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Scenarios for coping with contingency: The case of aquaculture in the Finnish Archipelago Sea

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Abstract

Scenario-making is a common method for anticipating technological and other kinds of futures. This article discusses scenario-making from a methodological point of view. How do we cope with contingency, that is, the problem of not knowing what developmental trajectories in the present will turn out to determine future events? Two distinctions are suggested as tools for analyzing scenario-making strategies. The first concerns the analytical lenses, or epistemic approaches in our terminology, with which the future is understood. The second deals with the degree of variance in the future development. We divide the epistemic approaches to the future into conventional and unconventional scenarios, and the degree of variance in the future development into trend- and event-based scenarios. We argue that both unconventional and event-based scenarios have been neglected as tools for coping with contingency. A case study — the technological system of fish farming in southwestern Finland — is used to demonstrate the difference that unconventional and event-based scenarios can make for representations of the future. © 2002 Elsevier Science Inc. All rights reserved.

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1. Introduction

Thirty-five years ago, most experts within the Finnish fishing industry shook their heads at the crazy idea of farming rainbow trout at sea [1,2]. Independently of this,

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other experts projected catastrophic futures of depopulation for the Finnish archipelago areas [3,4]. Both groups of experts were proven wrong. In 1991, Finland's annual production of sea-farmed rainbow trout was over 15 million kilograms, at a value of FIM[1] 385 million [5]. These figures qualified the country as a major world producer of large (1–3 kg) rainbow trout [6,7]. At the same time, the depopulation trend started to level out in the archipelago areas. Fish farming at sea had turned out to be an important part of the solution to the depopulation problem [7,8]. Unanticipated development like this should make us reflect on the ways in which we represent the future in planning and management.

Constructing scenarios of possible future development has become a popular way of dealing with uncertain developments [9–11]. Scenarios are constructed concerning climate change, biodiversity, business development, national economy, global futures, etc. In this article, we treat scenarios as descriptions of possible pathways of development, articulated for the purpose of facilitating informed decisions about the future. In accordance with many current overviews of future studies' methodology, we place scenarios in the field of planning sciences, which fuse together prescriptions about how to proceed optimally from the present state to some preferred future state, with descriptions of the present circumstances and the historical trends that led to them [12–14].

Yet, the method of constructing scenarios is neither straightforward nor unproblematic. Socioeconomic and ecological development is characterized by *contingency*, which refers to the problem of not knowing what developmental trajectories in the present will turn out to determine future events. Contingent events are events that surprise us because we lacked the instruments for seeing them coming. While unpredictable, contingent developments are not random ones. As Stephen J. Gould puts it when describing the history of evolution in nature, a historical explanation of the unfolding of events does not emerge from deductions from laws of nature, but from sequences of preceding states, where major and often randomly triggered changes in any step of the sequence would have altered the final outcome [15]. In retrospect and despite the random influences, outcomes can be explained in causal terms because they are dependent upon what happened before. But when approached as a future process, evolution is highly unpredictable and final outcomes must be considered to be contingent.

The unexpectedness of events can be explained in at least two ways. First, events can be contingent because of restrictions in the particular lenses, which we have chosen for looking into the future. More technically, we propose the term *epistemic closure* for representing the necessary methodological limitations of scenario construction. In modeling, for instance, one must make decisions on what kinds of data to collect and how to relate different kinds of data in the model. Whenever a particular kind of epistemic closure becomes a habit within some field of scenario-making (for instance, futures for the Finnish fisheries sector), we use the term *conventional scenarios*. The problem with the culture of conventional scenario-making is that its analysis of the future is restricted

[1] Finnish marks.

— it can only register the events and trends that its particular approach allows it to see. There is a risk of highly contingent developments for which there is no preparation in society. Therefore, we want to emphasize the importance of constructing *unconventional scenarios*, that is, scenarios that are not based on conventional epistemic closure and do not follow trends identified in conventional scenarios.

