

On Sustainability in Baltic Aquaculture



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Workshop Blue Growth
Riga

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... everything is sustainable

Deutschlands ungeliebte Klimaschützer

Kernkraftwerk Neckarwestheim
 Jahreserzeugung: 16 Mrd. kWh
 CO₂-Ausstoß: Null



Deutscher Industrie-Verband

Help us Preserve "The Magic of Nature"

Dear Guest:
 Every day tons of detergents and millions of gallons of water are used to wash towels that have only been used once.

A towel on the rack means
"I'll use it again"
 A towel on the floor means
"Please exchange"

Thank you !

Si Como No
 00351 - 694 - 890001
 Hauptstraße 1 • 4100 Bielefeld



Help us Preserve "The Magic of Nature"

Dear Guest:
 Bed sheets are washed daily in thousands of hotels that consume millions of gallons of water and tons of detergents. Sheets are customarily changed daily, but if you feel that this is unnecessary, leave this card on your pillow in the morning, and your sheets will not be changed that day.

Thank you !

Si Como No
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 Hauptstraße 1 • 4100 Bielefeld



gesellschaftliche Verantwortung übernehmen

Soziales Engagement fördern

Als weltweit erfolgreiches Unternehmen übernimmt Samsung soziale Verantwortung und möchte dazu beitragen, das Leben nachhaltig zu verbessern. Zahlreiche Initiativen weltweit unterstützen die ökonomische und soziale



Um eine friedliche und nachhaltige Nutzung der weltweiten Ressourcen zu sichern, untersagt Samsung, dass sogenannte Konfliktminerale in der Produktion verwendet werden. Dazu gehören Minerale wie Tantal, Zinn, Wolfram oder Gold, die in Konfliktgebieten in unethischer Weise abgebaut werden. Die Einhaltung dieser Vorgabe wird systematisch überprüft und durch Schulungsmaßnahmen ergänzt.

Einsatz erneuerbarer Energien

Ziel ist es, den weltweiten Einsatz von erneuerbaren Energien in den Samsung Firmenstandorten zu verstärken. Durch mehr direkte Stromerzeugung, den Ankauf von Ökostrom und den Zertifikatswerb für Strom aus erneuerbaren Energien erschließt Samsung stetig neue, saubere Energiequellen.

Recycling gebrauchter Produkte

Samsung geht bewusst mit Ressourcen um, die nur begrenzt verfügbar sind. Daher werden möglichst viele Elektronik-Altergeräte zurückgenommen und recycelt. So hat Samsung



Umweltschutz in der Region

In Deutschland wird der Umweltschutz von Samsung engagiert durch einen eigenen Umweltbereich vorangestellt. Dieser berichtet direkt an die Geschäftsführung und wird von den Umweltspezialisten der verschiedenen Divisionen umfassend und fachkundig unterstützt.

„Wir nehmen schon seit vielen Jahren engagiert am Umweltaktionstag 'Sauberes Hessen' teil. Wir sind auf die große Beteiligung unter den Mitarbeitern sehr stolz. Sie verdeutlicht den hohen Stellenwert des Themas bei Samsung.“

Sebastian Stiegler, Senior Manager Environmental Protection bei Samsung Electronics

bietet Samsung seinen Strom seit Jahren aus erneuerbaren Quellen. Die Geschäftsreisen mit der Deutschen Bahn sind CO₂-neutral und im Fuhrpark werden bereits zwei Elektrofahrzeuge getestet. Der Abfall am Standort wird von den Mitarbeitern konsequent getrennt und die Belegschaft beteiligt sich regelmäßig an der jährlichen Umweltkampagne „Sauberes Hessen“.



Corporate Citizenship

Um das gesellschaftliche Engagement voranzutreiben entwickelt Samsung eine weitreichende Strategie. Samsung orientiert sich an den Millenniums-Entwicklungszielen der Vereinten Nationen und umfasst für drei Kernthemen insgesamt fünf Corporate-Citizenship-Programme, werden durch lokale Maßnahmen ergänzt, die auf Geheiß vor Ort eingehen.

Engagement in Deutschland

Samsungs Vision ist es, Menschen weltweit dazu zu ren, sich frei zu entfalten und ihre Potenziale auszus. Um ein positives Arbeitsumfeld zu schaffen, besteht umfangreiche Aus- und Weiterbildungsprogramme, angebote, Unterstützungsprogramme für Mitarbeiter und präventive Maßnahmen gegen Diskriminierung, wird auf Basis jährlicher Mitarbeiterbefragungen kontinuierlich verbessert.



Sustainability – a rubber word



- Brundtland Commission of the United Nations on March 20, 1987: “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”
- Our attitude towards nature and responsibility for the generations after us (Ott 2015)
- No generation within the chain of generations is given preference (Voget)

Konrad Ott 2015: Zur Dimension des Naturschutzes in einer Theorie starker Nachhaltigkeit. Metropolis-Verlag, marburg, 298 pp.

Why should we be responsible?

- "The Principle of Equality"
- „ ... all men are **created equal**, that they are endowed by their Creator with certain unalienable Rights, that among these are **Life, Liberty and the Pursuit of Happiness**
- => no **person** is preferenced
- => No **generation** is preferenced (Voget)
- => „fair bequest package“ to coming generations

IN CONGRESS, JULY 4, 1776. A DECLARATION BY THE REPRESENTATIVES OF THE UNITED STATES OF AMERICA, IN GENERAL CONGRESS ASSEMBLED.

WHEN in the Course of human Events, it becomes necessary for one People to dissolve the Political Bonds which have connected them with another, and to assume among the Powers of the Earth, the separate and equal Station to which the Laws of Nature and of Nature's God entitle them, a decent Respect to the Opinions of Mankind requires that they should declare the causes which impel them to the Separation.

We hold these Truths to be self-evident, that all Men are created equal; that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty, and the Pursuit of Happiness.—That to secure these Rights, Governments are instituted among Men, deriving their just Powers from the Consent of the Governed, that whenever any Form of Government becomes destructive of these Ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its Foundation on such Principles, and organizing its Powers in such Form, as to them shall seem most likely to effect their Safety and Happiness. Prudence, indeed, will dictate that Governments long established should not be changed for light and transient Causes; and accordingly all Experiments have been, that Mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the Forms to which they are accustomed. But when a long Train of Abuses and Usurpations, perverting totally the Intent of Government, evinces a Design to reduce them under absolute Despotism, it is their Right, it is their Duty, to throw off such Government, and to provide new Guards for their future Security. Such has been the patient Sufferance of these Colonies; and such is now the Necessity which constrains them to alter their former System of Government. The History of the present King of Great-Britain is a History of repeated Injuries and Usurpations, all having in direct Object the Establishment of an absolute Tyranny over these States. To prove this, let Facts be submitted to a candid World.

He has refused his Assent to Laws, the most wholesome and necessary for the public Good.

He has forbidden his Governors to pass Laws of immediate and pressing Importance, unless suspended in their Operation till his Assent should be obtained; and when so suspended, he has utterly neglected to attend to them.

He has refused to pass other Laws for the Accommodation of large Districts of People, which those People would otherwise have obtained; and by this he has endeavored to prevent the Population of these States, for that Purpose obstructing the Laws for Naturalization of Foreigners; refusing to pass others to encourage their Migration hither, and raising the Conditions of new Acquisitions of Lands.

He has obstructed the Administration of Justice, by refusing his Assent to Laws for establishing Judiciary Powers.

He has made Judges dependent on his Will alone, for the Tenure of their Office, and the Amount and Payment of their Salaries.

He has erected a multitude of new Offices, and has heaped Honours on Office, to increase the Burden on our People, and to draw away our Money.

He has affected to render the Military independent of and superior to our Legislatures.

He has combined with others to subject us to a Jurisdiction foreign to our Constitution, and unacknowledged by our Laws; giving his Assent to their Acts of pretended Legislation.

For quartering large Bodies of Armed Troops among us;
For compelling them, by a mock Trial, from Parliament for any Murders which they should commit on the Inhabitants of these States;
For carrying on an unwarlike Trade with all Parts of the World;
For imposing Taxes on us without our Consent;
For depriving us, in many Cases, of the Benefits of Trial by Jury;
For transporting us beyond Seas to be tried for pretended Offences;
For abolishing the free System of English Laws in a neighbouring Province, establishing therein an arbitrary Government, and enlarging its Boundaries, so as to render us at all times an Example and a Labour for the same; for pretending to exercise the Power of suspending the Writ of Habeas Corpus;
For taking away our Charters, abolishing our most valuable Laws, and altering fundamentally the Forms of our Governments;
For imposing on our Colonies a Taxation without their Consent;
For abolishing our Government here, by declaring us out of his Protection and suspending our Writ of Habeas Corpus;
He has plundered our Seas, ravaged our Coasts, burnt our Towns, and destroyed the Lives of our People;
He is, at this Time, transporting large Armies of foreign Mercenaries to augment the Writs of Death, Desolation, and Tyranny, already begun with circumstances of Cruelty and Pride, barely pardoned in the most barbarous Ages, and totally unworthy the Head of a civilized Nation;
He has combined with others to subject us to a Jurisdiction foreign to our Constitution, and unacknowledged by our Laws; giving his Assent to their Acts of pretended Legislation, in the following Manner, to wit: That he has endeavored to bring on the Inhabitants of our Frontiers, the merciless Indian Savages, which have been the most implacable Enemies of the whole People, to excite them to Hostilities against us, and to commit Murther, Rape, and every other Act of Violence against us, with a cruel and unchristianlike Intention.

In every Stage of these Oppressions we have Petitioned for Redress, and have received for Answer, that our repeated Petitions have been refused only by repeated Denial. A Prince, whose Character is thus marked by every Act which may define a Tyrant, is unfit to be the Ruler of a free People.

Nor have we been wanting in Attention to our British Brethren.—We have warned them from Time to Time of Attempts by their Legislatures to extend an unwarrantable Jurisdiction over us. We have reminded them of the Circumstances of our Colonies and Settlements here. We have appealed to their native Justice and Magnanimity, and we have conjured them by the Ties of our common Kindred to disavow such Usurpations, which would surely interrupt our Commerce and Consanguinity. They too have been deaf to the Voice of Justice and Consanguinity. We must, therefore, acquiesce in the Necessity, which denounces our Separation, and hold them, as we hold the rest of Mankind, Enemies in War, in Peace, and Friendship.

We, therefore, the Representatives of the UNITED STATES OF AMERICA, in GENERAL CONGRESS ASSEMBLED, appealing to the Supreme Judge of the World for the Rectitude of our Intentions, do, in the Name, and by Authority of the good People of these Colonies, solemnly Publish and Declare, That these United Colonies are, and of Right ought to be, FREE AND INDEPENDENT STATES; that they are absolved from all Allegiance to the British Crown, and that all political Connections between them and the State of Great-Britain, are and ought to be totally dissolved; and that as FREE AND INDEPENDENT STATES, they have full Power to levy War, conclude Peace, contract Alliances, establish Commerce, and to do all other Acts and Things which INDEPENDENT STATES may of right do. And for the Support of this Declaration, with a firm Reliance on the Protection of Divine Providence, we mutually pledge to each other our Lives, our Fortunes, and our sacred Honor.

Signed by Order and in Behalf of the CONGRESS,
JOHN HANCOCK, PRESIDENT.

ATTEST,
CHARLES THOMSON, SECRETARY.

PHILADELPHIA: PRINTED BY JOHN DUNLAP.

L. Voget 2008: Der Greifswalder Ansatz starker Nachhaltigkeit als Beitrag im umweltethischen Diskurs?

Vortrag im Rahmen des XXI. Deutschen Kongress für Philosophie: Lebenswelt und Wissenschaft

.. and how?

- **Strong interpretation:** nature capital kept constant over time („constant natural capital rule“)

=> not much that we can do!!



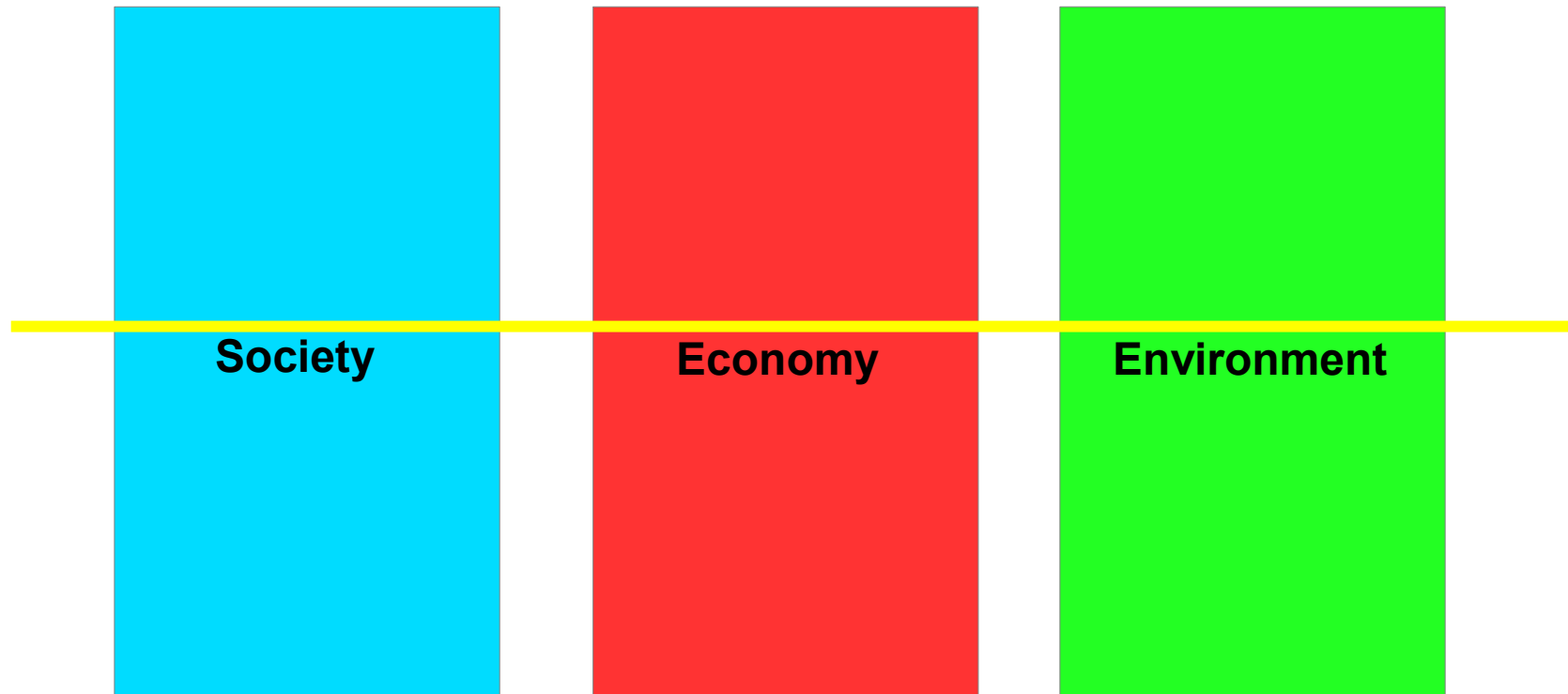
- **Weak interpretation:** exploited nature capital can be substituted, provided that the net welfare does not decline („non declining utility rule“)

=> Living in an artificial world ? („RHS“?)



