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Baltic herring for food: Shades of grey in how backcasting recommendations work across exploratory scenarios

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ABSTRACT

Scenario methods can be used to cope with future uncertainties by envisioning plausible futures and identifying paths to reach desirable targets. The objective of this paper is to develop novel proposals revealing generalised dynamics on "HOW" the different normative recommendations can work under different exploratory scenarios. Previous literature has focused more on developing methods for integrating normative and exploratory scenarios than on theorising dynamics of the HOW question. We examine this theoretical question via a case study on potential futures of use and governance of Baltic herring catch. The case study: 1) develops recommendations on how the use of Baltic herring as food can be increased based on a participatory backcasting workshop with fisheries experts; 2) identifies four exploratory scenarios on the future of Baltic fisheries governance based on a literature review; 3) assesses how the recommendations work under four alternative plausible futures. We identify and discuss six generalised dynamics answering the HOW question. Together, these stress the need to analyse simultaneously multiple drivers, stakeholders, exploratory scenarios, normative recommendations, and synergies and frictions between recommendations. This work contributes to capacities to cope with future changes and proactively develop practical means to make our world more sustainable.

1. Introduction

How to make decisions under future uncertainties? This is a key question, for example, for enhancing sustainability in the age of pressing social and environmental challenges. Scenario methods are one promising and much used alternative to cope with complexity and uncertainty and to enhance possibilities for informing future sustainability (Carlsen et al., 2013; Reilly and Willenbockel, 2010; van Vliet and Kok, 2015; Vervoort et al., 2014; Wilkinson et al., 2013; Wright et al., 2014). Scenarios can act as a crucial bridge between environmental science and policy if they succeed in overcoming the retention of previous agendas and knowledge (Sarkki et al., 2017). Scenarios can influence policymaking by summarising and synthesising scientific knowledge in an understandable format (IPBES, 2016), and by engaging stakeholders and policymakers in knowledge production and increasing ownership and use of the scenarios in practice (Kok et al., 2007; O'Brien and Meadows, 2013). However, limited uptake of scenario results is often due to poor knowledge on whether and how normative recommendations would work across different exploratory futures (Green and Weatherhead, 2014). Cho (2013) reviewed technological forecasting literature and proposed that combinations of exploratory and normative scenario approaches have been among the most interesting applications in the field.

Exploratory scenarios describe various alternative plausible futures and are commonly used in global environmental assessments (e.g. MA, 2005; van Vuuren et al., 2012). Exploratory scenarios are not projections or predictions, but holistic and schematic descriptions of how the future may unfold under a logic framed by variations in key uncertainties and their implications for the behaviour of selected drivers. Exploratory scenarios often come in sets of two or more, each of which follows an internal logic and consistency. They describe how large-scale social, economic, environmental, political and ideological realities may change and interact in the future, leading to alternative plausible futures (Raskin et al., 2005; Wilkinson, 2009; Vervoort et al., 2014; Gallopín, 2015). Exploratory scenarios outline various plausible development paths and their consequences without being policy-prescriptive (Kok et al., 2007). Thus, exploratory scenarios are good for addressing the impacts and implications of large-scale drivers and trends, but fall short in proposing actual measures that could be used to achieve a desirable future.

Normative target-seeking scenarios, such as those done by participatory backcasting methods, can be used to help scientists, decision-makers and other stakeholders to co-produce recommendations and paths on how to achieve a desirable future point or to avoid undesired futures (Robinson, 2003; Robinson et al., 2011; Quist et al., 2011; Kishita et al., 2017; Vergragt and Quist, 2011; Wangel, 2011; Robinson

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et al., 2011; Zimmermann et al., 2012). Backcasting "involves working backwards from a particular desired future end-point or set of goals to the present, in order to determine the physical feasibility of that future and the (policy) measures that would be required to reach that point." (Robinson, 2003). The output of a backcasting exercise is a set of concrete operational actions for different stakeholders that are needed to reach a desirable future. The downside of target-seeking scenarios is their lack of attention to the larger societal context, which has effects on what kinds of paths are likely or even possible, and what kinds of normative recommendations will work in different kinds of futures.

To overcome these problems, recent research has aimed to combine the two types of scenarios in various ways to address how normative proposals would work across diverse futures (e.g. Kok et al., 2011; Milestad et al., 2014; van Berkel and Verburg, 2012). The aim of such a combination is not to give merely a snapshot of a particular future, but to propose transformation pathways within a systemic description of alternative future states (see Saritas and Nugroho, 2012). The combination can assess how effective and robust certain actions or policy measures defined by backcasting are, by deliberating whether and how they work under different alternative exploratory scenarios.

Exploratory and backcasting scenarios have been integrated in various ways. Integrative and participatory methods have been used, focusing on the identification of normative so-called "robust recommendations" that work under many plausible future worlds (Kok et al., 2011; van Vliet and Kok, 2015). Star et al. (2016) have used researcher-driven exploratory scenarios as a background for participatory backcasting. Marlow et al. (2015) created exploratory scenarios, and used policy decisions and plans that the local community is considering to capture the normative views. Then participatory assessment was conducted to understand how the exploratory scenarios may affect the ability of the community to achieve their normative objectives for the future. Green and Weatherhead (2014) have applied quantitative methods by identifying diverse futures through probabilistic scenario methods and then using decision-criteria to calculate the outcome of normative recommendations in each future. Also Kingsborough et al. (2017) utilise a probabilistic model to quantify estimates of effectiveness of a range of normative adaptation options under different future situations. The integrated "approach shows high potential, but as the methodology is in its infancy, more research is needed" (van Vliet and Kok, 2015: 43).

