

EUROFISH MAGAZINE

Estonia

**COASTAL FISHERY SUFFERS ACUTELY FROM
PREDATION BY CORMORANTS AND SEALS**

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VERIFISH PHOTO CHALLENGE

boosts awareness of
sustainable seafood

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STRONG PARTICIPATION

at retreat for
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GUEST PAGES:

Dr Alexandra Leeper, CEO,
Iceland Ocean Cluster



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SELECTED ARTICLES

PREDATORS TAKE MORE FISH THAN ESTONIAN COASTAL FISHERS CATCH



Estonia's coastal fishers are increasingly challenged by grey seals and great cormorants, whose booming populations now consume more fish than the fishery itself. These predators not only threaten fish stocks

but also damage gear and undermine fishers' livelihoods. Estonia has launched a three-part strategy for cormorant control—egg oiling, deterrence, and hunting—and is expanding seal management through targeted hunting. Legal, environmental, and EU trade constraints complicate progress.

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Czech researchers have found that adding sugar beet to hybrid fishponds significantly reduces eutrophication risks. In modern pond systems where fish waste is high in nitrogen and phosphorus but low in carbon, excess nutrients can trigger harmful algal blooms. Through

mesocosm trials, sugar beet—rich in slow-release carbon—proved most effective in restoring nutrient balance and maintaining water quality.

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The Horizon Europe-funded **VeriFish** project is redefining sustainable seafood communication across Europe. By integrating environmental, nutritional, and social indicators, VeriFish offers tools like a mobile

app, knowledge base, and educational materials to support transparency and informed choices. Its tri-pillar framework and FAIR data approach aid consumers, producers, and policymakers in navigating complex sustainability demands. With pilot tests underway, VeriFish is poised to influence labeling, procurement, and compliance systems.

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The 2025 **Seafood Expo Global and Seafood Processing Global** in Barcelona brought together over 2,100 exhibitors and 35,000 professionals, affirming its role as the world's top seafood

trade show. Eurofish co-exhibited with Lithuanian and Albanian partners, while the expo showcased trends in automation, sustainability, and upcycling. Keynotes and sessions addressed climate impacts, trade shifts, and digital innovation. The event reflected both the global reach and the shared challenges facing the seafood industry in a rapidly changing world.

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Mowi Scotland is tackling the growing threat of jellyfish blooms with **bubble curtain technologies** adapted from its global operations. As warming seas intensify bloom risks, Mowi's site-specific systems at Portnalong and Stulaigh have reduced jellyfish presence

by up to 80%, improved fish welfare, and helped cut biomass mortality by 35%. These hydrodynamic barriers are now part of a broader strategy that combines monitoring, AI research, and international collaboration.

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One year after becoming mandatory, Estonia's **PERK** digital catch reporting system has proven both valuable and complex. Used by nearly 1,900 fishers, it improves data accuracy and oversight

but revealed challenges like system stability, mobile usability, and GDPR compliance in multi-user scenarios. The platform's web-based design and one-size-fits-all approach struggled with Estonia's diverse fisheries—from coastal waters to inland lakes and winter ice. Future development aims to balance flexibility with technical sustainability.

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HUNGARY



Szabolcs Szigeti, Deputy State Secretary, addressed a plenary session with a talk on existing and future measures of the Hungarian fisheries operational programme (MAHOP Plus).

Successful completion of the 49th Fisheries Science Conference in Szarvas

The Fisheries Research Center of the Institute of Aquaculture and Environmental Safety at the Hungarian University of Agriculture and Life Sciences (MATE) hosted the 49th Fisheries Science Conference on June 3–4, 2025, in Szarvas. Nearly 160 guests participated in the two-day event which saw 30 presentations and 16 poster displays across nine thematic sessions. Dr Gergő Gyalog, Head of the Fisheries Research Center (HAKI), officially opened the conference. Welcoming remarks were delivered by Dr Katalin Virág Sipos, Deputy Director General of the MATE Szent István Campus; Gábor Csörgits, Head of the Fisheries Department at the Ministry of Agriculture; and Pál Hodálik, Mayor of Szarvas. Following the opening ceremony, Szabolcs Szigeti, Deputy State Secretary responsible for the implementation of the Common Agricultural Policy

and Head of the MAHOP Managing Authority, presented the current and planned measures of the MAHOP Plus program. Professor István Szűcs from the University of Debrecen gave an engaging lecture on innovation and the challenges and opportunities facing innovative development in the domestic aquaculture sector.

For the second time in the conference's history, a panel discussion of the Hungarian Aquaculture Technology and Innovation Platform (HUNATiP) was held, where sector representatives openly discussed the future of fisheries. Topics included carp production, market organisation, strengthening the value chain, and the prospects for sustainable intensification. The nearly ninety-minute discussion concluded with a shared commitment that HUNATiP would support the sector's integration into European

innovation processes. Innovation was identified as a key to improving the sustainability, competitiveness, and resilience of fisheries, as well as a cornerstone of the successful implementation of the MAHOP Plus program. After the plenary sessions and the panel discussion, both Hungarian and international researchers presented their latest findings and innovations in various sessions and poster displays, conducted in Hungarian and English. This year, the program again featured discipline-based sections, including technology and feeding, reproductive biology and genetics, fish health, and hydrobiology. Additionally, dedicated sessions focused on social and environmental aspects of fisheries research, and many presentations highlighted innovative practical solutions—which were warmly welcomed by attendees.

ICELAND

BioMar group launches aquafeed partnership with Fóðurblandan in Iceland

BioMar, a leading global manufacturer of aquafeed, has expanded their operations into Iceland in joining a partnership with Fóðurblandan, a local feed company. BioMar, known for its emphasis on innovation and sustainability, is the first global aquafeed producer to establish manufacturing relations in Iceland. The agreement states that BioMar will distribute its products throughout Iceland. CEO of Fóðurblandan, Úlfur Blandon, thoroughly supports the collaboration of the



The partnership between BioMar and Iceland's Fóðurblandan will establish the nation's first local aquafeed manufacturing operation and will work towards domestic self-sufficiency in Iceland's aquaculture sector.

two companies, praising BioMar's world-class technical expertise in feed development. Mr Blandon considers that local feed development in Iceland is a necessary step to reduce aquaculture's carbon

footprint and lead Iceland toward a more sustainable future. The partnership is expected to improve the reliability of aquafeed production and supply in Iceland and decrease reliance on imports.

NORWAY

Watermoon Project sets a new standard for sustainable salmon farming

Norwegian aquaculture company Eide Fjordbruk is at the forefront of European sustainable fishing efforts with its Watermoon project that advances a submerged close-containment system for farming salmon. Developed to combat environmental concerns such as fish mortality, sea lice, and coastal pollution, Watermoon separates the farmed salmon from the surrounding water. The system also protects salmon from parasites like sea lice, which have been a growing concern in open-pen farms. The innovations of Eide Fjordbruk align closely with those of Norway as a whole, a nation that has just recently released a new policy direction that prioritises sustainable growth in aquaculture. Under White Paper No. 24: The Future



Eide Fjordbruk's Watermoon project is modernising the culture of fish with closed-containment salmon farming. By separating the fish from open waters, the project introduces an innovative solution to long-standing challenges to fish health as well as to the environment.

of Aquaculture – Sustainable Growth and Food for the World, the nation proposes a transition from traditional

regulatory standards of volume-based limits to impact-based frameworks that better address the ecological impacts of aquaculture farming. Proposed policies include sea lice quotas and stronger considerations of animal welfare. With the implementation of White Paper No 24., along with new efforts such as Watermoon, Norway has the potential to sustain their second most lucrative industry, the seafood sector, while setting new standards of environmental consciousness. While the large-scale adoption of these techniques and proposals is still in the works, companies such as Eide Fjordbruk are helping to implement these national frameworks that have the potential to expand across Europe.

SPAIN

Seven EU projects to strengthen European aquaculture present joint front at Aquaculture Europe

Aquaculture is the most varied farming sector in the world, involving a broad range of species, production systems, and levels of intensity. It is also considered one of the most sustainable methods of supplying animal protein to the projected global population of 8.5 billion by 2030. While the sector is expanding rapidly worldwide, aquaculture in the European Union has seen little growth. The European Commission is seeking to change this trajectory. Seven EU-funded projects—VeriFish, Mr.Goodfish, Baltic Muppets, EUMOFA, FishEUTrust, InnoAqua, and SAFE—are addressing different challenges and opportunities in aquaculture. Their shared objective is to increase the output of farmed fish and seafood in Europe, while improving efficiency and sustainability. Details about the work being carried out in these projects will be presented at Aquaculture Europe, which



Seven EU-supported aquaculture projects will have a joint stand at Aquaculture Europe in Valencia, Spain, where they will present their activities to boost European fish and shellfish farming.

takes place in Valencia, Spain, from 22 to 25 September. Eurofish will coordinate a joint stand (numbers 143–145) at the event to showcase all six projects. Aquaculture Europe is an annual event organised by the European Aquaculture Society. It features a scientific conference, trade

exhibition, industry forums, workshops, and student sessions, and provides a platform for the latest research and innovation in aquaculture. Visitors to the joint stand will be able to learn how the six projects are contributing to renewed growth in European aquaculture.

SPAIN

National campaign encourages young people to eat seafood

Spain has launched a €90,000 project that aims to combat the “lack of generational renewal” in the consumption of seafood and in interest in the Spanish fishing sector. The agreement, signed by the Association of National Fisheries Producer Organisations, Pesca España, with the Ministry of Agriculture will run from 2025 to 2026 and will account for the ongoing collaboration of the two organisations to encourage “healthier, more responsible, and locally sourced” consumption of Spain’s seafood. According to the ministry, the campaign will be two-fold, beginning with a focus on the relationship between “fish and sports” in 2025, followed by a shift toward younger



Spain’s national campaign to encourage the consumption of seafood focuses on young people whom it will target using social media.

audiences to demonstrate sustainable food models by 2026. The programme will include both educational content

and social media engagement, utilising influencers to help reshape the meaning of seafood in the eyes of the public, especially the Spanish youth. This is not the first initiative by Pesca España to launch such actions. The Ministry has outlined a four-year business plan spanning from 2024 to 2028 that tackles education in fisheries and aquaculture, aiming to increase awareness and foster more informed consumer habits. In 2024, the organisation targeted schools, launching an immersive experience designed to introduce fishing professions to young children. The efforts hope to preserve the country’s rich fish heritage and sustain generations of educated and aware citizens.

LATVIA

Association joins Europeche for more clout in negotiations

The Latvian North Atlantic Fisheries Association (LNAFA) was welcomed as a member of Europeche in April 2025, an association rooted in enabling “fluent communication” between European nations in the marine environment. Europeche represents over 45,000 vessels and 80,000 fishermen across ten different European countries. Joining Europeche marks a large step for the LNAFA, which operates primarily in distant waters, such as those around Greenland and Iceland and thus faces unique regulatory challenges. Membership of the organisation provides the LNAFA with a new forum to voice concerns about agreements and accessibility on an international level. Over



The LNAFA's membership of Europeche will work to strengthen the nation's voice in the European Union and advocate for fair fishing regulations.

the past few years, the LNAFA has served as Latvia's primary defence for access to distant fishing grounds, representing

the nation's deep-sea fleets in policy negotiations. The association has focused on “maintaining viable quotas and safeguarding industry jobs tied to international agreements.” Latvia's distant water fleets are responsible for a “significant” portion of the country's seafood exports, which is a €270 million industry.

Recently, the LNAFA has brought attention to the rising fuel costs and port fees imposed by the EU, arguing that these regulations disproportionately affect operations in distant waters. With its new membership to Europeche, the association can work to align themselves further with other distant-water operators and advocate for fair treatment within EU regulations.

ESTONIA

New record for fish roe sales set

In 2024, Estonia sold over 963 metric tonnes of farmed fish, and a record-setting 21 tons of fish roe. Fish roe, unfertilised fish eggs, are commonly harvested from rainbow trout, which was the nation's most farmed and sold fish, contributing to 87% of the farmed yield in 2024. Other commonly farmed species in Estonia include crayfish, at 17%, and tench, European eel, and African catfish. Additionally, Anton Kardanov, an analyst with Statistics Estonia, noted that fish roe sales nearly doubled from 2023, reaching a value of approximately EUR680,000. It is possible that this sharp increase is due to a near EUR4 decline in the



Estonia's farmed fish and seafood sales have risen in recent years. Sales of fish roe set a record in 2024.

price of fish roe per kilogram. Over the past two years, Estonia has shown a rise in quantity of fish sold after being in a decline from 2019-2022. Although prior to 2024, 2021 set a record for fish roe sales, the year saw an immense drop off in sales of rainbow trout and other fish. Despite 2024's success though, Mr Kardanov notes that increases in food prices have now reached the fish farming sector, pointing to an increase of nearly 30% in price per kilogram of farmed fish.



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SEAFOOD EXPO GLOBAL AND SEAFOOD PROCESSING GLOBAL 2025, MAY 2025, BARCELONA

Optimising efficiency, minimising waste, recurring themes at show

The 31st edition of Seafood Expo Global and Seafood Processing Global, held from 6 to 8 May 2025 at Fira de Barcelona's Gran Vía venue, reinforced its standing as the world's foremost seafood trade exhibition. With over 2,100 exhibiting companies from 87 countries and more than 35,000 industry professionals in attendance, the event functioned not only as a marketplace, but also showed a sector being shaped by climate change, evolving consumer demands, and technological transformation.

Eurofish attended Seafood Expo Global with a stand as usual. This year the co-exhibitors were an association from Lithuania and a private company from Albania. Both partners expressed their satisfaction with the show as a networking platform as well as a source of inspiration for new products and services.

All stakeholders in the fisheries and aquaculture sectors represented

This year's expo occupied 51,217 net square metres of exhibition space across six halls and the central gallery. The event brought together a broad spectrum of stakeholders: seafood suppliers, aquaculture technology firms, equipment manufacturers, packaging



Seafood Expo Global and Seafood Processing Global demonstrated once again their importance for the worldwide trade in fish and seafood.

specialists, logistics companies, policymakers and researchers. A notable aspect of the 2025 edition was the addition of new national and regional pavilions as well as companies representing countries such as Egypt, Greenland and Nigeria, underlining the increasingly global scope of the seafood trade.

Major corporations exhibited alongside startups and regional producers, reflecting a wide industry cross-section. Companies showcased fresh, frozen, canned and value-added products, as well as the latest in seafood

processing machinery, refrigeration equipment, traceability solutions and sustainable packaging. For Barcelona, the economic impact was projected to exceed €156 million, affirming the value of hosting such a concentration of international business activity.

Processing and innovation reduce waste

The Seafood Processing Global component of the event was especially

noteworthy this year for its focus on automation, sustainability and aquaculture technology. Companies presented integrated systems for fish processing, hygiene management and cold chain logistics. These innovations are increasingly essential as seafood producers seek to optimise efficiency and minimise waste. An encouraging trend was the attention given to resource upcycling. Crustalicious, a first-time exhibitor, presented products that use by-catch to produce premium crab meat. Similarly, Ocean Company focused on converting seafood by-products into usable ingredients. Neptune Elements' seaweed-based food additives and teas signalled the growing commercial potential of algae as a sustainable resource. Such initiatives suggest that parts of the seafood industry are moving beyond sustainability rhetoric toward tangible innovations with commercial and environmental impact.

Sustainability and traceability feature at stands and conference interventions

Sustainability was central in both the exhibition and conference programming. Sessions covered issues such as decarbonisation, aquaculture's environmental footprint, and resilient supply chains. Academic voices such as Ray Hilborn (University of Washington) added weight to discussions with data on climate impacts and biodiversity. Hilborn's talk, Seafood in a Changing Climate, explored the causes and consequences of marine environmental shifts, including ocean deoxygenation and migration patterns. Another session led by representatives from the FAO and WTO introduced

updated methodologies for assessing fish stock status—an effort to improve data quality and policy coherence in fisheries management. These topics reflected the increasing importance of science-based approaches to sustainability in global seafood governance. While such discussions are valuable, the industry still faces challenges in translating conference insights into enforceable practices. Much of the conversation remains exploratory, signalling a need for stronger regulatory alignment and more transparent monitoring frameworks.

A highlight was the keynote delivered by economist Xavier Sala-i-Martin from Columbia University. His talk, A New Uncertain World, placed the seafood sector within the broader economic context of trade tensions, inflationary pressures and geopolitical instability. By connecting global macroeconomic shifts with seafood's role as a strategic commodity,

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Prof. Sala-i-Martin underscored the need for adaptability in global trade practices and supply chain design. Altogether, over 80 international speakers across 20 sessions blended technical, commercial, and policy-oriented content at the conference. Topics ranged from traceability technologies and packaging innovation to consumer trends and digital transformation. The presence of such a diverse speaker base helped position the expo not only as a commercial platform but as an arena for thought leadership and sector-wide dialogue.

Reflections and future outlook

Seafood Expo Global and Seafood Processing Global 2025 succeeded in bringing the global seafood community together at a time of heightened uncertainty and rapid change. From economic headwinds to environmental pressures, the seafood sector faces complex and interrelated challenges that no single company or country

can tackle alone. The Barcelona event demonstrated the industry's appetite for innovation, from AI-driven aquaculture tools to seaweed-based consumer products. Yet, it also highlighted the threats from climate change, tariffs, trade wars, and international conflicts. The 2026 edition, scheduled for 21–23 April, will offer another opportunity to assess how the seafood sector copes with these challenges and whether investments in international collaboration, innovation, and green initiatives will result in a more resilient industry.

Metro Food Sourcing and GLOBALG.A.P. drive growth in responsible aquaculture

Metro Food Sourcing and GLOBALG.A.P. have reinforced their commitment to responsible aquaculture, showcasing their progress at the Seafood Expo Global 2025 in Barcelona. The event highlighted the effectiveness of the GGN label, a consumer-facing mark of traceability and sustainability, in promoting ethical seafood sourcing and boosting consumer trust. A widely recognised certification standard, GLOBALG.A.P. ensures aquaculture products meet rigorous food safety, environmental, animal welfare, and social responsibility criteria. Its Aquaculture Standard spans the entire production chain, including feed mills, hatcheries, nurseries, grow-out farms, and post-harvest handling. Complementary certifications, such as GRASP and the Chain of Custody (CoC), further strengthen its assurances by covering workers' welfare and safeguarding traceability.

The organisation now certifies over three million metric tonnes of aquatic species annually, with Atlantic salmon



From left, József Bárdos, Metro Food Sourcing; Remko Oosterveld, Business Development Manager Aquaculture and Leonie Fischer, Public Relations Manager, both from GLOBALG.A.P., at a presentation on the GGN label's contribution to the visibility of responsible aquaculture at Seafood Expo Global in Barcelona in May.

forming the majority of certified volume. Products bearing the GGN label, derived from GLOBALG.A.P. certified supply chains, are now present in 40 countries and has been linked to a 30% increase in labelled product sales in recent years. Retailers such as Metro Food Sourcing have embraced the GGN label across 19 countries, including Germany, Spain, and Poland. According to József Bárdos, Quality and Sustainable Development Manager at Metro Food Sourcing's Concarneau Trading Office, the label offers clear traceability and confidence in product origin. At the industry panel, Metro announced its application for CoC certification in Italy to further secure certified status throughout the supply chain. Plans to expand the product range with the

introduction of rainbow trout were also revealed, building on the success of Metro Chef's salmon and seabass lines.

GLOBALG.A.P.'s standards are recognised by both the Global Sustainable Seafood Initiative (GSSI) and the Global Food Safety Initiative (GFSI), confirming its alignment with top-tier benchmarks. Its Compound Feed Manufacturing (CFM) standard bans the use of ingredients from Illegal, Unreported, and Unregulated (IUU) fisheries, as well as those involving illegal deforestation or species listed in the IUCN red list, supporting responsible feed sourcing. Despite widespread certification, transparency in the aquaculture supply chain remains a challenge, particularly when products pass through intermediaries. GLOBALG.A.P.'s CoC

standard addresses this by ensuring documentation and separation of certified goods at each stage.

Some critics question whether consumers are willing to pay more for certified products. While surveys indicate interest in sustainable options, price sensitivity often influences buying decisions. However, stakeholders argue that certification can reduce compliance costs and build consumer trust, offering value beyond simple pricing. As legislative demands increase and consumer awareness rises, initiatives like GLOBALG.A.P. and the GGN label are shaping the future of aquaculture. With a growing certified portfolio and expanding international reach, these frameworks are paving the way for more transparent, ethical, and sustainable seafood supply chains.


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Kroma celebrates 50 years since selling its first gutting machine

Kroma, a Danish company with a long history in fish processing equipment, is marking 50 years since delivering its first gutting machine for trout. Founded over a century ago, the company continues to carve out a niche in primary processing solutions, specialising in gutting, descaling, and filleting. At Seafood Expo Global CEO Ivan Kristensen reflected on the company's evolution and current strategy. Although Kroma does not dominate the market, it maintains steady growth by delivering well-regarded, targeted products. Recent innovations include a silage system that allows fish by-products—such as guts, heads, and frames—to be stored without refrigeration. By using acid to neutralise bacteria, the system enables long-term storage and provides a safe, value-adding solution for pet food producers.

Ivan Kristensen notes that industry developments are pushing toward land-based fish farming, including systems in non-coastal regions. While large

corporations dominate salmon farming, Kroma sees opportunity in serving smaller, local producers who prioritise sustainability and reduced transport emissions. Kroma also supplies equipment for other species, including catfish, sea bass, sea bream, and mackerel, and is exploring entry into the whitefish segment. Kroma's product development reflects industry-wide shifts. While the basic mechanics of gutting and filleting have not changed significantly in the past decade, there is a strong push for more hygienic, easy-to-clean equipment. Machines are now designed to be fully accessible for cleaning, with all control systems protected from water exposure.

Automation is another growth area. Kroma can deliver integrated processing lines tailored to specific customer needs, sometimes approaching turnkey solutions. Depending on the customer's volume and budget, these systems can range from partially to fully automated. The company continues to expand internationally, including in the United States, where it is targeting the catfish market. Kroma's new filleting machine for portion-sized fish represents its latest innovation, aimed at boosting sales in both existing and new markets. With a pragmatic outlook, Mr Kristensen acknowledges the challenges of scale but remains



Seafood Expo Global was an occasion for Ivan Kristensen and Kroma to mark 50 years since the company delivered its first gutting machine for trout.

optimistic. He sees the company's flexibility and technical knowledge as key strengths in a sector where custom solutions and sustainability are becoming increasingly important.