Second, events can be contingent because they fall outside any detectable trend. Most scenarios consider the past to be a model for the future: existing trends are projected into the future, generally with a high and a low extreme value and one or a few middle values.[2] We call these scenarios *trend-based*. Other scenarios — called *event-based* scenarios — acknowledge that the past sometimes fails to be predictive of the future and focus more on the fact that small events can influence not only other small events but even the pattern of change. The occurrence of such events can be explained in different ways — for instance, as an effect of the freedom of agents or of the characteristics of complex systems. Common to all such explanations is the claim that events are unpredictable for all epistemic approaches. The task of event-based scenarios is therefore not to eliminate the contingent character of future events, but rather to make us realize that contingency is something we have to learn to live with and to demonstrate ranges of plausible expectations.

While both unconventional and event-based scenarios have been constructed in the past — such as those based on the nonlinear world development model reported in the Limits to Growth reports [17,18] — the overwhelming majority of scenarios can be characterized as conventional and trend-based. Examples abound. One of the most comprehensive global scenario studies of the past few decades, the Global 2000 Report to President Carter, was criticized for paying inadequate attention to major global geophysical or weather perturbations, for excluding consideration of natural, technological or social shocks and for falsely assuming that the future would be continuous with the past [19]. Similarly, the so-called coupled general circulation models, which provide the scientific basis for global climate change predictions, have not until recently been able to take into account rapid climate events and can only simulate the principal features, but not the details, of such events [20]. At the national level, the Finnish government has over the years published numerous scenario studies. Typically, however, Finnish scenarios of both the future of the national economy and the society in general explicitly exclude the consideration of 'crises' and 'very improbable possibilities' [21] and rather focus on description of social and cultural trends [22].

In what follows, we defend the view that unconventional and event-based scenarios are important in planning for the future, because they can (a) reduce contingency and/or (b) help us to be better prepared for contingent events. We will provide an analysis of the distinctions presented above: (a) conventional versus unconventional scenarios and (b) trend-based versus event-based scenarios. On the basis of these divisions, a two-dimensional categorization of scenarios can be constructed. To give our methodological bones

[2] For instance, the Intergovernmental Panel on Climate Change Reports [16].

some flesh, a small case study on the future of aquaculture in the archipelago of southwestern Finland is embedded in the text. The case is used for demonstrating what the notions of unconventional and event-based scenarios mean for the practice of projecting futures.

2. A two-dimensional categorization of scenarios

Scenarios have their limitations. They cannot function as objective road marks on our march to the future. Just like forecasts, scenarios are not transparent in relation to the future: their representations of the future can influence people's perceptions, decisions, etc., and thus either enforce or inhibit the contents of the scenario. In short, scenarios not only represent the future in some sense, but also participate in creating it.

The potential of scenarios to influence the reality that they describe derives from the fact that they are central elements of future-related discourses. As such, they constitute means through which different social actors can articulate their views of the future. Articulations of this kind both reflect and construct social interests, drawing on available cultural resources — like historical or mythical analogies; plots from novels, dramas or films; metaphors in present linguistic practices; and so on. Thus, scenarios are both socially and culturally embedded: they project the future in terms of the social interests and cultural resources that have dominated their making.

The social and cultural embeddedness of future projections can be exemplified by highway construction on the US West Coast after World War I and subsequent freeway construction from the mid-1950s to 1980s. These developments were made possible by widespread popular and political support, which materialized in public subsidies for road projects [23]. It is difficult to imagine that anybody criticizing the car-and-a-suburban-home ethos would have gained credibility at that time. Wisdom tends to come in retrospect. In 1970, the retired planning director of the by-then suburbanized Santa Clara County in the San Francisco region wrote an article for a conservation journal in which he acknowledged professional and political failure, because the valley's growth from 1950 to 1965 had been guided by anything but sound planning principles [23].