The objective of the present paper is to develop novel proposals revealing generalised dynamics on "HOW" the different normative actions can work under different exploratory scenarios. This has theoretical value, as previous literature has not focused much on theorising what kind of dynamics between normative recommendations across diverse futures may be, but focused more on developing methods for integrating normative and exploratory scenarios.

We examine this theoretical question via a case study on potential futures of use and governance of Baltic herring catch. The case study: 1) develops recommendations on how the use of Baltic herring as food can be increased based on a participatory backcasting workshop with fisheries experts; 2) identifies four exploratory scenarios crucial for divergent alternatives to use and govern Baltic herring based on a literature review; 3) assesses how the recommendations work under the four exploratory scenarios based on a desk study.

The empirical value is to explore how the use of a sustainable protein source, such as Baltic herring, can be increased, having positive environmental and health impacts. This contributes solving the challenge of feeding the growing human population with nutritious food (FAO, 2009; Godfray et al., 2010; Manders et al., 2012; UN, 25 September, 2015). Currently, fish accounts for approximately 15% of the total animal protein consumed by humans (FAO, 2016a,b; March 2016) and the demand for seafood continues to increase (FAO, 2014; Thurstan and Roberts, 2014). Baltic herring is one of the largest commercial catches in the Baltic Sea and has great potential to be used significantly more than currently as a sustainable source of protein for people (Pihlajamäki et al., 2018). However, complex social-ecological dynamics and uncertainties, including high dioxin levels in Baltic herring, fluctuations in consumer demand, access to the EU and global fish market, and the ability of the fishing sector to deal with the above-mentioned challenges, will affect whether Baltic herring will be used increasingly as food or not (Pihlajamäki et al., 2018).

The paper will continue by providing a brief background to the case of Baltic herring, followed by a note on materials and methods. The Results section sketches four exploratory scenarios based on literature and policy screening, identifies recommendations for increasing the use of Baltic herring as food based on the participatory backcasting method, and provides six examples of how the recommendations work in each of the four exploratory scenarios. Based on the six examples, we identify generalised dynamics on how the normative recommendations link to exploratory scenarios. We end with some brief conclusions, especially identifying a need for subsequent work on the HOW question.

2. Challenges in the use of Baltic herring as food

Baltic herring is one of the key commercial catch species in the Baltic Sea in terms of volume, but its use for human consumption is low and the majority of the catch is used as feed in fur and fish farming (ICES, 2015a,b). There are many reasons for this. Firstly, dioxin levels in large (over 17 cm) Baltic herring are often likely to exceed the allowed maximum level and therefore the sale of the fish for direct and indirect human consumption in the EU is restricted (Regulation (EU) No 1259/2011; Commission Recommendation (EU) 2016/688). Finland and Sweden, which are responsible for fishing over 60% of the total catch (ICES, 2015a,b), have an exemption to this rule and can sell all large herring domestically, while in other EU countries only herring that is not likely to exceed the maximum allowable dioxin level can be placed on the market. Secondly, the use of Baltic herring for human consumption has decreased owing to low domestic demand and poor access to export markets (Pihlajamäki et al., 2016). Domestic demand for traditional herring products has decreased (Natural Resources Institute Finland, 2015), especially among younger generations (Mononen and Urala, 2010), which implies that novel products attractive to various consumer groups would be needed to increase the markets (Pihlajamäki et al., 2018). Thirdly, the majority of herring fleets target herring for industrial purposes (Lassen, 2011). In Finland, for example, around two thirds of the catch has been, since the 1980s, used to feed fur animals (Setälä, 1996; Setälä et al., 2016). Fourthly, the use of herring for fishmeal and oil production has increased as the removal of dioxins from the fishmeal and oil during the production process has become economically viable. As a result, there is newly-found interest in investing in fishmeal and oil production plants in the Baltic Sea region (Setälä et al., 2016).

The benefits of using more Baltic herring as food are many. Currently, the EU fish market depends heavily on imported products and therefore the European Commission has called for improved fish and seafood self-sufficiency and availability (Regulation (EC) No 1380/2013). While the Common Fisheries Policy (CFP) sees aquaculture as the main strategy for increasing food security, small pelagic species, such as Baltic herring, also have a great contribution potential to increasing the use of locally produced fish products (Pihlajamäki et al., 2018; Tacon and Metian, 2009). The benefits for the fishing sector relate to improved social and economic viability, which is based on the differences in the market value of herring sold for food versus feed. Furthermore, a shift from fur animal feed to food directed fishing promises new jobs in the fishing sector relating to, for example, sorting and processing (see e.g. Setälä et al., 2016). From the perspective of human health, a recent risk-benefit analysis study suggests that, apart from the risk groups, the benefits of Baltic herring consumption for human health outweigh the potential risks relating to dioxin exposure (Tuomisto et al., 2015).

