



Industrial utilization of seaweed in Norway

Seaweed for Biofuels
Trondheim
25-26. September 2012

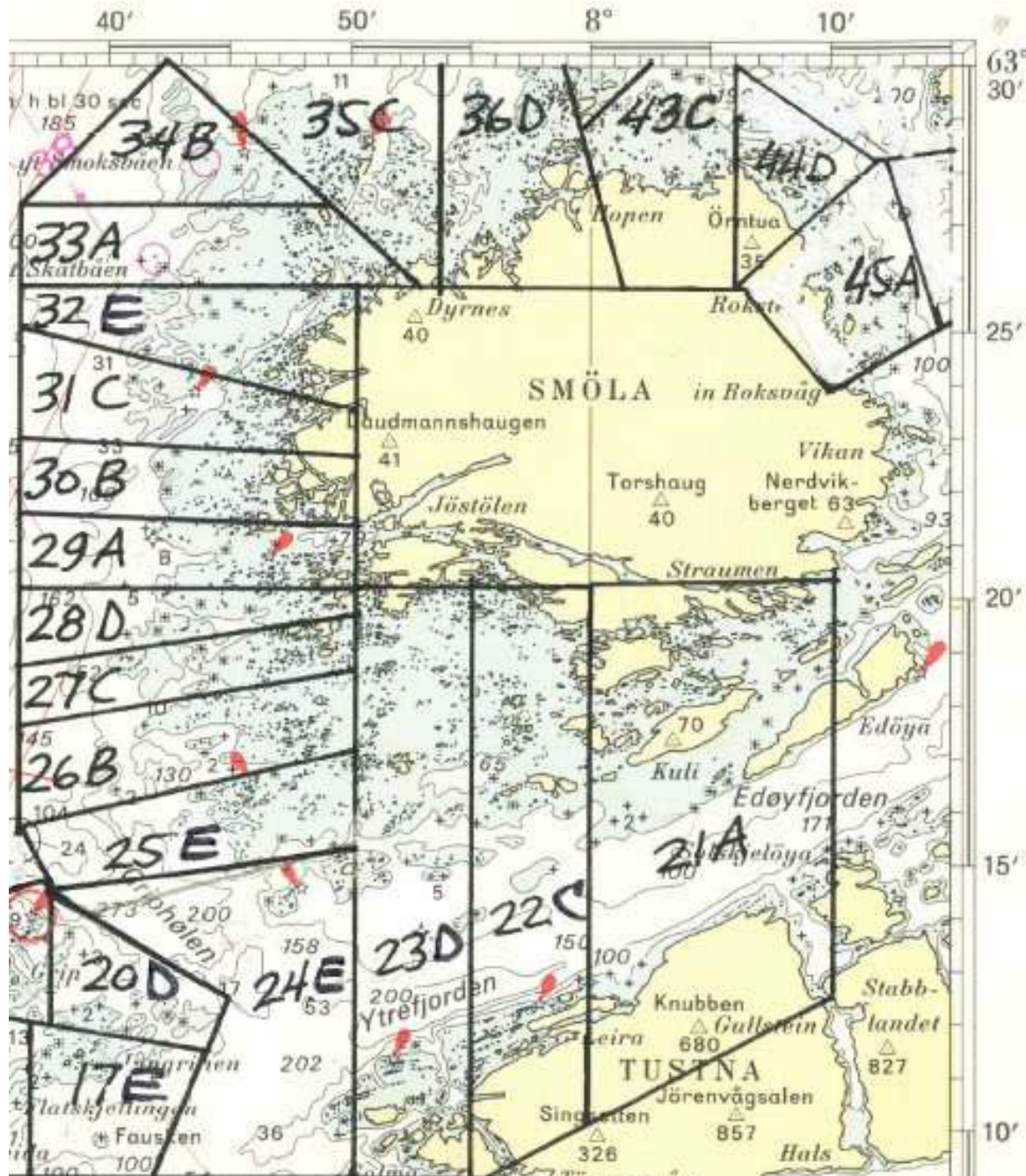
Long history

- Feed, fertilizers, iodine production and soda production (soap).
- Alginate, carrageenan, and agar are used in a number of applications in food, pharmaceuticals, biomedical and technical products.