2.1. Conventional versus unconventional scenarios

Social interests and cultural resources provide general frameworks for the construction of scenarios. However, as we get down to the technical specifics of scenario construction, we must also take into account theoretical and methodological issues. Like all descriptions of the world, scenarios are based on particular, more or less articulated, theoretical assumptions. These assumptions involve, for instance, the concepts through which the past, present, future and the path(s) between the three are described, the causal relationships between different phenomena, the way in which concepts should be operationalized (for instance, qualitatively or quantitatively?), the status of the scenario in relation to the 'real' future (if there is any such) and so on. General theories about such conceptualiza-

tions, causal relations and possible operationalizations can be called epistemic frameworks (for instance, frameworks for understanding economic growth, technological development, political mobilization or human action). In the making of scenarios, epistemic frameworks have to be applied to the case, the future of which interests us (for instance, the future of Finnish aquaculture). The process of application modifies the framework so as to make it appropriate for the case in question. This modification can involve the invention of new concepts, more particular hypotheses about causal relations, more particular ideas about operationalization and so on. In our terminology, an applied framework is called an *epistemic approach* [24].

The condition for articulating a scenario is that some scenario-making approach is decided upon. This implies that a boundary is drawn between the epistemic inside and outside of the scenario. We call this process of boundary definition *epistemic closure* [24]. Sometimes the process of epistemic closure can be quite uncontroversial, with no competing approaches left aside. In other cases, closure leads to controversy and social conflict. For social scientists, an interesting question concerns the social and cultural mechanisms behind epistemic closures. Generally, cultures of planning and management have developed their typical ways of relating to the future, such as models for economic or social prognoses that are used regularly. This implies that a particular epistemic closure has been generalized. Projections of the future or scenarios that are made in this way can be qualified as *conventional*.

We can gain some insight into the process of epistemic closure through Maarten Hajer's notions of storyline and discourse coalitions [25,26]. *Storylines* are narratives that frame our understanding of particular phenomena. They provide us with thought models and a language to articulate the phenomenon in question. In doing this, they distribute roles and moral positions to different actors and define the risks and challenges facing them. Storylines tell us about the history, present and future of the phenomenon, and are therefore crucial for mobilizing responses among social actors. In politics (in a wide sense), storylines are potentially powerful because they can engage heterogeneous actors in relatively homogeneous policymaking processes. This possibility derives from the general and ambiguous language ('modernization,' 'globalization' and 'sustainable development') used in many influential storylines. The term *discourse coalition* refers to discursive convergence of the way in which heterogeneous social actors represent their identities, interests and ambitions. Modern discourse coalitions have been found in, for instance, the area of environmental policies, where various actors position themselves around notions like ecological modernization and sustainable development. Successful storylines generate unified policy processes. At the same time, however, they limit the scope of policies by marginalizing perspectives that do not fit within their framework [27,28].

The generalization of a particular form of epistemic closure in scenario-making can be seen as a particular case of storyline formation. It defines the epistemic lens through which the future is depicted and, at least implicitly, performs many of the framing functions of storylines. Scenarios are often constructed through a process of negotiation between 'relevant' social actors — national and local authorities, business, interest groups, univer-

sities, etc. Thus, in scenario-making, we see the emergence of *epistemic coalitions*, a subcategory of discourse coalitions.[3]

Considering the epistemic restrictions of scenarios, we suggest that a high degree of homogeneity in the practices of constructing scenarios is problematic. It is quite natural that there is some norm acquiring the status of 'conventional,' because it is important to develop standards to make decision-making efficient in terms of time and money. Standards do not necessarily have to be static, but can change as the time reveals flaws in assumptions or errors in predictions. Yet, it seems crucial that resources are allocated also to the construction of *unconventional* scenarios that make it possible to identify other developmental trends and reflect on their implications for the future of whatever happens to be the focus of analysis.

