMTA

TABLE 4. Profitability analysis using the net present value (NPV in US$) and internal rate of return (IRR in %) of an integrated culture system simulating three different net salmon productions (200, 400, and 600 tons) and four different fish stock densities (15, 30, 45, and 60 $kg \cdot m^{-3}$), considering the internalization of the total environmental costs reduced by the nutrient scrubbing capacity of *Gracilaria chilensis* and its conversion into another commercial marine crop.

		Profitability indicators	
Fish net production	Stocking density	NPV	IRR
200	15	n.p.	n.p.
	30	n.p.	n.p.
	45	39,982	15.8
	60	270,230	20.8
400	15	n.p.	n.p.
	30	n.p.	n.p.
	45	1,133,772	25.7
	60	1,666,931	32.2
600	15	n.p.	n.p.
	30	818,195	19.4
	45	2,496,785	30.3
	60	3,322,135	37.5

n.p., no profit.

Chopin et al. 2001 J. Phycology

CONCLUTIONS

- IMTA is technically feasible
- Regulations are required
- Drivers promoting seaweed aquaculture are necessary

GRACIAS!!

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