- **Intermediate position:** substitution, if profits from non-regenerative sources are invested in regenerative sources

The three pillars of sustainability



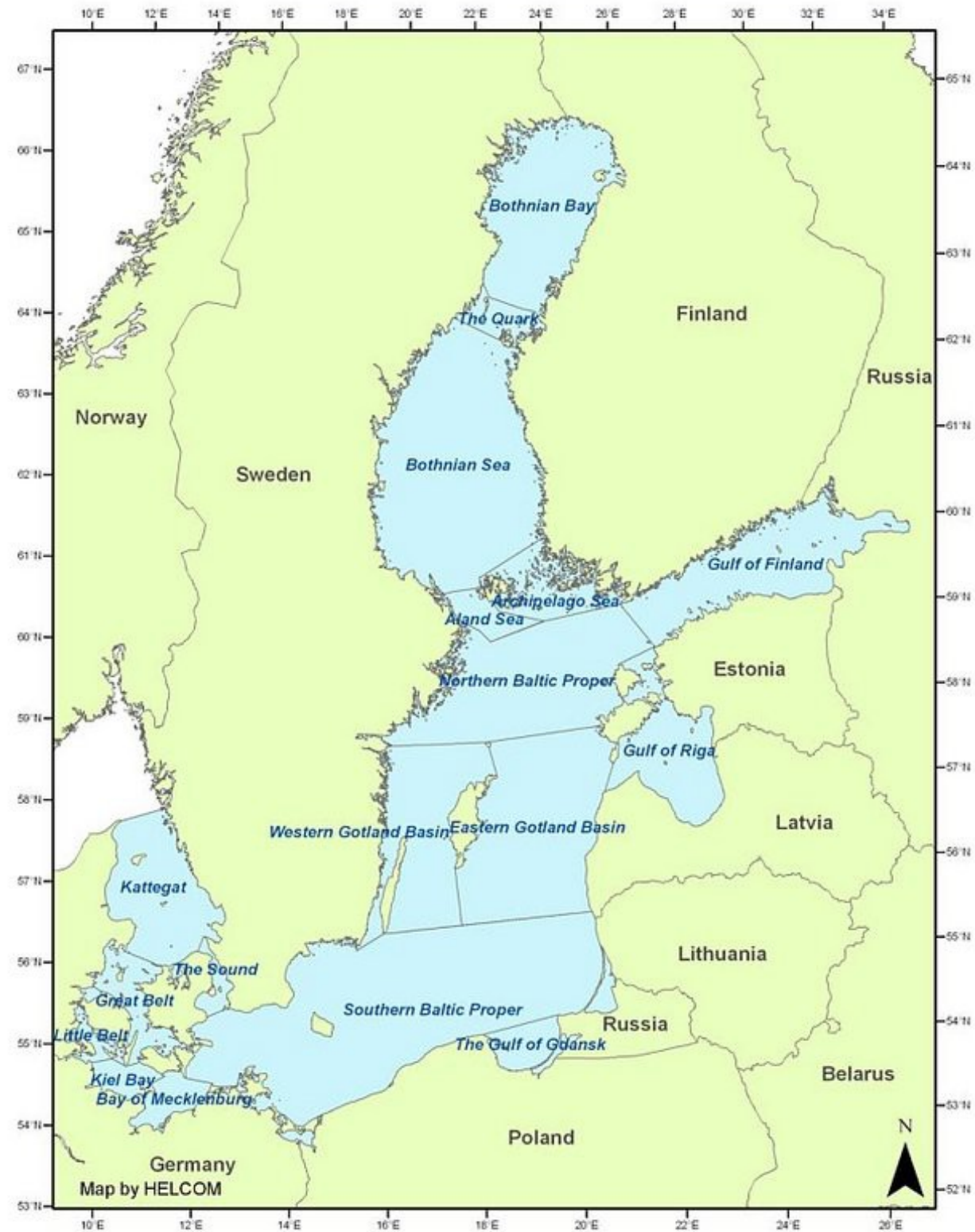
- Critical limits are required!!
- E.g.: WFD



Indicators of (limits of) sustainability in the Baltic

- Eutrophication !!!
- Overfishing
- Invasive Species
- Pollution (incl. ammunition / war deposits)
- Competitiveness
- ... more

Geography, Regions, adjacent countries

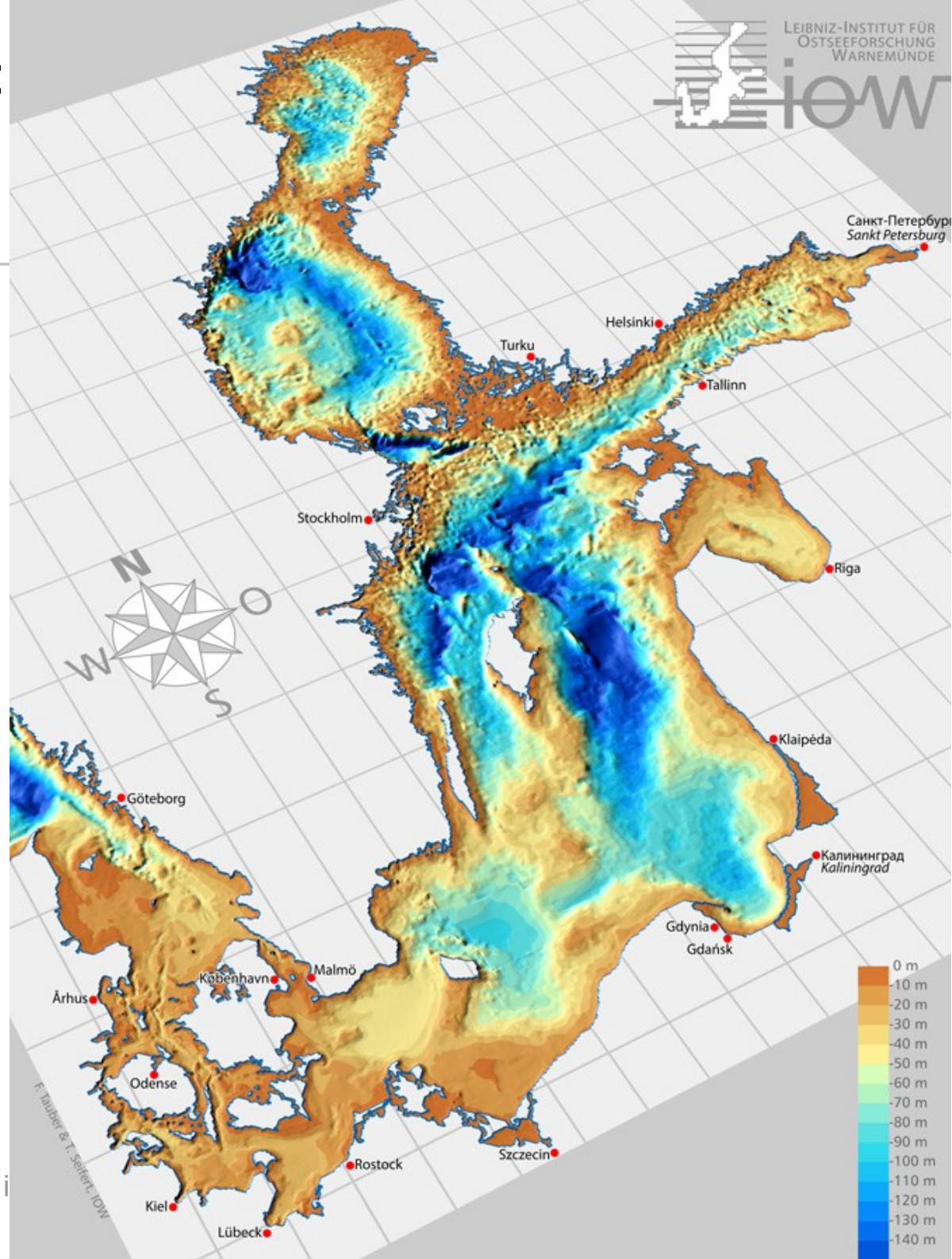
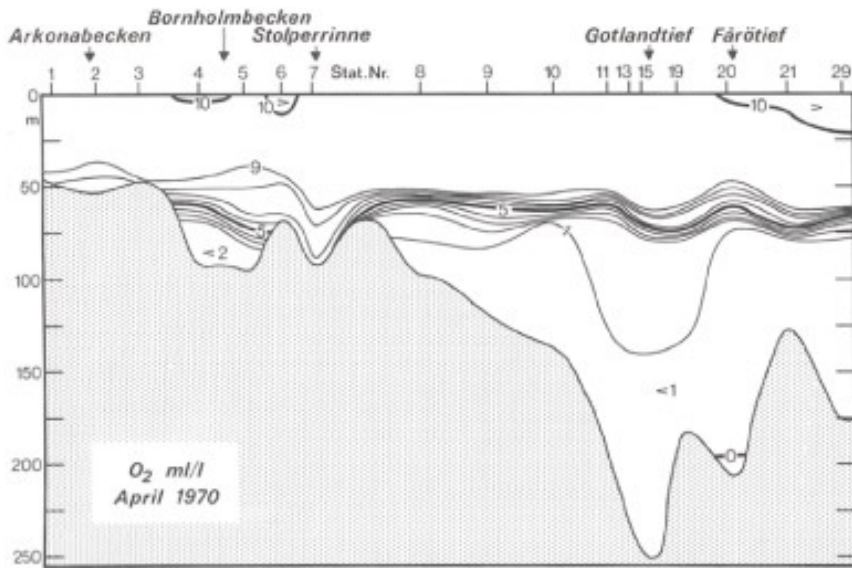


Sustainabi

Map by HELCOM

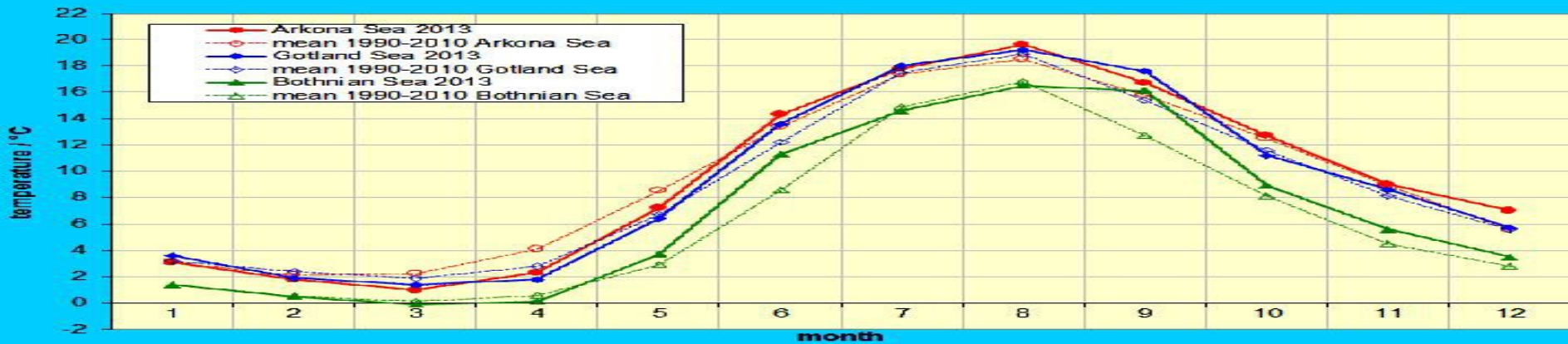
Geology and hydrography:

Limited water exchange



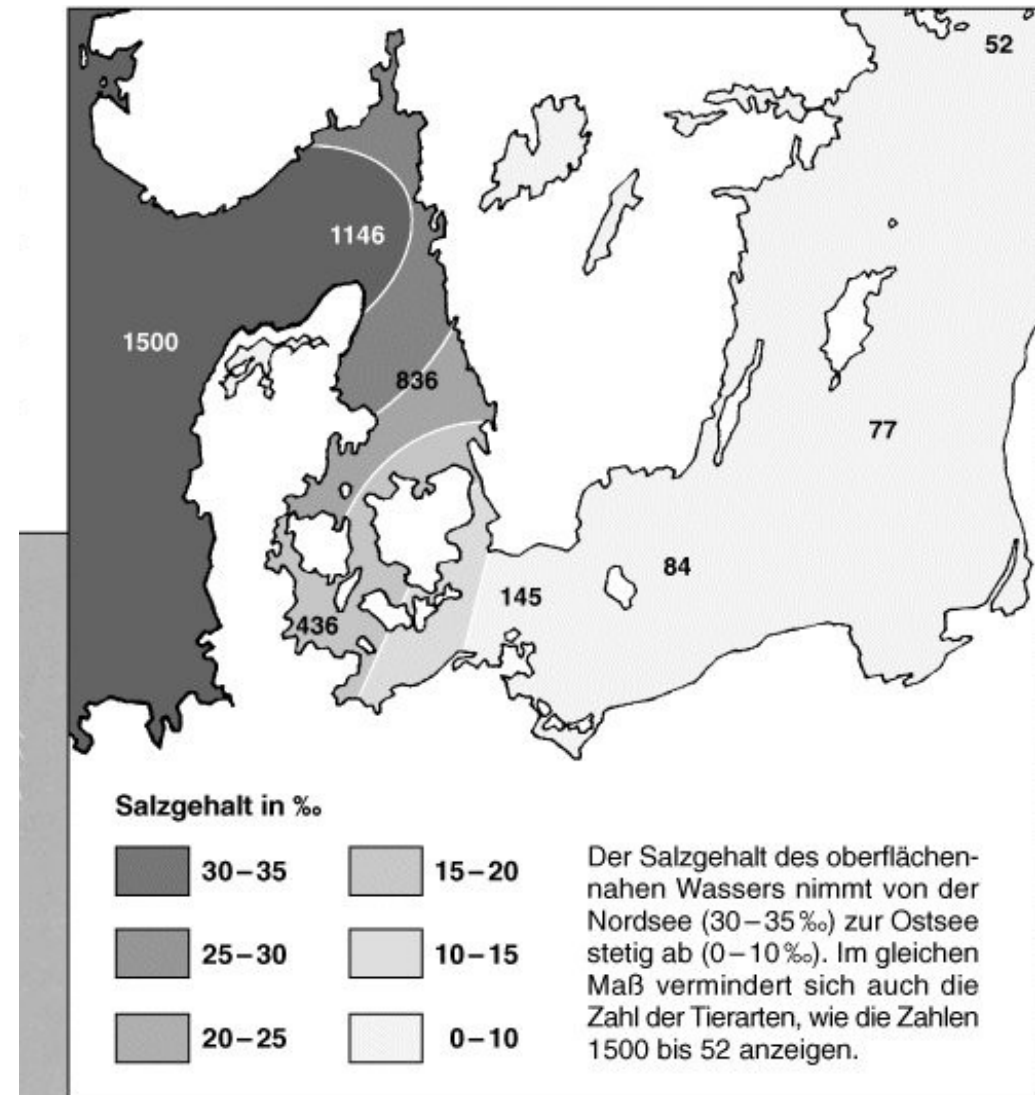
Geological and hydrographic characteristics