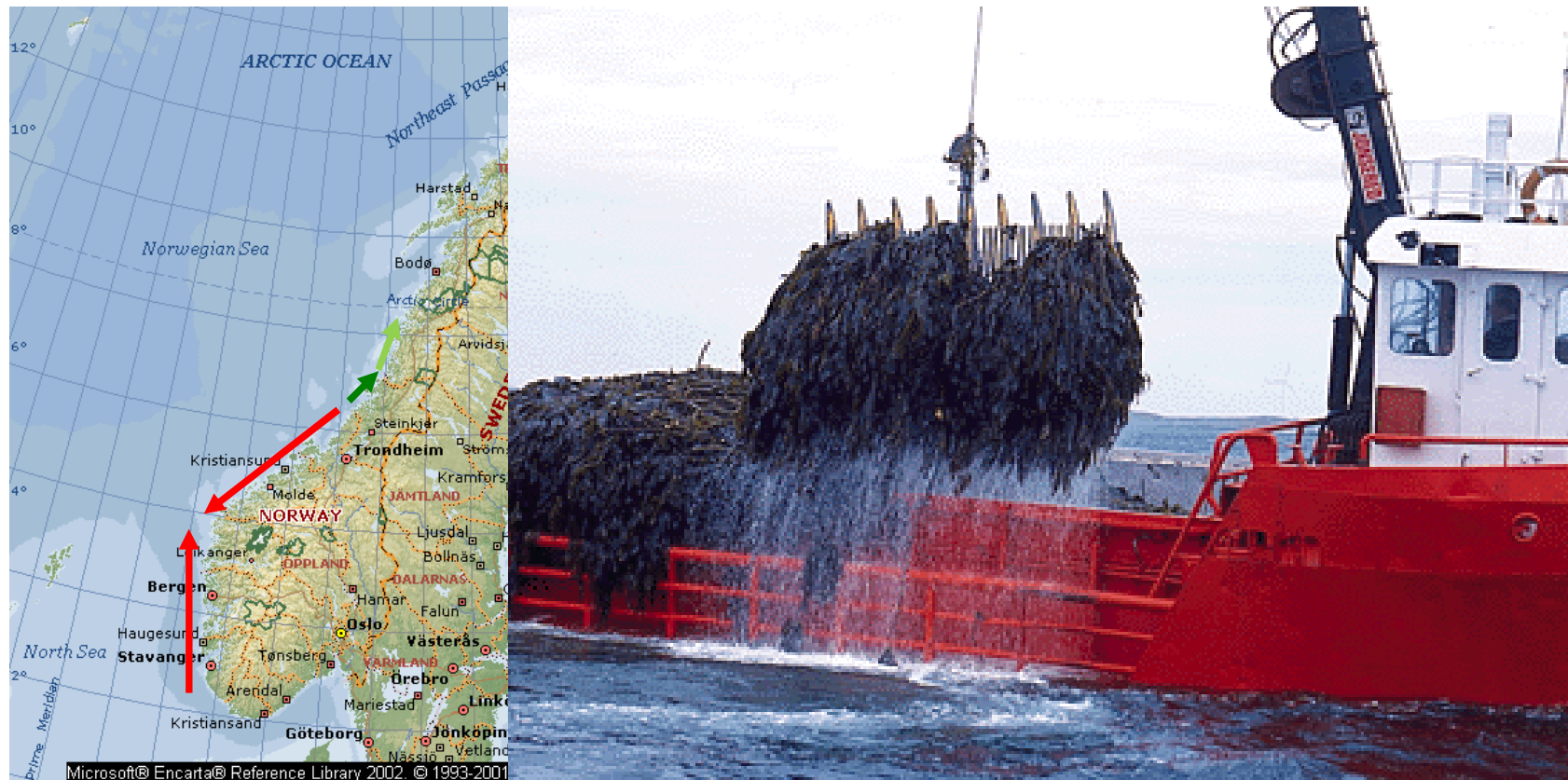


History of *Laminaria hyperborea* resource management

- 1963 - Start of seaweed trawling (Rogaland)
- 1960'ies: Study of fish in the harvesting areas
 - Re-growth studies
 - Environmental issues
 - The first regulations established to avoid conflicts with traditional fisheries
- 1972 →: The utilized coastline was divided into harvesting fields
 - Each field was harvested every 4-5 years
- 2000 – Sør-Trøndelag opened for harvesting
- 2010 – Start harvesting trials in Nord-Trøndelag in collaboration with the Institute of Marine Research