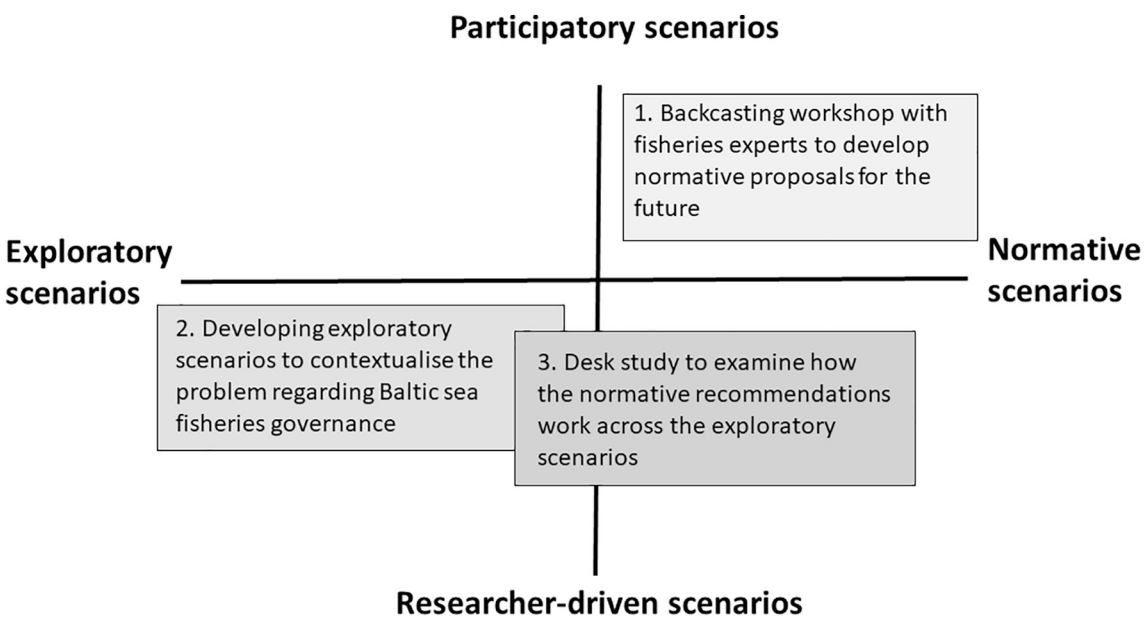

Fig. 1. Three-step methodological process located in scenario methods matrix including participatory and researcher-driven scenario work, and exploratory and normative scenarios.

3. Material and methods

To answer the HOW question (how normative recommendations work across exploratory scenarios), a three step methodology was used (Fig. 1). The methodology to answer the HOW question needs a set of exploratory scenarios and normative recommendations in order to connect the two. In general, the scenario development is a process including more or less participatory approaches, and normative vs. exploratory approaches. Often the scenario methods are not based on a single approach to answer the HOW question, but rely on mixed methods combining participatory and research-driven strategies, and exploratory and normative approaches (Star et al., 2016).

To answer the HOW question, exploratory scenarios have often preceded backcasting methods, leading to the integration of the two (van Vliet and Kok, 2015). This enables scanning normative recommendations against diverse exploratory scenarios by the stakeholders in the backcasting exercise. Here we utilised a different strategy: we first had the participatory backcasting workshop, then we defined the exploratory scenarios by research-driven strategy, and finally combined the two with a desk study. Having the results of the participatory workshop as a background, we directed our exploratory scenarios to be relevant for the objective to increase the use of Baltic herring as food defined by the workshop participants. This enabled us to examine the HOW question with an empirically informed desk study. Further methodological development would include adding participatory aspects also to the elaboration of the exploratory scenarios and to deliberate the HOW question in a participatory workshop setting.

3.1. Backcasting method

The backcasting method is often built on the premise that by working backwards there will be less thinking than usual from the current status quo and people might discover that there is much more possible than was first thought. The backcasting method is often participatory and engages stakeholders since it is important to co-produce normative proposals with various societal implications (Robinson et al., 2011; Wangel, 2011; Vergragt and Quist, 2011. The backcasting method was applied as part of a two-day stakeholder workshop on the dioxin problem of Baltic herring, which was arranged in Copenhagen in February 2016 (Pihlajamäki et al., 2016, 2018). Eleven experts, representing fishermen, producers, administration, researchers and NGOs, from four Baltic Sea countries (Finland, Sweden, Estonia and Denmark) were engaged to identify paths to a desirable future.

The method started with the workshop participants identifying a desirable future for Baltic herring, which was to use more Baltic herring as food than currently. This desirable future was divided into three sub-targets that could enable the actualisation of the overall objective: 1) 35% of the total Baltic herring catch to be used as food in Baltic Sea countries by 2040; 2) 40% of the total Baltic herring catch to be exported and consumed as food; and 3) the dioxin level in Baltic herring used as food to decrease to a safe level. The division into sub-targets was done by our research team to provide a clear rationale for participatory backcasting working backwards from these normative future targets towards the present. The group was divided into three subgroups in which each group addressed one of the three sub-targets for increasing the use of Baltic herring catch for food. The group work was scheduled for 2.5 h in the agenda. The groups first identified sets of development paths working from the sub-targets back to present. We had prepared a template with five-year intervals from the present up to 2040, but the groups rather discussed the sequence of the events than using the milestone years. The benefit of this was to be able to concentrate on whether some actions could be done already now in the present year, or if there are paths of actions that would be enabled only later after other actions. The downside was that the final paths did not include milestone years. The groups also identified the role of different governance actors in the implementation of the actions. Finally, the groups were supposed to assess the impacts of the actions on different management objectives (social, ecological, environmental) revealing potential trade-offs associated to the identified paths. However, the development paths turned out to be quite complex and only one group completed the identification of potential trade-offs, while the other two finished with discussion on stakeholder-specific actions. The identified and detailed paths including chains of actions to reach the three objectives are published elsewhere (Pihlajamäki et al., 2018).