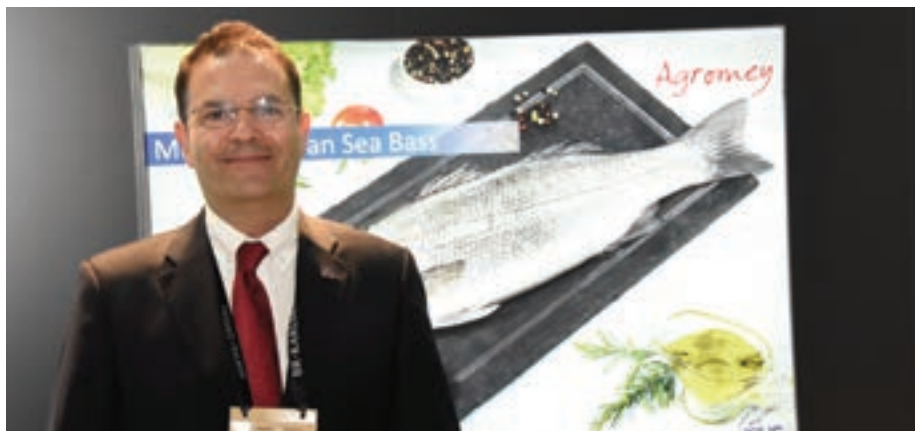
Agromey's revival under Kiliç boosts stability, growth

Agromey, once a major Turkish aquaculture company, has emerged with renewed strength after being acquired by Kiliç Holding in 2024. According to Tolga Uruk, the sales director, the company struggled financially from 2016, culminating in court-ordered financial protection from 2018 until early 2023. During this

period, the former owner attempted multiple times to sell the company without success. It was only at a Boston exhibition in March 2024 that an agreement was finalised with Kiliç, the world's largest producer of sea bass and sea bream. The acquisition has brought financial stability to Agromey. Under Kiliç, the company resumed full production and now operates as a subsidiary while retaining its brand identity. Currently, Agromey produces around 25,000 tonnes annually, with half of that being sea bream. Its main markets include Europe, the Middle East, Ukraine, and the United States.

Agromey's recovery coincides with a challenging period in the aquaculture sector. There is a widespread shortage of sea bass, attributed to high mortality rates in hatcheries caused by a combination of poor water conditions, climate change, and difficulties sourcing key raw materials like fish meal and oil. Sea bass production takes around two years, making it slower to recover than sea bream, which matures in about a year. As a result, both species have seen significant price increases due to high demand and limited supply. Despite the merger, Agromey and Kiliç operate in

distinct markets. Agromey specialises in processed and fresh fish, with a key facility in the Netherlands, while Kiliç handles larger-scale production. This separation avoids internal competition and enhances the strategic reach of the combined operations. Mr Uruk believes that production levels will remain stable in the short term, as expansion would require significant investment. Instead, the focus will be on maintaining profitability amid global inflation and increasing demand for healthy seafood. For Agromey, the acquisition not only marked the end of a difficult chapter but also opened the door to a more secure and sustainable future.



Since its merger with Kiliç, Agromey has enjoyed financial stability and has resumed full production of some 25,000 tonnes of seabass and seabream annually, says Tolga Uruk, the sales director.

Luckyfish serves the premium market for seabass and seabream

OA leading seafood processor in Europe, Luckyfish has built its reputation not on volume, but on quality and resilience. The company primarily focuses on seabass and seabream, with seabass comprising around 70–75% of its production. While not a major fish producer in volume terms, Luckyfish is a key player in processing, emphasising contract-based production over speculative output, says Ismail Aksoy, the CEO. Environmental challenges, particularly global warming, have had an impact across the aquaculture sector. However, Luckyfish has responded with a proactive strategy. By selecting robust broodstock and adjusting feeding regimes, production density, and feed quality, the company works to mitigate environmental stressors. One important measure includes the use of Mediterranean-origin juveniles, which are more resilient to higher temperatures compared to Atlantic strains. This

careful genetic selection is natural, not manipulated, and aims to maintain low mortality and strong performance.

The feed itself is another critical focus. Luckyfish produces its own high-quality feed from trusted suppliers it has worked with for over a decade. This consistency ensures fish are not stressed by dietary changes. Although high feed costs are a concern, the benefits are clear: healthier fish and minimal mortality. Luckyfish's brand is underpinned by a commitment to animal welfare and environmental responsibility. "Our fish are lucky," says Mr Aksoy, referencing the company's effort to provide ideal living conditions. The company is confident that this philosophy translates into superior products for its customers. About 90% of Luckyfish's production is processed, added-value products, primarily frozen and destined for European retail markets. The company partners with major supermarket chains across southern Europe and the UK, supplying private-label products under stringent quality standards. While small volumes also reach the US and Russian markets, Europe remains the core focus. Ultimately, Luckyfish's approach—grounded in sustainability, consistency, and quality—positions it



Ismail Aksoy, CEO of Luckyfish, has adopted a proactive strategy to mitigate stress from environmental changes on the seabass and seabream the company produces.

as a premium supplier in a competitive market. The company's success suggests that a measured, high-standard production model can thrive even in the face of environmental and economic pressures.

events

Arbacommerce: sustaining tradition through turbulent waters

Arbacommerce, a Croatian family-owned company run by Nikica and Dolores Paunović, has been a fixture in the Adriatic seafood industry for over two decades. Specialising in small pelagic fish such as anchovies and sardines, the company is deeply rooted in the maritime traditions of the region. Arbacommerce produces marinated and salted fish products, which are well recognised in Croatian and Slovenian markets under both its own and private labels. Despite its strong regional presence and established operations, Arbacommerce faces significant challenges. A combination of environmental change, regulatory constraints, and overprotection of predator species—especially tuna—has disrupted the availability of fish. Mr Paunović points out that while tuna populations have surged due to long-term protection measures, this has come at a cost to smaller fish stocks, which both humans and tuna rely on. As he puts it, “we are both interested in the same fish, but they are in the sea—we are not.”

The couple notes that pelagic fish populations are naturally cyclical, but



Dolores and Nikica Paunovic from the Croatian company Arbacommerce produce marinated and salted anchovies along with frozen fish using raw material from the Adriatic.

bureaucratic inertia and one-size-fits-all EU regulations have compounded the issues. For example, restrictions force fishermen to discard any tuna accidentally caught, even if already dead, a policy Mr Paunovic views as wasteful and illogical. To weather the downturn in local supply, Arbacommerce has turned to importing anchovies from Spain. However, the owners are clear that their identity lies in processing fresh Adriatic fish, a product they consider superior and emblematic of their cultural heritage. While their mainstay is frozen fish, which sustains the business

through volume, they continue to invest in their marinated and salted lines. These products cater to niche markets and fill gaps during off-seasons. Arbacommerce supplies not only Croatia but also Italy, Spain, Slovenia, and Greece. Despite the difficulties, the Paunovićs remain committed to their trade. They hope for regulatory changes and improved conditions but stay realistic. Their focus remains on maintaining quality and preserving a centuries-old tradition in one of Europe's most pressured seas. This business is part of our history after all, Mr Paunovic says.

Partnerships and precision shape Aller Aqua's feed solutions

Aller Aqua is one of Europe's top aquafeed manufacturers, operating seven factories across Denmark, Germany, Poland, Egypt,

Zambia, China, and Serbia. With around 750 employees—600 dedicated to fish feed—the company takes a global yet highly localised approach. Each factory produces feed tailored to the regional species and farming conditions, ensuring responsiveness to local needs while maintaining flexibility across facilities. As Kenneth P. Madsen, the group marketing manager, explains, Aller Aqua's strength

lies not only in quality feed but in its commitment to long-term partnerships. “Let's grow together” is more than a slogan—it reflects the company's hands-on approach. Aller Aqua technicians routinely visit farms, conduct feed performance assessments, and help farmers adapt to changing environmental conditions. Whether it's varying temperatures, altitudes, or seasonal patterns, the company

applies knowledge from across its global network to develop customised solutions.

Sturgeon feed is a particular area of expertise. Aller Aqua sponsors the Sturgeon Forum and works closely with top European caviar producers. While sturgeon represents a key market, the company also maintains a strong presence in trout and other species, drawing on its deep research history. Founded over a century ago, Aller Aqua has evolved from its agricultural roots to become a leader in aquaculture nutrition.

Innovation is central to its strategy. The company is exploring alternative proteins like insect meal, poultry protein, and grass-based sources.

Though still limited in volume, these ingredients are increasingly in demand by environmentally conscious producers. Functional feeds—adapted to seasonal changes and specific health challenges like parasites or wounds—are another growing focus, especially as climate change affects water temperatures and increases risks from and varieties of disease. Despite recent fluctuations in caviar prices and other market pressures, Aller Aqua remains committed to its customers and stays focused on delivering nutritional excellence backed by research and on-site collaboration. This strategy ensures that farmers receive not just a product, but a partner invested in their long-term success.



Aller Aqua

Feeds for sturgeon are an area of expertise at Aller Aqua, which also sponsors the Sturgeon Forum and works closely with top European caviar producers.

Islaužo Žuvis produces a range of innovative products from pond-farmed fish

Islaužo Žuvis, a Lithuanian pond fish farming company with roots dating back to 1965, has evolved from a Soviet-era collective farm into a modern producer focused on sustainability, quality, and culinary innovation. Led by Darius Svirskis the company raises carp and bighead carp among other species in polyculture. Abdalla Chahine, who joined the company in 2023, brings a unique perspective shaped by a background in marketing, technology, and a passion for food. As a food technologist and communications specialist, he is helping to realise the owner's vision of zero-waste production and responsible resource use. Mr Chahine's work focuses on creating new products from parts of the fish that are traditionally discarded, aligning with the company's commitment to circular economy principles.



Innovative products based on carps created by Abdalla Chahine, a food technologist from the Lithuanian company Islaužo Žuvis, proved highly popular at SEG.

One of his innovations is a fish pâté made from carp liver, intestines, and the swim bladder—nutritious and flavourful components rarely used in the region. Despite some cultural resistance, the product has found a small but loyal customer base. Available only in the company's own shops and with a short four-day shelf life, it represents

both a culinary and logistical breakthrough. The company also produces fish fat, extracted and sold in jars. Bighead carp fat is rich in omega-3, 6, and 9 fatty acids, offering a natural alternative to dietary supplements. Processing is done with care to preserve nutritional value, keeping temperatures low and avoiding intense treatment. Islaužo

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Žuvis' commitment to quality extends beyond the fish. Spices and ingredients for value-added items like smoked sausages are carefully sourced, often by Mr Chahine himself. While not scalable to

industrial levels, this artisanal approach ensures high standards and supports local sourcing. In a market that often prioritises volume, Islaužo Žuvis offers a different model: one that values tradition,

innovation, and sustainability equally. With its focus on whole-fish usage and a small-batch production ethos, the company proves that responsible aquaculture can also be creatively fulfilling.

Wadakyu manufactures traditional Japanese smoked and dried fish in Europe

With roots stretching back to 1925 in Tokyo, Wadakyu has grown into a leading global producer of traditional Japanese smoked and dried fish products. Still family-owned, now in its third generation, Wadakyu specialises in katsuobushi—dried and smoked skipjack tuna flakes—which are fundamental to Japanese cuisine, particularly in dishes like ramen and udon. To serve the growing European demand for Japanese food, Wadakyu established full-scale manufacturing operations in Spain about a decade ago, after earlier ventures in the UK and Poland. Located in Porriño near Vigo, their Spanish facility sources fish from the Atlantic and Indian Oceans, ensuring compliance with European food safety standards. Every step of production—from boiling and deboning to smoking, drying, shaving, and packaging—is handled in-house using local labour.

The traditional katsuobushi production method involves multiple cycles of smoking and resting, often over a period of two to three weeks. The result is an extremely hard, wood-like block of fish, which is then shaved into delicate flakes used in soups, sauces, and seasonings. Wadakyu also processes other species such as mackerel, sardines, scallops, and octopus, offering both smoked and dried formats depending on the



Sachiuki Wada, CEO of Wadakyu Europe. Based near Vigo the company smokes fish which is then grated into flakes for use in Japanese food.

application. Though the essence of the process remains true to Japanese tradition, adaptations are made to meet European regulations. Despite these changes, the flavour profiles of Wadakyu's products remain distinct by species, allowing chefs across Europe to craft dishes with precise and authentic tastes. As interest in Japanese cuisine grows, so does demand for products like katsuobushi, which is considered essential by chefs aiming to replicate true Japanese flavour. Wadakyu's dedication to quality

and heritage sets it apart in the European market, where it remains virtually the only large-scale producer of katsuobushi. By combining century-old methods with European sourcing and manufacturing, Wadakyu is not only preserving a vital element of Japanese gastronomy but also expanding its influence in international kitchens. With a local team of 20 in Spain and continued operations in Japan, Wadakyu remains committed to delivering authentic, high-quality ingredients to chefs around the world.

Mussels from Galicia: protecting quality and tradition in shellfish production

Mejillón de Galicia or Mussels from Galicia is the official protected designation of origin (PDO) for mussels cultivated in Spain's north-western coastal region. The PDO serves as both a certification of origin and a guarantee of superior quality, ensuring that all mussels carrying the label are produced, processed, and packaged in Galicia according to strict standards. This European-certified body represents around 50 companies and approximately 1,000 producers, operating over 2,000 registered mussel rafts in the Galician rías. In total, Galicia produces an average of 200,000 tonnes of mussels annually, making it the leading mussel-producing region in Europe. Mussels under the PDO label are sold in a variety of formats, including fresh, frozen, cooked, marinated, and canned, with over 500 different commercial products on the market.

The association plays a key role at trade events like Seafood Expo Global, promoting its certified producers and their products to buyers and partners. Its aim is not just to protect the geographic name but to preserve the artisanal methods, traceability, and



Mejillón de Galicia or Mussels from Galicia is the protected designation of origin that guarantees the origin and quality of products sold under the label.

ecological conditions unique to Galician mussel farming. However, like many aquaculture sectors, production has faced challenges from environmental changes. In 2023, output declined significantly due to a shortage of the phytoplankton mussels rely on for food. This was attributed to a lack of strong northern winds, which usually bring nutrient-rich waters from the Atlantic into the estuaries. But in 2024 wind conditions improved and production recovered. Seasonality also affects the market. Fresh PDO-certified mussels are typically available from July through February, when the meat quality meets the label's high standards.

Other processed formats are available year-round. Exports, particularly of canned and frozen products, reach markets around the world—including high-profile destinations like the United States, where products certified by the PDO have even featured in meals served to former President Obama. While Chilean mussels are sometimes imported to Spain during local shortages, Galician mussels remain the preferred choice for their distinctive quality and regional heritage. Through strict certification and active promotion, the PDO continues to uphold Galicia's reputation as a world leader in mussel production.

Thai Union Poland specialises in premium canned fish for export markets

The Polish branch of Thai Union, one of the world's leading seafood companies, operates a strategically located processing facility near Poland's northern ports. Established in the mid-1990s and acquired

by Thai Union in 2014, the plant has evolved into a key exporter of premium canned fish, supplying over 30 countries across Europe, North America, Asia, and Oceania. Specialising in canned sprats, herring, mackerel, and now salmon, the Polish facility sources

raw material from the Baltic and North Seas. Its core product—canned sprats—is highly regarded in overseas markets for its quality, says Joanna Petersen, Global OEM sales and Market Director, who attributes this partly to the fact that the processing facility was owned

by a Norwegian company which manufactured products under the King Oscar brand before being bought by Thai Union. The plant's output is geared primarily towards export, with about 80% of production destined for international markets. It supplies several of Thai Union's major brands, including John West, Mareblu, and Chicken of the Sea, and remains closely linked to the heritage King Oscar brand. Its reputation for quality and export focus sets it apart from many domestic producers who began as local suppliers and later expanded internationally.

Despite fluctuations in fish stocks and raw material availability—especially for sprats—the facility maintains production by adapting sourcing strategies and expanding its product lines. Recent increases in herring quotas and rising demand for salmon have opened new opportunities. The company is now investing in new SKUs (stock keeping units) and sees potential to scale capacity in the future. As a central part of Thai Union's global network, the Polish plant



Joanna Petersen is responsible for sales of Thai Union Poland's canned products to countries in Europe, the US, Asia, and, Oceania.

benefits from collaboration across sister companies, sharing business concepts and supporting branded product strategies worldwide. While the domestic market remains important, the plant's primary role is as an “export machine”, says Ms Petersen, with some 80% of the

total production being exported. With its strong foundations, focus on premium quality, and integration within a global seafood network, Thai Union Poland continues to play a vital role in connecting European seafood expertise with global markets.

Preservative-free hand-peeled prawns define Resko

For over 27 years, Resko, based in Poland, has specialised in processing North Atlantic cold-water prawns—known for their delicate flavour and premium quality. The company is Europe's last remaining hand-peeling facility for prawns, supplying major Scandinavian markets such as Sweden, Norway, and Denmark with high-quality, ready-to-eat shrimps in brine, says Magdalena Junciewicz, the company CEO. Around 70% of its output serves retail under private labels, while the remainder goes to food service. Setting Resko apart is its commitment to both craftsmanship and innovation.

Hand-peeling, although labour-intensive, preserves the colour, texture, and taste of the prawn far better than mechanical methods, which can strip away flavour and visual appeal. This artisanal approach makes Resko's product a staple in quality-conscious markets. In recent years, Resko has taken a bold step towards cleaner food processing. Motivated by growing consumer awareness and a desire to move away from traditional preservatives like benzoic acid, the company embarked on a two-year R&D journey. The result is a “clean-label” prawn product preserved only with sea salt and treated using cold pasteurisation—a high-pressure process that kills bacteria without affecting taste or texture. This technology ensures a 50-day shelf life without chemical additives, and the final product tastes as if freshly peeled.

This clean-label product, newly introduced to Scandinavian chefs and retailers,



Magdalena Junciewicz, CEO of Resko. The company produces cold-water prawns that have a long shelf life without using chemical preservatives.

has received strong positive feedback. It's especially appealing to consumers looking for convenience without compromise on health or flavour. Resko has also developed clean-label ready meals with shrimp and pasta, offering 35-day shelf life without additives—a rarity in the seafood sector. Beyond product development, Resko

is also making packaging more sustainable. The new monofoil bags use 90% less plastic than traditional jars and qualify for reduced ecological taxes, supporting broader environmental goals. While the clean-label products are currently more expensive, Resko sees them as valuable additions rather than replacements.

Their appeal lies in quality, transparency, and environmental responsibility—values that are increasingly defining consumer choice. With strong supplier relationships in Greenland and a commitment to ethical sourcing and innovation, Ms Junciewicz feels Resko is setting a new benchmark for seafood processing in Europe.

Arctic Circle processor puts Finnish flame-cooked salmon on the map

Hatala, a family-owned seafood processor located near the Arctic Circle in northern Finland, has built its reputation on quality, sustainability, and tradition. With salmon sourced from nearby northern Norway just 8–10 hours away, the company efficiently transforms high-quality raw material into a wide range of consumer-ready products, states Katja Ruokolainen, Marketing Manager. At the heart of Hatala's operations is its flamed salmon—a Finnish culinary tradition where salmon is cooked over an open fire using only salt and flame. This product has no added flavours or smoke aroma, offering a unique, clean taste. Though well known in Finland, flamed salmon has gained international appeal. Hatala now exports it under both private label and its own brand to countries such as Switzerland and Germany. In addition to flamed salmon, Hatala processes whole fillets and uses the trimmings

for items like salmon balls and fish-vegetable balls. Salmon heads and bones are directed to the pet food industry, ensuring a no-waste approach. The company also processes products from trout and local Finnish whitefish species, supporting over 400 independent fishermen.

Hatala handles around 18 thousand tonnes of salmon annually, making it Finland's largest importer of Norwegian salmon. Two automatic filleting lines manage the salmon, while more delicate local fish are hand-processed. While most products are sold fresh or frozen, some—like vendace—are used to create value-added items like fish balls for the domestic market. The domestic market remains Hatala's primary focus, where the company serves both retail and food service sectors. However, international growth is increasing. Export efforts have required significant consumer education, especially around flamed salmon, which many initially mistake for smoked or



The team from Hatala was at SEG promoting the company's flamed salmon and other products.

even raw fish. Once tasted, the response is overwhelmingly positive. Though salmon pricing remains volatile, Hatala mitigates risk through long-term supplier relationships. Now nearly 90 years old, the company continues to balance heritage with innovation, using its Arctic proximity, efficient logistics, and commitment to sustainable processing to deliver high-quality fish products to customers at home and abroad.

Iras: Danish technology for precision fish handling

Based in Denmark, Iras has long been a key supplier of fish handling equipment to the global fishing and aquaculture sectors. With decades of experience in pumping and grading solutions, the company

continues to adapt its systems to meet the demands of evolving species, vessel types, and farming environments. At the core of Iras's offering are systems that move fish gently and efficiently—whether from trap nets on coastal boats or through large-scale

aquaculture installations. The company also provides grading equipment, which sorts fish, and is designed in both compact and full-scale versions for use on vessels or at land-based facilities. Peter S. Rasmussen, the CEO, emphasises Iras's commitment to

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adapting its equipment for new challenges. Species like kingfish, for instance, are stronger and more resistant to conventional pumping methods than salmon. Rather than simply increasing pump speed or power—which risks damaging the fish—Iras is exploring more sophisticated ways to improve flow and reduce stress during transfer.

A recent example of Iras's versatility is its collaboration with small-scale fishermen in Estonia, where it provided a pump system tailored for trap net operations on compact vessels. This attention to smaller-scale operations sets Iras apart from some competitors who focus on large wellboats or big fishing vessels. While Europe remains Iras' primary market, the company also

has clients in South America and parts of Asia. Its equipment is known for consistent build quality, with the same stainless steel construction used across all systems, whether for vessel or land installations. Beyond pumping and grading, Iras also offers ice handling systems, though this remains a smaller part of its business. Looking ahead, the company is preparing for industry trends such as deeper fish tanks and larger farms, which pose challenges for traditional vacuum systems. Though Mr Rasmussen declined to reveal specifics, he confirmed that Iras is actively developing new solutions to meet these technical limits so that the company is well positioned to support the future of sustainable and efficient fish handling worldwide.



Iras specialises in gentle handling solutions for farmed and wild fish. Pictured, Peter S. Rasmussen, the CEO

Dutch start-up reimagines fish with plants

Vegan Fisherman, a Netherlands-based company founded five years ago by Simon Visscher, is at the forefront of plant-based seafood innovation. With its unique rice flour-based technology, the company produces fish alternatives that offer both taste and nutrition while keeping the ingredient list clean and natural. From its inception, Vegan Fisherman set out to fill a gap in the growing plant-based protein market: seafood. Mr Visscher began by experimenting in his kitchen, driven by the lack of viable fish substitutes compared to the booming plant-based meat sector. The result is a product line built on rice flour, chosen for its white colour and ideal texture that mimics the flake and bite of white fish. Algae powder is added to supply omega-3, 6, and 9 fatty acids, replicating the nutritional profile of traditional seafood without using animal products. The company's flagship items include fish sticks, shrimp

alternatives, and seaweed-skinned fish fillets. Vegan crab cakes have been developed specifically for the UK and US markets, while shrimp croquettes cater to Belgium, and the German market receives a product styled after traditional Backfisch. This tailored approach has helped Vegan Fisherman gain listings across the Netherlands, Belgium, Germany, and more recently, France.

Production is outsourced to a company in Urk, a traditional fishing town, while product development and branding remain in-house. All Vegan Fisherman products are made with natural ingredients and are free from synthetic additives, preservatives, or artificial binders. "If you want to make a plant-based product, then make a plant-based product," Mr Visscher says, emphasising his commitment to authenticity. While the chilled range offers up to 29 days of shelf life, frozen products—favoured by retailers—can last up to two years. Flexitarian families are a key demographic, often swapping plant-based fish sticks for conventional versions without changing their routines. As sustainability and consumer awareness



Simon Visscher has developed a line of fish products for vegans.

grow, Vegan Fisherman is well positioned as a clean-label, future-focused food company offering plant-based solutions with a strong culinary and environmental conscience.