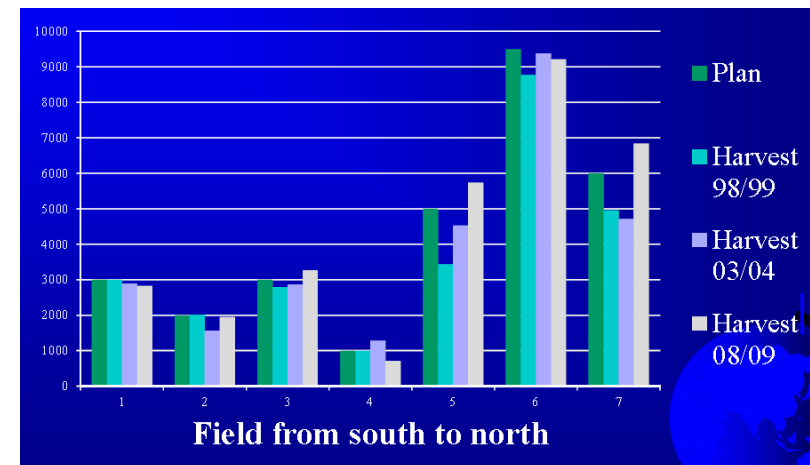


Harvesting



Resource utilization and regrowth

- FMC harvest 130-170000 MT *L. hyperborea* per year
- Standing stock estimated to 50 mill tons
- Utilization of 0,34 %
- The reproduction is good and predictable
- Internal control of regrowth in new fields
- Different regrowth studies from the Universities and research institutions
- From 2004 regrowth studies part of the annual program of the Institute of Marine Research



The Seaweed Management Plan conclusion (Ministry of fisheries)

“Through the years a continuous knowledge about seaweed harvesting and its impact on living organisms in the sea has been developed. So far it is not shown that seaweed harvesting represents unacceptable or irreversible injury on other living organisms or ecosystems”



Why process seaweed in Norway?

- Unique seaweed resources
- Energy and fresh water availability
- Products differentiated based on alginate properties and quality

Alginate in Food Products



Alginates in Pharmaceutical applications

- a few examples:



Application	Some Brands and Manufacturers
Anti-reflux/ indigestion	API in Gaviscon (Reckitt Benckiser); Raft-forming component in Maalox (Novartis), Algicon and Algicote (Aventis)
Controlled Release tablets	Isoptin/Biaxin/Dilacorone (Verapamil HCl, Abbott/Knoll), Nicorette Commit (GSK), Klacid/Klaracid (Clarithromycin, Abbott)
Dental Impression materials	Jeltrate (Dentsply), Cavex (Cavex), Algitray and OrthoPrint (Zhermack)
Wound care dressings	Tegagen (3M), Kaltostat (Convatec), NuDerm (J&J), AlgiSite (S+N), Coalgan (Brothier)

Biomedical Applications



NOVAMATRIX™

Ultrapure Polymer  Systems

- Alginate
 - UltraPure alginate
 - Sterile alginate
 - Wound care alginate
- Chitosan
- Sodium hyaluronate
- Research products
 - Novatach
 - Novafect
 - Novamatrix-3D

The alginate market trends

- Value of global alginate market estimated to 125 mill USD
- 1999-2007: Cost up, prices down
- 2008-2012: Cost up, prices up
- Strong competition - Chinese manufacturers are growing and taking more volume
- Western manufacturers are consolidating
- Very difficult to enter market as new manufacturer due to the high capital investment required and moderate profitability
- Food: The challenge of being an "E-number"
- Continuous need to find new and differentiated applications

Future opportunities

- Innovation - product and applications development – IP
- Advanced applications within Pharma, Biomedical, Health and Wellness
- Customer cooperation and partnership
- Further improve sustainability of our operation
- Improved resource utilization, explore other components of brown seaweed
- Introducing new molecules to the market requires
 - Regulatory documentation
 - Scientific documentation of efficacy



Health ingredients in Brown Seaweed

Component	g / 100 g dry matter	Cited health benefits
Alginic Acid & salts	15 – 45	Dietary fiber, cholesterol reduction
>85% M alginate	-	Immune stimulation – ProtaSea AFH
Mannitol	4 – 16	Diuretic, decreases brain and eye pressure
Polyphenols / Phloro-tannins	0.5 – 10	Antioxidants
FucoXanthin	<0.1	Thermogenic effect (Weight loss)
Fucoidan	0 – 10	Gut health, immune stimulation, antibacterial, reduced arterial inflammation, cancer cell destruction
Laminaran	0 – 10	Immune stimulation
Potassium	1.3 – 3.8	Cardiovascular and nerve functions
Magnesium	0.5 – 0.9	Cardiovascular and muscle functions
Iodine	0.01 – 1.1	Aids thyroid hormone production



Based on ref: Food Ingredients: Health & Nutrition, ‘Seaweed: the most nutritious form of vegetation on the planet?’, Feb ’07; Indergaard & Minsaas (’91), PubMed



Seaweed trawling has no documented influence on fishery