2.2. Trend-based versus event-based scenarios

A particularly significant methodological consideration in scenario-making concerns the degree of variance in the elements that constitute the scenario. Our introductory section stressed that the world sometimes changes in completely unpredictable ways. Yet, such knowledge is rarely integrated in scenario-making — be it conventional or unconventional.[4] Normally, change is seen as a scenaric invariant within some idea of gradual evolution. Scenarios that are built on such assumptions can be called trend-based scenarios. In trend-based scenarios, change is often graphically illustrated as continuous lines extending from a single point in the present to several alternative points in the future. In light of historical evidence, this is an inept way of describing both socioeconomic development [30] and natural evolution [15]. What is more, recent paleoclimatological studies indicate that past climates have been characterized by events caused by dramatic and rapid temperature fluctuations. Not surprisingly, events such as floods, landslides and avalanches have been identified as key challenges for constructing scenarios of the consequences of future climate change [31].

This is not to say that there is no stability in the world and that trend-based scenarios are doomed to fail. Our claim is rather that surprising changes do happen and that trend-based scenarios are unable to deal with this possibility. They should therefore be complemented with event-based scenarios, that is, scenarios which attempt to describe the future in less

[3] Epistemic coalitions are heterogeneous and should not be confused with what Peter Haas has called *epistemic communities* [29]. The latter term refers to networks of professionals "with expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area" [29]. In distinction from epistemic coalitions, epistemic communities are homogeneous, consisting of members that share normative and causal beliefs, notions of validity and who feel involved in a common policy enterprise. While the term 'epistemic coalition' refers to agreement among different actors about the approach to be applied in scenario-making, 'epistemic community' refers to one of the actors that might be involved. According to Haas, however, the epistemic community might be a very influential actor, because as society becomes increasingly complex and the future feels more and more uncertain, the need for expertise increases. In scenario-making, this would imply that experts or epistemic communities are gaining, or have gained, significant influence in determining the epistemic approach to be applied.

[4] The challenges of nonlinear development have been discussed within the field of futures studies by, for instance, Mannermaa's [13] and Vapaavuori's [10] collection of articles.

linear terms. Events are, as was mentioned in Section 1, not predictable as expressions of trends. In event-based scenarios, we are interested in events that affect the future of whatever it is that interests us. To the extent that social change is understood in terms of trends, events bring change into social change itself. In other words, social change becomes a *variant* rather than an invariant in the scenario.

Event-based scenarios can be constructed on quantitative basis, applying, for instance, trend impact analysis (TIA) or the mathematics of chaos and complexity [32,33]. Such scenarios should, however, be complemented by narrative scenarios, and this is what we want to focus on in the rest of this section. The point of narrative event-based scenarios is not to predict a *particular future*, but rather to demonstrate the *type of future* that can be envisioned on the basis of an informed (quantitative or qualitative) analysis of the present day society. This is done by exemplification: the type of future is exemplified by narrating a particular future. Why?

Narrative, event-based scenarios should not only describe what could happen, considering what we know about our situation today, but also the *kinds* of challenges and opportunities that could arise in a future of contingent events. Put in another way, event-based scenarios should give us an impression of what it would be like to live in conditions determined by event-based variations in the parameters of change. In trend-based scenarios, which operate according to the principle of gradual evolution, such analysis is often considered superfluous, since the challenges and opportunities are already known. In fact, the perceived challenges and opportunities generally function as the motivation for making trend-based scenarios (e.g., when demographic prognoses are made to help decision-makers design social security systems). Narrative, event-based scenarios are different. Their task is not to specify already known kinds of opportunities and challenges, but rather to introduce new ones.

2.3. Combining the perspectives

The trend-based versus event-based distinction is clearly different from the conventional versus unconventional distinction. The first distinction refers to the extent to which unpredictable events dominate the plot of the scenario, while the second is related to the epistemic approach that dominates scenario-making within a particular field. We are therefore in a position to formulate a four-field based on the two dimensions of scenario construction, as shown in Table 1.