COD CLUSTER ANNUAL CONFERENCE, 3-4 JUNE 2025, GARDERMOEN

Fishing and farming are key to food security

The annual conference of the Cod Cluster, a Norwegian gathering of all those involved in the country's whitefish industry, discussed various issues that retard the sector's efforts to fully realise its potential.



A Norwegian word *ILAG*, meaning together, reflects the Cod Cluster which harnesses all the different strands of the Norwegian whitefish industry, including fishers and farmers, to jointly develop solutions to challenges.

Cod Cluster, a Norwegian whitefish cluster, gathered its members on 3-4 June at Gardermoen (Oslo) for its annual two-day conference.

The cluster works to improve conditions for Norwegian companies involved in fishing, processing, and selling codfish, both wild-caught and farmed. A recurring word in the programme was *ILAG*

which means together in Norwegian. Because without working together, there will be less growth, development, profitability, and settlement along the Norwegian coast. Norway is a major seafood nation, and there is cross-party political agreement that settlement and business activity is very important along the entire coast—which is among the world's longest.

The cluster represents five key areas along the value chain

The conference started by providing a status update on the five areas the cluster works within: processing, live storage,

cod farming, by-products, and market. The cluster's goals include increasing activity in the industry, enhancing the profitability of the fishing sector, and creating more settlement along the coast. Although the cluster has been working on most of these issues for ten years already, there is still a long way to go before the fish is fully utilised and the desired profitability has been achieved. The research presented in this session of the event unfortunately showed that the cluster is, to an extent, heading in the wrong direction. The question that then lingered in the air was whether this was a development that could be reversed?

What about cooperation between the fleet, the fishing industry, and cod farming? It may seem that there are conflicting interests between the different parts of the industry. A representative from each part of the industry was therefore challenged to say why the other two were important to them. A fisherman, a fish industry representative, and a cod farmer at least on the stage agreed that they both can and must work together. The industry needs year-round access to raw materials both to achieve profitability but also to be able to offer attractive jobs. Without a living community and an industry, the fisherman has no place to deliver their catch. And with ever-decreasing quotas on wild cod, farmed cod can help build jobs, communities, and markets for cod, both nationally and internationally.

Economically active coastal areas offer multiple benefits

The importance of a living coast was the next topic raised at the conference. This is critical both from a security policy perspective but also from a value

creation point of view. Preparedness is becoming increasingly important in an unstable world, and fishing and aquaculture will be important for self-sufficiency for Norway in a crisis. Furthermore, fishing and aquaculture together are Norway's second-largest export industry, and the value creation that occurs as a result of activity and settlement along the coast is also economically very important for Norway.

Why is it so difficult to turn good reports and ambitions into actual action? We look at the political and regulatory brakes in the system—and what it takes to create real development. How can we get the fish to yield more, strengthen the industry, and ensure that the seafood sector contributes to jobs and value-creation along the coast? The Norwegian fishing industry is very strictly regulated through a multitude of laws and regulations. As mentioned above, there is cross-party political agreement to strengthen the seafood industry. However, it has proven difficult to achieve in practice. Over the last two to three decades, 20 or 30 public investigations have been made on how development can be accelerated. Almost all these investigations are now gathering dust in a drawer. Why is that? Implementation of the reports' recommendations is prevented by precisely the same strict regulations—or rather the lack of political will to change the regulations. This was one of the conclusions that emerged during the session on how more value creation can be achieved. Participants also discussed whether EU membership was a solution. Today, almost 30,000 jobs within the EU are solely based on raw materials from the Norwegian seafood sector. Opinion polls show that support within Norway for EU membership has risen considerably over the last months but still lags the “no” side. After a lively if inconclusive debate the first day of the conference ended with a festive meal highlighted by farmed cod from Ode.

Seeking to achieve 100% yield from fish

On the second day of the conference, the focus was on market development, especially for farmed cod, which is helping to open many new niche markets for Norwegian whitefish. Furthermore, work is being done to achieve the goal of 100% utilisation of the fish. Norway still has a way to go before that goal is achieved. But with the continuous development of new technology and greater awareness at all levels that the whole fish can be used for human consumption, there is hope of reaching the goal quickly. After this introduction, participants split into two groups. The wild fish group addressed the topic, increased production of wild fish in Norway, both by looking at the history of cod fishing and the genesis of the current situation. This group also discussed fisheries crime and potential measures to combat it. The cod farmers group discussed issues around regulations and the use of vaccines. The group also held a workshop on further breeding work on farmed cod.

This meeting place for the industry will always be important. Here, issues can be discussed and possible solutions presented in the spirit of *ILAG*. The traditional whitefish industry is far from fully developed, and cod farming is still only in its infancy. All the stakeholders can learn from each other, and therefore it is so important that there is a forum where knowledge can be exchanged and concerns can be expressed. The Cod Cluster's annual conference provides just such an opportunity, and all participants will be heartily welcome to next year's event.

*Maiken Johnsen, Cod Cluster,
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 VERIFISH'S PHOTO CHALLENGE HIGHLIGHTS HOW EUROPEAN PERCEIVE SEAFOOD IN EVERYDAY LIFE

Capturing sustainability through images

As part of its ongoing efforts to improve communication around sustainable seafood, the Horizon Europe-funded VeriFish project launched a pan-European photo challenge designed to raise awareness and promote public engagement.

The initiative, coordinated by Eurofish under Subtask 3.4.5, invited individuals from across Europe to submit photographs that visually express the principles of sustainable fisheries and aquaculture. With categories spanning environmental sustainability, nutrition and health, and socio-economic impact, the challenge aimed to bridge scientific, policy, and consumer audiences by translating technical themes into personal and visual narratives. The contest ran from February to the end of May 2025 and was promoted across LinkedIn, Instagram, Facebook, X, and Bluesky in nine languages. Participants were asked to submit one original photo accompanied by a short caption of 50 to 150 words that connected the image to one of the three sustainability pillars defined by the VeriFish project. The challenge was open to all, regardless of background, and the wide range of entries received reflected the diversity of perspectives and geographies that characterise Europe's seafood landscape. Submissions came from professionals in the fisheries sector, students, and members of the general public.

A distinguished panel of judges—composed of experts from FAO, ICES, EATIP, GDST, MAC, CNR, and

API—evaluated the entries according to criteria such as thematic relevance, photographic quality, and storytelling impact. The winning submissions are a testament to the power of visual communication to engage audiences on complex sustainability topics.

Lorenzo Ragazzi, from Olbia, Italy, was selected as the overall winner of the challenge, and also took first place in the Environmental Sustainability category. His photograph, captured by drone over aquaculture cages off the

coast of Sardinia, depicts a bottlenose dolphin swimming beside a sea bream enclosure. The image underscores the harmony that can be achieved between marine life and aquaculture when practices are designed with environmental stewardship in mind. According to Mr Ragazzi, sea bream aquaculture here supports sustainable seafood production, reducing pressure on wild fish stocks while preserving water quality and promoting responsible environmental practices in the Mediterranean.



Lorenzo Ragazzi's contest winning photo offers a striking aerial view of the intersection of Sardinia's marine life with aquaculture.



Ingeborg Korme's photo of a local fisher in Ganvié, Benin took home the prize in the Socio-Economic Sustainability category.

In the Socio-Economic Sustainability category, **Ingeborg Korme** of Brussels, Belgium, was awarded first place for her photo taken in Lake Nokoué, Benin. The image features a local fisher inspecting nets near the stilt village of Ganvié, highlighting traditional practices that ensure food security in the absence of refrigeration infrastructure. Ms Korme noted that keeping fish in submerged cages allows communities to ensure fresh supply and sustain livelihoods. Her submission effectively illustrates the interplay between resource management and community resilience in low-income settings.

The Nutrition and Health category was won by **Alexandra Denisa Szabo**,

based in Italy, who combined her photograph of grilled fish with a poetic caption describing seafood's contribution to health and well-being. Her concise message—"Fish that helps our hearts and minds rise"—emphasises the nutritional value of seafood and the role it plays in sustainable diets. Ms Szabo discovered the challenge via LinkedIn and praised the opportunity it offered to connect food culture with sustainability values.

The Photo Challenge represents just one component of VeriFish's broader social media and storytelling strategy, which also includes influencer-led campaigns and a series of thematic storytelling sessions. These initiatives

aim to create accessible entry points into the project's more technical workstreams, including the development of sustainability indicators and consumer engagement tools. Selected entries from the photo challenge will be exhibited at the upcoming VeriFish Conference and published in future editions of Eurofish Magazine, providing further visibility to the winning participants and their messages.

By turning the lens toward local practices, marine environments, and community narratives, the VeriFish Photo Challenge has demonstrated that meaningful sustainability communication can—and should—begin with a simple image and a story well told.

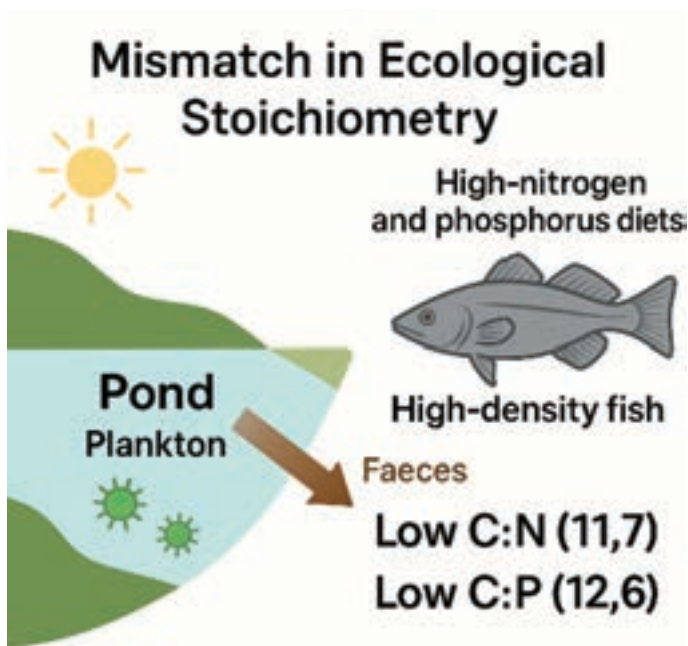


Figure 1: Hybrid cage-in-pond system. Pond water is collected for a mesocosm experiment to balance the imbalanced aquaculture effluent generated in these systems.

ROLE OF PLANT FIBRES IN SAFEGUARDING HYBRID FISHPONDS AGAINST EUTROPHICATION

Providing fish a better pond environment

Researchers in the Czech Republic have shown that the addition of sugar beet as a source of carbon to the outer pond in a hybrid pond system contributes to keeping the hybrid pond free from algal blooms among other benefits.

Pond fish farming in Central and Eastern Europe is being modernised by using new hybrid systems. These include combinations like cages inside ponds, tanks next to ponds, and ponds connected

to recirculating aquaculture systems (RAS). In these systems, the pond works like a natural filter. It cleans up uneaten feed, fish waste, and excess nutrients—mainly nitrogen (N) and phosphorus (P)—from fish kept in high-density areas

like tanks or cages. These fish are usually fed protein or N- and P-rich diets because they are high-value carnivorous species. Such feed is also quite refined (low in indigestible organic matter) and faeces lack a high carbon (C) content but are rich in N and P. For example, a commercial feed derived faeces from *Sander lucioperca* (pike-perch) routinely fed in the university's hybrid pond system could have 63.6% C, 4.39% N and 5.75% P on a dry matter (DM) basis. The waste from the fish ends up fertilising the pond, which boosts the growth of plankton and benthos. These become food for other fish that do not need extra feeding, helping turn waste into more fish for human consumption. This way of farming is an example of circular aquaculture. It is smart, resource efficient, and sustainable (Figure 1).

Fish waste with low C and excess N and P affects ponds negatively

Despite the efficient use of resources—from an ecological stoichiometry

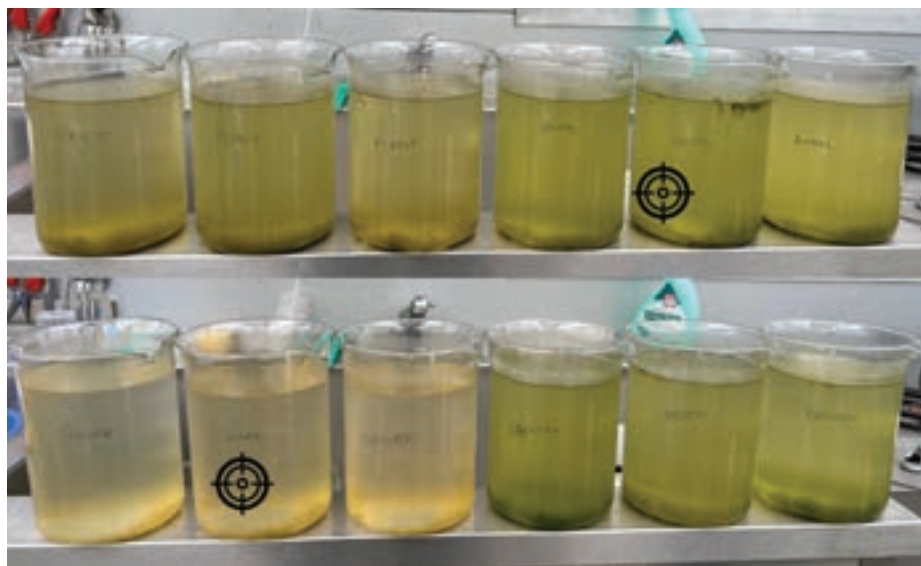


Figure 2: Outcome of mesocosm challenge pilot trial. Sugar beet suppressed eutrophication, while animal-type faeces triggered eutrophication and cyano-bacterial bloom (data not shown).

viewpoint, the faeces are not ideally balanced for microbial uptake and biomass conversion. The low molar N:P ratio suggests that phosphorus may be in excess, and carbon may not be sufficient for microbial C:N:P demands unless complemented. Adding selected plant-based carbon sources externally could enhance nutrient assimilation and improve sustainability in hybrid pond systems (Figure 1). While indoor systems like RAS can easily adjust carbon levels and pH daily (using, for example, sodium bicarbonate), people often forget to manage carbon in pond systems. Many believe that ponds naturally get carbon from sediments or the air. However, repeated use of ponds can drain their carbon, much like farming the same soil too much with inorganic N, P fertilisers can wear it out.

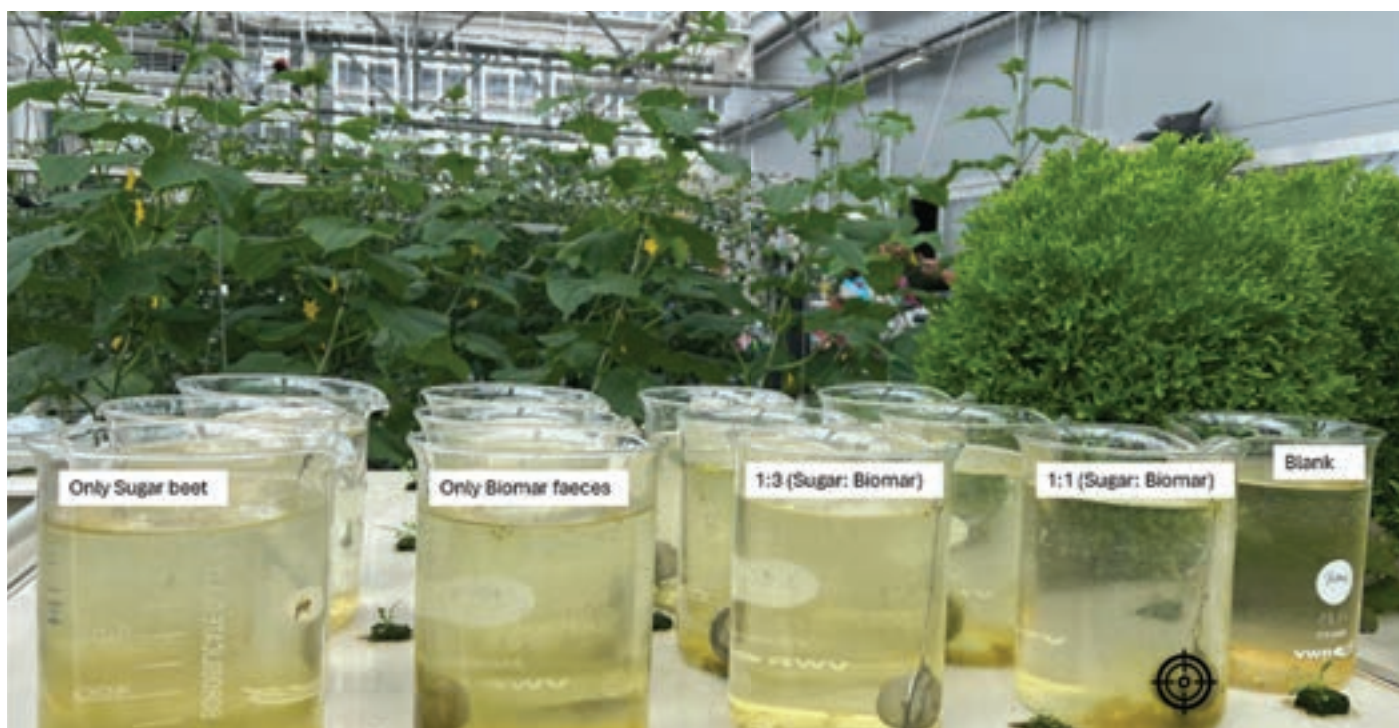


Figure 3: Outcome of main mesocosm trial balancing N, P rich commercial faeces in hybrid pond water with a sustained-release C-source (sugar beet). Balancing commercial faeces with sugar beet at 1:1, chlorophyll and cyano-chlorophyll was significantly suppressed compared to “only commercial faeces” or “insufficiently balanced commercial faeces (1:3, sugar beet: commercial faeces)” (data not shown).



Figure 4: Example of a balanced daily input for eco-hybrid ponds—feeding commercial feed to enclosed fish and sugar beet to the open pond.

When ponds have too much N and P but not enough C, it can lead to algal blooms and water pollution, breaking EU environmental rules. To fix this, ponds need a good natural source of carbon.

The concept shows that some plant-based by-products from farming and food processing—usually used only for cattle feed or compost—could be a cheap and scalable way to add carbon back. Not all types of plant fibre work, but some show good potential to help clean the water and balance nutrients in these modern pond systems.

A two-stage mesocosm experiment was conducted using 2-liter beakers filled with pond water from hybrid systems and placed in a greenhouse water bath (Figure 2). The setup included four treatment groups with three replicates each, plus a blank control (13 beakers total). A tea

strainer in each beaker held solid inputs. In the pilot trial, the scientists introduced solids at a 1:1000 dilution to test for eutrophication (algal overgrowth). Four types were used: (1) Plant-based faeces (high in C, N, P); (2) Animal-based faeces (low C, high N, P); (3) Spent brewery grains (biologically pre-processed C source); (4) Extracted sugar beet (mechano-thermally processed C source). Animal-based faeces triggered strong algal and cyanobacterial blooms, making them the worst choice. Plant-based faeces caused less eutrophication but were

impractical due to carnivorous fish dietary constraints and weak suppression. Brewery grains were too bioavailable, rapidly stimulating eutrophication. Only sugar beet acted as a slow-release carbon source, effectively preventing eutrophication, due to its predominantly lignin-cellulosic matrix (Figure 2).

Sugar beet, in the right proportions, shows promising results

In the main trial, the researchers used faeces from pike-perch fed commercial EFFICO in the hybrid pond system and selected sugar beet as the ideal sustained-release carbon source (93.3% C, 1.74% N, 0.14% P, DM basis). The faeces were collected using a Guelph

system under controlled feeding conditions and freeze-dried for use. Five mesocosm treatments were tested at a realistic 1:10,000 dilution in 2 L pond water: (1) 0.2 g sugar beet; (2) 0.2 g commercial faeces; (3) commercial faeces with sugar beet at 1:3 ratio; (4) commercial faeces with sugar beet at 1:1 ratio; (5) blank pond water. Results showed that the 1:1 sugar beet to commercial faeces treatment effectively controlled eutrophication, maintaining water quality comparable to the blank pond water. This treatment also preserved dissolved oxygen (DO) levels during both day and night in non-aerated mesocosms. In contrast, commercial faeces alone or with insufficient sugar beet (1:3) led to eutrophication (Figure 3).

So, what does this scientific result mean in real-world practice? A simple rule of thumb is this: for every 100 kg of fish feed used in the intensive part of a hybrid pond, about 10 kg of sugar beet should be added to the surrounding pond area. In other words, apply sugar beet equal to 10% of the daily feed amount in the outer pond, as shown in Figure 4. This approach helps keep the hybrid pond clean over time. It supports ecological balance, prevents eutrophication, and helps meet the environmental standards of the EU Water Framework Directive.

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Bubble curtain technologies, like those developed by Mowi Scotland, create a protective barrier around salmon pens, helping to mitigate the damage caused by jellyfish blooms.

COMBATING JELLYFISH BLOOMS WITH MOWI SCOTLAND'S NEW TECHNOLOGIES

Rising temperatures, increasing threats

Mowi's salmon farming operations in Scotland have benefited from introducing and adapting a technology against jellyfish that has proven effective at the company's farm sites in other parts of the world.

Jellyfish blooms are not a new phenomenon in Scottish waters. These events, while historically episodic, are becoming increasingly frequent and severe. The escalation has been linked to broader patterns of climate variability and ocean

warming by marine scientists. Although Scotland's average sea temperature has not risen dramatically across all seasons, localized thermal spikes of up to 1.5°C in particular regions and during certain times of the year have had significant ecological impacts. These subtle

but consequential increases in sea temperature appear to be creating ideal conditions for the proliferation of jellyfish and phytoplankton.

This variation in marine conditions has introduced a new and urgent layer of complexity for aquaculture operators. Jellyfish blooms are now widely recognized not just as seasonal issues, but as chronic, high-risk phenomena that can damage farm infrastructure, compromise fish health, and significantly disrupt production cycles. Farms located in sheltered inlets or fjords, where circulation is slower, are at greater risk of bloom accumulation. Among those at the forefront of mitigation efforts is Mowi Scotland, which has taken decisive steps to integrate advanced monitoring systems and technological interventions into its farm management practices. One of the most promising innovations trialled in recent years is the bubble curtain—a hydrodynamic barrier designed to keep harmful organisms from entering salmon pens. These systems have been deployed at

two distinctly different Mowi sites: Portnalong, a sheltered farm with high jellyfish retention, and Stulaigh, an exposed farm influenced by tidal flows. Drawing upon global expertise from operations in Chile and Canada, Mowi has implemented these systems as part of a wider, adaptive strategy to protect stock and maintain performance under increasingly volatile conditions.