Temperature differences



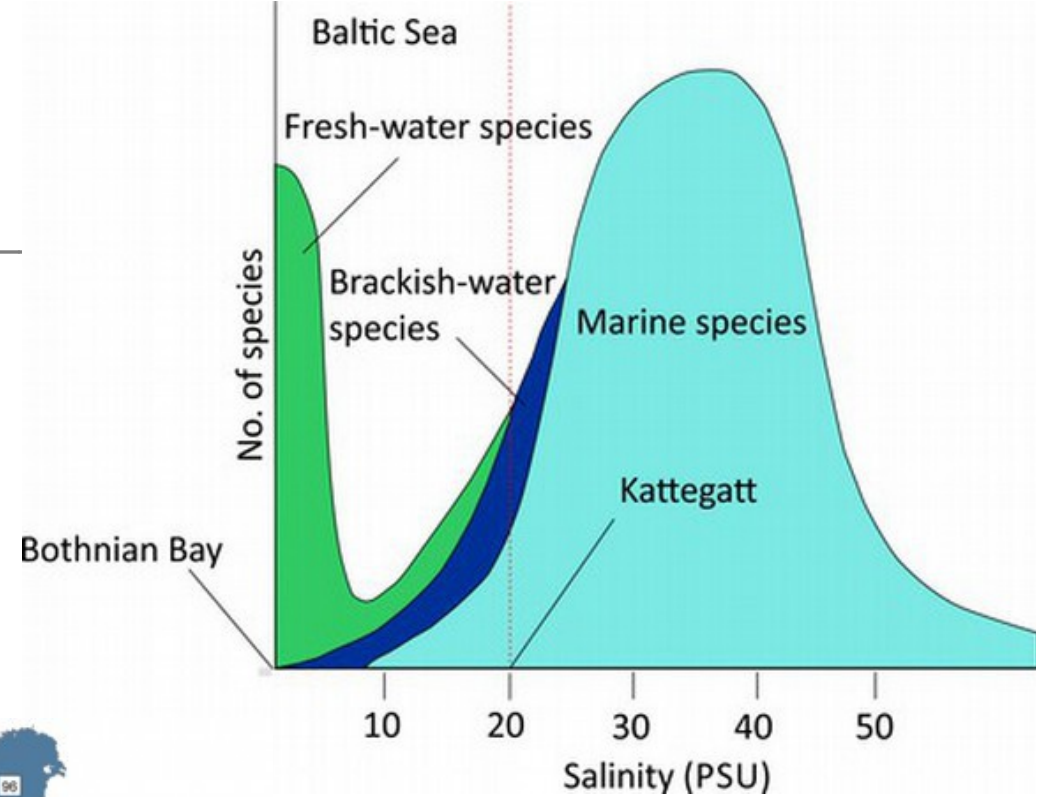
Marine ecology

- Brackish water:
Salinity gradient from West to East
- Oxygen deficiency
- Temperature variation of 20° K

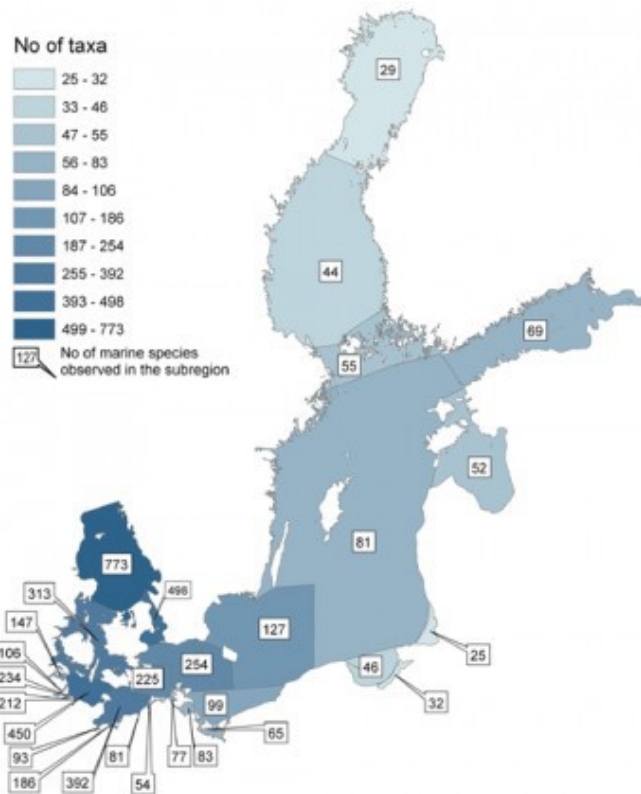


Marine ecology

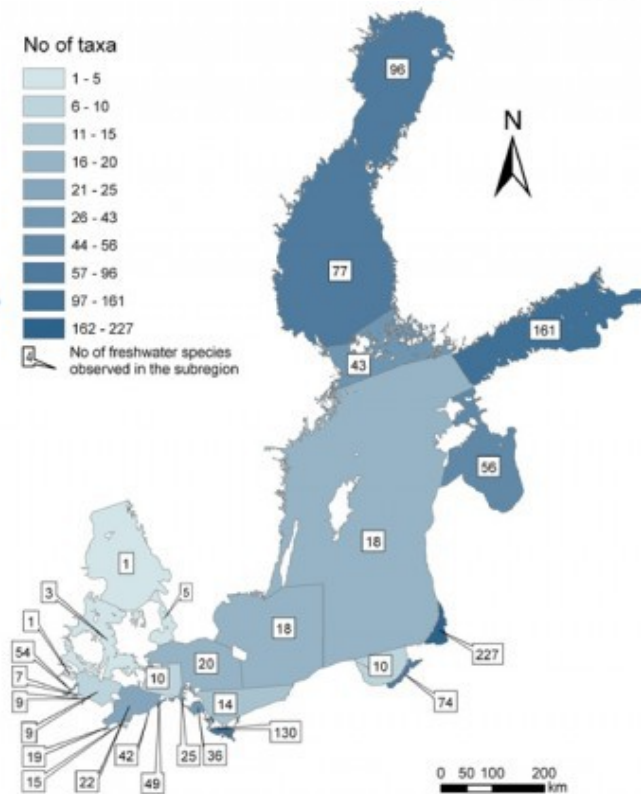
- Brackish water diversity minimum



Marine

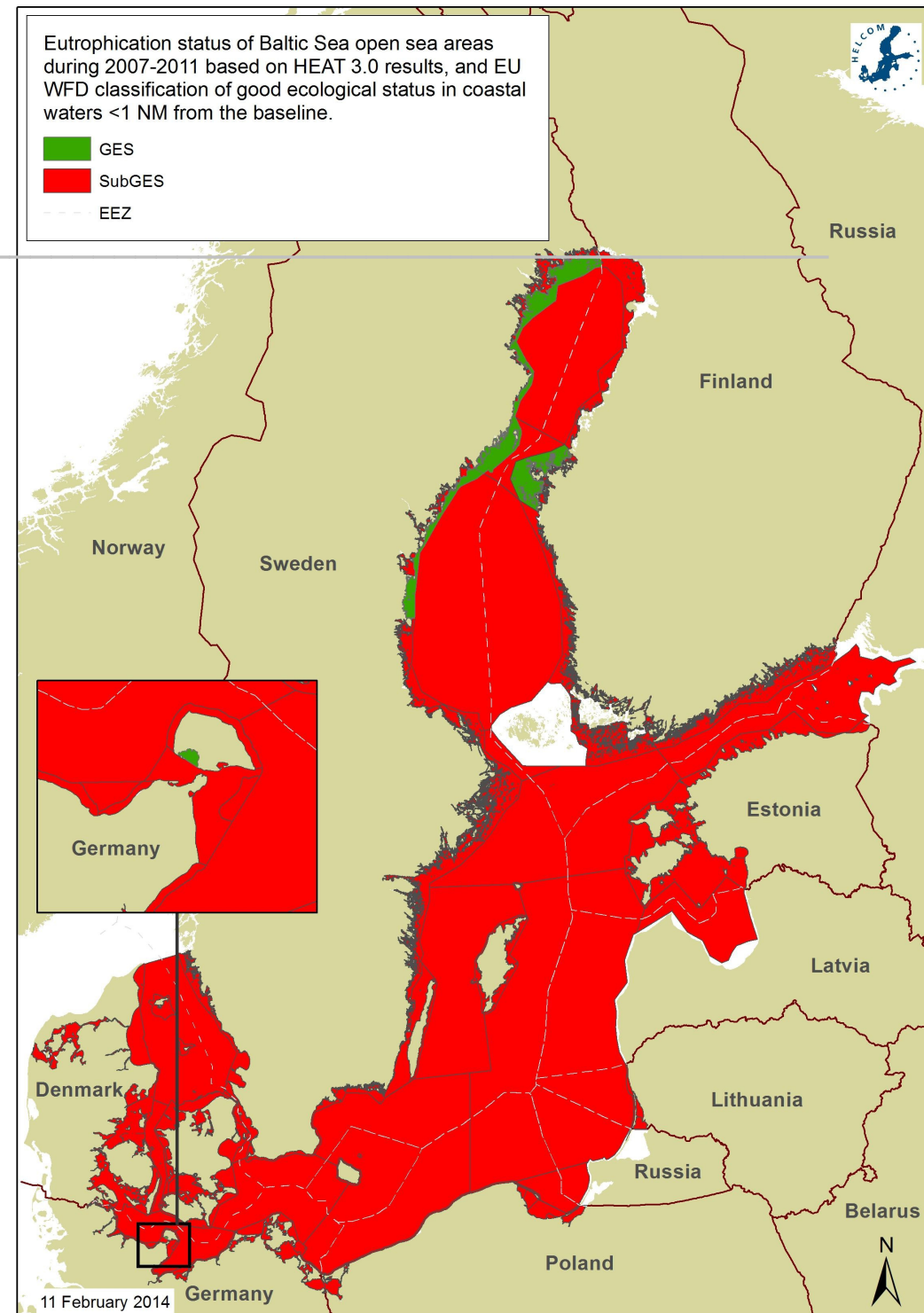


Freshwater



Eutrophication is the paramount environmental issue in the Baltic Sea

- Eutrophication in the Baltic Sea has led to problems, including “dead bottoms“, nuisance algae growth and deteriorated water quality
- Despite the efforts to reduce nutrient inputs (WFD, MSFD), they are still estimated to be 4 to 5 times higher than in pre-industrial times
- Consequently, according to German and Danish legislation, no increase in nutrient emissions will be tolerated and licensing of new aquaculture operations is connected to a 0-emission operation,
- Avoidance of nutrient emissions is the bottleneck for further aquaculture development of aquaculture in the Western and Southern Baltic Sea



CRM (1994)



- >150 Environmental Impact Assessments (mostly local)
- Ecological studies for federal and state governments and agencies,
- ICZM-concepts for Schleswig-Holstein, Israel, Indonesia, Chile
- Aquaculture (Algae, blue mussels, mullets, mikroalgae)
- IMTA
- R & D projects on marine actives

and oceanBASIS (2001)

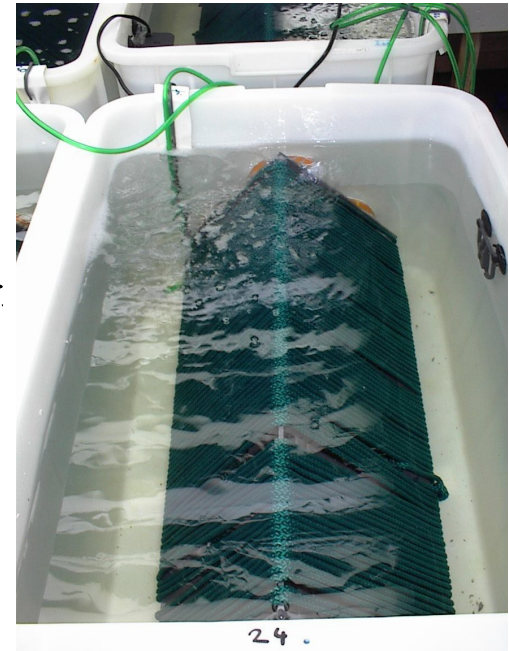
- Products from sustainable marine resources
- Algae extracts for cosmetic supplier
- Collagen from „marine evertbrates“
- Cosmetics („OceanWell“)
- Food from the sea („Meeresgarten“)



Saccharina latissima



Saccharina latissima



24.