Table 1 outlines four categories of scenarios: conventional trend-based, unconventional trend-based, conventional event-based and unconventional event-based scenarios. In the following, we are most interested in the unconventional trend-based and the conventional event-based scenarios (italicized in Table 1), because in our assessment they constitute the less-charted territory of scenario construction. The unconventional trend-based scenarios attempt to outline foreseeable developments in domains of change not ordinarily perceived as having an influence on the activity of interest. In the case of aquaculture in the Archipelago Sea (to be described in Section 4), we think such unconventional trends might be Russian energy policy, Norway's decision to join the EU, Baltic algae blooms and the reinvention of archipelago communities. The conventional event-based scenarios focus on surprising events

Table 1
Categories of scenarios based on epistemic approach and variance in development

	Epistemic approach	
Variance in development	Conventional	Unconventional
Trend-based	Foreseeable trends in domains known to have an influence on the activity of interest	*Foreseeable trends in domains not expected to have an influence on the activity of interest*
Event-based	*Surprising events in domains known to have an influence on the activity of interest*	Surprising events in domains not expected to have an influence on the activity of interest

in domains of change that are empirically known to have an influence on the activity of interest. In the case of Finnish aquaculture, such events might be dramatic fluctuations in value-added tax (VAT), the disappearance of the Helsinki Commission for the Protection of the Baltic Sea and unexpected change in fish consumption.

We are less concerned with the two remaining diagonal cells in Table 1. By conventional trend-based scenarios, we mean projections into the future of foreseeable trends known to have an influence on the activity of interest. We are not implying that these scenarios are irrelevant, only that they provide a rather narrow view of the future and that much research has already been done on the predictive and extrapolative methodologies that they rely on. For the sake of clarity, we are also omitting the unconventional event-based scenarios — although we do mention some parameters around which such a scenario could be constructed.

3. The case: aquaculture in the Archipelago Sea, Finland

To illustrate what we mean in practice by the unconventional trend-based and conventional event-based scenarios, we will apply these notions to the case of aquaculture in the Finnish Baltic Sea archipelago, which we have studied extensively [2,34–42]. To understand the scenarios, one has to know something about the history of Finnish aquaculture and its present situation.

In Finland, aquaculture constitutes the major branch within the fisheries sector [6]. It consists of food fish and fry production in cages, tanks and artificial and natural ponds. A distinction can be made between inland and sea farming. While inland farming uses fresh water, sea farming is performed in the brackish water of the Baltic Sea. From the perspectives of aggregated quantity and economic value, sea farming is significantly more important than inland farming. Yet, sea farming is dependent on the juveniles produced by inland farmers. Finnish aquaculture at sea is extremely homogeneous with a complete domination of one species, rainbow trout [5].

Rainbow trout farming at sea was introduced at the end of the 1960s [1,38]. The fish is raised to the size of 1–3 kg in net cages. After a careful start, the amount of establishments increased exponentially during the 1980s, first in the Turku archipelago and a few years later in the Åland archipelago. The dramatic development is clearly illustrated by the increase of

fish produced at sea farms from less than 1 million kilograms in 1978 to more than 15 million kilograms in 1991. During the same time span, the value of sea-farmed rainbow trout increased from FIM 55 million to FIM 385 million (1992 prices). These numbers can be compared with the decrease of the value of Finnish professional fishery at sea between 1980 and 1991, from FIM 241 million to FIM 153 million [5]. In the 1990s, the developmental trajectory of fish farming changed direction — partly as a result of environmentally motivated restriction introduced by the authorities and partly as a consequence of poor profitability brought by low prices. In 1998, Finnish sea farmers produced approximately 13 million kilograms rainbow trout at a value of less than FIM 200 million (1997 prices) [43].