Jellyfish blooms and fish welfare have complex linkages

The threat jellyfish pose to aquaculture is both multifaceted and poorly understood. Their effects are not limited to visible blooms of large species. In fact, the most dangerous offenders are often microscopic jellyfish whose presence is not obvious without detailed sampling. Even at low densities, these jellyfish can deliver significant harm through mechanisms that include oxygen depletion, toxin exposure, and physical gill damage. At night, blooms can rapidly reduce dissolved oxygen levels in the water column, creating environmental stress that weakens salmon immune responses and increases mortality risk. Even more concerning, jellyfish possess stinging cells—nematocysts—which they release upon contact. These microscopic structures act like harpoons, injecting toxins into the gill tissues of the salmon. The result is a cascade of health issues: inflammation, impaired respiration, secondary infections, and in some cases, death.

Although salmon themselves are resilient to slight increases in temperature, it is the indirect effects of these warming patterns—i.e., increased bloom activity—that prove most harmful. The blooms are difficult to anticipate and may vary not just by season, but also by site, depending on current, nutrient availability, and other localised

oceanographic characteristics. To address this complexity, Mowi Scotland has instituted a comprehensive monitoring protocol. Across its farms, trained staff conduct daily inspections, measuring water temperature, oxygen saturation, and performing microscopic analysis of water samples taken at various depths and pen locations. Although full automation remains a future goal, Mowi continues to invest in R&D efforts to develop AI-driven identification systems that could eventually replace manual monitoring with real-time digital tools. Until that time, frontline mitigation relies on the experience and responsiveness of farm personnel.

Bubble curtain principles and site adaptation

The principle behind bubble curtain technology is simple but effective. The system releases a continuous stream of bubbles, typically from aeration tubing or specialised diffusers placed at depth. These bubbles rise vertically, creating an upward current of oxygenated water that displaces surface layers, where jellyfish, plankton, and other undesirable organisms tend to accumulate. At Portnalong, a site historically plagued by persistent jellyfish and phytoplankton blooms, a bubble curtain system was installed using a technology known as Bubble Tubing®. The setup creates a moving barrier around the salmon enclosures, redirecting biologically loaded water away from the pens. The location's sheltered nature made it ideal for this type of system, which requires stable conditions to operate efficiently.

In contrast, at Stulaigh, where exposure to currents and swell is more pronounced, a Tight Microbubble Screen (TMS) system was deployed. Installed at 25 metres, the TMS forms a fine mesh of rising microbubbles that

acts like a vertical fence. This barrier is designed to block or slow the intrusion of micro-jellyfish, phytoplankton, and other harmful agents. Notably, the system may also have benefits beyond biological control, potentially intercepting hydrocarbon residues or suspended contaminants. These installations reflect the need for site-specific adaptation. A solution that works well in a calm fjord may be ineffective in exposed waters. Mowi's comparative trials have provided a deeper understanding of how these systems respond to different hydrodynamic settings, informing future deployment strategies.

Portnalong site, a case-study in bubble curtain efficacy

Few examples illustrate better the impact of bubble curtain systems than recent results from Portnalong. Previously, this site had been so saturated by jellyfish and plankton that Mowi was forced to relocate entire salmon generations to alternative farms, sacrificing growth performance and increasing operational complexity. However, the tide turned in 2024, when for the first time in three years, salmon were successfully grown and harvested on site. Even more significantly, the harvested fish were rated superior grade, suggesting that not only did the fish survive the bloom season, but they thrived within it. Daily monitoring confirmed the effectiveness of the system. Enhanced sampling both inside and outside the bubble curtain zone show that, for many days, the presence of jellyfish and plankton inside the curtain was up to 80% lower than outside. While variability existed, the overall trend demonstrated consistently lower biological pressure within the protected area.

The system operated around the clock, requiring specific training for

staff to manage its components. Power demands were considerable, particularly due to the continuous 24-hour operation. Yet the trade-off was clear: stable fish health, reduced mortality, and the suspension of emergency transfers. This success has prompted further interest in evaluating the long-term return on investment. Though energy costs are high, manufacturers are already developing next-generation systems with improved energy efficiency, making wider adoption increasingly viable.

Bubble technology is one tool in a comprehensive management strategy

Bubble curtain technology does not offer a one-size-fits-all solution, nor should it be viewed as a standalone fix. However, it has become an important pillar in Mowi Scotland's broader environmental management framework. Alongside routine sampling, environmental forecasting, aeration systems, and stock movement strategies, the curtain technology has helped reduce losses and improve fish welfare outcomes. The figures from 2024 are telling. Biomass mortality across all Mowi's Scottish seawater farms declined by 35%, while fish-by-fish mortality dropped by 45%. Although attributing all this improvement to bubble curtains would oversimplify a complex system, they played a critical role, particularly at high-risk sites.

However, challenges remain. Operating costs must be balanced against benefits. Micro-jellyfish detection continues to rely heavily on manual sampling, and climate-induced variability makes planning difficult. Despite this, Mowi sees value in maintaining a multi-layered approach, combining data collection, staff expertise, and



Bubble curtains are one component in an environmental management strategy, that includes routine sampling, and stock movement plans, to reduce mortalities and improve fish welfare.

site-adapted technologies to build resilience against biological threats. One of the strengths behind Mowi's strategy has been its ability to draw on international experience. Before installing the bubble curtain systems in Scotland, Scottish farm managers consulted with counterparts in Chile and Canada, both of which have faced similar bloom-related challenges.

Climate change underscores the need for collaboration across geographies

Once the systems were in place, a delegation from Mowi Norway visited the Portnalong site to observe the technology in action. These visits not only enabled firsthand evaluation but also reinforced a culture of internal knowledge transfer, allowing successful strategies to be replicated and refined across regions. Cross-border discussions helped inform system selection, site adaptation, and operational protocols. This spirit of collaboration is increasingly important as climate change drives shared challenges across aquaculture geographies. Whether in northern fjords or southern

bays, the common thread is a need for adaptable, science-based tools—and the willingness to learn from one another's successes and failures. The story of bubble curtains at Mowi Scotland is still evolving. Plans are already underway to continue their use at Portnalong and Stulaigh in 2025, and new sites are being assessed for potential deployment. Meanwhile, internal teams are working with suppliers to enhance system design, reduce energy demand, and integrate smart control technologies that respond automatically to bloom conditions.

Beyond equipment upgrades, Mowi is also investing in advanced data analysis, using historical bloom data and environmental models to improve forecasting. The long-term goal is a predictive system where monitoring, detection, and response are fully integrated—allowing farms to deploy defences before the threat fully materialises. Research into jellyfish ecology continues in parallel. Understanding bloom triggers, movement patterns, and toxin composition will be key to designing next-generation mitigation tools. The bubble curtain is an important tool in this arsenal, but its full potential will only be realised when combined with broader scientific insight and operational foresight.

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The Verifish app enables users to scan QR codes or search seafood products by name to receive comprehensive sustainability and nutrition profiles.

VERIFISH, A HORIZON EUROPE INITIATIVE, IS ENABLING INFORMED SEAFOOD CHOICES ACROSS THE CONTINENT

Meeting Europe's sustainability challenge



As Europe's fishing and aquaculture sectors navigate increasingly complex sustainability demands, the need for transparent, science-based communication tools has never been more critical. The VeriFish project, a Horizon Europe-funded initiative, is addressing this challenge head-on by developing a comprehensive framework that bridges the gap between technical sustainability data and practical decision-making tools for consumers, producers, and policymakers alike.

The European seafood sector faces a unique paradox: while seafood represents one of the most widely traded food commodities globally,

it remains among the most misunderstood by consumers. Issues surrounding overfishing, habitat degradation, labour practices, and nutritional misinformation create barriers that prevent

stakeholders from making truly informed decisions about sustainability. VeriFish is transforming this landscape by providing the tools and infrastructure necessary for transparent, verifiable sustainability communication. In 2025, VeriFish has delivered a suite of groundbreaking outputs that represent significant milestones in sustainable seafood communication. These include the comprehensive Indicator Framework (D2.2), strategic communication guidelines (D4.1), detailed specifications for the mobile application (D3.2), and innovative media products (D3.3). Together, these deliverables form the foundation for transforming how Europe approaches seafood sustainability.

A holistic approach to sustainability assessment

At the core of VeriFish lies its innovative Sustainability Indicator Framework (D2.2)—a comprehensive system that evaluates seafood products across three interdependent pillars: environmental impact, nutrition and health, and socio-economic responsibility. This tri-pillar approach, detailed in the recently published framework deliverable, ensures that sustainability extends beyond traditional metrics to



Verifish offers both the opportunity and support to European fisheries and aquaculture operators to increase the sustainability of their activities.

encompass the full spectrum of what makes seafood truly sustainable. The environmental pillar addresses the ecological footprint of both capture fisheries and aquaculture operations. Key indicators include overfishing status, gear type impact, bycatch levels, seafloor damage, biodiversity impacts, greenhouse gas emissions, and spatial management effectiveness. These metrics draw from authoritative sources including the FAO's Global Record of Stocks and Fisheries (GRSF), FishBase, SeaLifeBase, the IUCN Red List of Threatened Species, and WISE-Marine databases. The framework's strength lies in its interoperability with existing certification and governance schemes, supporting.

Breaking new ground in sustainability communication, VeriFish incorporates a dedicated nutrition and health pillar that highlights seafood's contribution to human dietary needs. Using databases such as EuroFIR's FoodExplorer and the FAO/INFOODS

uFish, the framework evaluates protein quality, omega-3 content, micronutrient density, allergen risk, and sodium concentration. This innovative approach helps consumers understand the connection between choosing sustainable seafood and making healthy dietary decisions, moving the conversation beyond ecology to include personal and public health benefits. For the aquaculture sector, this presents new opportunities to communicate the nutritional advantages of responsibly farmed products. The third pillar ensures that seafood's human dimension receives equal attention. Indicators evaluate working conditions, labour rights, wage fairness, health and safety standards, and adherence to international human rights conventions. Data sources include the International Labour Organization (ILO), the Global Slavery Index, Transparency International, and OECD governance indices. Special attention is given to protecting indigenous and small-scale fishers.

The VeriFish knowledge base allows data-driven decisions

Supporting the indicator framework is the VeriFish Knowledge Base (KB), a sophisticated semantic engine that integrates dozens of primary datasets into a coherent, machine-readable ecosystem. Built upon the established GRSF ontology, the KB expands to include biological, nutritional, geographical, governance, and socio-economic dimensions. The Knowledge Base incorporates data from EMOD-net Biology, GBIF, FishChoice, Marine Regions, and national food databases, creating a robust infrastructure that follows FAIR data principles—Findable, Accessible, Interoperable, and Reusable. National authorities, retailers, and NGOs can access the data to generate real-time sustainability assessments and risk profiles for specific species or fishing areas. Future API integration will further enhance these capabilities, supporting everything from traceability systems to sustainability reporting.

The VeriFish mobile application represents the consumer-facing culmination of the project's technical innovations. Available in multiple languages and optimized for both Android and iOS platforms, the app enables users to scan QR codes or search seafood products by name to receive comprehensive sustainability and nutrition profiles. Consumers receive easy-to-understand scores and guidance, while technical users—including food retailers and certification bodies—can access detailed indicator data and sources. For producers and processors, the app functions as an input interface where fishermen can enter catch data, vessels can upload documentation, and suppliers can validate sourcing chains.

Educational outreach to build ocean literacy

Recognizing that digital tools alone cannot drive behavioral change, VeriFish has also invested significantly in educational products. Central to the media strategy is “Fishy Businesses,” a strategy card game designed to foster awareness about species diversity, fishing pressures, and nutritional values. Illustrated in comic-book style, the game makes learning engaging for students, consumers, and industry stakeholders. Each species card features factual data on sustainability and nutritional status based on scientifically verifiable criteria including overfishing risk, bycatch impact, and nutritional value. The D3.3 deliverable specifies the development of a 12-month educational calendar featuring different seafood species alongside sustainability tips, nutrition highlights, and seasonal recipes. These calendars are being distributed through fishmongers, public libraries, school networks, and culinary training institutes. Additional materials include large-format posters on sustainable aquaculture practices, interactive gear-impact infographics, educational videos, and downloadable maps showing regional fishing patterns and risk zones. These resources support live events, museum exhibitions, and EU-wide ocean literacy campaigns.

Targeted communication strategies

The Initial Recommendation for How to Efficiently Communicate to Consumers About Seafood (D4.1) represents an analysis of consumer behavior and communication preferences in the seafood

sector. This deliverable identifies six distinct target personas, from eco-conscious millennials to health-focused parents. The deliverable provides detailed guidance for communicating with each consumer segment, including practical examples for both wild-caught and farmed seafood products. These insights from D4.1 are being incorporated into draft CEN Workshop Agreement guidelines—a precursor to potential European standardization of sustainability messaging in the seafood sector.

VeriFish tools are currently undergoing pilot implementations and stakeholder testing, preparing for real-world integration into national labeling schemes, retail traceability platforms, and public food procurement standards.

Supporting regulatory compliance

For European fishing and aquaculture operators, VeriFish offers practical tools for meeting evolving sustainability requirements. The framework's compatibility with existing certification schemes reduces compliance complexity while providing clear pathways for demonstrating environmental and social responsibility. The comprehensive data integration capabilities support various regulatory needs, from EU taxonomy alignment to sustainability reporting requirements. This positions VeriFish as essential infrastructure for navigating Europe's increasingly complex sustainability landscape.

Beyond compliance, VeriFish creates new market opportunities for responsible producers. The consumer-facing tools enable direct communication of sustainability credentials, potentially commanding premium prices for verified sustainable products. The educational components build consumer awareness and demand for responsibly sourced seafood, expanding market opportunities for compliant operators.

Building tomorrow's seafood infrastructure

The VeriFish project represents more than a research initiative—it constitutes strategic infrastructure for sustainability communication in one of Europe's most complex food sectors. With the deliverables launched in 2025 and pilot implementations underway, the project is preparing for integration into existing market and regulatory systems. By translating abstract principles of environmental justice, nutritional wellbeing, and social equity into practical, understandable formats, VeriFish is establishing the foundation for informed, intentional, and responsible seafood choices across Europe. As climate pressures intensify, consumer expectations evolve, and regulatory requirements expand, the importance of such comprehensive sustainability tools will only increase. VeriFish is not merely addressing current challenges—it is building the infrastructure to anticipate and meet future needs, ensuring a healthy relationship between Europeans and their marine resources.

For Europe's fishing and aquaculture sectors, VeriFish offers both opportunity and support in navigating the transition to more sustainable practices. By providing the tools for transparent communication and verified sustainability claims, the project empowers responsible operators to differentiate themselves in an increasingly conscious marketplace while contributing to the long-term health of marine ecosystems and communities. As the project moves from development to implementation, its impact on the future of European seafood sustainability is poised to be both significant and lasting.

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ESTONIA'S COASTAL FISHERY

Adapting to different challenges

Commercial fishing in Estonia is split into different segments depending on the area being fished and the size of the vessel. Vessels in the coastal fleet are the smallest and most numerous. Baltic Sea trawlers number under two dozen and are all above 18 m in length, while the high seas fleet comprised three active vessels in 2023 with an average length of 61 m.

The Estonian coastal fishery remains a crucial part of the nation's fishing sector despite facing mounting challenges. It spans the Baltic Sea's varied regions—the Gulf of Finland, the high seas near Saaremaa and Hiiumaa, the Väinameri Sea, the Gulf of Riga, and Pärnu Bay—and relies primarily on trap nets and gill nets, with a fleet composed almost entirely of small boats under 12 metres in length. While this fishery contributes significantly to domestic fish supply and coastal livelihoods, it is under strain from demographic, environmental, economic, and regulatory pressures.

Entering the coastal fishery can be dauntingly expensive

According to Erko Veltson, fisheries specialist at the Estonian Fisheries Information Centre, the average age of a coastal fisher in Estonia is 55 and rising. Entry into the sector is prohibitively expensive for many younger people. Prospective fishers often face upfront investments



More modern technology, less bureaucracy, and a smaller initial investment may tempt young people to the fishing industry.

of around €100,000 for gear, licences, and vessels, with little or no government support. As Mr Veltson says, neither the government nor the EU supports it... I think this is the main issue. Most new entrants come from fishing families and inherit the necessary infrastructure; for

outsiders, the barriers are often too high. There have been discussions within the administration about extending support to young people who wish to join the sector, but so far they have not led to concrete measures, he adds. Fishing activity is seasonal and is concentrated in

Bringing science and industry closer together

Innovation is a priority

Hendrik Terras, Minister of Regional Affairs and Agriculture is keen to further develop the links between scientists and the seafood industry to find practical solutions to challenges in areas like aquaculture, processing, and the environment. He also wants to encourage more innovation in the industry and sees closer ties to the scientific establishment as a way of achieving this. As a small country we cannot achieve scale, he says, so we must rely instead on precision and on using our resources as efficiently as possible.

The focus on collaboration is driving the ministry's work with chefs to develop ways to prepare the meat of cormorants and seals. The idea is for restaurants to offer exotic foods on their menus to attract tourists which in turn could boost the economies of coastal areas. Mr Terras says the national authorities are moving towards greater control of these two predators to reduce the burden on fishers as well as to limit the pressure on fish stocks. He looks forward to working with his counterparts in the other Baltic nations and in the European Commission to increase the efficacy of control measures.

Accelerating generational change in the fishing industry is possible with the right incentives, Mr Terras feels. Making the industry more attracting by deploying new technologies, offering financial assistance at the start of a career, and reducing bureaucracy are some of the ideas he has to encourage young people to consider employment in the sector.

specific months, notably April and May for Baltic herring, with activity declining sharply in summer when warmer waters compromise fish quality. This forces many fishers to diversify their income, combining fishing with other work. Earning a living purely from fishing is not feasible, says Mr Veltson

In 2023, there were 2,282 coastal fishers in total in Estonia of which 1,935 were registered to fish in the Baltic Sea. Less than 3% (55) of these fishers were women. The counties with the greatest number of fishers were Harju in the north, and Saare, Pärnu, and Hiiumaa in the west. According to the latest Estonian Fishery Yearbook (2022-23) for only 10% of coastal fishers is fishing their main source of income. Around 2,015 vessels were used by coastal fishers in the Baltic Sea, a number that has increased steadily since 2016. Together these vessels had just under 22,000 kW of power and 2,348 GT. Despite high registration numbers, only about 300 to 400 fishers are actively catching and selling fish. While fishing remains a cultural touchstone, it is not always economically sustainable, particularly given the competition from invasive



Hendrik Terras, Minister of Regional Affairs and Agriculture, Republic of Estonia

species, declining fish stocks, and predation by cormorants and seals. These predators consume fish stocks on a scale that exceeds catches by fishers. Although limited seal and cormorant control is permitted, the EU's ban on

trading seal products limits mitigation efforts. The authorities seek to encourage the consumption of cormorants by organising training course for chefs on how to prepare cormorant meat. If successful it may establish a market for the

Baltic Sea coastal fishery catches, tonnes

	2018	2019	2020	2021	2022	2023
Fish total	10437	10809	10496	11705	9311	12017
Baltic herring	8064	8293	7735	9176	6806	9328
European perch	1137	979	749	792	760	793
European smelt	284	502	915	720	704	657
Others	361	351	410	444	361	508
Silver bream / roach	133	158	183	154	204	212
Ide (fish)	49	50	48	65	69	127
Garfish	75	130	122	105	159	107
Northern pike	68	76	77	60	55	101
Flounder	169	150	176	115	108	98
Vimba	97	119	80	75	86	88

Statistics Estonia

significant in coastal areas. In 2023, the estimated revenue from coastal fishery reached €7.4 million—a notable increase from €4.8 million in 2022, largely driven by higher first-sale prices and a strong herring season. Baltic herring continues to dominate in volume and value, especially in Pärnu Bay, which accounted for nearly 8,000 tonnes of the species in 2023, more than in any other region. Smelt, perch, and pikeperch also contribute significantly to the overall catch. Efforts are being made to add greater value to the catch so that fishers continue to earn even if catch volumes or raw fish prices fall. At the Fish Information Centre staff members offer training to fishers and to employees in processing factories on how to process and add value to fish.

Baltic herring dominates catches

In the Gulf of Finland, catches remain lower than in other regions, with herring, flounder, and perch being the most important species. Here, herring catches have fluctuated modestly since 2014 with a faintly increasing tendency since 2016. Flounder numbers have

birds and create an incentive for hunters to target them. To persuade sceptics of the merits of this approach a livestream from a cormorant colony has also been set up to show the impact of large cormorant colonies on the surrounding vegetation. Nevertheless, a balance has to be struck between vilifying cormorants and allowing them to multiply unrestrictedly. The Estonian Ornithological Society named the cormorant its bird of the year in 2025 suggesting that the predator also has its supporters.

Climate change has direct and indirect effects

The impact of climate change, while not yet drastic, is evident in warmer winters and shifting seasonal patterns. Some species are becoming more scarce or unpredictable, while others, such as the round goby, a previously maligned non-native species, are now economically significant. The round goby catch has increased notably across multiple regions, particularly in the Väinameri Sea and the Gulf of Riga, and its market value rose by

35% from 2022 to 2023. However, overall Baltic herring is still the most commercially valuable species with catches in 2023 reaching over 9,300 tonnes or more than three fourths of the total coastal catch. The other two significant species were perch and smelt, which accounted for 6.6% and 5.5% respectively of the volumes and 30% and 7.8% of the value of the total Baltic Sea catch.

Economically, the sector remains modest at the national level though



Erko Veltson, Fisheries Specialist, Fisheries Information Centre

generally fallen over the years. The year 2023 was no exception with flounder catches at 34 t—better than each the three previous years but a 50% drop compared to the years 2011-16. The 2023 perch catch in this region, while modest, was the highest in nearly a decade. In value terms, catches of sea trout and salmon were the most important species after herring. Areas near Saaremaa and Hiiumaa also see significant flounder and round goby activity, though flounder catches in these waters hit record lows in 2023. The round goby has surged, however, with catches rising to 46 tonnes in 2023. In these waters, perch is also growing in importance, with the 2023 catch reaching 34 tonnes. The Väinameri Sea, another key coastal fishing area, saw record catches in 2023, driven primarily by perch and ide. The perch catch reached 317 tonnes, while ide catches hit 84 tonnes—both the highest in the 2007–2023 data series. Whitefish, herring, and roach also contributed significantly. Notably, trap nets have become more prominent here, with increasing catches of species like gibel carp and vimba bream. All in all, the 2023 catch was

In the Gulf of Riga (excluding Pärnu Bay), herring remains dominant but at reduced volumes—the 2023 catch was 411 tonnes, half the long-term average. However, the round goby and perch are filling part of this gap, with goby catches reaching 177 tonnes and perch holding steady at around 132 tonnes. The region's garfish catch more than doubled in 2023 compared to the previous year, highlighting its growing role in the coastal fishery. Pärnu Bay stands out as the most important area for both volume and revenue. In 2023, it accounted for the largest share of the national herring catch. Smelt and perch also perform well here, with smelt catches exceeding 630 tonnes and perch around 290 tonnes. Pikeperch, while once more prominent, remains low at 22 tonnes. Vimba bream stocks have risen since the removal of the

Sindi dam on the Pärnu River, allowing better spawning conditions, and catches remain strong at nearly 70 tonnes in both 2022 and 2023. For the coastal fishery as a whole revenues jumped in 2023 to EUR7.4m after declining 11% year on year in 2022 to EUR4.8m. The increase in 2023 was driven by higher first sale prices for herring and smelt combined with stronger catches of herring. In 2023 catches were lower than the average of the 2007-23 period due to the low herring catch. However, the total yield from other species as a whole was higher thanks to round goby, catches of which more than doubled compared to the year before.