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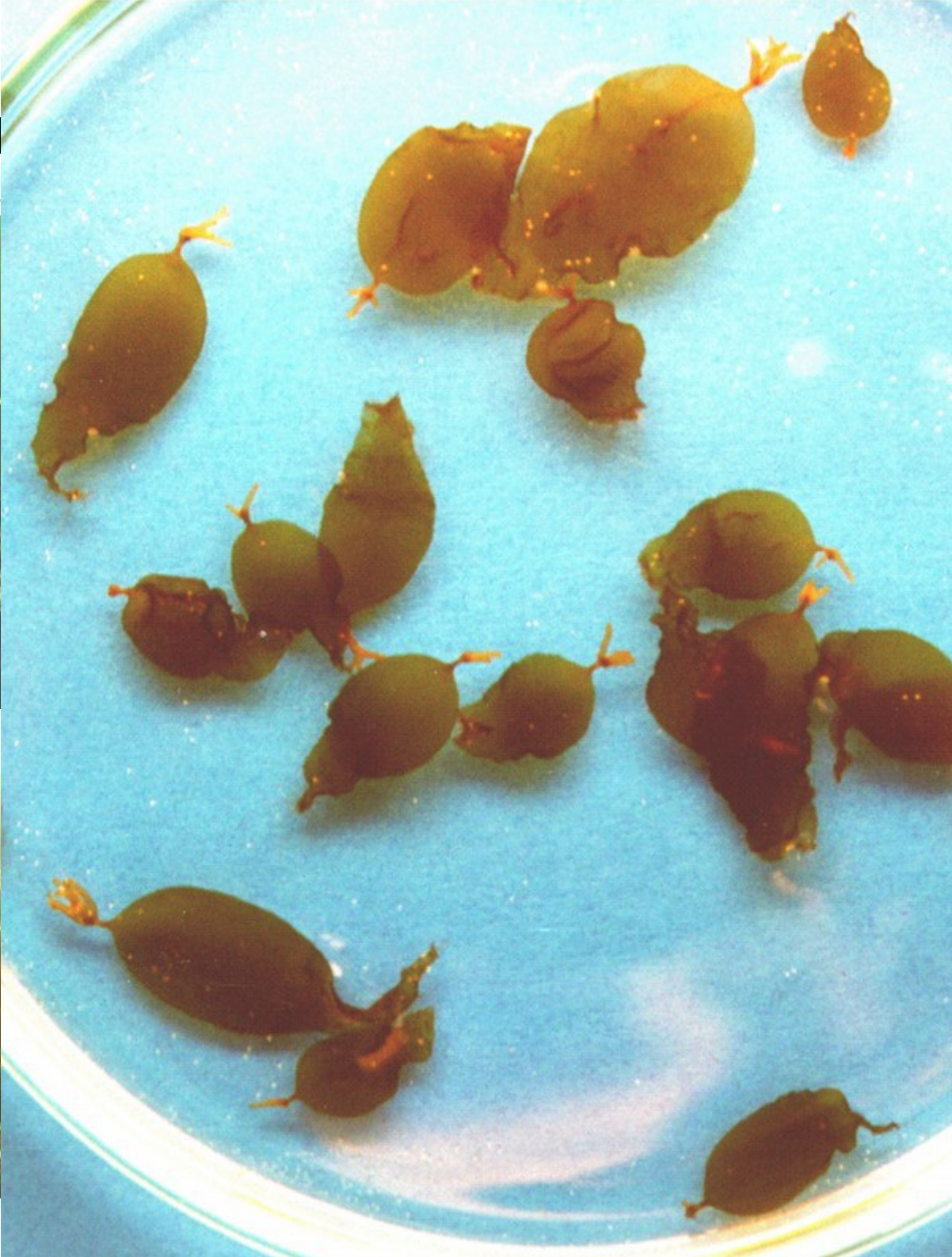
Saccharina latissima



ustai



Saccharina l.



24.



Saccharina latissima – neue Anzuchtmethode über 2 Jahre



Season 1 (Dezember)

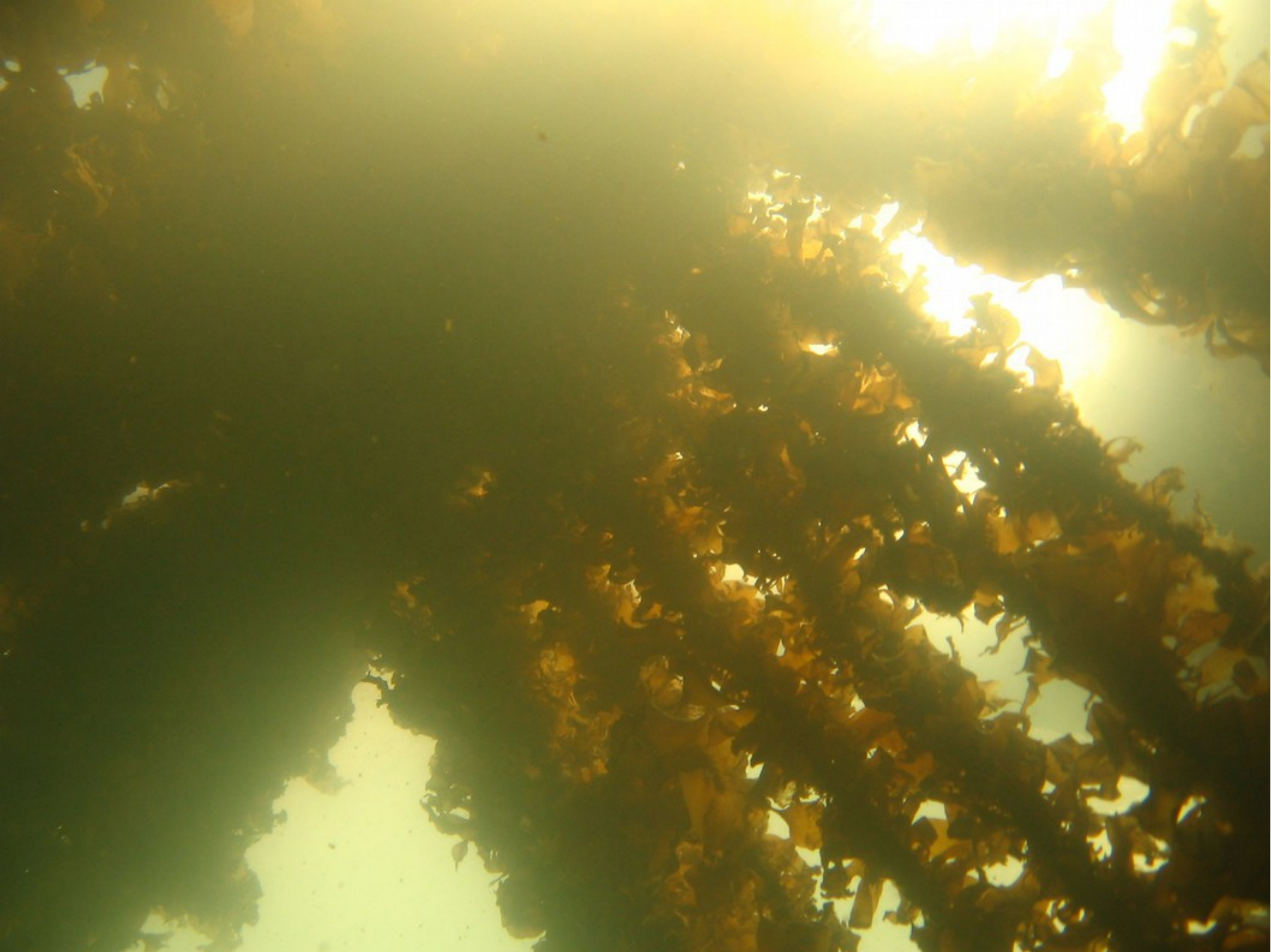


1. Saison (Juni)



2. Saison (Juni)

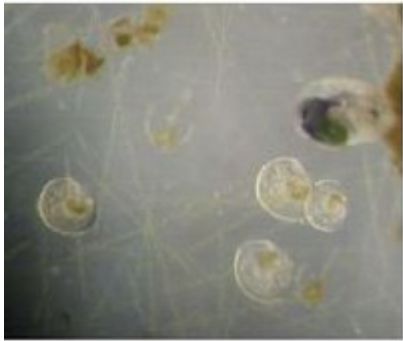




Nutrient removal by *Saccharina latissima*

Wet algae	Composition (wt)	Removal (10 t production)
Nitrogen	0,64%	64 kg
Phosphorous	0,11%	11 kg

Mussels: Production cycle

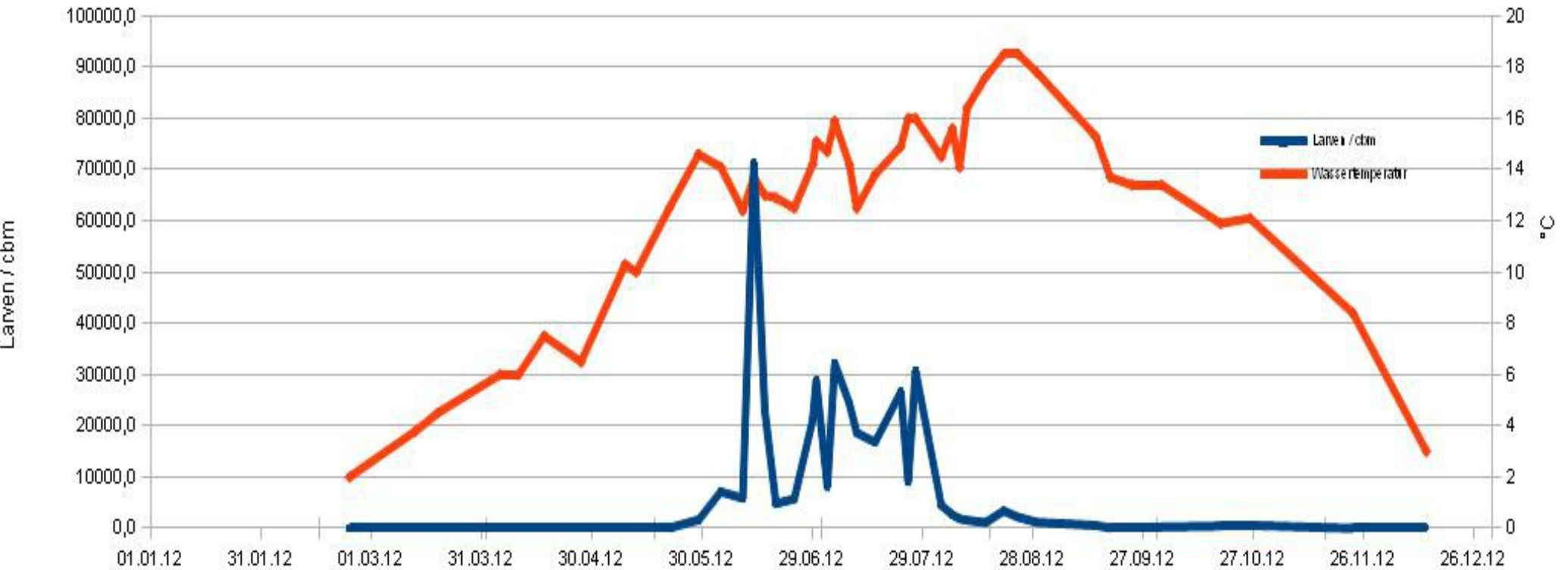


Expose substrates to collect larvae



- Collectors: webbing (5 cm wide, 3,5 m long)
- Exposure time: short before spatfall
- Approx. 40 – 50 larvae cm⁻²
(= 40,000 – 50,000 per m substrate)

Mussel larvae abundance during the year

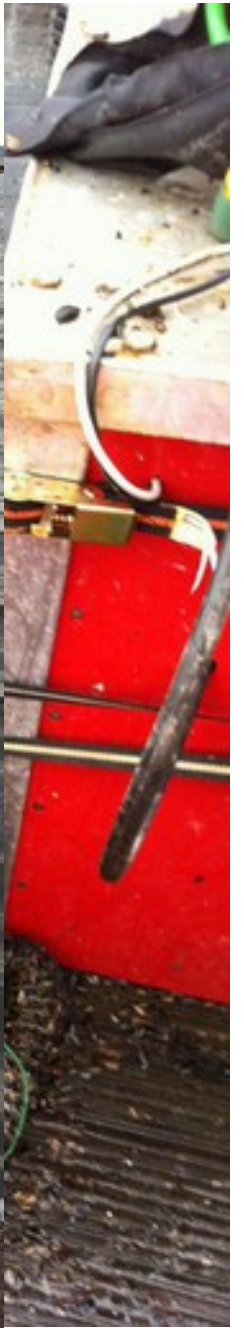


Socking



Bal

Socking



Checking

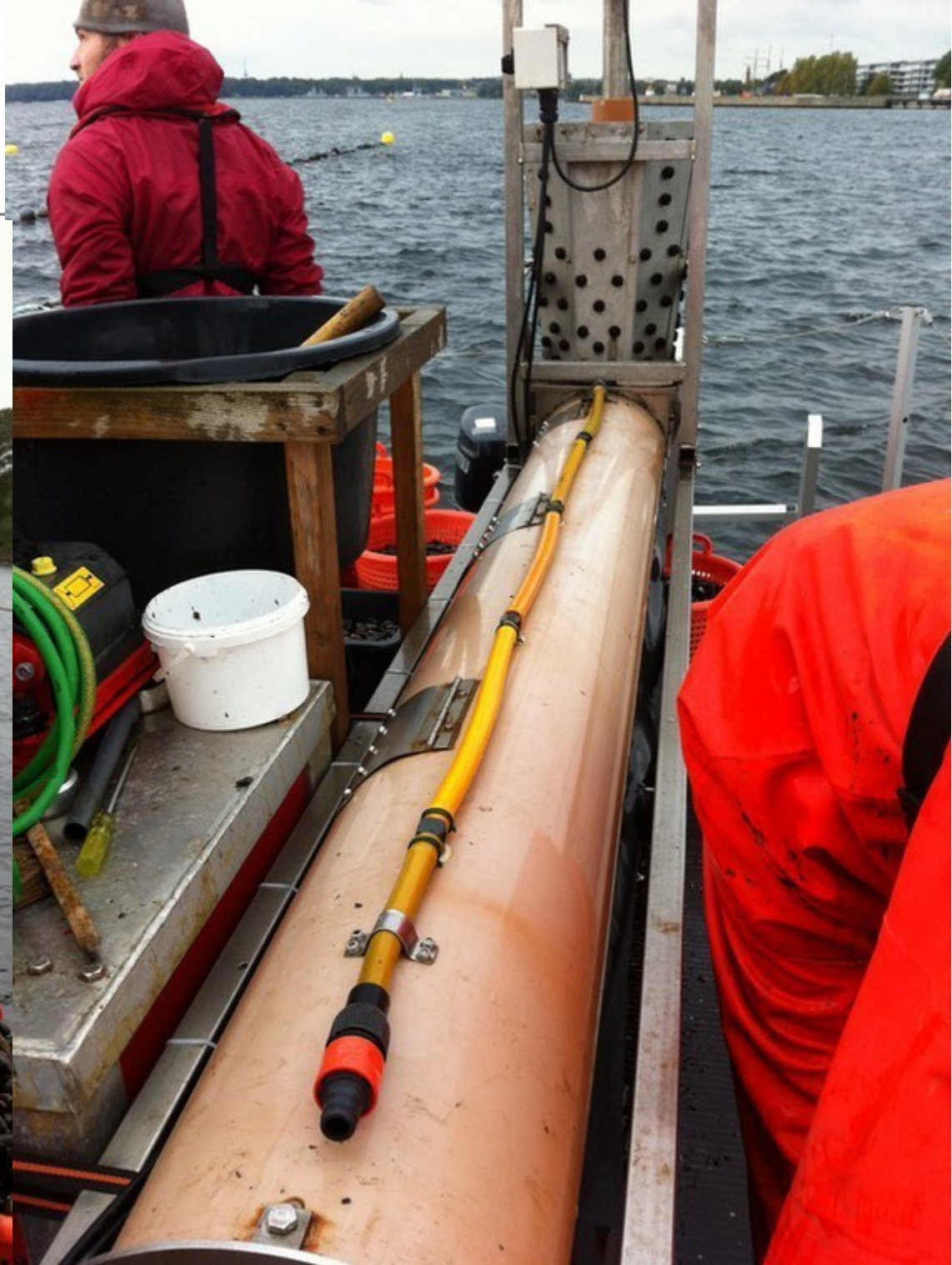


Harvest



y in

Sorting



Selling



Kieler Meeresfarm



- 2014: Establishment of „Kieler Meeresfarm“, Dr. Tim Staufenberger

Nutrient removal by mussels farming

Wet Mussel with shell	Composition (wt)	Removal (100 t production)
Nitrogen	1,00%	1000 kg
Phosphorous	0,20%	200 kg