Sea farming is located in the archipelago areas along the Finnish coast, the southwestern archipelago between Hanko and Åland being the most significant area [43]. To simplify, we call this archipelago area the Archipelago Sea according to common practice, although there is no strict geographical definition for that name. The introduction of rainbow trout farming coincided with a period (1950–1975) of strong depopulation in the Finnish archipelago areas, and the enterprise became an important factor in leveling out the negative trend [2,7]. Today, aquaculture is an important source of employment in several municipalities [8]. Although being a relatively new business in the archipelago, it has been argued that fish farming has functioned as a way of preserving and developing the fishery traditions in the area during times of decline in 'normal' fishery [36,44].

The economics of aquaculture is complex. The greatest expenditure for fish farmers is represented by feed, which is produced by Finnish fodder industry using imported fish. Salaries, interest-levels and taxes are also significant expenses [8]. On the income side, the market price of rainbow trout is the major determinant. Most competition comes from Norwegian farmed salmon and mass-produced cheap meat like pork and poultry [45]. Unlike the rest of the Finnish fisheries sector, aquaculture ever received direct price subsidies. Fish farmers are therefore used to the risks of the free market [6]. The Finnish membership in the European Union (EU) (from 1 January 1995) implied changes in the form of market dependency. The general liberalization of the food markets affected the Finnish fish prices negatively from the producer's point of view. Finland is part of the Common Organization of the Markets (COM) within the EU. As the Union adjusts the COM to the World Trade Organization (WTO), the mechanisms influencing Finnish food and feed prices are not only internationalized, but also globalized [46].

Since the early 1970s, Finnish aquaculture has been surrounded by conflicts concerning the environmental impacts of the industry [1,47]. Fish farmers have been accused for being responsible for ecological problems like mass growth of algae, silting of shores, pollution of fishing equipment, etc. — problems that have serious aesthetic, ecological and potentially also economic consequences in the archipelago. Mass media have been instrumental for putting the aquaculture controversy on the public agenda, enveloping the pollution problem in a rich context of political and cultural symbolics [39,48].

The aquaculture controversy has often been framed within a larger discourse on the ecology of the Baltic Sea. This was achieved, for instance, by the inclusion of aquaculture in the Helsinki Commission's (HELCOM, the major instrument for international cooperation for improving the environmental state of the Baltic Sea) hotspot list over sources of serious

pollution into the Baltic Sea [49]. The poor environmental condition of the Baltic Sea has meant that any eutrophication-related bad news about the sea can lead to significant public and political pressure on the business — independently of the extent to which fish farming can be proved to have causal responsibility. Advocates of fish farming have tried to counter these negative attitudes by emphasizing that the environmental problems of aquaculture are primarily a local or regional matter and that the contribution to Baltic Sea pollution is very small (1.2% of the phosphorous release and 0.4% of nitrogen-release into the Baltic Sea in 1990 according to Karttunen and Vielma [50]. According to HELCOM, the numbers were 1.5% and 0.4%, respectively [37].). There have also been considerable improvements in fish farming practices to decrease pollution: for instance, better composition of the feed and better feeding practices [50]. New cage technologies are being developed at the moment (Eklund, interview, May 1999 in Dragsfjärd). Some ecologists have also proposed an integration of cage farming of salmonids with mussel-rearing in order to 'recycle' the surplus nutrients coming from cage fish farming [51].

During the 1990s, the amount of rainbow trout farmed in Finland has slowly decreased [5]. This reduction is apparently due to two factors. On the one hand, authorities have been more restrictive in giving permits, since the algae problem in the Baltic Sea has alarmed the public and since aquaculture in the Archipelago Sea has remained on the HELCOM hotspot list. On the other hand, the enormous expansion and export of farmed Atlantic salmon in Norway has caused price pressure on rainbow trout farmed in Finland. Large farms cannot easily get permits to expand and some small farms have closed down due to low prices. However, some large farms have continued to export rainbow trout to Japan.