Trap and gillnets are the most commonly used fishing gear

Fishing gear and practices are locally specific and often traditional. In Pärnu Bay, for instance, herring is caught using pound nets placed in established, informal zones known among the fishermen. While officially unregulated, territorial habits are respected while in other regions, spatial conflicts are less pronounced due to lower fisher densities and wider available areas. Trap nets in Pärnu Bay, for instance, are placed 300 m apart. In other parts of the Gulf of Riga too trap nets and gill nets are the main gear used followed by seines. Longlines are responsible for a small fraction of the catch. Fishing effort is influenced by fish abundance and the availability of other employment opportunities. It tends to fall when abundance is low or other work is readily available. Catches from the Pärnu Bay in 2023 were higher than the average of the 2009-23 period thanks mainly to herring and smelt. For other species (perch, pike-perch, vimba bream, and garfish) catches have remained below average since a peak in 2014.

Technological changes are also reshaping the sector. The mandatory introduction of electronic catch reporting has been met with frustration, particularly among older fishers. The requirement to report via smartphone in wet, cold conditions has proved challenging, leading some to leave the industry or delegate reporting to younger colleagues. Despite government efforts to improve the system's usability, it remains a source of contention. Producer organisations (POs) play a role in organising the market, particularly in Pärnu, where one PO agrees on herring prices with processors before the season begins. However, not all fishers join these bodies. As Mr Veltson notes, mistrust rooted in the Soviet-era legacy of collective farming still affects attitudes toward cooperation. Yet, younger fishers are gradually showing more interest, encouraged by higher levels of support available to PO members.

Coastal fishery needs to be made more attractive for young people

Overall, the Estonian coastal fishery illustrates a complex and changing sector. It is anchored in tradition but adapting to shifting biological, social, and regulatory conditions. It remains economically modest but locally vital, especially in coastal regions. Without meaningful support to address generational turnover and entry costs, the future of the sector looks uncertain. Yet, as Mr Veltson points out, there is resilience: "I think the coastal fisheries will survive. But... it needs to become more interesting for our youngsters." The preservation and adaptation of this sector will depend not just on fish stocks or quotas, but on broader policies that acknowledge its cultural and economic role along Estonia's coast.

Managing competition from nature

The Estonian fishing industry faces mounting pressure from two powerful natural competitors: the great cormorant (*Phalacrocorax carbo sinensis*) and the grey seal (*Halichoerus grypus*). Both species are native to the Baltic region but have seen unprecedented population growth in recent decades. This surge has led to significant consequences for coastal fisheries and aquaculture, prompting national and regional management responses.

Cormorants and grey seals are both apex predators that feed primarily on fish. Their increasing numbers have placed them in direct conflict with human fishers. According to data from the Estonian Ministry of Regional Affairs and Agriculture, coastal fisheries



extract approximately 12,000 tonnes of fish annually. This figure is matched by the estimated fish consumption of cormorants and closely followed by grey seals, which consume around 11,000 tonnes per year. Combined, these predators now remove more biomass from the sea than human fishers, a reversal that has altered the marine resource balance in Estonia's coastal waters.

Cormorant numbers surge

While historically present, cormorants were a rare sight in Estonia until the 1980s, says Herki Tuus from the Fisheries Policy Department in the Ministry of Regional Affairs and Agriculture. The population began expanding rapidly in the 1990s, particularly the continental subspecies *P. carbo sinensis*. Improved environmental conditions, such as lower levels of heavy metals in the aquatic ecosystem, as well as the Birds Directive, which protects all naturally occurring wild bird species in the EU,

contributed to this growth. The speed at which it has multiplied justifies the term invasive as the species takes over habitats and damages areas with its acidic excretions compounding the malign ecological impact. By 2024, the number of breeding pairs had reached 44,000, a number that is estimated to increase by 10% a year, with a total summer population of around 160,000 individuals including fledglings. Cormorants consume approximately 0.4 kg of fish per bird per day. Given their population size, their total fish consumption now matches or exceeds that of Estonia's entire small-scale coastal fishery. This level of extraction has raised concerns not only about fish stock sustainability but also about the economic viability of coastal fishing activity. The birds are also seen as a threat to inland aquatic ecosystems. When colonies form on the mainland, they are difficult to manage as they nest in trees and their feeding habits can decimate fish populations in rivers and lakes. In coastal areas, on the other hand, they nest on the ground on rocky islets in the sea or along the shore and are easier to control.



Endrik Tõnsberg

Cormorants not only prey on coastal fishers' catches but also eradicate vegetation with their toxic faecal matter.

**Herki Tuus,
Fisheries Policy
Department,
Ministry of
Regional Affairs
and Agriculture**



Mark Soosaar

Cormorants can nest in trees as well as on the ground. Oiling the eggs, a method of control, is easier when the nests are on the ground.

A three-pronged management strategy

To address the problem, Estonia has implemented a comprehensive cormorant management strategy. A renewed cormorant management plan was introduced in 2024 and further updated

for 2025. This plan includes three main tools: egg oiling, deterrence, and hunting. Egg oiling involves spraying food-grade oil onto eggs to prevent hatching. The method is considered a humane way to suppress population growth over time, as adult birds are not killed. In 2023, Estonia authorised oiling in 10 colonies, affecting around 3,000 nests. In 2024, this expanded to 12 colonies and

14,000 nests. For 2025, the plan includes oiling in 35 colonies, potentially impacting 28,000 nests, or more than 74% of the nests in those locations. Deterrence is used mainly in spawning areas such as the Pärnu River, where large flocks of cormorants have threatened smelt populations. Non-lethal deterrents like loud noises and lights are deployed to scare birds away from these critical habitats and to prevent them from settling as a colony. Hunting is permitted from August through December, with approximately 1,000 to 1,500 birds taken annually. While the numbers are modest compared to the population, hunting is seen as part of a broader strategy to limit damage. The government has even begun promoting cormorant meat as a culinary option to increase public interest in hunting the bird. The target of the management plan is to reach back to 9,500 breeding pairs of cormorants.

However, while Estonia may implement its own management strategy, Mr Tuus is keenly awaiting an EU-wide strategy the roadmap of which is currently being drafted and should be released in mid-2025. How the plan is

finally adopted will also have a bearing on national efforts to manage cormorants, some of which have been stymied by the courts, where environmental and ornithological groups have challenged cormorant-managing measures. Mr Tuus hopes that an EU-wide plan will carry legal strength that will assist national authorities. Although Estonia lost an early case due to insufficient justification, subsequent licensing decisions have been better documented, and the most recent court ruling has so far favoured the state. Moreover, the efficiency of management measures increases in relation to the number of countries that apply them. The Estonian plan will work better if similar measures are also being applied by our neighbours, Mr Tuus points out.

Seals pose a threat to fish stocks, fishers, and their gear

Grey seals have followed a similar trajectory. After being severely affected by pollution in the 1970s and 1980s, their numbers have rebounded in recent decades thanks to environmental recovery and protection measures. The current population in Estonian waters is estimated at over 7,000 individuals. Each of these consume up to 5-10 kg of fish

per day. Their impact extends beyond fish consumption to gear damage, particularly in gill net fisheries. Seals often raid nets, tearing them, eating some fish, but also partially consuming, damaging, or killing the other fish in the net, rendering the catch unfit for human consumption. A 2009 study valued the damage at €1 million, representing 20–30% of the revenue from coastal fisheries. Given the increased seal population, the present-day figure is likely much higher. Some compensation for damaged gear is available but the amount is negligible and the paperwork formidable so very few fishers apply. The use of seal proof gears and deterrent devices however is supported through the EMFAF (European Maritime, Fisheries, and Aquaculture Fund), but they work best with trap nets. For gillnets they are less efficient. The nature of seal damage also creates operational uncertainty. Fishers report interrupting their activity for days when seals are sighted, as the risk of ruined gear and lost catch is too high. Seals are not merely competitors; they are a direct economic threat to small-scale fishers. In fact, according to Mr Tuus, seals are considered an even bigger threat than cormorants because of the damage they do to fishing gear.

In terms of the total volume of fish consumed, seals and cormorants are responsible for two thirds, while fishers are responsible for a third. This creates a tension because fish stocks must attain good

status. One way is to restrict the fishery but limiting this enough to compensate for what cormorants and seals take would mean virtually terminating the fishery altogether. From a fisheries management point of view, Mr Tuus says, we therefore need to manage the pressure on stocks from all three sources.

Seal management and legal constraints

Seal hunting is allowed in Estonia under a protection and management plan adopted in 2015. Initially, the annual quota was set at 1% of the population and was rarely met due to complex regulations, including bans on shooting from motorboats and burdensome sample collection requirements. These rules were relaxed in 2023, and the 2025 hunting quota was raised to 3% of the population (187 individuals). Hunters are now encouraged to target “problematic” seals—individuals known to repeatedly attack fishing gear—rather than just any seals at large. This targeted approach aims to reduce the most disruptive animals while avoiding widespread culling. Despite the quota, the number of seals actually hunted remains low. Cultural practices on Kihnu Island support seal hunting and full utilisation of the carcass, including for meat and handicrafts. However, this remains an exception. In most of Estonia, hunted seals are either partially used or discarded, due in large part to the EU’s seal product trade ban.

The EU trade ban on seal products is a barrier to sustainable use

The EU bans the commercial trade of seal products except those sourced from indigenous communities, such as the



Seals too are a menace for coastal fishers as they compete for the same stocks, prey on catches, and damage fishing gear.

Inuit in Canada and Greenland. Estonia, lacking such a classification, is effectively barred from selling any seal-derived goods, including meat, skins, and handicrafts. Estonian officials argue that this restriction undermines the principle of sustainable use. The grey seal, they point out, is now abundant and can be hunted under controlled conditions. The trade ban turns the carcass into waste rather than a resource, reducing the incentive for regulated and humane hunting. The ban's origin lies in emotive campaigns against the inhumane culling of seal pups, which Estonia neither practices nor permits. There is growing pressure to reform the regulation to allow trade in non-pup products from sustainable Baltic hunts.

Unlike cormorants, which are migratory and present across Europe, grey seals are largely confined to the Baltic. While they constitute a nuisance for fishers across the Baltic, it is in the northern Baltic that their numbers have

exploded, with the population in Estonia roughly double the 3,000-4,000 individuals needed for good status. For cormorants, Estonia supports the development of a pan-European management plan, recognising that national actions can be undermined by cross-border migration. A coordinated effort, currently being drafted by EIFAAC (the European Inland Fisheries and Aquaculture Advisory Commission, an FAO body) for the European Commission, is expected to provide legal and policy backing for national management plans. Estonia anticipates that this will strengthen its position in future legal challenges and encourage similar measures in neighbouring countries. For seals, a Baltic-specific management approach is being advocated. Countries like Sweden and Finland already implement more extensive seal hunting programmes, and regional coordination could lead to more coherent strategies that balance conservation with fisheries sustainability.

Successful predator management calls for widespread backing

Estonia's experience illustrates the complex interplay between wildlife conservation, fisheries management, and rural economies. Cormorants and grey seals, once indicators of ecological recovery, have become pressing management concerns. The state has responded with science-based, legally sanctioned interventions aimed at reducing the damage to fish stocks and fishing livelihoods. However, the success of these measures hinges on broader support—from EU regulatory reform to regional cooperation and public acceptance. Without this, local fishers may find themselves bearing the burden of conservation success, even as their own livelihoods hang in the balance.

YLICOOOL REPRESENTS THE NEW FRONTIER OF BALTIC CUISINE

Serving seals and cormorants on a plate

A chef with his own catering company is reimagining wild meats to include hitherto largely unknown species like cormorants and seals. This development could create a new market and help deal with the threat these animals pose to fishers and fish farmers.

In the evolving world of gastronomy, where tradition often meets innovation, Urpo Reinthal stands out as a pioneer. The founder and head chef of Ylicool, a catering company based in Tartu, Estonia, Mr Reinthal is not only creating unique dishes but also pushing the boundaries of what is considered acceptable and sustainable food. While Ylicool offers a wide variety of catering options, it is



Urpo Reinthal, a chef with his own catering company, is fascinated by the versatility of cormorant and seal meats and by the prospect of creating a market using these proteins.

Mr Reinthal's work with two controversial and rarely used ingredients—seal and cormorant—that positions him at the vanguard of ethical and ecological culinary practices in Estonia.

The genesis of a culinary experiment

Ylicool started life as a restaurant nearly a decade ago before transitioning into a full-service catering operation. With Mr Reinthal as Ylicool's owner, head chef, driver, waitress, and dishwasher, as he describes himself, the business has steadily built a reputation for sourcing and transforming unusual ingredients. In the 23 years he has been in the restaurant business, he has consistently advocated for sustainable gastronomy, an interest that has brought him into collaboration with local hunters, fishermen, and even the University of Tartu. The interest in using cormorant and seal

meat is not born from culinary novelty alone. Mr Reinthal's journey began when researchers from Tartu University brought him a cormorant and asked whether it was edible. "Every bird is edible," he responded, and thus began his experimentation. Cormorants are widely considered a nuisance species in coastal Estonia, particularly by local fishermen as a single bird can consume up to 500 g of fish a day. Despite this ecological impact, hunting them involves complex regulations. After being shot, the birds must be inspected by a veterinarian, processed in a licensed facility, and only then can they be used in food preparation.

Undeterred by bureaucracy, Mr Reinthal has become one of the few chefs in Estonia to study cormorant meat closely. What he discovered is a protein with unique properties—dark, lean, and highly sensitive to preparation methods. When pan-fried and served medium rare, it resembles liver or has a light fishy note. Smoked, it takes on the flavour of wild duck. When turned into beef jerky, it transforms again, this time tasting unmistakably like fish. In his words, "the cormorant is like a taste chameleon."

Its lean structure, with little to no fat or muscle, makes it tricky to prepare. The meat resists absorbing flavour unless marinated extensively. However, in the hands of a skilled chef, its adaptability becomes its greatest asset. Mr Reinthal has tested various methods: smoking, slow-cooking, frying, and tartare. He together with the Ministry of Regional Affairs and Agriculture has also hosted workshops where chefs from across Estonia tried their own interpretations of cormorant dishes. Herki Tuus from the ministry, who has been promoting consumption of cormorants, says it is a delicious bird. For tourists both local as well as those from abroad it is exotic to eat cormorant and many would like to try it. While public response is split—some diners find it fascinating and delicious,

others reject it outright—Mr Reinthal believes that careful, creative preparation can win over sceptics. He notes that "if I tell you it's fish, you believe it; if I say it's meat, it works too. The taste changes so much depending on what I do." Mr Tuus points out that although a bird weighs around 2 kg, it is really only the breast that is big and meaty enough to eat, it does not have drumsticks like other gamebirds. This relatively low yield combined with the fact that not many cormorants are shot, and that too only in the season from August to the end of the year, means that cormorant meat is priced at the high end which may put off potential buyers. Mr Reinthal, however, feels that tourists will not be deterred by the price as they would be attracted by the novelty of eating cormorant. For coastal areas this may be another way to supplement the incomes of fishers and hunters, increase the flow of tourists, and boost local economies. He is therefore also pushing to reduce the bureaucracy associated with hunting to increase the supply of cormorants to the market as well as to shorten the time between shooting a bird and having it delivered at a restaurant.

Seal meat goes from folklore to fine dining

Mr Reinthal's foray into cooking seal came as a result of a workshop in Kihnu, a small Estonian island where seal hunting and preparation have been traditional practices for over a century. What began as a joke—"Next time I'll cook seal!"—turned into a serious undertaking when locals handed him a 200-kilogram animal. Like cormorant, seal presents culinary challenges and ethical questions. The meat is dark, lean, and has a distinctive smell. The fat is stored in a layer under the skin. But again, Mr Reinthal's approach is one of experimentation. He has tried



Cooking courses for chefs is a good way to popularise ways to prepare the meat from cormorants and seals.



The meat of these predators is highly versatile. Different preparations create very different tastes and textures so even sceptical diners should find something that appeals to them.

boiling, smoking, preserving, and even making grilled sausages using a 50-50 mix of seal and chicken. He discovered that the fat, when melted, does not solidify in the same way as pork fat but remains flexible and oil-like, even when frozen. This oil, once filtered and flavoured with lime, salt, and balsamic vinegar, makes a surprisingly good salad dressing and has historically been used in cosmetics and medicine. Seal oil, high in omega-3 fatty acids, was once used to waterproof shoes and is now under consideration as a niche health product. Mr Reinthal envisions bottling it and selling it as a culinary and wellness item, potentially supporting local economies like Kihnu's, which struggle with depopulation and limited resources.

Seal meat, he notes, is juicier than cormorant and has a softer texture. It does not dry out easily during cooking, thanks to the fat layer between skin and muscle. He has developed several preparations that appeal to a modern palate, such as sliced, marinated and smoked

fat sliced on black bread with red onion and mustard mayonnaise—what he calls Estonian tapas—that he recommends consuming with a shot of vodka!

Beyond taste: sustainability and bureaucracy

Both cormorant and seal are more than culinary curiosities. They represent a broader vision for local, sustainable food systems. Estonia's coastal ecosystems suffer under the weight of overpopulated predator species. Traditional responses like egg oiling or trap deterrents have had limited success. Mr Reinthal sees consumption as a pragmatic solution: "If you make it valuable, people will manage the population more responsibly." However, hurdles remain. Current Estonian regulations classify cormorants and seals under strict licensing regimes, making it difficult

for chefs to access the meat. While Kihnu residents enjoy certain exemptions due to cultural traditions, most other regions cannot legally sell or serve these meats, even if they are harvested under quota. Mr Reinthal, with support from the Estonian Head Chefs' and Hunters' Associations, is lobbying for reform. He wants to streamline the process so that freshly hunted animals can reach restaurant kitchens without weeks of administrative delay. He argues that there is a market for such products—especially among tourists seeking authentic, local experiences. If I'm a tourist and I go to a restaurant in Saaremaa and see cormorant or seal on the menu, I will try it. It's something different. It may not be cheap, but it is unique.

The future of Baltic food

For Mr Reinthal, cooking is not just about flavour; it is about narrative,

ethics, and place. The use of wild ingredients connects food back to landscape, seasonality, and cultural memory. Whether it is a confit of wild duck or a smoked fillet of cormorant, his dishes tell stories—about resourcefulness, stewardship, and culinary courage. Ylicool's future may very well lie in expanding these stories. The company already works with other wild meats

like boar, deer, and beaver. But cormorant and seal offer a chance to shape the conversation around food in a way that takes levels of predation into account. As Mr Reinthal sees it, “we help the fishers, support local economies, and give tourists something unforgettable. It’s a virtuous circle.”

He does not anticipate these meats becoming everyday staples—you won’t

buy cormorant in a shop, but their place in high-end and culturally rooted cuisine is, he hopes, just beginning. And in a world where novelty often trumps meaning, Mr Reinthal shows that food can be both radical and responsible. Through Ylicool, the Baltic table is being reimagined—not just with new ingredients, but with a new sense of purpose.

LIIVI LAHE KALANDUSKOGU (ASSOCIATION OF FISHERIES OF THE GULF OF LIIVI)

Springtime Baltic herring in Pärnu Bay

The fishery for Baltic herring on the Pärnu Bay is compressed into a two-month season where teams of fishers go out in two vessels, one for transport and the other a smaller support vessel, to empty their trap nets. The fish is brought back to shore loaded into tubs and delivered to processing facilities within a few hours.

In Estonia's Pärnu Bay, on the Gulf of Liivi, the spring season marks a period of intense but short-lived activity for local coastal fishermen. Every year, from April to early June, hundreds of fishermen converge on the bay to catch Baltic herring—a species that has long supported the livelihoods of coastal communities. This is a fishery defined by seasonality, tradition, innovation, and community, as described by Ms Esta Tamm, head of the NGO Liivi Lahe Kalanduskogu (Association of Fisheries of Gulf of Liivi), during an

interview conducted aboard a working vessel during the 2025 season.

A seasonal fishery rooted in tradition

Coastal fishing in the Gulf of Liivi is centred around trap nets, a passive form of fishing gear placed in traditional locations close to shore. Most of these locations are inherited, passed from father to son or acquired informally through community ties. These trap nets are only



Esta Tamm, the leader of the NGO, Liivi Lahe Kalanduskogu (Association of Fisheries of Gulf of Liivi).

used during the herring season in spring when cold water ensures high quality. Warmer temperatures degrade the fish's condition quickly, making it unsuitable for consumption or sale. The trap net system, typically composed of a 600-metre-long leading line and a catch box of approximately 35 by 12 metres and six



Margus Post, the captain of the vessel, is one of the first coastal fishers to install a pump to transfer the fish from net to boat, an innovation he is very satisfied with as it reduces manual handling and is faster and less demanding than transferring the fish by hand.

metres deep, relies on the natural movement of herring into the net corridor. Once inside the box, the fish are unable to escape. Nets are spaced at least 300 metres apart and placed in shallow coastal waters—often around 10 metres deep in the Pärnu Bay area, locations that have remained consistent for decades.

The Association of Fisheries of Gulf of Liivi has around 100 professional fishermen who are members of the Association in the Pärnu region, although the number of people involved in coastal fishing extends well beyond this. According to Ms Tamm, the total number of coastal fishers in the region is around 380. The NGO functions as a support body facilitating coordination, quota management, and advocacy. The fishery is not cooperative in structure. Fishermen typically operate independently or in small teams of five to eight members. These brigades may be family units or ad hoc teams formed for the two-month season. Despite the lack of formal cooperatives, informal networks and shared knowledge help

the community manage resources and labour efficiently.

Regulation and quotas

The Baltic herring fishery is governed by national quotas, which allocate a set amount of allowable catch per trap net. Fishing activities are regulated both by quotas (such as for herring) and by the presence of several designated areas in the bay (e.g., sailing and surfing zones) where fishing is either prohibited or allowed only under time restrictions and specific agreements, says Ms Tamm. Additionally, we operate under a fishing rights system, which is allocated to fishermen in the Pärnumaa region. This means each fisherman has a defined number of fishing gear units. Not all fishing gear is used at the same time. Since the Pärnu River is also salmon river, this also imposes both temporal and spatial restrictions on fishing activities. Baltic Herring, however, is the most important species in terms of volume. Fishing takes place up to the 20 m depth contour from the coastline. The Pärnumaa fisheries area to which the Gulf of Liivi belongs accounts for some 70% of the total Estonian coastal fishing volume. In 2025, each net was allowed to catch between 40 and 42 tonnes of herring. The total number of trap nets in the region was about 145, making the aggregate seasonal capacity

substantial. This quota system replaced the earlier “Olympic” method of open competition, which forced fishers to catch as much as they could until the quota was exhausted. The new system reduces overfishing and allows for more humane working hours. Allocation of nets is traditionally determined by familial inheritance or personal purchase, with no centralised or commercialised market. Because these nets are valuable and offer the potential for significant short-term income, they are considered a major asset. A significant share of the Baltic herring catch goes to processing rather than direct human consumption. One prominent figure in the fishery owns both the fishing operation and a processing facility managed by his daughter. The company specialises in producing pet food, ensuring that most of the catch is utilised.