3.2. A desk study to identify exploratory scenarios

We utilised research-driven methods for creating exploratory scenarios on general future states of Baltic Sea fisheries governance, because our research focus was to examine the dioxin challenge, and its

relationship to using Baltic herring as food. Therefore, the exploratory scenarios provided necessary general backgrounds describing alternative futures, in which the normative goal of increasing the use of herring as food functions differently. Also recent exploratory scenarios on the Baltic Sea were available (e.g. WWF, 2012), and they were fine-tuned by checking their consistency with larger-scale exploratory scenario logics (European Commission, 2012; Kriegler et al., 2012; MA, 2005; O'Neill et al., 2017). An established scenario building method (Wade, 2012) was used to explore the alternative societal conditions for Baltic Sea fisheries and environmental governance in 2040.

The methodology to create exploratory scenarios included the following phases: 1) identification of drivers, 2) identification of two key uncertainties that affect how various drivers might develop, 3) creating storylines reflecting four scenarios separated by the two uncertainties by reviewing recent scenario literature (European Commission, 2012; Kriegler et al., 2012; MA, 2005; O'Neill et al., 2017; WWF, 2012), and 4) outlining their specific relevance for Baltic Sea fisheries governance. A common approach in creating exploratory scenarios is to define two key uncertainties separating four scenarios that behave divergently in respect of the key uncertainties (van Vuuren et al., 2012). We chose the extent of human impact on the Baltic Sea environment and the extent of policy and governance integration as key uncertainties that frame the logics of four exploratory scenarios. These are similar to the WWF (2012) scenarios in which governance integration and ecological footprint are used as key uncertainties.

3.3. A desk-study to combine exploratory and backcasting scenarios

For the purposes of this paper, the authors extracted six recommendations from the backcasting paths focusing on questions of who should do what to increase the consumption of herring as food. The six recommendations were identified so that they include actions by various stakeholders, and cover all three sub-targets.

The results of the combination of exploratory and backcasting scenarios outline how the six recommendations to increase the use of Baltic herring as food gained from the backcasting exercise work across the four exploratory scenarios. We then assessed how each of the six recommendations would work in the four divergent worlds the exploratory scenario describe, providing us with 24 examples. Inductive content analysis was used to cluster the 24 examples under six generalised proposals on how backcasting recommendations can work in the exploratory scenarios. Inductive content analysis can help to build a hypothesis and assumptions on theoretical questions where theory is limited (Tracy, 2012), such as is the case here.

We present a summary of all 24 examples in the appendix (Appendix 1), but chose the six most interesting examples that are relevant for identifying theoretically interesting dynamics related to the "HOW" question. The selection was based on assessment of the underlying logic of the 24 examples in terms of what kind of dynamics of HOW they reveal. To build novel theoretical assumptions on the HOW question, we consider it a credible choice to not include all examples, but just those contributing directly to our Discussion section. In the Discussion section, we develop theoretically relevant assumptions, which can inform future work on combining exploratory and normative scenarios.

A key shortcoming in our scenario methods to develop the theory further is that the integration of normative and exploratory scenarios was not participatory, but a desk-study. Through a participatory method we would have gained even stronger grounds for building theoretical proposals addressing the HOW question. Even though our workshop method did not include a separate session on combining backcasts to exploratory scenarios, still the workshop discussions included relevant points for the combination. Where such statements were missing, we used our expertise to identify the dynamics of the HOW question (Section 4.3).

4. Results

4.1. Four exploratory scenarios

The four identified exploratory scenarios that describe different worlds by 2040 are: 1) "Transformation to sustainability", 2) "Business-as-usual", 3) "Inequality", and 4) "Transformation to protectionism". These scenarios diverge in relation to how the dynamics of the key themes and drivers unfold, having divergent implications for the use of Baltic herring as food. Table 1 outlines the relationships of the four scenarios to key themes or drivers. The drivers to be included were chosen due to their high relevance to Baltic herring and its use as food.

4.2. Summary of backcasting results

Based on the backcasting method in the stakeholder workshop, we identified various paths towards the target of increasing the use of Baltic herring as food significantly. Table 2 outlines six key proposals on how this could be done and focuses on who should do what to promote the target.

4.3. Combining the exploratory and backcasting scenarios

Having outlined the logic of four exploratory scenarios (Table 1) and six recommendations on how the use of Baltic herring as food can be increased (Table 2), we can combine these two results to innovatively analyse how each of the six recommendations works in each exploratory scenario (see Appendix 1). Below, we provide six examples of the dynamics of how backcasting recommendations work under the exploratory scenarios.

Dynamics 1: Creating access to the EU market for Baltic herring in the "business-as-usual" scenario.