In the Archipelago Sea Region, the economic significance of the primary sector has continued to decrease during the 1990s, while the importance of tourism and service production as well as the welfare sector has increased [52,53]. Fish farming is still of crucial importance in some municipalities, while tourism and leisure-related services are gaining in importance in other municipalities.

The authority responsible for maintaining and developing the Finnish fisheries sector is the Ministry of Agriculture and Forestry. Much of the research on fish farming is done by its Game and Fisheries Research Institute. The Ministry of the Interior, and especially its Island Committee, has taken an interest in the role of fish farming for regional development. The Finnish Environment Institute, under the Ministry of the Environment, is concerned with the environmental impacts of fish farming. The government-owned Kera (today Finnvera), as well as the Ministry of Trade and Industry, has seen fish farming as a business to be supported and technology to be developed. Fish farmer interests have been promoted by their organization, Suomen Kalankasvattajaliitto. In Åland, there are corresponding institutions, although at a smaller scale. All these actors have produced a significant amount of published material related to the future of fish farming in the Archipelago Sea.

The discussions about the future of fish farming focus on economic, technological, practice-related, environmental, social, biological and medical issues. *Economic concerns* have been domestic market developments, exports, interest rates, taxes, insurance, competition with other products, product development and refining, marketing and exploration of opportunities for a more diversified aquaculture. The economic frame also involves

monitoring and predictions of Finnish fish consumption and consumer attitudes to fish [6,45,54–60]. In the area of *technological development*, attention has been directed towards new feeds, new instruments for feeding, refining technology, cage technology and removal of pollution [47,55,57,58,61,62]. *Practice-related work* has aimed at improving efficiency, hygiene and quality in all parts of the chain from production to consumption. Education and information are important parts of this work [6,57,58,61]. *Environmental scenarios* have focused on the reduction of pollution according to policy targets, the localisation of fish farms, investigations of how climate change and ecological changes in the sea can affect the health and growth of farmed fish and the development of regulations and policies in granting permits [6,47,55,57,61–64]. *Social challenges* have been seen in conflicts between different interest groups, the structural change in the professions of the fisheries sector, the promotion of family enterprises and the role of fish farming for regional development [6,47,63,65,66]. *Biological research* has aimed at speeding up growth, controlling reproduction and improving disease resistance in the fish, both by traditional breeding methods and, more recently, by using modern biotechnology [6,47,55,57,61]. *Medical concerns*, finally, have covered disease prevention practices, preventing fish diseases from spreading to and within Finland and strategies for dealing with epidemics [6,57].

Scenarios in the sense of focused narratives about plausible or possible futures of Finnish fish farming are rare.[5] The future is rather projected through general goals, particular targets, articulated challenges, acknowledged risks and, most commonly, through more or less implicit assumptions about how markets, environmental policies, technologies, consumption patterns, etc. will change in the future. Claims about the future tend to be either prescriptive or implicit (or at least not discussed critically). The material that we have studied clearly shows a tendency towards conventionalization. Most reports apply the same set of epistemic approaches to the future of fish farming. Future projections are also clearly trend-based, despite the experiences of sudden fluctuations in the sector. We are not thinking only of the surprising emergence of sea farming as a major element in Finnish fisheries, but also of the drastic decline of exports of rainbow trout from 2100 tons in 1985 to 200 tons in 1986 [63].

4. Seven scenarios

We can now return to the discussion about unconventional and event-based scenarios. To illustrate the way in which such scenarios change our perspectives on the future, we will outline a set of potential trajectories of development that could have an influence on Finnish acquaculture, yet cannot be identified by relying on the epistemic approaches or the extrapolation of past trends presently adopted by the Finnish fisheries authorities and fish farmer organizations. Our scenarios are constructed as stories about the future — even if

[5] The exception being [6].

narrated in the past tense — and thus introduce the topic of the future in a clearly articulated (in distinction to an implicit and hidden) way. The point here, however, is not to narrate entire scenarios, but merely to demonstrate the way in which unconventional approaches can introduce novelty into discourses about the future. In the terminology of the United Nations' Millennium Project, what follows are general scenarios within a system of *nested scenarios*, describing the boundary conditions for more detailed scenarios [67].