Innovative technology is slowly making its way into the fishery. One notable advancement is the adoption of a pump system to transfer fish from nets to boats, significantly reducing manual labour. Developed locally and first deployed during the 2025 season, this pump allows a single vessel to load several tonnes of fish more quickly and with fewer workers. Though costly, this innovation may receive EU funding under programmes supporting sustainable fisheries infrastructure. First sale of the catch does not occur through a formal auction but rather through



Emptying the net calls for a team of eight to ten people in a second vessel who gather the catch next to the main vessel to facilitate the transfer to the hold.



If the catch is good the boat will sail back to the harbour after emptying a single net, otherwise it moves on to the next.

arrangements between fishers and producer organisations or direct buyers. Trucks wait at the harbour to transport the catch to processing sites immediately, reducing the time between catch and handling. Some fish is sold directly to consumers at harbours, especially during events like Open Harbour Day at the end of April.

A diverse but challenging livelihood

Although Baltic herring is the primary catch during spring, local fishermen also target perch, pike-perch, smelt, and round goby at other times of the year using different gear such as gillnets. Perch and pike-perch, in particular, are more valuable per kilogram, often fetching €3 to €6, compared to €0.35 for herring. However, catches are more limited and require year-round effort. Most fishermen (around 90%) do not rely solely on fishing for income. Many diversify into agriculture, horticulture, forestry, bee keeping, fish processing, or construction

outside the Baltic herring season. Some participate in EU-funded mobility and training programmes. The demanding nature of the job, combined with its seasonal structure, discourages many young people from entering the profession full time.

The sector faces environmental pressures as well. Seals and cormorants increasingly compete with humans for fish and damage fishing gear. Ms Tamm notes that Estonia had over 44,000 nesting pairs of cormorants in 2024, and fishermen regularly report gear loss or destruction caused by seals. These factors add operational risk and affect the yield sometimes leaving fishers with just a third of the catch with the rest either eaten or damaged so that it is unfit for human consumption. She feels the state of fish stocks depends largely on external factors, such as the predators while fishers carry out their activities in a responsible and sustainable way. Catches are recorded and reported with an electronic logbook, which most, though not all, fishers are satisfied with as the system does not function as well as it should, says Ms Tamm. Older fishers tend to

struggle with the system too, and so the ministry has enabled authorised people to enter the data on their behalf.

Sustainability and cultural legacy

Despite the challenges, the fishery remains stable. The number of trap nets has remained consistent over decades, and local fishermen observe that the catch levels have not declined significantly. Passive fishing methods like trap nets exert relatively low environmental pressure compared to trawling, and their selectivity reduces bycatch. The fishery is also deeply rooted in local culture. Coastal villages owe much of their historical development and economic survival to spring herring fishing. Homes were built with the income from successful seasons, and local customs, including food traditions and community festivals like the smelt festival and Open Harbour Day, are intertwined with the fishery.

Ms Tamm and others involved in the fishery reflect a strong sense of identity tied to the sea. Young fishermen speak of their pride in maintaining family traditions, even as they seek other careers or balance fishing with modern education and travel opportunities. The fishery not only sustains livelihoods but also helps maintain coastal communities' cohesion and resilience. Supported by organisations like Liivi Lahe Kalanduskogu and connected to national and EU programmes, the fishery has managed to sustain itself economically and ecologically while adapting to modern pressures. Though fewer young people are committing to full-time fishing careers, those who do participate contribute to preserving a way of life that has defined the region for generations.

For more information, visit the Association of Fisheries of Gulf of Liivi: <https://www.kalanduskogu.ee/en>.



Mehis Rohtla

GoPro cameras and live-scope sonar were used to measure the reaction to underwater noise from wind turbines when the fish were confined to a fixed space.

ESTONIAN RESEARCHERS STUDY POTENTIAL IMPACTS OF WIND FARMS ON VALUABLE FISH STOCKS

Effects of offshore wind noise on Baltic herring

As efforts to increase energy security in the Baltic gather strength, offshore wind farms will play an important role. The impact of noise from wind turbines on fish stocks is a little-studied subject, which researchers in Estonia seek to remedy.

The growing demand for renewable energy in the Baltic region has prompted a surge in plans for offshore wind development across the region. Polish researchers estimate

the potential for offshore energy in the Baltic Sea at 85 GW. But as this push accelerates, so too does concern over the potential ecological impacts. The construction and operation phases of offshore wind farms result in geophysical,



Mehis Rohtla

Dr Mehis Rohtla, Estonian Marine Institute at the University of Tartu, is studying the impact of underwater noise from offshore wind turbines on Baltic herring stocks.

geochemical, and hydrological, among other, influences on the environment. One of the key questions under investigation is how underwater noise from offshore wind turbines could affect marine life, particularly Baltic herring,



Mehil Rohtla

Studies on the impact of noise from wind turbines on fish stocks are few and far between partly because of the expense involved in terms of equipment and man-hours.

a commercially and culturally significant species.

Studies based on the artificial reproduction of sound

At the forefront of this research is Dr Mehil Rohtla from the Estonian Marine Institute at the University of Tartu. Since 2022, his team has been conducting a government-funded study to simulate and assess the behavioural responses of Baltic herring to underwater noise resembling that of offshore wind turbines. Notably, since there are currently no offshore wind farms operating in Estonian waters (though several are planned), the researchers have had to recreate the noise environment artificially. Using underwater loudspeakers capable of emitting low-frequency sounds, the researchers are simulating the kinds of acoustic disturbances expected from future high-capacity turbines—those rated at 15 to 20 megawatts. These devices, when deployed, are expected to emit predominantly low-frequency noise. Bandwidths

chosen by Dr Rohtla's team for their experiments are 100 Hz and 500 Hz.

The project is multidisciplinary, bringing together marine biologists, physicists, and chemists, with collaboration between the University of Tartu and Tallinn University of Technology. Chemists played a critical role in developing a novel hydrogen-powered system for generating electricity offshore, which allows the noise equipment to operate continuously at sea, independent of battery limitations. Fieldwork has been conducted across multiple locations, including the Gulf of Riga, Pärnu Bay, and off the western island of Hiiumaa. Each site hosts a different set of experiments and/or herring behaviour: spawning migration, spawning, and feeding. By studying these phases separately, the researchers aim to understand the full scope of the herring's behavioural responses to sound at different points in their yearly life cycle. Experiments involve both free-swimming herring in open water and controlled tests in net cages. The open-sea studies are especially notable for their scale and complexity. Once a herring shoal is located using sonar, researchers anchor the sound source and monitor the fish's movements by conducting transects—

systematic paths taken by a survey vessel around the sound source. These allow them to map the distribution and density of fish before and after the introduction of artificial turbine noise. In the net cage experiments off Hiiumaa, a location selected for the clarity of its water, GoPro cameras and live-scope sonar provide visual and acoustic data on individual fish reactions within a fixed space.

Responses to noise depend on several factors

The core objective of the research is to identify a reaction threshold—the point at which sound intensity triggers a measurable behavioural response in the fish. Establishing this threshold, expressed in decibels at a specific frequency (primarily 100 Hz), would allow developers to model the potential impact zones of their proposed wind farms using local acoustic propagation models. Such data would be crucial for environmental impact assessments and could inform more responsible site selection and turbine spacing. So far, the experiments have yielded nuanced findings. During the spawning period, which occurs in shallow waters nearshore, herring appear relatively unaffected by turbine-like noise. Despite the presence of sound levels reaching 150–160 decibels near the source, herring continued to gather in large numbers in spawning zones, often within a few metres of the speaker. Dr Rohtla hypothesises that the drive to spawn may override the fish's sensitivity to external stressors. A similar tolerance was observed during spawning migration through deeper waters, suggesting that fish remain largely undisturbed during this phase. However, a different picture emerged during the feeding period, which occurs in deeper offshore zones. Here, some herring were observed avoiding areas within a 500-metre radius of the noise source, although

the fish did not abandon the broader area entirely. According to Dr Rohtla, the feeding phase is probably more sensitive to disturbance, since the fish are not engaged in an urgent biological function such as reproduction.

The team also noted that sound propagation characteristics vary with water depth. In shallow waters, low-frequency noise scatters and is also absorbed by the seabed, limiting its range. In deeper water, however, such noise can travel further, potentially broadening the impact zone. These physical factors mean that each prospective wind farm site would require its own tailored acoustic modelling. In the controlled cage experiments, fish began exhibiting flight responses—such as erratic swimming and depth changes—at distances of around 100 metres from the sound source. These reactions occurred when exposed to sound levels of around 130–140 decibels. However, Dr Rohtla cautions that the confined conditions of cage experiments may influence fish sensitivity to sounds, as the fish are under stress and unable to flee entirely, which may alter their reaction threshold. By triangulating findings from free-swimming and cage-based experiments, the researchers hope to define a reliable behavioural threshold for noise exposure. This will allow regulators and developers to more accurately predict the size and scale of potential disturbance zones in different underwater environments.

Herring is a commercially critical species in the Baltic

Herring was chosen for this research not only because it is Estonia's national fish and a cornerstone of its commercial fishery, but also because of its sensitivity to sound. Compared to many other fish species, herring have well-developed hearing across a wide range of frequencies



Once a herring shoal is located using sonar, researchers anchor the sound source and monitor the fish's movements by conducting transects—systematic paths taken by a survey vessel around the sound source.

while also being very sensitive to the intensity of sound. Dr Rohtla points out that this makes them an ideal indicator species for acoustic impacts in marine ecosystems. This line of research is particularly urgent in Estonia, where up to ten offshore wind farm developments are in planning stages. Each could significantly affect coastal marine habitats. The Gulf of Riga and Western-Estonia, both important herring habitats, are among the regions earmarked for development. While current environmental assessments often rely on literature from other regions or on theoretical assumptions, Dr Rohtla argues that real-world experiments in Baltic conditions are essential.

He also stresses that offshore wind infrastructure decisions must be based on data from the same ecosystem in which they are to be deployed. The Baltic Sea, with its shallow depth, unique salinity profile, and distinct seasonal cycles, is unlike the North Sea or Atlantic. As a result, extrapolating from studies conducted elsewhere may not provide an accurate picture of local impacts. The project has also catalysed the revival of underwater acoustics research in Estonia. According to one of the team members, the study of underwater acoustics in Estonia has been largely dormant since the Soviet period. The acquisition of hydrophones, underwater speakers, and new measurement protocols has re-established a foundation for future marine noise studies in the region. So

far, no peer-reviewed publications have emerged from the project, though Dr Rohtla notes that a master's student is preparing a thesis based on the results. After the termination of the project in this September, the results will be communicated through peer-reviewed publications and conference presentations.

Results should inform planning of wind farms in the Baltic

For now, Dr Rohtla and his colleagues remain focused on finishing field experiments, analysing results, and refining their threshold estimates. With offshore wind projects advancing rapidly, the team hopes their findings will contribute to more sustainable planning and a clearer understanding of how energy transitions intersect with marine ecology. While offshore wind remains essential for reducing carbon emissions, Dr Rohtla stresses the importance of ensuring that its deployment does not come at the expense of critical marine species like the Baltic herring. As usual with scientific studies they generate at least as many questions as they answer. He would therefore recommend establishing one wind farm first and studying the impacts before proceeding with more.

DIGITISING CATCH REPORTING HAS BEEN A VALUABLE LEARNING EXPERIENCE

Implementing PERK—one year after

PERK, the Estonian acronym for the digital platform created for commercial fishers to report their catches, has now covered all fishing segments for a year. An assessment of the system shows what it has achieved and what could be improved.

Originally launched in 2018, PERK—Püügandmete Esitamise Rakendus Kaluritele—was developed as a digital platform to simplify and modernise catch reporting for Estonia's commercial fishers. For several years, its use was optional and limited to specific fisheries segments. However, in 2024, Estonia made the system mandatory for all licensed commercial fishing activities marking a significant milestone in the country's broader transition toward digital fisheries governance. PERK replaced paper-based and hybrid reporting systems with a single online solution aimed at reducing administrative burden, improving data quality, and ensuring real-time accessibility for authorities.



Results from review will shape future developments

One year into implementation, the system is firmly in use by nearly 1,900 registered users. While the overall transition has been successful in achieving core objectives, the rollout has not been without friction. The first year has offered valuable lessons on balancing user feedback with system stability, planning helpdesk capacity, and understanding the constraints of a limited user base. These experiences now inform the path forward.

PERK was never intended to be a static application. From its early launch, it was designed to evolve in response to user needs. Fishers across Estonia actively provided feedback on how to streamline entries, improve usability on mobile devices, and reduce redundant steps. This openness to input created momentum but also introduced challenges. As user suggestions were incorporated and features layered into the system, technical complexity began to impact stability. There were periods where some users experienced delays in data synchronisation or difficulties saving entries—especially during busy reporting windows. The core



Esti Tamm, Association of Fisheries of Gulf of Liivi

Ice fishing is just one of the types of fisheries in Estonia that the PERK system was designed to cover. Others include those on the Peipsi lake, Võrtsjärv lake, the Estonian coast, and lamprey fishing each with its own specificities, suggesting the complexity PERK must deal with.



Esti Tamm, Association of Fisheries of Gulf of Liivi

Ice fishing in the Pärnu bay targets pikeperch. Catches in both 2022 and 2023 were around 22 tonnes each.

architecture, originally optimised for straightforward data submission, became increasingly burdened by new functions, user-specific customisations, and exceptions. Looking back, a more incremental roadmap and clearer delineation between essential and optional features might have helped maintain performance consistency.

Support was there—but not always the fix

While technical support was always available throughout the first year, not

every issue could be resolved immediately. “Some days it worked fine, other times it didn’t save my entries correctly, and it wasn’t immediately clear what was causing the issue,” says Tarmo Luks, a coastal fisherman from Pärnu. “Support was there when I needed it, and they always responded. But in certain cases, it wasn’t a quick fix—they told me the issue needed a technical change from the IT side. That takes time, and in the meantime, we had to find workarounds.” These situations were not the result of missing helpdesk infrastructure but rather the absence of immediate solutions when the issue required system-level changes. The reality is that not all support queries can be resolved on the first contact—particularly when they relate to the codebase or data structure. This has prompted reflections on how to improve not just the technical response but user communication pathways. Better feedback mechanisms, clearer troubleshooting flows, and additional training resources are now under development.

One factor influencing both usability and technical flexibility is the web-based nature of PERK. Rather than

developing a native mobile application, the platform was designed to run via browsers on desktop and mobile devices. This decision was based on economic and logistical reasoning: building two native apps—one for Android and one for iOS—would have required parallel development and long-term maintenance commitments. Given the scale of the user base (approximately 1,900), the investment required to support dual native environments was deemed unsustainable at the time. A responsive web platform was selected as a single-codebase solution that could serve all users across devices. However, this approach has some limitations. Web apps are inherently more dependent on stable internet connections and do not offer the same offline capabilities or system-level integrations as native apps. This means that in low-signal coastal areas, some users experienced slower performance or temporary issues storing unsent entries—though the platform was built to cache data and synchronise once connectivity was restored. These trade-offs are now being re-evaluated as part of the system’s long-term development strategy. Future updates may explore hybrid

solutions that retain the single-platform philosophy while improving offline and mobile-first capabilities.

Business use cases and the GDPR dilemma

A significant implementation challenge emerged from the mismatch between individual user design and company-level use cases. PERK was developed with the logic that the individual fisher—the person physically conducting the fishing activity—submits the data. However, larger fishing companies soon began requesting functionalities that would allow centralised oversight, shared user access, and internal reporting across vessels and crews. As modifications were attempted to support these requests, tensions arose with data privacy regulations (GDPR). In several cases, granting license holders access to crew-entered data risked violating privacy boundaries that had not been fully anticipated in the original system design. These experiences revealed a gap in early-stage analysis: the user base had not been sufficiently segmented, and use cases related to business administration, supervisory roles, and multi-user coordination had not been structurally mapped. Retrofitting these capabilities after roll-out introduced complexity, requiring legal reviews and system architecture adjustments that delayed deployment. Going forward, more thorough user profiling and stakeholder consultation are planned to guide future functionality in line with both legal frameworks and sector needs.

One unavoidable consideration for the future is the scope of investment relative to the user base. With fewer than 2,000 active users, PERK must balance expectations for functionality and flexibility with the economic realities of custom software development. Every additional module or interface revision must be carefully weighed for its operational impact, budgetary cost,

and long-term maintainability. At the same time, the system has fulfilled its regulatory purpose: authorities now receive structured, near-real-time catch data from all segments of the fleet. This has improved oversight, facilitated quota tracking, and reduced reporting gaps. “We’re seeing more consistent data coming in and fewer late submissions,” says Ivo Kask, a fisheries inspector with the Environmental Board. “It helps from an enforcement and transparency perspective, but yes, the first year has also shown us where system boundaries need to be clearer.”

Catering to all Estonian fisheries’ complexity is too ambitious

The first year of PERK’s full-scale use has demonstrated the value of digitalisation in fisheries reporting—but it has also revealed the many layers of complexity involved in trying to build one unified system for a sector that, in practice, operates under a patchwork of distinct rules, environments, and traditions. One of the most important reflections from this year is that the challenge hasn’t only been technical—it’s deeply structural. Estonia’s fishing sector is not a monolith. Instead, it is composed of multiple, highly specialised fisheries, each with its own legal context, operational logic, and cultural practices. This makes the task of developing a coherent and universal reporting system not only ambitious, but extraordinarily complex.

For example, on Lake Peipsi, reporting must align with bilateral agreements between Estonia and Russia, including shared quota management, restricted areas, and unique temporal fishing rules. In contrast, Baltic Sea coastal fishing operates under EU fisheries policy and national maritime law, with entirely different control requirements and fleet profiles.

Then there is Võrtsjärv, a large inland lake with its own ecological dynamics and regionally adapted fishing practices, which do not align with Peipsi or coastal systems. Lamprey fishing in rivers is highly seasonal and uses specialised traps and gear. Winter fishing brings further complexity, as it occurs directly on the ice without vessels, meaning GPS tracking and trip reporting logic often break down. Meanwhile, shallow-water net fishing, where nets are laid manually by walking into the water, defies assumptions baked into most maritime reporting systems—there are no engine hours, no departure or arrival points, and no vessel monitoring involved. Each of these methods brings with it not only operational diversity but also administrative complexity. What may appear as a minor field in a user interface—like trip type or gear classification—may in fact require dozens of conditional rules and exceptions behind the scenes. Designing a “simple” interface becomes impossible when the underlying logic must account for hundreds of situational variables.

Future iterations must combine flexibility with robustness

In light of this, it’s clear that the original ambition of creating one system for all fishers was always going to involve compromises. In some ways, the challenge was underestimated—not due to a lack of expertise, but because no single design process could fully anticipate the combined effect of such local diversity. As we moved from pilot cases to full implementation, these differences began to assert themselves more forcefully, requiring reactive changes and adaptations that tested both the system’s technical architecture and our own assumptions.

The path forward involves acknowledging this complexity as a baseline reality, not an obstacle to be eliminated.

Future development must be informed by more structured input from the full range of user types, and a governance model that can balance flexibility with sustainability. Rather than continuing to add features in response to every edge case, we must clarify the system's

core scope and build it to be robust and adaptable around clearly defined boundaries.

PERK has succeeded in laying the foundation for digital catch reporting in Estonia. What we have learned in its first year is that its continued success

depends not on simplification, but on intelligent adaptation to the genuine diversity of fishing practices that define Estonia's waters, rivers, and lakes.

Indrek Adler, Ministry of Regional Affairs and Agriculture, indrek.adler@agri.ee

A BALTIC ISLAND'S LEAP INTO SUSTAINABLE INNOVATION

Planet Ruhnu and the seaweed vision

An entrepreneur based on a remote Estonian island is building a seaweed farming business from scratch from production, to processing, marketing, and sales.

In the middle of the Gulf of Riga lies Ruhnu, a tiny Estonian island closer to Latvia than to mainland Estonia. Isolated and quiet, Ruhnu is a speck of land only 12 square kilometres in size, with a year-round population that drops from some 400 people to around 50 in winter. Despite its remoteness, Ruhnu is becoming the setting for an ambitious experiment in sustainable living, local innovation, and the transformation of marine resources. Ruhnu is part of UNESCO biosphere reserve programme which sets an example for the coexistence of man and nature.

Creating a future on a tiny island

Architect and entrepreneur Mihkel Urmet, originally from Tallinn, stumbled

upon Ruhnu by accident during a fishing holiday. There, he met Eeva Lauk, a native of the island, and gradually moved to living on the island full-time. Yet life on Ruhnu presented challenges, particularly around employment and sustainability. The seasonal nature of tourism, limited local jobs, and harsh winters made it clear that something new was needed to create a future on the island. The solution did not come from land, but from the sea. While Ruhnu itself is small, the surrounding marine territory is vast. This contrast inspired Mihkel and Eeva to look at the sea not only as a landscape but as a potential source of income. At first, they explored sustainable fishing. However, over time they discovered that fish populations had declined, partly due to increasing seal populations and natural marine dynamics. The sea is eutrophic, he says, meaning it is too rich in nutrients some of which comes from



Mihkel Urmet and Eeva Lauk. The couple is establishing a business based on the cultivation of seaweed on the Estonian island of Ruhnu.

agriculture runoff. If agriculture has been part of the problem, could it also be a solution to fix the sea?

Through a chance architectural commission, Mr Urmet met Jonne Kotta, a leading marine biologist in Estonia. Their discussions shifted the focus from fish to seaweed. Seaweed, it turned out, offered unique advantages: it did not need fresh water or fertiliser, it absorbed carbon dioxide, and it could thrive in Ruhnu's nutrient-rich waters. The couple's interest quickly turned to experimentation. Their early products were developed using wild-harvested seaweed. These included a Baltic twist on Korean kimchi and a gin infused with seaweed, both of which were enthusiastically received by local testers and visitors. Although Estonia has little tradition of eating seaweed, fermented cabbage and sauerkraut are



Among the products made by Planet Ruhnu is a seaweed infused gin.

familiar staples, making the leap to kimchi—fortified with seaweed—relatively seamless.

Collecting wild seaweed gives way to cultivation

Building on this success, Mihkel and Eeva began designing a formal method of cultivation—the goal was to get cleaner and higher quality raw produce. Working with TalTech (Tallinn University of Technology), they developed doughnut-shaped floating units inspired by traditional fish cages which are formed of a floating ring at the surface to which a net is attached. These modular structures allowed for controlled seaweed farming in the shallow, calm waters off one side of the island. Buoys help keep them afloat and they are anchored to ensure they stay in place. The cages are inoculated with seaweed end-April or early May which grows and can be harvested until October. The winter is then used to convert the biomass into value-added products. Ruhnu's waters, ranging from two to four metres in depth in the selected area, are ideal for the non-attaching types of

seaweed they chose to grow. These species reproduce while floating freely, requiring no seabed anchoring. Mr Urmet selected two varieties that were edible and tasty and started to grow them. Unlike fish or mussel farming, which involve animal welfare concerns and are prone to stress-related losses, seaweed cultivation is low-impact and potentially more sustainable. Seaweed predates trees and is robust against environmental fluctuations, although warmer waters may pose challenges in the future. Estonia's regulatory framework has not caught up with this entrepreneurial approach to growing seaweed. There are few, if any, laws or guidelines for seaweed farming. Official studies have even discouraged it, concluding it was not economically feasible. Getting permits is time-consuming and difficult, says Eeva, partly because no one quite understands what we are doing or why. Despite these headwinds, their company, Planet Ruhnu is forging a path, developing not only products but also the structures, processes, and business models required to make their venture work.