Even if a normative recommendation seems to work under a certain scenario, its effects may be nullified by other dynamics in the scenario. Workshop participants expected that European markets will open for herring if the demand for fish as a source food continues to increase and the state of various other fish stocks consumed in the European market continues to decline. Opening of the markets is also supported in the business-as-usual scenario by a tendency to promote free trade and remove protectionism within the EU. In this scenario, the risk management is likely to change to maximise the contribution of the EU's fisheries to food security. In other words, the Member States are likely to be allowed to place herring that exceeds the maximum allowable dioxin level on the EU market, providing that consumers are informed accordingly. However, in this scenario the demand for Baltic herring food products remains low and therefore it was wondered in the workshop whether this opening niche for herring in European markets is likely to be filled by various cheap products brought in by the global economy. Thus, in this scenario, despite the access to the EU fish market, Baltic herring fisheries would most likely contribute to the food security indirectly as fish feed and as fishmeal and oil developed for human consumption.

Dynamics 2: Branding the products under the "Transformation to protectionism" scenario.

Specific recommendations may not actualise in a certain scenario, but there may be other developments in the scenario that substitute the recommended action. The workshop participants considered that the branding of herring products is key to increasing their consumption, and recognised that trends in branding herring products were linked to sustainability and health issues. In the "transformation to protectionism" scenario, the markets between countries are closed. In addition, the demand for herring food products is low and there are no

Table 1
Four exploratory scenarios and their relationships to key factors affecting the use of Baltic herring as food.

Scenarios Key factors	Transformation to sustainability (*Integrated governance and low human impact*)	Business-as-usual (*Integrated governance and high human impact*)	Inequality (*Fragmented governance and low human impact*)	Transformation to protectionism (*Fragmented governance and high human impact*)
Relation to environmental problems	Very proactive	Reactive	Proactive–reactive, varies across the Baltic Sea region	Proactive only if national economy or security threatened
Risk perception	Precautionary principle	Cautiousness when allowed by economic development	The poor bear the risks, while those well-off manage risks actively through individual choices	Only risks threatening national (food) security acknowledged
Innovations	Subsidies and support for green innovations	Innovations promoting economic growth	Some regions thrive, others struggle	Innovations enhancing national self-sufficiency
Technological development	Fast	Very fast	Slow	Very slow
Production	Increased efficiency, implementation of ecologically best practices	Increased efficiency, but practices less environmentally friendly	Efficiency increases in some countries, (some) industries play an important role	Low efficiency, environmental friendliness ignored
Environmental awareness and engagement	High	Medium-low	High	Low
Environmental management	Ecosystem-based marine and fisheries management for Baltic Sea, with strong sectoral integration	Ecosystem-based fisheries management, but with weak sectoral integration	Sectors, species and regions managed mostly in separation	Optimisation of resource use for economic development
Fisheries governance	Combination of top-down and bottom-up	Actors who generate economic growth can influence	Some firms and factories engage effectively, but free riders exist	Top-down regulation from nation states
Food consumption	Low-meat diets with emphasis on regional brands. Demand for herring products high	Meat intensive diets, cheap products from global market. Demand for herring products at current low level	Divided between consumers making economic vs. green and healthy choices. Demand for herring products increases	Few national products dominate, meat intensive diets, demand only for top predator fish species, less for herring products
Dimensions of sustainability	Balance between all dimensions	Economy dominates, but others are also acknowledged	Environmental and social sustainability by those who can afford it	Attempts towards economic and social sustainability within countries
Economic development	Challenge to create green growth	Global economy	Uneven	National economies
Key problem	Reactions of stakeholders who do not share green values	Path dependency and limited capacity for transformation	Problems with environmental (in)justice	Lack of cooperation between countries
International relations	Global cooperation for green futures	Main focus on the EU and regional collaboration, but international collaboration also works	EU weakens, bilateral collaboration in the region and Europe, poor relations to elsewhere	No collaboration regionally and globally, the EU becomes obsolete

Table 2
Summary of the six recommendations on how to increase the use of Baltic herring as food, identifying who should do what.

Recommendations	Who and how	The sub-target
1. Develop the Baltic herring brand *to increase attractiveness of Baltic herring products*	- Formal fisheries governance system (i.e. the EU and national decision-makers and authorities) supports the fishing industry in the production of traditional and new trendy products made of both small and large herring. - Fishing industry collaborates with civil society and researchers to provide information on the sustainability of the stock and whether the fish is safe to eat or the eating recommendations apply (labelling as marketing tool). - Cross-sectoral collaboration to improve the overall image of the Baltic Sea.	Cross-cutting
2. Production of fishmeal and oil for human consumption *to gain access to the fishmeal and oil food market*	- EU decision-makers impose equal quality standards for products developed in the EU and imported outside the EU by removing the EU regulation banning the use of Baltic fish in fish oil for human consumption. - Fishing industry responds to the megatrend of enhancing human health through fish-related products by developing a market for fishmeal and oil food products made of Baltic herring. Fishmeal and oil producers establish separate production lines for food intended as fishmeal and oil, and develop high-quality fish oil from herring. - Civil society, fisheries managers, researchers and fishing industry collaborate to get certifications and labelling. - Researchers provide studies relating to quality, monitoring and health.	Cross-cutting
3. Use the feed directed share of the catch and by-products from food processing in aquaculture *to maximise the contribution of herring to food security*	- Formal fisheries governance system enforces and supports the use of feed-directed share of the catch, large non-compliant herring and by-products from food processing as feed in aquaculture. - Fishing industry and management collaborate to develop sorting, processing and distribution. - Civil society, fisheries managers, researchers and fishing industry collaborate to get certifications and labelling in order to increase the value and attractiveness of Baltic herring feed.	Cross-cutting
4. Target fishery towards small herring *to gain access to the EU market*	- The formal governance system supports innovative fishing methods targeting small dioxin-free herring, enforces sorting of the catch and ensures that only small herring enters the market unless otherwise indicated. - Fishing industry together with the civil society campaign to promote the consumption of healthy local fish. Large herring is used as feed in aquaculture. - Studies to assess areas from which sorting is needed and their percentages.	Reducing the dioxin content in herring
5. Create access to the EU market for Baltic herring *to respond to the CFP objective of increased seafood self-sufficiency and availability in the EU*	- The formal governance system supports product development and branding, and guarantees that products entering the market are compliant with the EU regulation or alternatively amend the regulation to allow access for large herring to the EU market and provide eating recommendations to risk groups. - Fishing industry invests in development and marketing of new products as well as promoting traditional products. - Civil society develops image of local, healthy and sustainable products and participates in dissemination and advertisement of the products. - Health studies to improve understanding of the benefits and risks of eating herring.	Increase markets for Baltic herring in EU
6. Create access to the global market *to respond to growing global demand for fish*	- EU and national authorities ensure that the fish entering the global market is safe to eat or eating recommendations are provided. They also foster good relationships with other countries. - Fishing industry creates new trendy products, develops existing markets and distribution channels, and looks for new market opportunities. Fishing industry collaborates with civil society to get ecolabels and certifications. - Civil society has a key role in promoting the image and brand of Baltic herring. - Market, health and socio-cultural value studies needed to support action.	Increase export of herring products outside EU