Nutrient balance in combined fish / seaweed / mussel cultivation

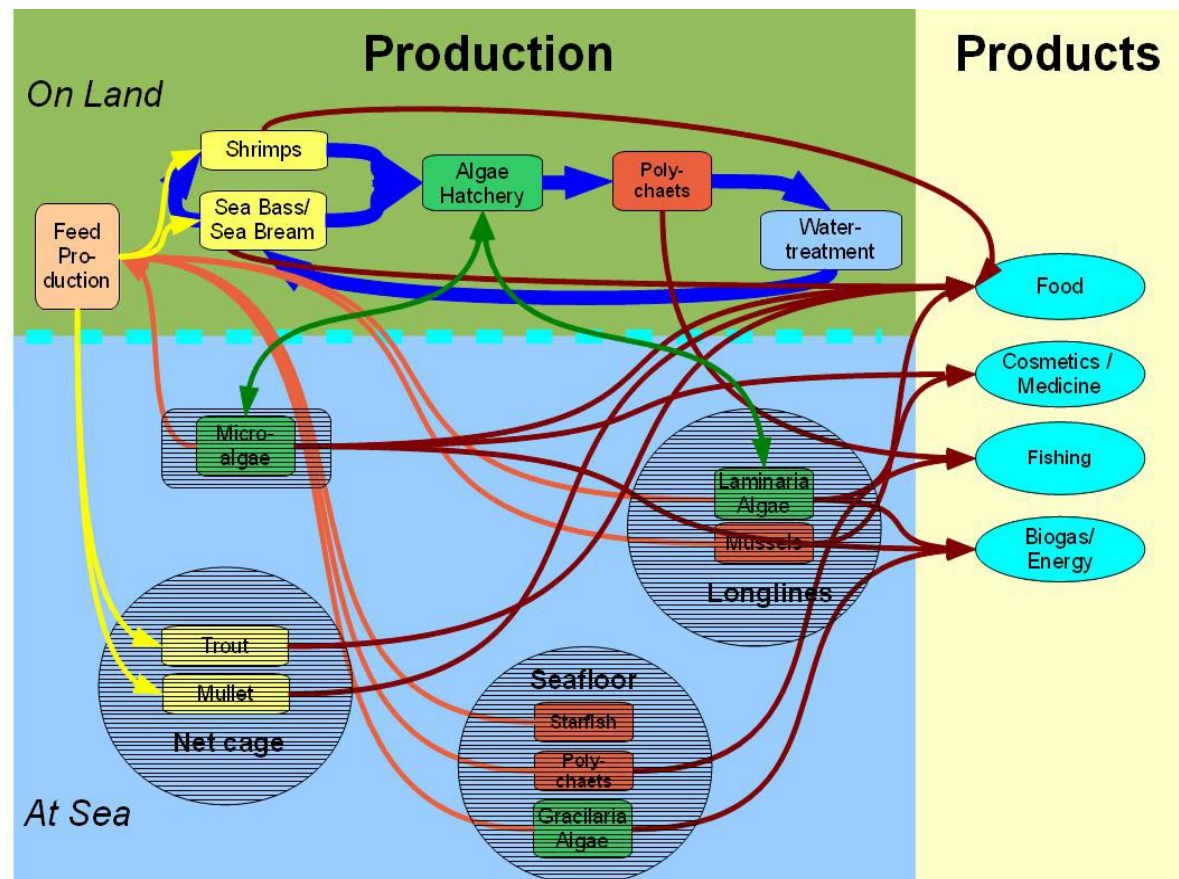
	Removal by algae & mussels
Nitrogen	1064 kg
Phosphorous	211 kg

Nutrient balance in combined fish / seaweed / mussel cultivation

	Removal by algae & mussels	Input by production of 20 t fish	Balance
Nitrogen	1064 kg	1178 kg	114 kg
Phosphorous	211 kg	140 kg	-71 kg

Approaching the IMTA concept:

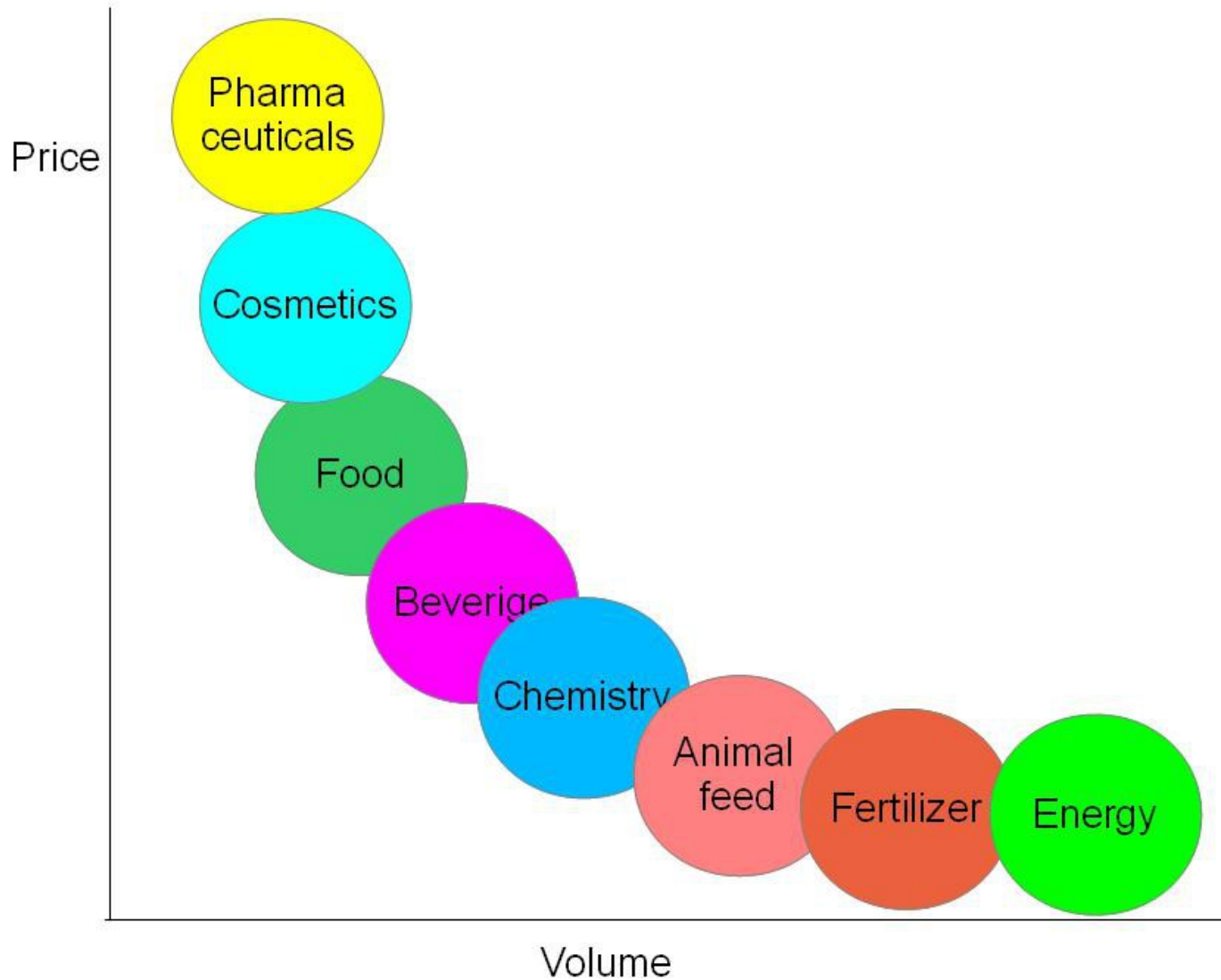
- Feed input as source of nutrients can be compensated by extractive aquaculture.
- Goal: circular economy – like a small farm in the mountains
- Closed nutrient cycles
- Different organisms from different trophic levels
- The metabolic remains of one species is food source for other species
- Resembles natural cycles, focused on species attractive to humans



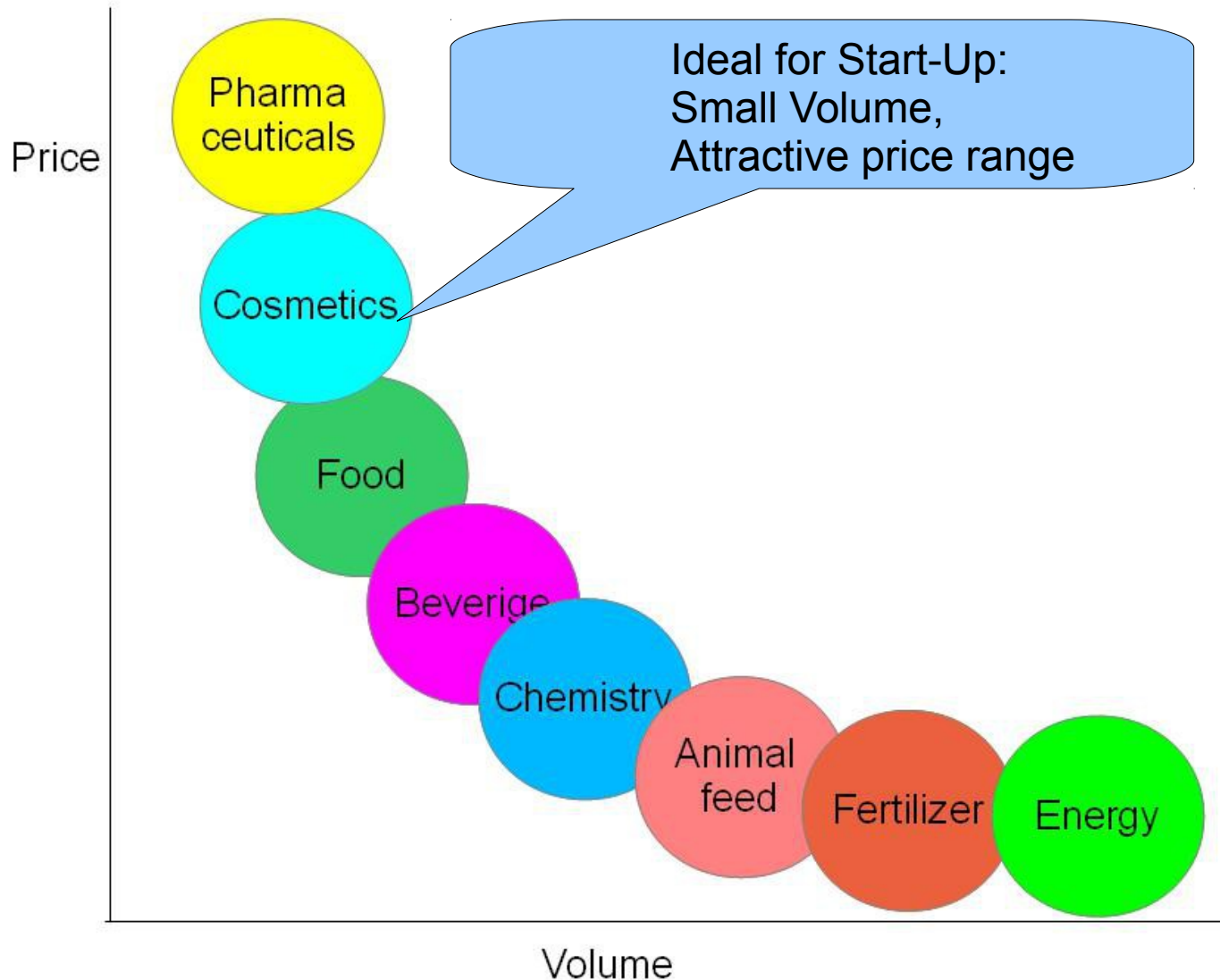
The role of economy

- This is all on biology, ecology, technical doability.
The most important question for a substantial development of sustainable operations is the economical feasibility!!!
- And this is where biotechnology comes into the play, as it creates:
- **Added value!**