Value addition is critical for economic reasons

The project goes beyond just farming seaweed. Mihkel and Eeva are trying to do more than just sell raw material. This decision is both practical and strategic. Offering dried seaweed alone has little market appeal in Estonia but turning it into gourmet food or a premium spirit makes the business viable. Seaweed farming plays on the growing interest in vegetarianism—while consuming meat has a high environmental footprint, eating plants is better for the planet, and a seaweed diet has a positive impact on nature—eating seaweed makes the world a better place, they say. The vision also includes sustainable infrastructure. The couple plans to set up their processing facility next to the off-grid island's backup power station, which runs on biodiesel. They hope to

capture and reuse the station's waste heat to dry seaweed, further reducing their environmental impact. All production electricity needs will come from wind and solar energy. Their business is still in its early stages. The gin is currently contract-distilled off-island, as building an alcohol factory on Ruhnu made little sense. The kimchi is handmade and sold primarily through direct contact or on their website, Planet Ruhnu. Commercial volumes remain small, but a growing fan base and positive reactions suggest broader interest. The couple is working to scale up production and is exploring wholesale and retail opportunities.

Seaweed has many potential uses

The duo's ambitions remain rooted in the unique geography and culture of



The seaweed is freshly harvested from cages in the sea and is used in different applications including kimchi and gin. The potential is considerable as seaweed has, among others, uses in medicines, cosmetics, paper, and packaging.

Ruhnu. The seaweed kimchi connects local traditions with global trends, turning the island's folkloric association with cabbage into a modern story about the environment and healthy living. The community garden and cooperative land use, while historically trendy in Ruhnu, mirror global interest in sustainable, communal agriculture. Seaweed's potential is vast. Beyond food and drink, it has uses in medicine, cosmetics, paper, and packaging. An Italian company has already approached Planet Ruhnu to supply seaweed. Their first request was for 10 tonnes, far beyond the couple's current output. For now, they are focused

on food-grade seaweed, where the value per kilogram is highest and quality standards are most demanding.

A model for small-island dwellers everywhere

For the moment we treat it like a hobby, and we are putting a lot of effort into creating the whole value chain and developing it into a business, says Mr Urmet. But the small scale is a strength. Each decision—from drying

methods to distribution—can be carefully calibrated to maximise value, reduce waste, and protect the environment. Even in a future where Ruhnu might export to Latvia or beyond, the emphasis will likely remain on premium, low-volume, high-quality products. On an island with no bridge to the mainland and where even the weather determines whether visitors can arrive, Ruhnu is becoming a quiet pioneer of climate-friendly entrepreneurship. Its seaweed business offers not only a livelihood for its residents but also a model for other isolated communities seeking to build sustainable futures from local resources.

VETIK OÜ IS EXPERIMENTING WITH THE NATION'S HISTORICALLY LARGE NATURAL RESOURCE

Uncovering Estonia's untapped red seaweed industry

The coastal waters of Kassari Bay, Estonia are home to a local natural resource *Furcellaria lumbricalis* – or red seaweed. This unique species, one largely unknown to global markets, grows freely on seabeds, forming dense carpets that have supported a continuous, but underrecognized history of small-scale harvests in the Baltic region.

Though not often commercially harvested, red seaweed is now at the forefront of research for companies like Vetik OÜ that are investigating its commercial potential by finding ways to responsibly harvest the species, and to use it in agriculture, food, and cosmetics.

Historical harvest and utilisation

The discovery of the abundance of red seaweed dates back to as early as 1814, when the species was first identified as a “potential bioresource” by Danish naturalist Heinrich Gustav Lehmann.¹ *F. lumbricalis* was not harvested for use until the mid-1900s, however, when its presence was identified not only in the immediate Baltic region, but also in Danish coastal regions, like Kattegat.

¹ https://zenodo.org/records/11186314?utm_source=chatgpt.com



Tanel Ilmjärv, CEO Vetik OÜ, discusses the processing of red seaweed at the company's processing site in Saaremaa.

Since then, the estimated abundance of red seaweed in Estonia has only grown. Observations described in the 1960s predicted a 150,000-ton wet weight of *F. lumbricalis*, and a 2017 estimate says that the current wet weight may exceed 179,000 tonnes. Upon discovery, the commercial interest in red seaweed was driven by its potential to produce furcellaran, a type of carrageenan that is often used as a gelling agent in agricultural, pharmaceutical, and cosmetic industries. In 1966, the company Estagar, the only other Estonian company specializing in red seaweed, began harvesting this furcellaran primarily for culinary purposes, utilizing the copious amounts of loose-lying *F. lumbricalis* found in the Kassari Bay.

Over time, the organisation's production expanded beyond applications to food, and the company experimented utilising furcellaran in innovative ways such as in the

development of packaging materials, cosmetic pigments, and pharmaceutical formulation. The startup Vetik OÜ is experimenting with ways in which *F. lumbricalis* can enter the market whilst navigating complex harvesting and processing regulations. The company is building on the substantial research and interest into red seaweed that has accumulated since the twentieth century. Going beyond traditional uses, the company is analysing new ways to valorize its biomass. The seaweed contains pigments, bio-stimulants, proteins, and lipids, says Tanel Ilmjärv, the CEO of Vetik, which can also be extracted. Vetik's goal is to start processing the red seaweed efficiently so that they can extract and utilise its other elements in different sectors.

Seaweed's potential as a bio-stimulant met with scepticism by farmers

Vetik has taken a particular interest in the realm of bio-stimulants. Mr Ilmjärv describes bio-stimulants as active extracts used by farmers to improve land's fertility. When it comes to red seaweed, bio-stimulants are extracted by breaking down the seaweed's natural compounds, like proteins, that contribute to plant health and growth. These bio-stimulants are then added as ingredients to fertilisers. However, the company has struggled to introduce these products



Red seaweed in different stages of processing.



Granulated red seaweed prepared for extraction or use as a bio-stimulant.

into the commercial market. You have to provide companies with products or specific features, that are better than the ones that they're already using, which is a challenge, says Mr Ilmjärv. Despite its scientific promise, earning their first scientific grants in 2021, gaining traction from the agricultural market often requires a clear history of effectiveness and economic advantages, something that Vetik is still working on. Doing trials in regular fields takes years, Mr Ilmjärv points out. You must have at least three cycles of cultivation with positive results to really build up trust with farmers.

For now, Vetik will focus on improving the production of red seaweed

derived extracts and defining its best role in the commercial market. The company is focused on developing both efficient and stable harvesting and processing systems for Kassari Bay's *F. lumbricalis*. Mr Ilmjärv notes that establishing these methods is no easy task, but that the company has developed machinery that is ready to go from a very small scale to a pilot scale production. In production, red seaweed is first collected from the seabed washed, milled and different material streams are isolated. These steps yield the isolation of key components like furcellaran, pigments, or bio-stimulants which can be used in a variety of sectors.

Strict regulations hinder industry development

Despite the abundance of *F. lumbricalis* in Estonia, covering an area of up to 170 km², its harvest is subject to strict regulation, in which only 2,000 tonnes of biomass may be harvested each year by licensed companies. According to a published 2019 report, this regulation is "to assure environmentally sustainable and long-lasting utilisation of the unique loose-lying red algae."² To navigate these restrictions, Vetik uses other methods to harvest red seaweed during the year. We can go to the beach for beach-cast seaweed, Mr Ilmjärv says, but when it comes is not always predictable, so it has its limits. These constraints make the scalability of the red seaweed industry a challenge. For Mr Ilmjärv the main issue is that red seaweed is not yet cultivated. *F. lumbricalis* is entirely wild harvested, unlike many other commercially valuable seaweeds, and thus is dependent on natural cycles and environmental conditions which add additional hurdles to the regulatory quotas already in place.

After many years, red seaweed is finally attracting the attention it deserves not just by Estonians, but by other players in the seaweed market. While there are evident challenges in the Estonian seaweed industry, from harvesting limits to commercial barriers to entry, Vetik OÜ is contributing to research and trials in the development of red seaweed as both a sustainable and scalable resource. It is the groundwork laid today by this research that will nurture a successful, sustainable seaweed industry in the future.

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² <https://zenodo.org/records/11186314>

ESTONIA'S VABATAHTLIK KALAKAITSE IS DEDICATED TO PROTECTING THE NATION'S AQUATIC LIFE

The volunteer organisation guarding Estonia's rivers

The guiding principle behind Vabatahtlik Kalakaitse, an Estonian grassroots volunteer fish protection organisation, is *we don't just protect the fish, we protect the future*. What began as a small conservation effort by like-minded, nature-oriented individuals has transformed into one of the nation's leading conservation efforts, boasting a team of everyday volunteer citizens who play a crucial role in safeguarding Estonia's aquatic areas and marine life.

From participating in late night patrols to educating the public of the importance of preserving the country's rich natural resources,



Vabatahtlik Kalakaitse is one of Estonia's most important efforts in preserving the nation's aquatic landscapes. Each fish counts, say Rait Kikkamägi and Siim Uustalu, leaders and long-standing members of the organisation, we do this because of the future we want.

A small group of anglers becomes a nation-wide phenomenon

The humble origins of Vabatahtlik Kalakaitse lie in the pure dedication from a

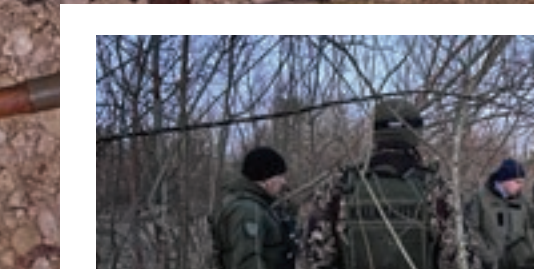
small group of Estonian anglers. In 2014, a group of members from the Eesti Kalastajate Seltsi, or the Estonian Fishermen's Association, participated in a walk along the Keila River with the goal of monitoring fishery related activity. Over time, this small working group and its monitoring activities gained popularity and Vabatahtlik Kalakaitse was established. These walks along Estonia's waters were prompted by individuals noticing poaching activity in local rivers and being alarmed by the sight. In response, these anglers would set up camps to monitor activity and alert law enforcement of anything illegal. The consistency and diligence of the organisation is what has helped it to build it up to what it is today. Initially, the movement was



Vabatahtlik Kalakaitse

Fish poaching is less acceptable now partly thanks to the outreach efforts by volunteers at Vabatahtlik Kalakaitse. Shown, a haul of illegally fished trout.

Leaders and long-time members of Vabatahtlik Kalakaitse, a volunteer fish protection organisation, Siim Uustalu (left) and Rait Kikkamägi.



Vabatahtlik Kalakaitse



Volunteers must be prepared to work at night and to walk through rough terrain to keep an eye out for poachers.

self-funded by volunteers, but as it has built credibility, Vabatahtlik Kalakaitse has earned government funding for its projects. Now, say the two leaders, they use this funding to buy boats, drones, and other tactical equipment to help monitor fishing activity.

At its core, the organisation relies entirely on the efforts of its volunteers, so depending on availability, projects are scaled differently. They say that there are about ten individuals who work on projects every day, 365 days a year. Other volunteers are

less consistent, but as the organisation has become better known, its outreach has grown as well. Today, social media is Vabatahtlik Kalakaitse's strongest form of communication, while maintaining the integrity of the company's mission remains an important tenet of recruiting volunteers. The company's core group of workers says that it is dedication that matters more than numbers. We don't accept just anyone, Mr Kikkamägi explains. No one can enter the organisation before a background check because you never know who will want to join. Trust is everything for us.

Regular patrols keep poachers at bay

Vabatahtlik Kalakaitse prioritises recruiting individuals who are driven to protect Estonia's waters from poaching. In the past, the organisation has



Poachers target most species of fish not necessarily just those with the highest value such as trout and salmon. Pictured, common bream

been infiltrated by poachers themselves disguised as volunteers, trying to play a “double game” and gain insights into the techniques used to identify illegal activity. Learning from these mistakes, the initiative now has measures in place to vet potential members. So, what does Vabatahtlik Kalakaitse’s work look like in practice? Membership tasks can vary from patrolling rivers, to collecting fish data, to reporting illegal activity. Volunteers may also contribute to educational work in local communities, sharing their knowledge of conservation with other anglers and lovers of the outdoors. The organisation prioritises always being available and prepared to catch illegal activity. We are not just walking around and waiting for something to happen, Mr Uustalu clarifies. We always have a plan, we communicate by radio, and use night vision and other equipment, depending on what we need, when we patrol.

The patrols are well organised. Last autumn in Pärnu, members walked two kilometers through forests and fields to get near an area unseen and then nabbed the poachers.

The government could not do it, but we did, the two leaders declare. Vabatahtlik Kalakaitse knows that most poaching activity happens at night, so each night volunteers will work in small groups, equipped with tools and their knowledge of the local terrain to monitor for any illegal activity. The organisation notes that higher volumes of poaching occur in the months near Christmas, calling it “the season” for poachers to hunt fish such as salmon. When illegal activity is detected, the organisation has specific ways of addressing it using peaceful and just methods to resolve situations. A member of the initiative, when encountering a poacher, must identify themselves as a volunteer fish conservationist, notify a fish inspector and their field manager, and report the activity to the Environmental Board. We do not have the right to detain anyone, so we will involve the police if needed, but we are independent of government authorities, Mr Kikkamägi emphasises.

The work includes educational outreach activities

When the team is not catching poachers in the act, they are participating in other projects. Mr Uustalu says that members of Vabatahtlik Kalakaitse will go into schools to talk to students. The organisation attempts to make the importance of conserving resources simple, using analogies and examples to explain the effects of poaching and illegal fishing activities. Reporting done by Vabatahtlik Kalakaitse to authorities plays a crucial role in triggering official action against illegal fishing. Once the Environmental Board receives information, tips, and evidence from the organisation, it can initiate action with investigations and the issuance of penalties which can reach

up to EUR2,000 for illegal fishing.

For over ten years, Vabatahtlik Kalakaitse has worked to ensure the safety of Estonian fish. Messrs Kikkamägi and Uustalu say that they can see that their efforts are helping, as the broad acceptance of poaching has decreased over time. Ten years ago on the same river, poachers were freely walking around and didn’t care about anything. They just took the fish they wanted, they recall. Now, you don’t see that anymore in Estonia. Nowhere. They are afraid of us. The initiative has also built credibility within the environmental sector, becoming a touchpoint for many concerned citizens who may not be members of Vabatahtlik Kalakaitse themselves. People don’t see us as an official organisation; they see us as neighbours who care, says Mr Kikkamägi. This makes a huge difference in the communication and the trust in the communities. The efforts of the organisation have been acknowledged well beyond the scope of the initiative itself, receiving accolades and thanks from various cities and organisations across Estonia.

A model for other grassroots organisations

As Vabatahtlik Kalakaitse continues to raise awareness, it is well positioned to expand its impact within the country. The combination of true grassroots mobility with a strong understanding of the necessity of ecological preservation is not only respectable but inspiring for all those interested in environmental sustainability. The organisation proves that meaningful change can start with just the care and hard work of individuals within local communities.

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Jürgen Visnapuu member of the board of XW Production is responsible for sales and marketing. He wears another hat as the manager of Orissaare harbour on Muhu Saaremaa island.

HOW XW PRODUCTION, AN ESTONIAN STARTUP, IS REDEFINING UTILITY BOATS FOR DIFFERENT SECTORS

Sharp looks and strong performance

A shipyard is capitalising on its founders' flair for design and vessel building to realise a modular concept for work boats that allows them to be quickly and easily configured for different purposes.

When Jürgen Visnapuu left behind a fintech venture in Manhattan and returned to Estonia, the sea became both refuge and direction. Managing Orissaare harbour on the island of Saaremaa, he encountered a small

but skilled boatbuilding operation run by naval architect Niclas Kling and Reimo Vöting, a shipbuilder. Their vision was as ambitious as it was technical: a modular, high-performance utility boat that could be configured like a toolkit. Out of that meeting, XW Production was born.

From maritime defence to a wide range of applications

XW Production is now an emerging player in the specialised boatbuilding market, with a concept built around flexibility, resilience, and high-spec engineering. The company builds aluminium-hull vessels with fully modular interiors, originally conceived for maritime defence, but now catching attention from a much broader set of customers. The company is rooted in Estonia's long tradition of shipbuilding, particularly on the islands of Saaremaa and Muhu, where skilled welders are more easily found than on the mainland. Mr Vöting's shipbuilding background includes stints with two of Estonia's leading yards. Mr Kling, a Swedish naval architect with a coast guard background, brought in the design and technical rigour. Mr Visnapuu added the missing link—business development and sales.



A version of XW Production's platform being put through its paces. Tests by the navy demonstrated the vessel's robust construction.

XW's flagship product is a rigid hull inflatable boat (RHIB), 7.5 metres long, capable of reaching speeds over 50 knots with a 300 horsepower Mercury engine. While that speed is impressive, what makes the boat different is how it is constructed. Everything from the console and jockey seats to cargo modules and crane mounts can be removed, repositioned, or replaced. The core idea is platform-first: the boat is built to accept a wide variety of mission-specific modules, which can be swapped quickly without tools or technical training. The military was the first serious audience to take note. Through Estonia's Defence Industry Association, XW Production initiated a series of demo drives with navy units and special forces. One group ran the boat at full speed through harsh seas, trying to push the limits of the hull and its inflatable pontoons. After rigorous testing and inspection, they found nothing broken. This performance, combined with practical features such as rapid tube replacement (the air tubes are not glued but slide on and off), earned the attention of Estonia's armed forces. The boat was subsequently rented for a major defence exercise and is scheduled for further military trials.

Careful design and robust construction

What stands out is how the boat's construction aligns with operational needs. The pontoons are designed with five separate air chambers, and even if all are compromised, the boat's buoyancy will keep it afloat. It is equipped with a network of small internal airbags that ensure stability even if the hull is breached by gunfire. The aluminium hull is robust, with welds left exposed intentionally—professional visitors to boat shows have praised their precision and quality. The modularity is not just a design flourish. Modules include compressor racks for pneumatic tools, crane mounts, adjustable seating, and machine-gun platforms. Even the main console, typically a fixed structure in most boats, can be moved or entirely removed. XW Production uses a German fastener system, similar to those in commercial aviation, and the deck railings are reinforced to support high-torque loads from towers or equipment.

The company's boats have now been tested or used by search and rescue teams, technical diving units, and marine infrastructure firms. The Estonian navy's mine-diving team has provided written

feedback, helping XW develop a second generation of modules tailored to their needs. These include open-deck configurations, special storage for diving gear, and a mobile air compressor for underwater tools. XW is also working with TalTech, Estonia's leading technical university, on integrating autonomous navigation systems into its vessels. Using TalTech's "AI Captain" platform, the goal is to offer unmanned capabilities for search, survey, or patrol missions. The vessel's existing electronics system makes this integration relatively straightforward. Beyond defence, XW sees commercial potential in industries like harbour operations, aquaculture, and wind farm support. Mr Visnapuu, through his harbour management experience, says how large ports often require multiple vessels for different tasks—towing, patrolling, oil spill response, passenger transfer, or cargo handling. A modular platform could consolidate these into a single vessel reconfigurable for each role. Conversations are underway with Tallinn Port, Saare Wind Energy, and other state-owned infrastructure operators. The boats have already been rented for undersea cable-laying projects and are viewed as potential assets for the growing offshore wind and fish farming sectors. In particular, a Canadian seafood processor has shown interest in adapting XW's vessels for autonomous use in aquaculture—sending out unmanned boats to feed or monitor fish stocks. Visnapuu is also in discussions with commercial fishers to understand the precise module configurations that could support their work.

Investments in capacity to increase output almost 4-fold

While production today is limited—XW can currently build around 20 boats a year—the team is working to scale up. Plans are in place for a new factory near the main harbour in Muhu. With



The vessel has earned compliments from industry professionals at events such as boot Düsseldorf, an important show for the boat industry.

€1.5 million in investment, the facility would include cutting and bending machines, cranes, and robot welders, increasing output to around 75 boats a year. For now, the core team remains lean. It includes the three founders, two sales consultants, and around ten people involved in production, design, and welding. Design and digital architecture are handled from the Swedish side, while the Estonian team leads manufacturing. XW is also becoming a Mercury engine dealer, providing better integration and support for clients. XW Production's pricing reflects its ambitions. A typical 7.5 to 9-metre boat, equipped with modular features, ranges from €250,000 to €300,000, depending on customisations. These are not pleasure boats—they are working platforms with real-world testing behind them. The business model also includes subcontracting. XW builds hulls for a well-known Swedish fishing brand, although this work is kept discreet to respect client confidentiality. This partnership has provided insight into performance optimisation and advanced marine design.

In materials and methods, the company is careful. Aluminium sheets are mostly sourced from Italy. Laser and waterjet cutting is done in Tallinn for now, but the planned factory will bring all these processes in-house. The emphasis remains on hand-crafted welding, especially in tight corners and complex

sections, which machines cannot easily reach. Although much of XW's innovation sits in tangible engineering, it is also part of a wider conversation about the future of maritime infrastructure. Defence clients are now asking for diesel outboards that meet strict biofuel standards. The industry is not yet ready for battery-electric propulsion at scale, due to the weight and cost of current battery technologies. Yet, Mr Visnapuu is watching this space closely, recognising that geopolitical and commercial pressures could accelerate shifts toward sustainable propulsion. For a company that only built its first demonstrator in 2023, XW Production has come far. Its prototype vessel, initially self-funded and built without a client in mind, has

turned into a showcase for Estonia's small but capable boatbuilding sector. The boat has travelled to expos like boot Düsseldorf and drawn praise from international professionals.

Flexibility and customisation are among the unique selling points

The idea behind the company—one boat, many roles—is deceptively simple. But the execution demands engineering excellence and an understanding of what different users need from their maritime platforms. Whether for a diver needing a compressor and clean deck layout, a port needing a tow vessel on Monday and a cargo shuttle on Tuesday, or a military unit needing a reconfigurable patrol boat, XW aims to provide a single solution. It remains to be seen how far the company can scale up, and how quickly. But its modular, mission-focused vision for utility vessels positions it well in a market that increasingly values adaptability and resilience over volume and standardisation. In that space, XW Production is not just building boats—it is building a new concept.

XW Production

Magasini, Piiri
Muhu island
Estonia

Tel.: +372 53739913
jorgen@xwproduction.com
xwmodular.com

Founders: Niclas Kling, Reima Vöting
Board Member: Jürgen Visnapuu

Product: Modular platform for vessels used in different services
Sectors: Defence, diving, marine infrastructure maintenance, aquaculture, harbour operations, potentially also fishing
Vessels produced/year: Currently 20, in the future 75
Employees: 15
Modules: Compressor racks, weapon platforms, crane mounts, adjustable seating

**TALTECH'S MARINE TECHNOLOGY COMPETENCE CENTER
DEVELOPS NEW AUTONOMOUS MARITIME TECHNOLOGIES**

Estonia's push for self-regulated marine vessels

Research into naval architecture and marine technologies is important for Estonia with its long coastline, maritime border with Russia, and freezing winters. Environmental and security concerns will both be addressed at a new interdisciplinary centre of excellence for marine technologies.