markets for environmentally friendly products or luxury products. Therefore, there is little incentive for the national governance systems and civil society to brand herring products. However, in this scenario, increasing (fish) food self-sufficiency at the national level becomes a priority. Therefore, the use of herring as feed in aquaculture increases, thereby also increasing the contribution of Baltic herring fisheries to food security indirectly.

Dynamics 3: Create access to EU markets in the "Inequality" scenario

The recommendation may seem to lead to better outcomes for many stakeholders, but also has side effects and negative impacts for other stakeholders. In the "Inequality" scenario, the consumption of Baltic herring will increase in the region due to growing demand for local and sustainable food products. However, due to the low enforcement power of the EU, there is no region-wide system in place to ensure that the herring entering the market is safe to eat or that sufficient information is provided to the consumers about the risks and benefits of herring consumption. As a result, herring that is likely to exceed the maximum allowable dioxin level can also be placed on the market. While some countries already have a risk management system in place for large herring, others do not. This implies that the health benefits and risks are unequally distributed in the Baltic Sea region between the countries. In some countries, consumers are informed about the potential risks related to Baltic herring consumption and in others the increased use of herring in this scenario may have negative health impacts on people, especially risk groups if they consume Baltic herring in great quantities. Therefore, side effects and trade-offs related to recommendations may emerge, and probably in different ways under different exploratory scenarios.

Dynamics 4: Gaining access to global markets and targeting small herring in the "business-as-usual" scenario.

The normative recommendation may work in a certain scenario, but have divergent implications for different stakeholder groups. Dynamics 3 considered inequalities within the countries where the herring is caught and consumed; here we point out implications of certain normative recommendation to different countries, functioning with

different logics and drivers. The workshop participants drew from their past experiences, and pointed out that the dioxin content of herring is not an issue when the fish is sold to Russia for human consumption—the current sale ban relates solely to political disagreements—whereas China, a potentially large buyer of herring, is more conscious of the health risks related to dioxins. Thus, the fisheries sector might ensure that the fish entering the Chinese market is safe to eat, i.e. by placing small herring on the Chinese market, while Russian consumers continue to be exposed to dioxin risks due to the lack of national and international safety regulations. Furthermore, there would be no economic incentives to change this logic. Therefore, targeting small herring in the business-as-usual scenario is likely to be fisheries dependent characterised by the divide between those targeting Chinese markets by catching small herring, and those focusing rather on quantity sold as a bulk product to Russia.

Dynamics 5: Gaining access to the EU market and targeting small herring in the "transformation to sustainability" scenario

The normative recommendations may also link to each other. Here we address a case where two or more recommendations will mutually reinforce each other, leading to a strong basis for the recommendations within an exploratory scenario. In the "Transformation to sustainability" scenario, EU policymakers will open a European market for Baltic herring and, at the same time, consumers choose and support sustainable herring products. Therefore, in that scenario, policymaking and citizen and consumer behaviour match each other. On the other hand, in this scenario, trends of the precautionary principle, integrated and ecosystem-based fisheries management and demand for environmentally friendly products will promote the development of novel products from small dioxin-free herring, thereby promoting also size-selective fishing and sorting the catch. This leads to fisheries strategies also to match with policies and consumer behaviour.

Dynamics 6: Fishmeal and oil for human consumption in the "Transformation to protectionism" scenario

Dynamics 6 addresses a situation where a recommendation for certain stakeholder groups under a specific exploratory scenario works only partially, and in order to work needs to be supported by other actors or policies that are not likely in the given scenario. In the "Transformation to protectionism" scenario, national subsidies and incentives will exist to fund investments to produce fishmeal and oil for human consumption. However, in that scenario, due to slow economic growth, fisheries have limited funds and therefore, unless the investments are fully subsidised, it is unlikely that investments for high-quality products are made.

5. Discussion

In this Discussion section, we develop theoretically relevant assumptions, which are based on the six key dynamics between normative backcasting recommendations and exploratory scenarios that were identified in Section 4.3.