Example: Potential products from *Saccharina latissima*



Example: Potential products from *Saccharina latissima*

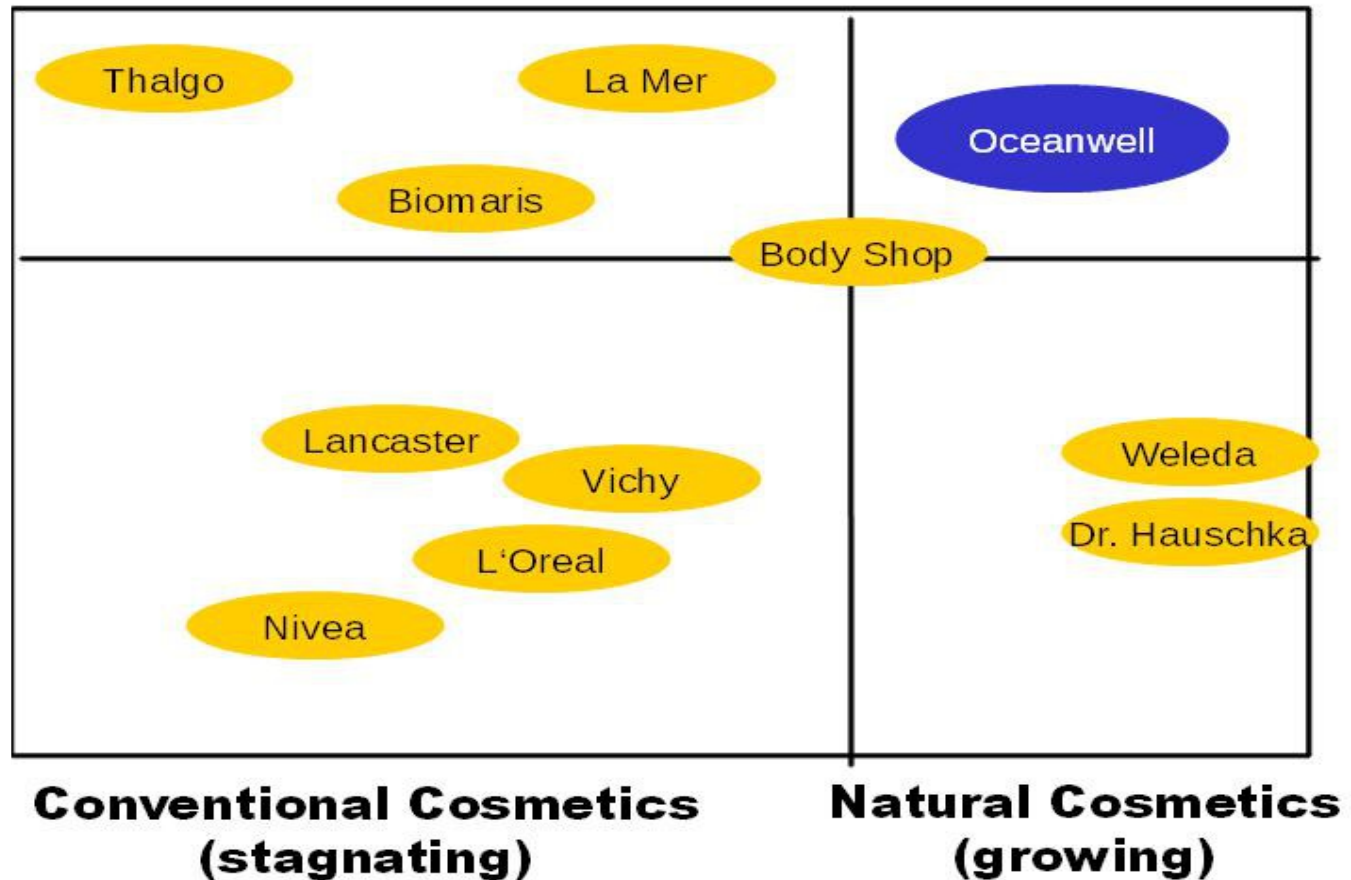


Market segments



**Marine
Cosmetics
(growing)**

**Non - Marine
Cosmetics
(stagnating)**



Extracts from Algae: The ocean-basis example

- Idea: Using algae extracts in cosmetics
- Basis: *Saccharina latissima*
- Claims:
 - Benefits for skin and health: (antioxidants, vitamins, trace elements...)
 - Regionality (from here...)
 - Ecological sustainability (farm)
 - Exclusivity (the only...)
- Process: fermentation or H₂O extract
- Production with contract partner
- Distribution as cosmetic line and active for large supplier company



Sustainability in Baltic Aquaculture

Seaweed extraction

- Grinding
- Fermentation
- Filtration

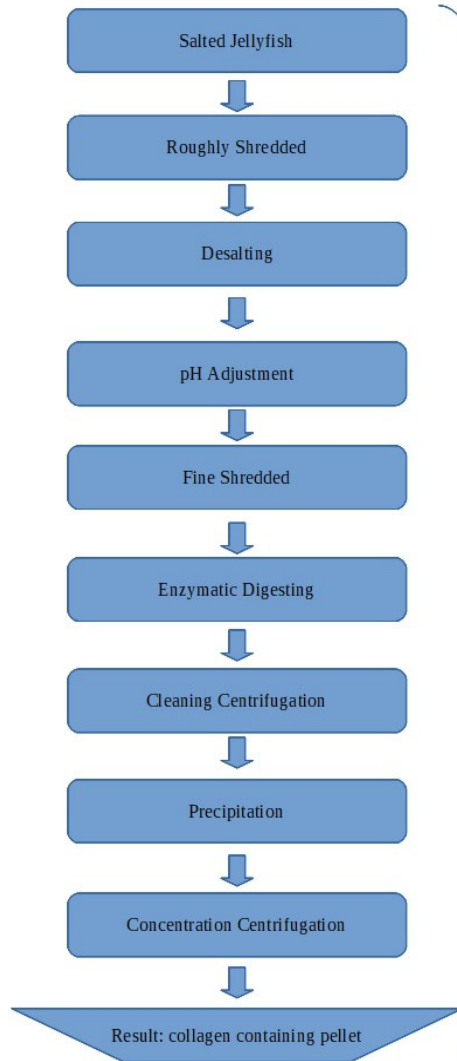


Collagen production from jelly fish

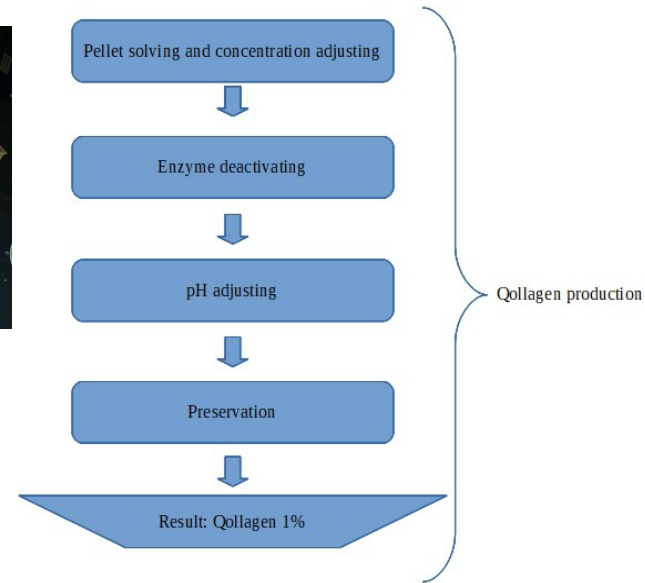
Production of Qollagen 1%

Step 1: Isolation

Step 2: Dilution



Collagen gaining process:



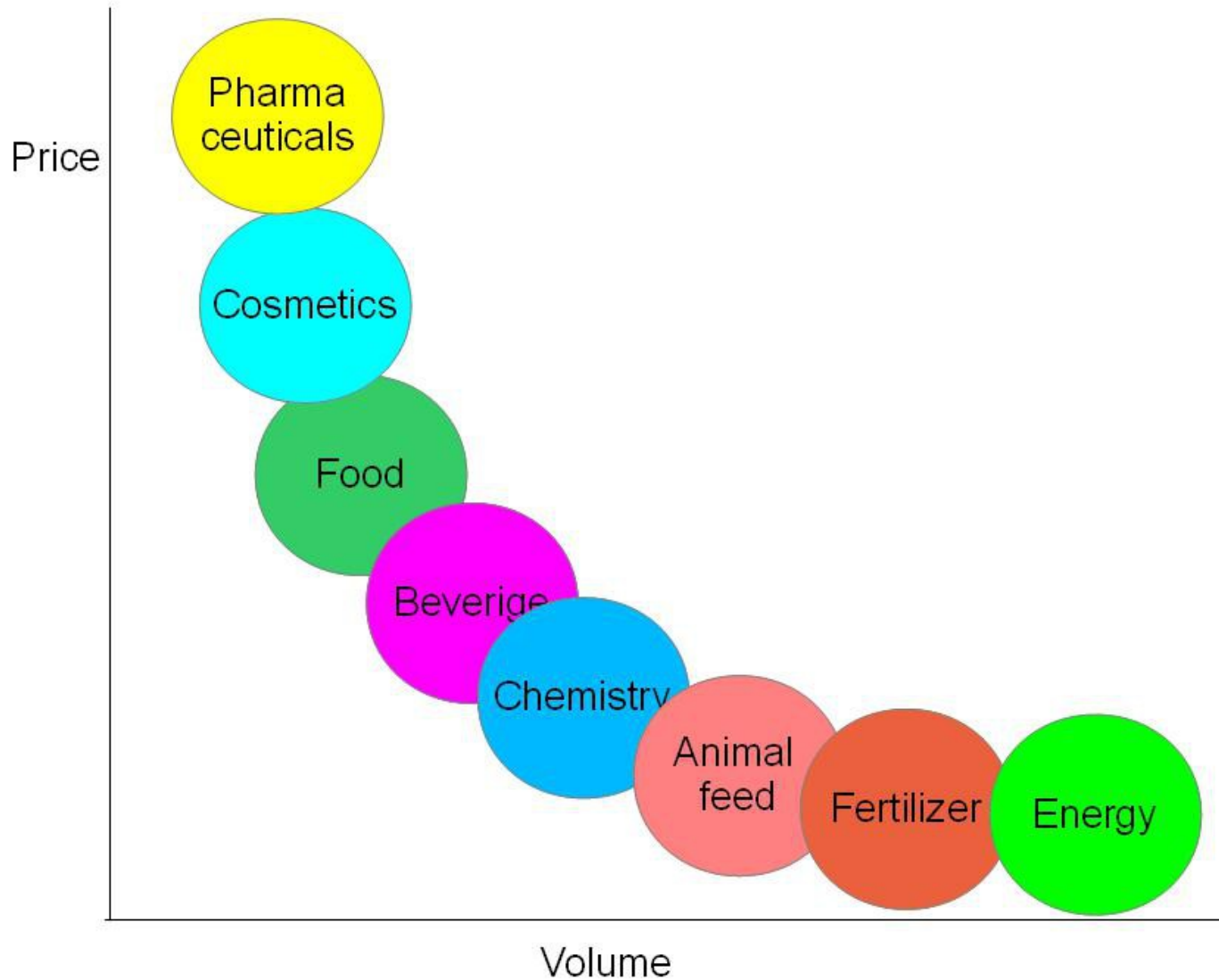
Added value – region specific!!

- Vegetarian is „in“ (=> problem with ocean collagen)
- The marine nimbus - particularly in regions not too close to the sea..
- Considerable environmental awareness
 - Aquaculture is considered better than exploitative fisheries
 - Top issue for sustainability in the Baltic sea: Nutrients!!!
 - Algae are Bio-labelled
 - Cosmetic is Natrue-labelled





Example: Potential products from *Saccharina latissima*



Pharmaceuticals

- MAS 2005 – 2008 with UKSH, GEOMAR
- Collin 2008 – 2011 with Uni Lübeck (Notbohm)
- Epifood 2009 – 2011 with Imagenes Berlin, CAU Kiel (Döring)
- AAC 2010 – 2013 CAU Kiel (Alban), UKSH Kiel (Kalthoff, Peipp), Numaris Regensburg
- Peroximar 2013 – 2015 with CAU (Plieth),
- Suntec 2016 – 2018 CAU Kiel (Birger, Schulz)
- Fucosan 2017 – 2019 SDU Odense, CAU (Alban), UKSH (Klettner, Fuchs)

Prevention and protection 1

→ antibacterial activities (MAS project)

Inhibition [%]

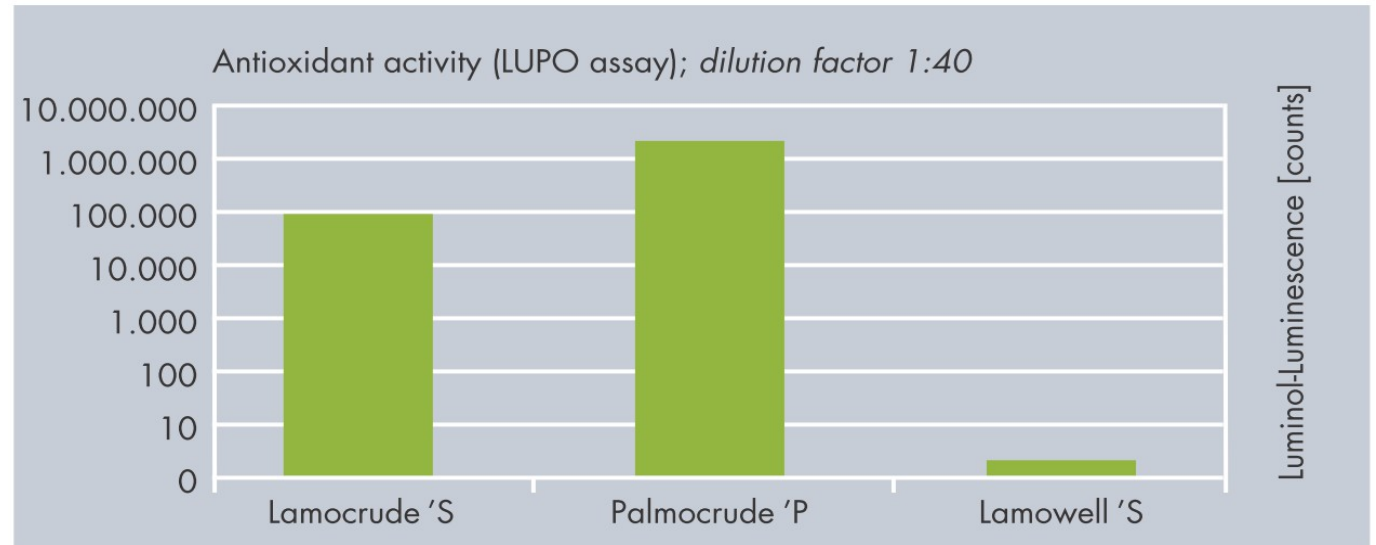
		<i>St. aureus</i>		MRSA		<i>St. epidermidis</i>		<i>Ps. aeruginosa</i>		<i>B. epidermidis</i>	
		5%	10%	5%	10%	5%	10%	5%	10%	5%	10%
Commercial Extracts											
Lamocrude'S	Ex242	47***	52***	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
Lamowell'S	Ex243	33	72***	neg.	neg.	neg.	neg.	neg.	34	neg.	neg.
Palmocrude	Ex244	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
Fucoidan	Ex245	49	41	neg.	26	72	82	30	31	neg.	26
Kollagen	Ex246	34	neg.	neg.	neg.	neg.	neg.	33	29	20	29
Extracts under Development											
		1%		1%		1%		1%		1%	
CCL16	Ex247	n.b.		96		87		n.b.		n.b.	
AAC148	Ex248	100		100		100		26		neg.	
Control	DMSO	neg.		neg.		neg.		28		20	
AAC 150F	Ex249	n.b.				n.b.		n.b.		n.b.	
CLA1	Ex250	n.b.		n.b.		n.b.		n.b.		n.b.	