Professor Kristjan Tabri, Programme Director (Building and Civil Engineering and Architecture), Tallinn University of Technology (TalTech)

At the Tallinn University of Technology in Kuressaare, Estonia, a research institution is developing modern, adaptive solutions and technologies for the nation's marine environment. The Marine Technology Competence Center (MARTE) is at the forefront of researching stable and secure marine technologies, pursuing projects that range from scaling modern maritime vessels, to simulating Baltic ice formations, to autonomously monitoring fish ecosystems.

Ship design and performance are among the important research areas. Established in 2011, the university's marine-based initiatives combine state-of-the-art engineering with environmental monitoring. Since its creation, MARTE has been rooted in marine and maritime development and innovation. In addition to MARTE, Kuressaare college hosts a biomass valorisation laboratory. Professor Kristjan Tabri, Programme Director, explains that the main focus of the institution is applied research on naval architecture and marine technology, both to serve industrial partners who wish to develop a new product or technology, and to advance Estonia's capabilities in various areas, such as ship design and performance. One of the projects that MARTE works on concerns testing marine vessels in extreme weather conditions. The institute, utilising a 60-meter model test basin, analyses various vessels under simulated wave, pressure, and impact scenarios to evaluate their structural integrity and stability.

Analysis of climatic conditions impact on vessels

Technologies like maritime radars, cameras, and sensors help to interpret the sea conditions and adjust the

vessel in challenging environments. Such autonomous or semi-autonomous behaviour is important for the performance of service vessels, like rescue boats, or ships crossing waters known to be hazardous. Beyond ship construction, MARTE also analyses maritime conditions themselves, working to manage the relationship between difficult environmental conditions, like ice and wind, and ships. In Estonia where coastal waters are sometimes ice covered in winter this research is critical for naval construction and engineering. Recent research involves creating software to identify the different ice types that a vessel may encounter. By uploading hundreds of images of different ice types—intact or broken—the software works to identify the types of ice near the maritime vessel in real time so that it may respond appropriately to the changing conditions. Prof. Tabri admits, however, that this technology is still in its developmental stages. It's kind of a niche market, obviously, he says. It's quite tedious work, but the market is the vessels that have to operate in ice, and this work could ultimately contribute to the development of unmanned icebreakers.

Physical tests have some advantages over computer simulations

The institute mainly carries out model testing of various kinds. Structures are tested in the basin for their design, hydromechanics, stability, and seakeeping behaviour among other parameters. Marine technology i.e. systems dealing with situational awareness and vessel control, are also tested with the aim of investigating their suitability for autonomous or near autonomous vessels. Moreover, the institute has the facilities to test materials. Many



Age Teär (left), Coordinator of Knowledge Transfer, and Ruttar Teär, Head of Research Infrastructure Laboratories, Marine Technology Competence Center (MARTE)

of the tests can be done with numerical simulations on a computer, says Ruttar Teär, the Head of Research Infrastructure Laboratories, but it is better to do physical testing in real waves to understand how a vessel moves in the waves, or how the structure reacts to slamming in the water.

Despite focusing primarily on maritime vessel development, MARTE also works to support marine ecosystems and develop autonomous technologies to support sustainable fishing and the persistence of Estonia's aquatic life. To do this, various institutions and laboratories under the university come together to contribute to marine research under an umbrella structure called the Center of Excellence on Marine Technologies and Data Intelligence, says Ruttar Teär. We aim to identify, forecast, and manage the short and long-term effects of human activities on maritime ecosystems,

where we look both at the environmental aspects as well as at the security implications. To some extent, the information that we all have to gather is quite similar, he continues. With something like underwater noise, for example, you could identify certain maritime activities, but also why the fish are leaving a certain area. The shared data and experimentation help to draw relationships among the researchers of the university, consolidating resources and bringing together the various units. The new Centre of Excellence concept is proceeding quite well and allows us to reduce fragmentation within the university, Prof. Tabri says, as there are so many units who would deal with some marine aspects, so it would make sense to do it together.

*Lily Pampolina, Eurofish,
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WOMEN IN FISHERIES

A Mediterranean gathering

An event dedicated to women in fisheries broke down language barriers and built confidence and trust among the participants allowing them to reflect on their experiences without inhibition.

In April 2025, WWF Adria, in collaboration with the WWF Mediterranean Marine Initiative, hosted the first Mediterranean retreat dedicated to women in fisheries in Split, Croatia. The event, *Women Together in Fisheries*, brought together 40 women from eight Mediterranean countries: Italy, Tunisia, Turkey, Greece, France, Spain, Portugal, and Croatia.

Women from all walks of fisheries-related life

The majority of the participants were women working in small-scale fisheries (SSF) businesses across the Mediterranean. They were joined by researchers in the fisheries and aquaculture sectors, fisheries policy and administration officers, marine conservation experts, artists, and educators. Some participants were members of associations and networks for women in fisheries, while others held leadership positions in fisheries organisations. This diverse group created a powerful



Maja Pigonnet

A retreat for women from the Mediterranean engaged in fisheries-related activities held in Split, Croatia attracted participants with a range of backgrounds from eight countries.

opportunity to strengthen visibility, solidarity, and regional cooperation among women in the sector.

The retreat was designed as an informal and inclusive space, where participants could connect, share experiences, and reflect on the challenges they face as women in the sector. We deliberately called it a retreat to move away from the formal structure of a conference, explained Kora Dvorski, event coordinator from WWF Adria. Instead of a packed agenda, we focused on allowing time for genuine, personal interactions. While professional interpretation was available for the event, the organisers recognised that language barriers could still hinder spontaneous, face-to-face communication. To overcome this, retreat facilitators engaged participants in creative activities to foster cross-border dialogue. Under the guidance of WWF Greece's moderator Eleni Svoronou, women used body language, maps, role play, and group support to present their work in fisheries.

The result was a dynamic and fun atmosphere. By the middle of the first day, the room was filled with laughter and an overwhelming sense of mutual respect and admiration among the women, said Ms Dvorski. The energy in the room showed just how meaningful it was for these women to have a space where they could connect across borders, feel seen, and share their experiences freely.

Shedding light on the invisible force

As part of the retreat, WWF Adria organised the exhibition *Invisible force in fisheries* at the Split fish market. The portraits, taken by international documentary photographer from Croatia, Ivana Vareško, depicted fisherwomen working on their family-owned fishing boats. Some of the images had previously featured in Vogue and in FAO's 2024 report *Women in Fisheries in the*

Mediterranean and Black Sea Region: Roles, Challenges and Opportunities. The exhibition brought visibility to a group often overlooked and highlighted the essential contributions women make to small-scale fisheries.

Women make up approximately one-third of the fisheries workforce across the Mediterranean and Black Sea, including small-scale and industrial sectors (FAO, 2024)¹. Their participation varies by value chain stage and subregion. Women represent 28% of total fisheries employment, with the highest concentration—38%—in post-harvest roles such as sorting, cleaning, processing, and marketing. Their presence is lower in pre-harvest (16%) and harvest (10%) roles. However, these figures are likely underestimates due to the lack of gender-disaggregated data, informal work, and limited gender-focused research. As a result, women's contributions are often overlooked, leading to marginalisation in decision-making processes and underutilisation of their knowledge and expertise. Ensuring women's perspectives are included in fisheries research and governance is essential for sustainable and equitable future of fisheries.

Women leading change share their experience

The second day of the retreat began with the panel Women's Initiatives and Networks in Fisheries, moderated by Pinija Poljaković, an experienced public speaker. The panel featured four women leaders whose work continues to shape the sector:

Marilou Suc, blue economy consultant and co-founder of the Network of Women in Aquaculture (NOWA), described how the new network fosters a

supportive community that encourages women's participation and leadership in aquaculture.

Adriana Celestini, President of Penelope—Women in Fisheries in Ancona and former President of AKTEA, spoke about the importance of women's representation in fisheries governance and emphasised self-confidence as a foundation for active involvement.

Sandra Amezcaga, Secretary of the Galician network Mulleres Salgadas and of the European network AKTEA, highlighted the ongoing lack of institutional support for women's organisations and called for greater public awareness of the structural challenges women still face.

Antonia Vassiliou, President of the Panhellenic Association for Fishing Tourism, shared insights from her experience leading in a male-dominated profession and stressed the persistence required to create space for women in professional fishing.

The insights from these panellists offered a reflection on the evolving and increasingly visible role of women in the sector. Each of them has helped pave the way for greater recognition of women's work, stressing the importance of persistence and continued engagement. The community holds dear the memory, wisdom, strength, and passion shown by Adriana Celestini—whose legacy will continue to inspire women in their efforts to advance their role in fisheries.

Building momentum for a Mediterranean network

A key outcome of the retreat was the strong sense of support and belonging that emerged. Participants expressed a clear desire to stay connected and continue building a Mediterranean network

for women in fisheries. The retreat also sparked ideas for collaborative projects that could further strengthen regional cooperation and visibility. For most of the fisherwomen from Croatia, this was their first experience of an event designed specifically for them. Many were surprised to learn that in other countries, women fishers are formally organised in associations, cooperatives, and even market their own brands. This inspired a renewed sense of possibility and evoked practical ideas for action in their local communities. Following the retreat, the SSF Forum Workshop took place in Split on 9–10 April 2025. Co-organised by the General Fisheries Commission for the Mediterranean (GFCM) and WWF, the workshop welcomed 41 participants from eight countries. For the first time, women represented the majority of attendees. The objective was to bring together small-scale fishers to exchange knowledge, explore the impacts of fishing gear, and share practical solutions and local success stories from the region.

Looking ahead to a more equitable future

The *Women Together in Fisheries* retreat represented a critical step toward increased recognition, inclusion, and empowerment of women in the Mediterranean fisheries sector. By creating a supportive environment and promoting regional collaboration, the event helped lay the foundation for a more equitable and sustainable future—where the essential contributions of women are no longer invisible, but celebrated and embraced.

Kora Dvorski, Coastal communities officer, WWF Adria

¹ Merayo, E., Vakhitova, V., & Carlson, A. (2024). Women in fisheries in the Mediterranean and Black Sea region: roles, challenges and opportunities (General Fisheries Commission for the Mediterranean; FAO Fisheries and Aquaculture Division). Rome: FAO. <https://doi.org/10.4060/cc9869en>

THE ICELAND OCEAN CLUSTER

Using innovation to tackle blue economy challenges

Dr Alexandra Leeper

CEO

Iceland Ocean Cluster

The Iceland Ocean Cluster brings together some 70 companies that are active in the blue economy. The goal of their flagship movement, 100% Fish, is to derive the maximum possible value, and reach zero waste from marine resources through collaboration and innovation. Moreover, the cluster exports its model of community and trust inspiring the creation of similar groupings in other parts of the world. Dr Alexandra Leeper, the CEO, describes here the objectives of the cluster and the activities it engages in to achieve them.

Could you briefly introduce the Iceland Ocean Cluster: its mission and vision, and your role within the cluster?

The Iceland Ocean Cluster is a community that spans all different sectors of the blue economy based in the Ocean Cluster House in Reykjavík, Iceland but with projects, activities and Sister Ocean Clusters all around the world. Our mission is a sustainable and innovative blue economy. Our team and community are purpose driven and focused on connecting and supporting individuals, startups, organisations, institutes and businesses so great ideas that solve some of our biggest global blue challenges can thrive and resilient value is created.



Dr Alexandra Leeper, CEO, Iceland Ocean Cluster

The cluster is well known for its “100% fish” approach. How has this concept evolved, and what impact has it had on Iceland’s seafood industry? How does the cluster succeed when at least some of its members must be competing against each other?

100% Fish is the concept of not wasting any of the precious seafood that we spend time, energy and money to capture and farm, but instead finding sustainable and value creating ways to use 100% of our seafood. In Iceland this thinking has led to a significant increase in the value of cod and a total transformation of the philosophy and resilience of the blue economy. Atlantic cod, the model species for 100% Fish, once worth around \$12 (€10.5) per fish now can reach around \$5,000 by using not the fillets, but the head, skins, bones, guts and beyond in a diverse range of products and sectors. There are products ranging from the traditional, fish meal and fertiliser through to higher value products with

strong heritage, such as fish skin leather textiles in fashion items and cod liver oil, nutraceuticals and supplements such as fish skin collagen and mineral supplements from fish bones through to the very high value products used in pharmaceutical and medical applications such as fish skin grafts by a company called Kerecis.

And since not every fish is like Atlantic cod nor every country like Iceland, what is driving our work now, is learning how we can adapt and apply the core steps that has made 100% Fish so successful in Iceland to seafood contexts around the world. One big part of this success has been the identification of mutual challenges that members and seafood companies share, that are perhaps not part of the core business, but in fact a common pain point—so called, pre-competitive challenges—reducing loss and waste from processing is one such pre-competitive challenge that companies can benefit from collaboration over competition for mutual economic and environmental gain.

How has the development of aquaculture in Iceland influenced the activities of the cluster?

Aquaculture, both sea cage and land-based is one of the fastest growing food production sectors in Iceland. While the largest volumes are driven by Atlantic salmon and other salmonids, the land-based sector also hosts some exciting warm water species, possible due to the unique volcanic geology of Iceland, such as Japanese abalone, Senegalese sole and research species such as whiteleg shrimp and Nile tilapia. This results in growing diversity in the blue economy sector and it means, particularly in the case of Atlantic salmon, that there are increasing volumes of secondary biomass including processing cut-offs as well as sludge (the uneaten food and faeces). In both cases this has led to the Iceland Ocean Cluster extending its 100% Fish model to salmon and salmon sludge—where there is more “waste” to transform into value through collaboration. We also support emerging companies serving this sector such as technology and AI solution providers as the industry becomes more automated and digitised.

How does the cluster support the transition to more sustainable and circular practices in the blue economy? And what are some of the most promising innovations or startups you've seen recently within the Iceland Ocean Cluster ecosystem? Why do you feel they show promise?

There is always so much activity going on at the Iceland Ocean Cluster, both domestically and increasingly, all over the world where our team and collaborators are working toward innovation and good, sustainable business in the circular and blue economies. While there are many approaches that we take, there are some core ways we do this. We bring the right partners and communities together in an

ecosystem approach to foster good ideas, be that through match-making days for investors and entrepreneurs that are aligned in stage and value focus, bringing technology companies together and facilitating conversations on potential spin-off collaborations, or asking leaders to explore their vision for the blue economy and share where they are willing and able to work together now. We lead projects that can support research and innovation for full utilisation of seafood, and product development from secondary biomasses. We also invest, incubate, and nurture the next generation of great founder and exciting ideas that we believe in.

There are many promising startups and innovations that we work with, for example, Marea that are developing sustainable coatings for food made from microalgae side streams to replace supermarket fruit and vegetable plastic packaging. Hefring Marine that is using sensors and AI to improve vessel navigation, safety, fuel consumption and supporting energy transition. Primex who is transforming shrimp shells into chitosan for a wide range of products from food to cosmetics and even medical applications. In all cases these companies have a strong vision for a resilient blue economy and are providing innovative solutions for some of our most urgent blue challenges, plastic pollution, fuel consumption and footprint, and seafood waste.

Can you give examples of how seafood by-products are being used in new, high-value applications beyond food?

This, I am happy to say is becoming a very long list, so I will share just a handful of recent examples we have come across that are exciting, innovative and beautiful. The use of salmon blood into biomedical blood clotting agents and anti-coagulants by companies such as Salmonics. The use of fish skin collagen in dental care and regenerative medicine. The development of

mussel shells into bio-glass tiles in a collaboration between the architecture firm Bureau de Change and a student artist Lulu Harrison. Kerecis in Iceland is leading the way in skin grafts from fish skin but has also developed a whole range of further medical products that really showcase the wide range of possibilities for fish in health care. Please do explore our website <https://sjavarklasinn.is/en/> for other examples.

The cluster is known not only for innovation but also for thought leadership. Could you say something about recent publications, research initiatives, events, and other networking opportunities the Iceland Ocean Cluster provides to bring stakeholders together?

We are driven by a desire to create positive change in the blue economy, in Iceland and around the world and a big part of this is sharing our story and that of remarkable entrepreneurs and industries we work with around the world. This meant our team has had the chance to inspire action through 100% Fish in the US, Korea, New Zealand, Ghana, Chile, and the UK in the last 12 months, to name just a few. We welcome groups from all around the world too, to share our cluster model and the cluster house function and to explore new collaborative partnerships.

In May, Iceland held its annual Innovation Week run by the company, Iceland Innovation Week, who also have their office in our cluster house. This week sees the whole city light up with innovation and this year our team really wanted to showcase just how much activity is happening in Iceland and beyond. We hosted a range of events at the cluster, including some collaborative events with the United States Embassy in Iceland that brought innovators together to share experiences of entering the US market. We opened our doors to the public in our

Blue Open House where blue companies, from brand new startup ideas to mature companies in the circular and blue economies came to show and tell everyone who they are and what they do. Events like these mean we get to engage with new communities, companies increase their visibility and we all get inspired for the future of the blue economy!

There are a number of recent publications that can be found on our homepage from a range of projects with partners around the world about how we can create more value from seafood, how we can reduce waste, and how we can bring communities together to trigger meaningful change.

How does the cluster engage with the public or younger generations to raise awareness about the potential of the blue economy and circular innovation? And how does it collaborate with similar initiatives abroad, particularly in Europe? Do you see potential for the Icelandic model to be replicated in other coastal nations, and if so, what conditions are key for success?

We always host resident intern students from both Iceland and other countries at the Ocean Cluster House. We also have high school and university groups visiting from around the world. We consider this a really important part of our operations, both to hear the ideas and perspectives of younger generations and to share all our exciting ideas and to meet our community. One of the most important parts of this is really telling the stories that can inspire future leaders in the blue economy.

We have an ever-growing network of Sister Ocean Clusters around the world built on a philosophy of collaboration and modelled on the principles of community and trust that have been so effective in Iceland. Collectively, the Sister Ocean Cluster Network is

finding ways to work together on topics like 100% Fish, industrial symbiosis, and a more sustainable blue economy. Through this network of clusters there is a huge variety of innovation landscapes, cultures, approaches and priorities that strengthen the impact of a single cluster acting in isolation. Key success factors of all clusters include a driven leadership team with a strong purpose to find solutions and bring community together.

As a woman in a leadership position within the blue economy, how do you view the current level of gender diversity in the sector, and what advice would you give to young professionals, especially women, interested in working in ocean-related innovation and entrepreneurship?

This is a complicated question to answer as there is nuance and difference in the diversity at the sectoral, country and role level. Just looking at the statistics of gender in the blue economy in the EU (https://blue-economy-observatory.ec.europa.eu/women-blue-economy_en), it is clear that the sector is still unbalanced, with the employment of women in the sector and women's salaries still lagging. The industry would benefit from greater representation of women at key decision-making tables, and roles that can be more flexible to accommodate for balancing parenting and work. All this of course also requires societies, cultures and governments that enable people to thrive equally in work and life.

I would advise young people interested in a career in ocean-related innovation or entrepreneurship to find mentors, to get experience—try things, it's as important to find out what you don't like, as what you do. I would also advise exploring and articulating your "Why," why are you excited about the ocean sector, why is your idea one that needs to happen? Why are you the one to do it? Why

now? The ocean sector is increasingly diverse and needs diverse minds and solutions to evolve so find ways in which your skills set, and knowledge fit.

In your view, what will be the biggest challenge facing the Icelandic seafood industry in the next 10 years? How do you see the future of the Iceland Ocean Cluster? In which direction do you think it will or should evolve?

For the Icelandic seafood sector there are a number of key interlinked challenges to optimise the environmental and economic sustainability of the sector in the context of a changing climate. It will be essential to continue reducing the carbon footprint of the sector through more efficient gear, or alternative fuels, or hybrid vessels. Ensuring talent development in an industry that is becoming ever more technical and digital will be crucial to continue progress for the whole blue economy. As the salmonid aquaculture continues to expand in Iceland it will also be key to learn from the fisheries sector on topics including the Cod model of 100% Fish. These challenges are all highly relevant internationally, globally too, we still waste far too much of the precious seafood that we take time, energy and money to capture and farm. In 2023 the World Economic Forum estimated that world-wide we lose and waste more than 23 million metric tonnes of potentially edible aquatic food.

The Iceland Ocean Cluster is evolving to extend its mission and hard learned lessons about collaboration and 100% Fish around the world, extracting the secret sauce of what has been successful in Iceland and enabling seafood industries and communities across the globe to adapt and implement these models. We have started to do this in areas like Greenland, the Great Lakes and the Oregon Ocean Cluster in the US, and in Namibia, to name a few.

diary dates

19-21 August 2025

Aqua Nor

Trondheim, Norway
post@nor-fishing.no
<https://aquanor.no/>

20-22 August 2025

The 27th Japan International Seafood & Technology Expo

Tokyo, Japan
sf@exhibitiontech.com
<https://seafoodshow-japan.com/tokyo/>

20-22 August 2025

VietFish - Vietnam Fisheries International Exhibition

Ho Chi Minh City, Vietnam
<https://vietfish.com.vn/>

27-29 August 2025

Shanghai International Fisheries and Seafood Exhibition (World Seafood Shanghai)

Shanghai, China
<https://www.worldseafoodshanghai.com/>

2-4 September 2025

Global Shrimp Forum

Utrecht, The Netherlands
secretariat@shrimp-forum.com
<https://www.shrimp-forum.com/>



10-12 September 2025

Seafood Expo Asia

Singapore
Tel.: +1 207 8425504
sales-asia@seafoodexpo.com
www.seafoodexpo.com

11-12 September 2025

XII Anfaco World Tuna Conference

Vigo, Spain
tunaconference@anfaco.es
<https://tunavigo.anfaco.es>



22-25 September 2025

Aquaculture Europe *

Valencia, Spain
eas@aquaeas.eu
<https://www.aquaeas.org/>



7-9 October 2025

DanFish International *

Aalborg, Denmark
Tel.: +45 9935 5555
info@akkc.dk
<https://danfish.com>



ASOCIACIÓN ESPAÑOLA DE MAYORISTAS, TRANSFORMADORES,
IMPORTADORES Y EXPORTADORES DE PRODUCTOS
DE LA PESCA Y ACUICULTURA

7-9 October 2025

Conxemar *

Vigo, Spain
conxemar@conxemar.com
<https://www.conxemar.com/en/exhibition/>



13-17 October 2025

53rd WEFTA Conference

Gdańsk, Poland
wefta2025@mir.gdynia.pl
<https://wefta2025.com/>

5-7 November 2025

Busan International Fisheries Expo

Busan, Republic of Korea
bisfe@bexco.co.kr
<https://bisfe.com/eng/>

10-13 November 2025

World Aquaculture India

Hyderabad, Telangana, India
mario@marevent.com
<https://was.org/Meeting/code/WAI2025>



19-20 November 2025

3rd Catch Welfare Platform Conference

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