5.1. Reverse dynamics

The normative recommendations identified in backcasting may actualise in some scenarios, but still not lead to desirable effects due to other dynamics in a given scenario. Therefore, it is essential that the implications of various drivers apparent in scenarios should be checked against the recommendations as some of the drivers may create "reverse dynamics", nullifying the effectiveness of recommendations seemingly workable in specific exploratory scenarios (c.f. Pomeroy et al., 2016).

5.2. Substitution

The diversity of inter-connected governance measures has been identified as a property of social-ecological systems that increases resilience (Jones et al., 2013). Relatedly, we found that certain recommendations may not actualise in a certain scenario, but there may be other developments in the scenario that substitute the recommended action. Therefore, some recommendations may not work in certain scenarios, but detailed analysis can lead to finding alternative ways of achieving the normative target in other ways (see Gordon, 2015). The substitution represents a constructive alternative to deeming that some normative recommendations just cannot work in certain exploratory scenarios. For example, van Vliet and Kok (2015) have analysed a set of recommendations under four exploratory scenarios providing a possibility to identify substituting ways to reach the target under specific scenarios.

5.3. Risky reasons

The exploratory scenarios may seem to halt the proposed recommendations but similar developments may emerge for alternative reasons that, however, have different impacts, including risks and negative side effects (e.g. Nel, 2015). The "Risky reasons" dynamic is close to that of "Substitution" but stresses that if developments arise from alternative reasons, they may also have alternative negative side effects. Therefore, it is not enough to map whether certain recommendations would work in a certain scenario, but to examine how the recommendations could work in a way that can realise benefits and/or minimise risks also for those stakeholders in an inferior position (Fabinyi et al., 2015).

5.4. Unique realisation

Some exploratory scenario logics may support actualisation of the recommendation having benefits for some stakeholders, while at the same time the recommendation will not take place regarding other actors (e.g. Fitzpatrick et al., 2017). The normative recommendation can work for some actors in a certain scenario, but other actors may thrive under the same scenario with different and even opposing logic. Thus, the normative recommendations should be sensitive also to solve the unique challenges and be open to promote multiple strategies as successful under an exploratory scenario across stakeholder groups.

5.5. Mutual reinforcement

There may be self-reinforcing feedback that makes the recommendations more robust in certain scenarios (see Bundy et al., 2017; Gutiérrez and Morgan, 2017). Here, two or more likely recommendations will mutually reinforce each other, leading to a strong basis for development supported by the recommendations within an exploratory scenario. Exploratory scenario logics may give rise to various mutually reinforcing developments, promoting the simultaneous workability of numerous recommendations.

5.6. Doubtful support

Even if individual recommendations targeting a single stakeholder group would work in some scenarios, they may need support from other actors, which is not probable in the given exploratory scenario (see Bodin and Crona, 2009; Stöhr et al., 2014). The doubtful support concept addresses the uncertainty of various actors to work for the recommendation in the given exploratory scenario.

6. Conclusion

This paper has identified recommendations on how Baltic herring

can be used significantly more as food in the future in order to provide a sustainable source of protein and nutritious food. These recommendations were analysed against four exploratory scenarios. This paper has proposed advancements to scenario literature by theorising further the question on HOW normative recommendations function across exploratory scenarios. To theorise the HOW question, we identified six assumptions on the dynamics between normative recommendations and exploratory scenarios. We emphasise the need to simultaneously analyse multiple 1) exploratory scenarios; 2) sets of normative recommendations instead of single recommendation; 3) implications of multiple drivers on single recommendations; 4) implications of recommendations for multiple stakeholders; and 5) synergies and trade-offs between recommendations. These notes need to be taken into account also in future methodologies to address the HOW question.

While our analysis offers a constructive departure to further develop the scenario methodologies, future research is also needed. Firstly, the participatory aspect of our method could be expanded. While the six normative recommendations were co-produced with stakeholders, the ways in which these relate to the four exploratory scenarios were identified by the authors of the present paper. However, being able to assess how a recommendation works in diverse exploratory scenario logics requires in-depth understanding of the scenarios. Therefore, adding a participatory aspect would include "a risk of participants being overwhelmed by the complexity of the choices they are being asked to make" (Robinson et al., 2011: 756), requiring more than one workshop to build ownership of the scenarios (see Cairns et al., 2016; van Vliet and Kok, 2015). Secondly, the six identified assumptions need to be tested in other cases. Thirdly, we detached the six normative recommendations from longer paths identified in the participatory backcasting exercise. The next step would be to start from complex recommendation paths and their relationships to exploratory scenarios rather than from individual recommendations. However, this simplification was needed for this paper to provide baseline assumptions on the HOW question. Fourthly, the presented exploratory scenarios need more detail with regard to their specific relevance and realisation regarding Baltic herring. Finally, the combination and further development of scenario methodologies is needed to better envision what is plausible in a contextual sense, and how people could react to those plausible futures by operational actions (Bourgeois et al., 2017). To assess the actual impact of the use of participatory scenarios to influence governance, follow-up studies are needed (Quist et al., 2011). By exploring the alternative futures, we can be better equipped to cope with future changes and proactively develop a practical means to make our world more sustainable.