Algae compounds can strongly inhibit growth of *S. aureus*, *S. epidermidis* and MRSA

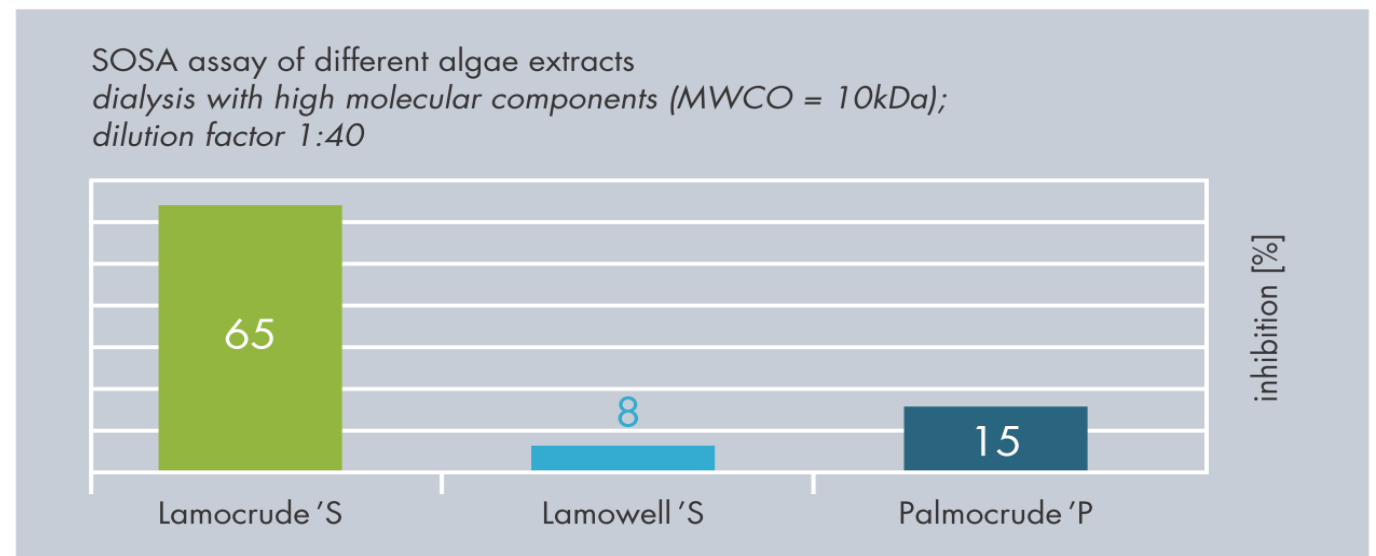
Prevention and protection 2

→ antioxidant activities

Antioxidant capacity (LUPO)

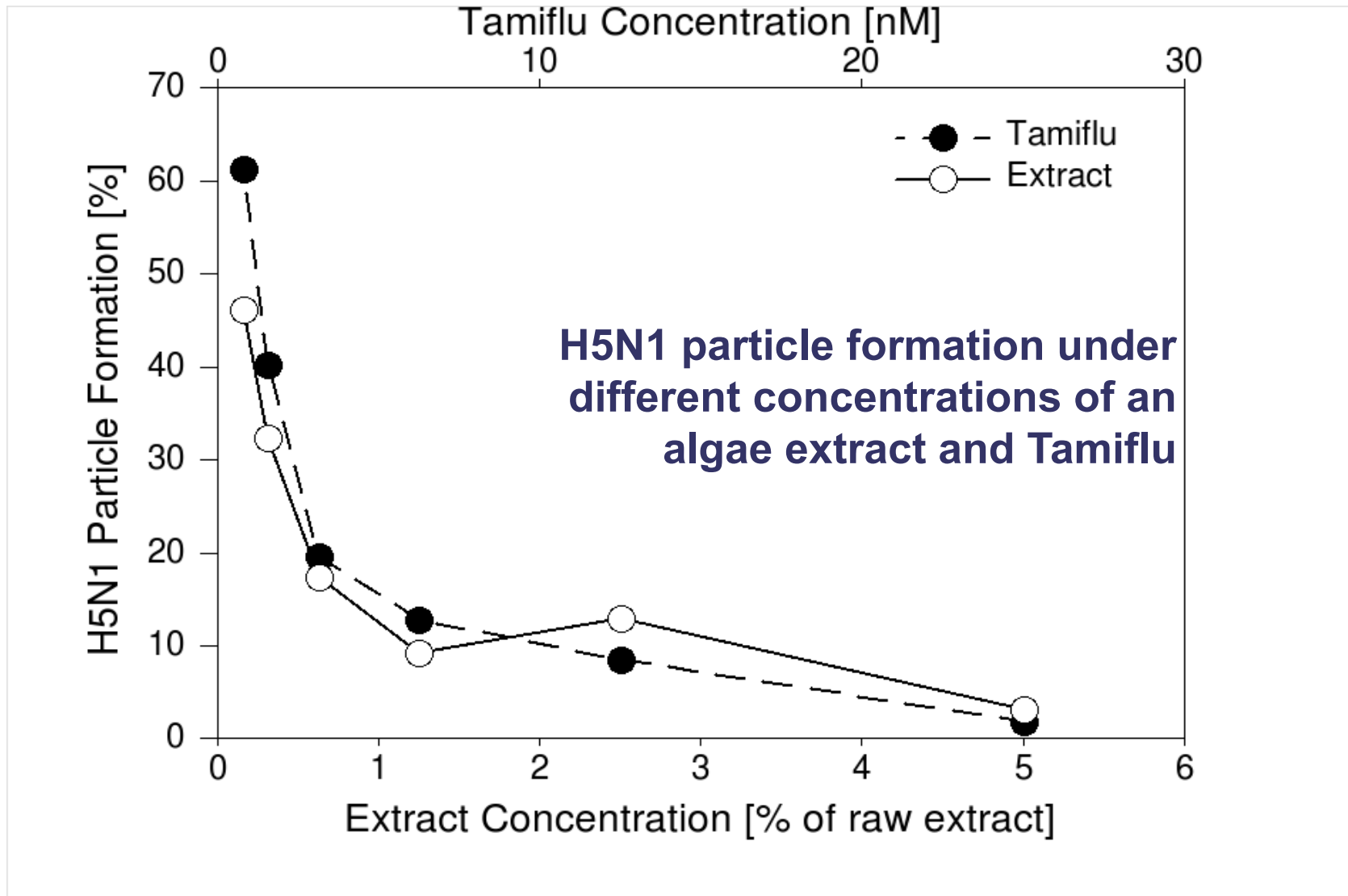


Radical scavenger activity (SOSA)



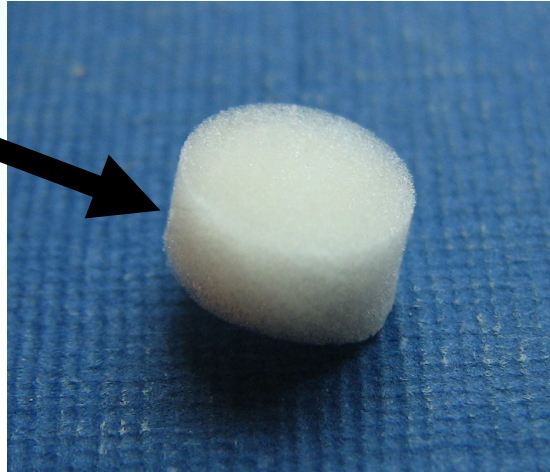
Prevention and protection 3

→ antiviral activities



Marine collagen bioscaffold (Collin project)

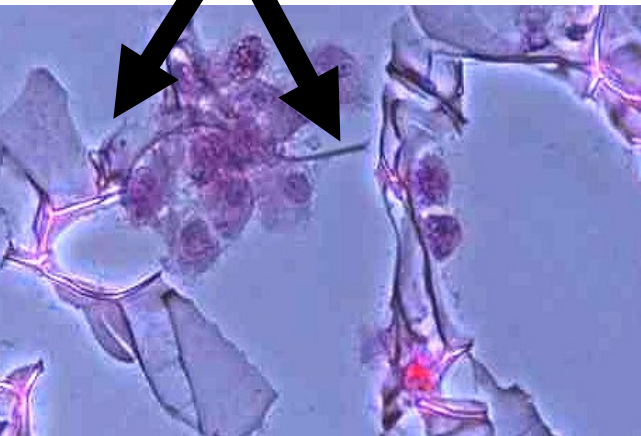
Bioscaffold



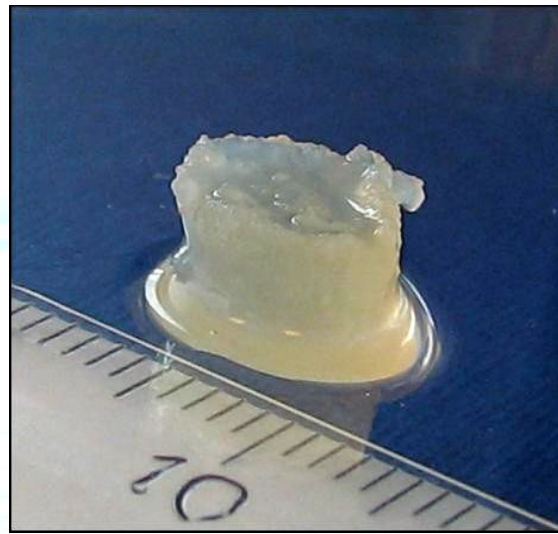
Marine collagen bioscaffold:

- cell compatible
- porous structure for optimal chondrocyte adhesion
- vital chondrocytes
- strong autologous collagen expression

Chondrocytes in bioscaffold



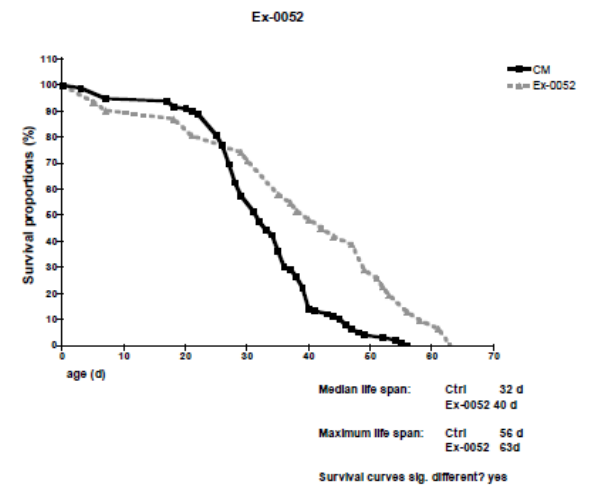
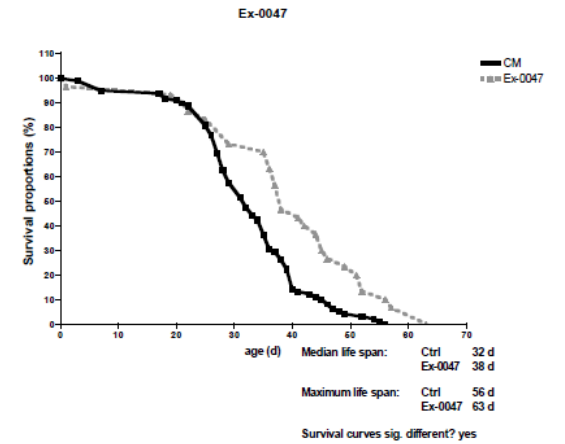
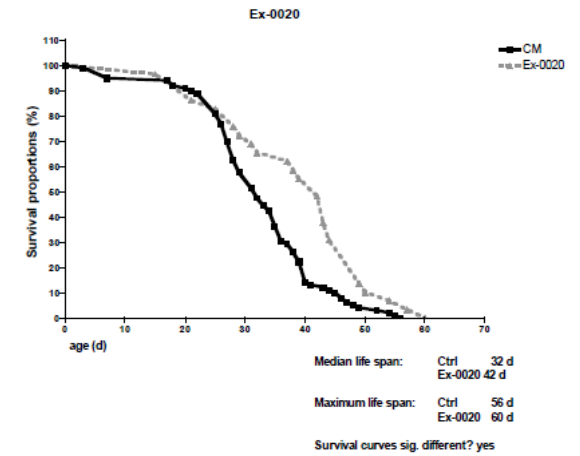
Autologous collagen



Epifood

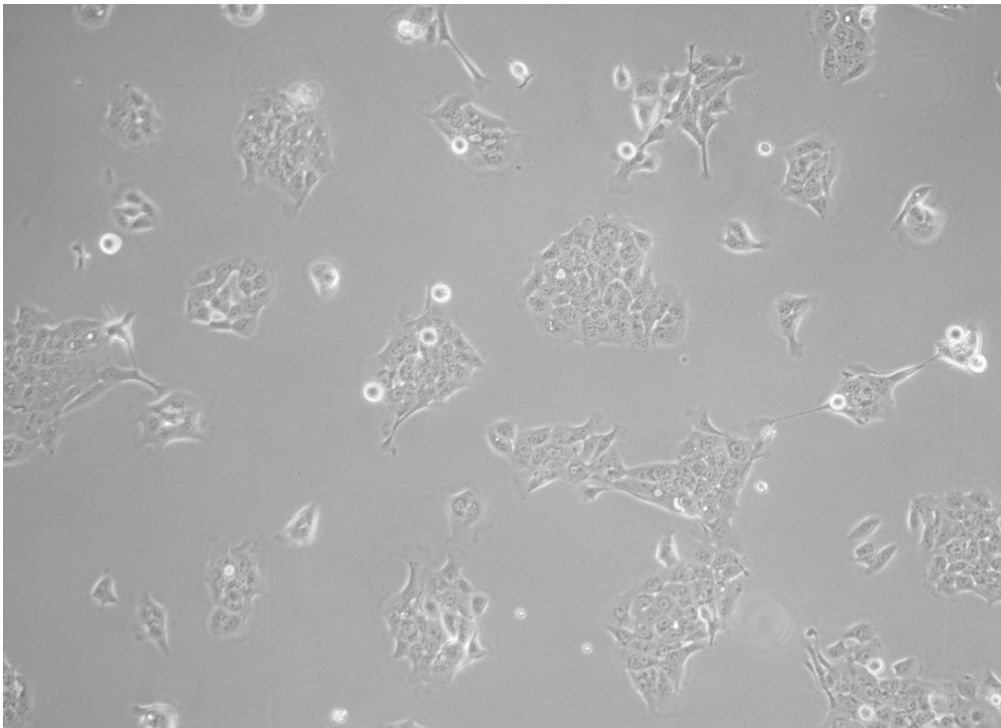


In 3 of 22 extracts:
Extended life spans
of *Drosophila*!