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Appendix 1. Scenario-specific dynamics regarding the six recommendations to increase the use of herring as food

Transformation to sustainability	Business-as-usual	Inequality	Transformation to protectionism
Recommendation 1: Brand the products			
There will be both EU and national support systems for innovations, product development, branding, and marketing. Due to overall proactive attitudes towards the environment, there will be consumer demand for these products leading to new investments that increase herring catch as food.	Despite the initially low regional demand for herring food products, there are incentives and motivation to invest in product development, branding and marketing to gain access to global markets. Investments relate mainly to the promotion of Baltic herring use in fishmeal and oil production.	National incentives are scarce. However, due to high demand for local and sustainable fish products, bottom-up local and bilateral initiatives for product development, branding and marketing emerge, increasing inequality in the fisheries sector across the region.	Limited motivation for national incentives to develop the herring brand for human consumption as the demand to produce feed for aquaculture increases significantly due to closed national markets.
Recommendation 2: Production of fishmeal and oil for human consumption			
EU policymakers impose equal quality standards for fishmeal and oil products produced in the EU and in other countries. This decreases the EU food markets' dependence on imported products. Investment support for innovative and sustainable herring products are provided by nation states, and there are growing markets for healthy and environmentally sustainable products.	There will be an economic incentive for fish factories to adopt novel technologies for developing luxury fish oil products from herring. This competes with cheaper and lower-quality products developed outside of the EU. Although the regional demand for herring food is generally low, new luxury and high-quality fishmeal and oil products are attractive to many in the region and globally.	There will be no national or EU level support to develop the production of fishmeal and oil products for human consumption. However, in some factories, investments are made while others lack willingness and/or capacity to deal with the related (economic) risks. The products compete with cheaper imported products, and only the rich can afford to buy local high-quality fishmeal and oil products.	Global megatrend for healthy food will not diffuse in a fragmented world. International market does not exist, but domestic fishmeal and oil brands for human consumption that are promoted nationally as part of a healthy diet may emerge.
Recommendation 3: Use the feed-directed share of the catch and by-products from food processing in aquaculture			
Owing to increased demand, herring is used primarily for direct human consumption and secondarily for fishmeal and oil production. To meet the demands of aquaculture and to increase seafood self-sufficiency, by-products of food processing are used in aquaculture.	Due to low demand and a reactive management approach, the main strategy to increase food security and safety is aquaculture, and therefore the majority of the catch is used directly for fishmeal and oil. There is, however, an economic incentive to utilise by-products as well.	Aquaculture is the main strategy for food security and safety due to already existing infrastructure. Despite the increased use of herring for human consumption, there are only a few local initiatives to utilise by-products.	Many countries use herring primarily in aquaculture. Use for human consumption decreases; however, in some areas the by-products are used in fishmeal and oil to maximise profit and increase self-sufficiency in aquaculture production.
Recommendation 4: Target fishery towards small herring			
Owing to proactive approaches to management, this proposal will be implemented in areas where maximum allowable dioxin levels in Baltic herring are likely to be exceeded. New methods are developed to implement size-selective fishing. The demand for herring food products in the region is	Implementation dependent on global risk perceptions. If access to global markets entails that the dioxin levels are low, a fishery responds to this by ensuring that the products exported meet the safety criteria. Owing to fast technological development, new fishing methods are available.	Healthy and local diet is valued so there is consumer demand for dioxin-free small herring, but due to lack of regional collaboration and weak fisheries management, the development and implementation of new fishing measures is slow. However, many fishing companies sort the catch to increase	Due to ineffective production, reactive attitude to environmental problems, lack of cooperation between countries, and economic incentive, innovative fishing methods will not be developed. Size-selective fishing and sorting of the catch continues to take place in certain

high, and therefore the majority of the catch is consumed regionally.		the availability of small herring for human consumption.	countries, e.g. Estonia, but only on a small scale due to low demand.
Recommendation 5: Create access to the EU market for Baltic herring			
The European market is opened as EU policymakers prioritise improved self-sufficiency. There is a system in place to ensure that the herring entering the market is safe to eat.	EU policymakers are likely to open the European market to promote the viability of the fisheries sector and food self-sufficiency as many other pelagic stocks have not yet fully recovered. Risk management perceptions are changed to allow the Member States to place all Baltic herring products on the market, provided that consumers are informed accordingly, e.g. by using labelling on whether the fish product exceeds the maximum allowable dioxin levels.	The enforcement power of the EU is weak and trade limited as many nations are reluctant to open their fish food markets to new products. In the Baltic Sea region, however, trading of herring food products increases to meet the growing demand. There is no regional system in place to ensure the herring entering the market is safe to eat or labelled appropriately. This means that large herring can also be sold on the market. Some local initiatives emerge that aim to provide information to consumers.	The EU will break and there will be national protectionist policies. Each country manages the risks independently, which yields varying strategies for the use of large herring. However, since the demand for herring food products is low, large herring is mostly used in fishmeal and oil production, and poses no serious risk to human health.
Recommendation 6: Create access to the global markets			
Create market share by promoting the brand, new products and by ensuring that the products are safe to eat. Owing to increased awareness of food safety issues globally, the demand for small herring exceeds that for large.	Russia and Ukraine are important buyers of large herring, whereas market share for small dioxin-free herring is created in Asia. The Baltic Sea countries work together to increase the volume available for export markets.	Although international collaboration is poor, the demand for fish products is high, which means that there is demand for Baltic herring products. However, the attempts to gain access to the important international markets are local, small-scale and scattered. This leads to a very inefficient export scheme.	Owing to protectionist barriers, there is no access to the global markets in this scenario.

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