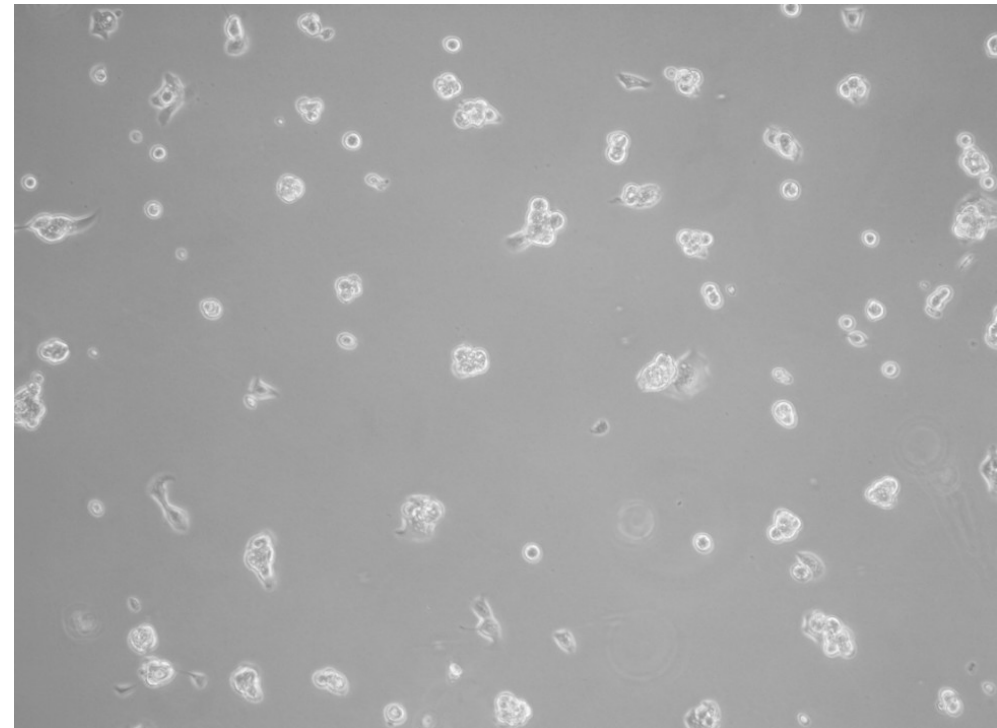


Extract from *Fucus vesiculosus* inhibits growth of pancreatic cancer cells (AAC project)

Control



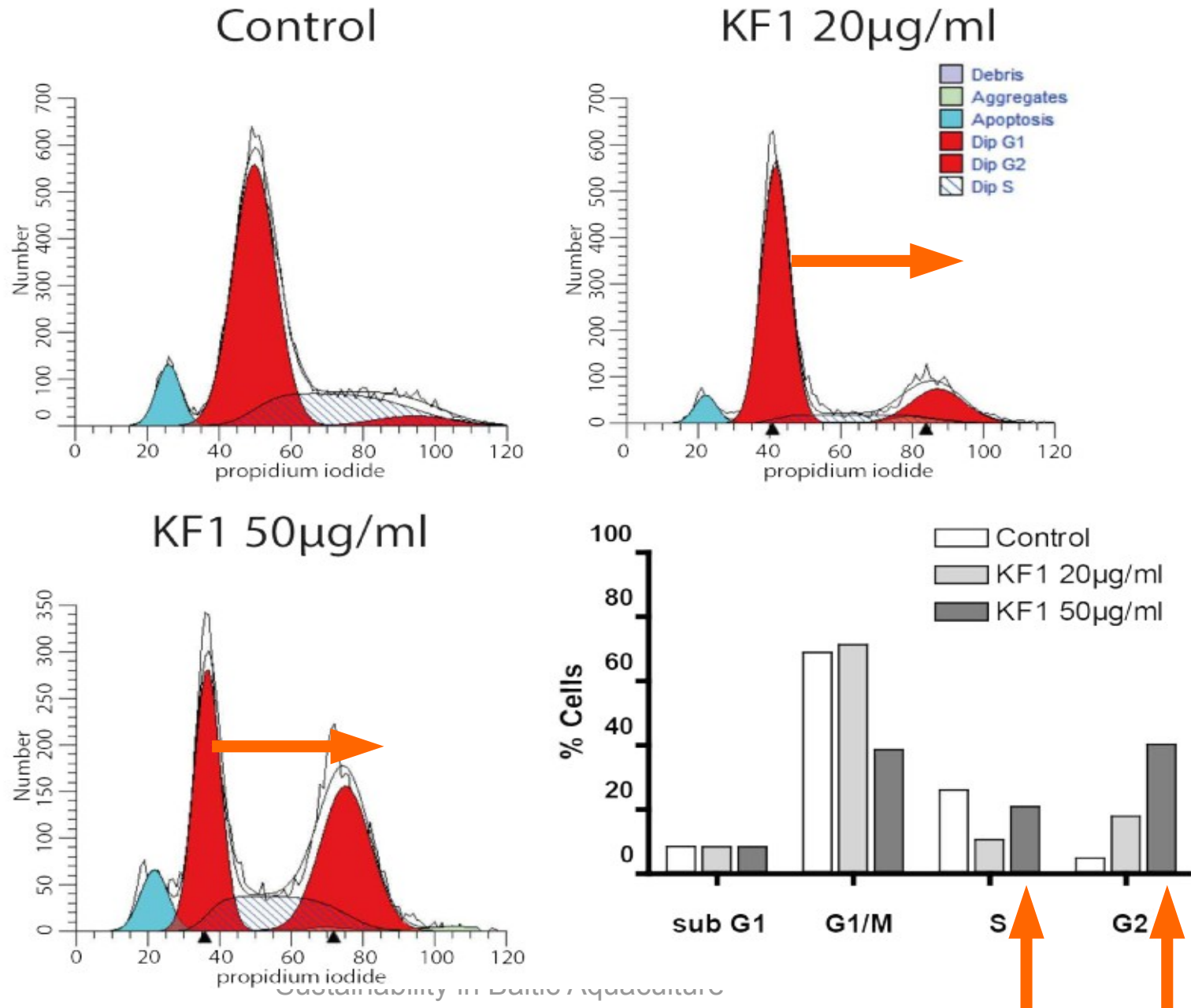
KF1 extract



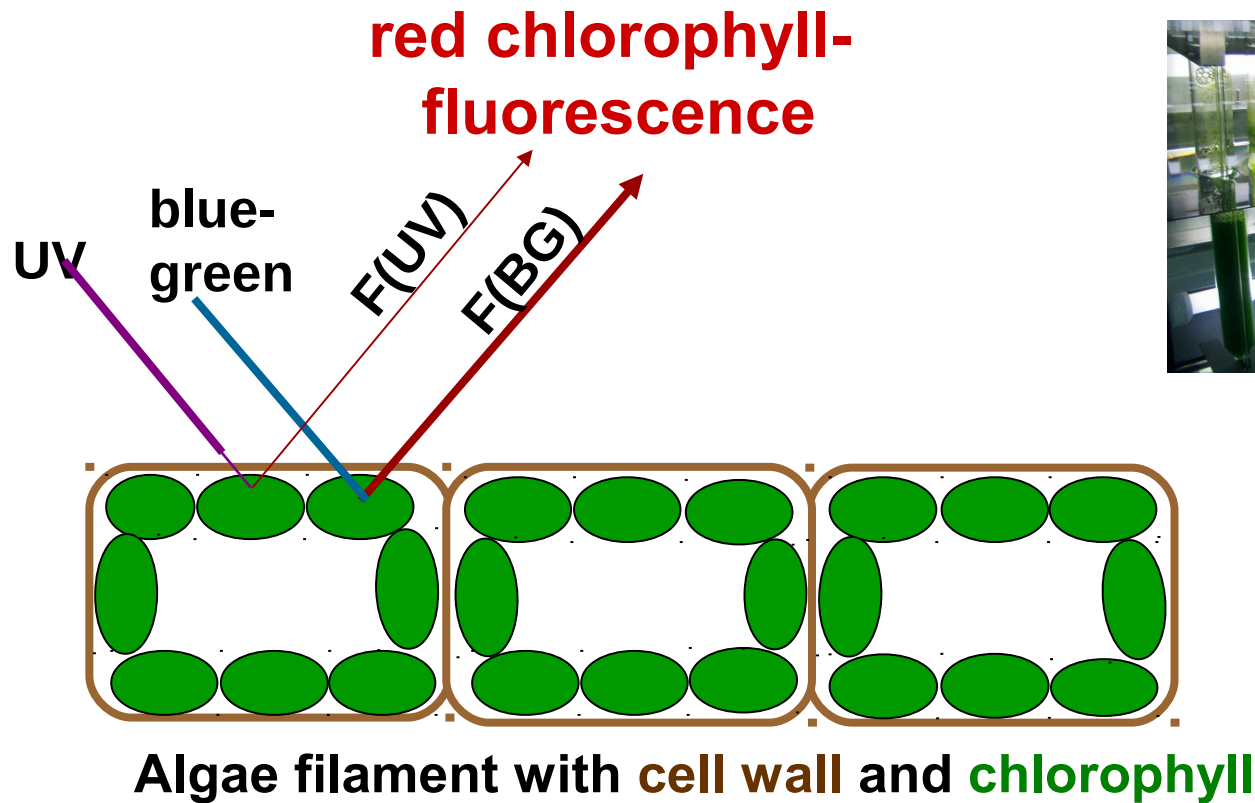
(after 24 h incubation)



→ Cell cycle arrest



Protection against UV-B-radiation (SunTec project)



$$F(\text{UV})/F(\text{BG}) \rightarrow \text{UV-transmittance}$$

Projekt „Suntec“

Wir fördern Wirtschaft



Landesprogramm Wirtschaft: Gefördert durch die Europäische Union - Europäischer Fonds für regionale Entwicklung (EFRE), den Bund und das Land Schleswig-Holstein

Sustainability in Baltic Aquaculture

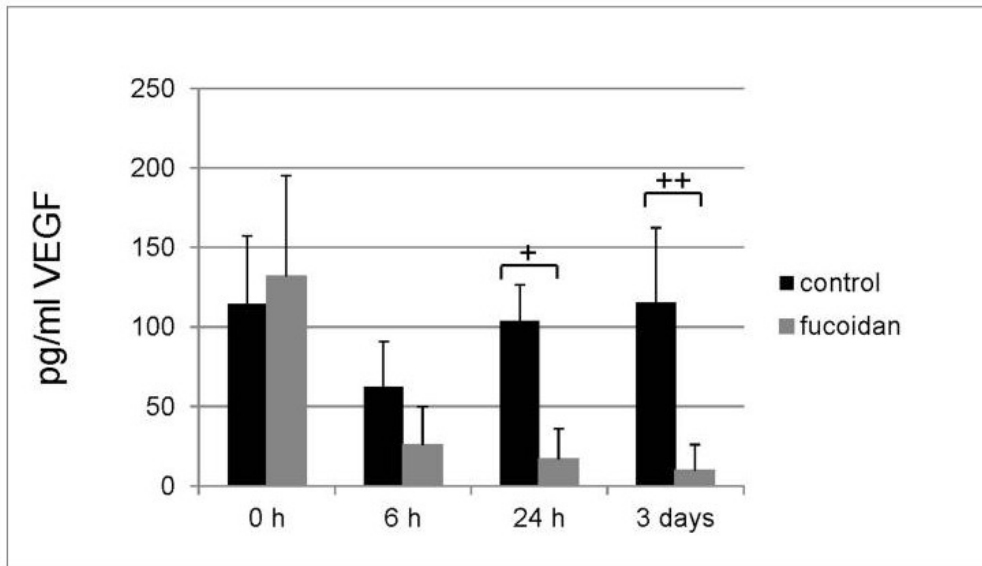
Establishment of a fucoidan-based value chain using endemic seaweed (FucoSan project)



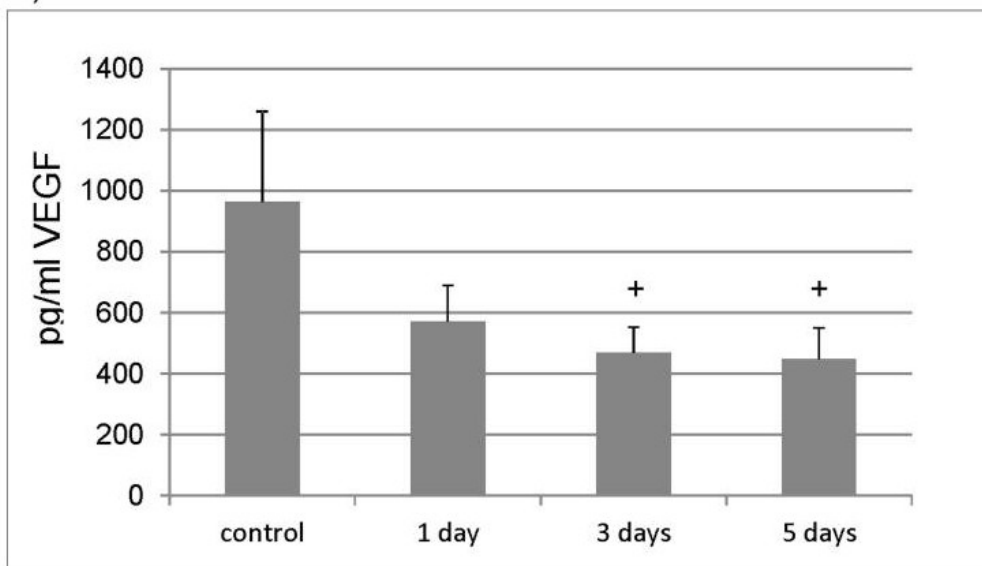
- Sustainable harvest (sampling/cultivation)
- Controlled quality of endemic algae
- Innovative processing
- New compound quality
- New products (cosmetics, pharma)

Algae preventing ageing symptoms (FucoSan project)

A) RPE/choroid organ culture



B) ARPE-19



Fucoidan reduces secretion and expression of Vascular Endothelial Growth Factor (VEGF) in the retinal pigment epithelium and reduces angiogenesis *in vitro*.

(Dithmer *et al.* 2014)

Summary

- Ecologically sustainable aquaculture: a must in the Baltic Sea – and also a marketing asset!
- Economic sustainability: limited resources, maximized value
- Target market for SMEs: Cosmetic, food, nutritive additives
- Biotechnology in cooperation with research institutions
- Despite promising results no
- Marketing and communication!

Thank you for your attention