Let us first look at four *unconventional trend-based scenarios* for the Archipelago Sea aquaculture, which focus on trends in parameters not conventionally thought to have an influence on the activity. The Finnish fisheries sector lacks the means for projecting such futures because they are considered to be external to the future of aquaculture when it comes to systematic projections.

4.1. Russian energy policy

When the Primorsk oil port project at the eastern end of the Finnish Gulf was officially launched with little certainty over financing in 2000, skeptics thought the idea would gradually wither away. Yet, the consistent increase in oil price since 2000 speeded up the extraction of oil and gas resources in northwest Russia. The EU's Northern Dimension Program, presented by Finland as a policy initiative to the EU in 1996 and solidified as an EU program in 2000, ensured financial and political support for the activity. In the minds of Russian decision-makers, the Primorsk oil port became the obvious gateway for transporting oil from the remote regions of Siberia to Central Europe and the rest of the world. Despite much-publicized environmental concerns expressed by Finland, Estonia and Sweden, in particular, port construction began with urgency in 2012 and full-scale oil transport in 2015. Oil tanker traffic increased dramatically in the Baltic. Confidence in the future of aquaculture in the Baltic Sea began to erode. That confidence received the definitive hit in 2017, when two oil tankers collided in bad weather in the Finnish Gulf outside the Archipelago Sea, spilling most of their cargo to sea. Aquaculture as a livelihood along the Finnish coast and Åland began to lose its significance.

4.2. Norway joins the EU

Norway, the Euro-skeptic of the late 1990s, decided to join the EU by popular vote in 2005. With strong support from aquaculture interests in Finland and Sweden, Norway successfully lobbied for significant subsidies for aquaculture and fishing, citing the need to preserve traditional European cultures in Arctic coastal and archipelago regions. A special support scheme was established under the auspices of the EU's Northern Dimension Program, which ensured significant funds from the EU to research, development and entrepreneurship in aquaculture. By 2010, Norwegian fish farmers diversified their economies by buying almost 40% of the Finnish sea-farms. Aquaculture in the Archipelago Sea became more industrialized, with a marked increase in production unit size and the level of fish product development. The Finnish and Åland authorities allowed this development arguing that it was the only way to maintain a viable fisheries sector in the country. As part of this development,

Finnish aquaculture lost its local character and complex conflicts arose between Norwegian aquaculture interests and Finnish tourist interests.

4.3. Baltic algae blooms

The occasional Baltic algae blooms of the 1990s had become a recurring event by the second decade of the new millennium. The most pronounced impact of the algae blooms on aquaculture was an indirect one. Aquaculture was more and more perceived as one of the hottest spots of nutrient loading into the Baltic, and thus a major contributor to the algae problem. The political pressure on Finnish and Åland authorities to increase their restrictions on fish farming at sea led to much more stringent requirements for renewed and new allowances. At the same time, a dramatic change occurred in the attitudes of the archipelago people. European and domestic tourism, which had become a major economic factor in these areas, was negatively affected by the poor image of aquaculture. Influential German newspapers reported about the health risks connected with bathing in the Baltic Sea archipelago and illustrated their articles with maps indicating the locations of fish farms. International environmental organizations urged tourists to boycott the Finnish archipelago. Local opinion in the archipelago municipalities turned against the trade for the first time in the short history of aquaculture.

4.4. Reinvention of archipelago communities

During the first decade of 2000, it became clear that two major groups of inhabitants were beginning to ensure the continued existence of archipelago communities in south-western Finland. There were the permanent inhabitants, many of whom relied on novel rural livelihoods such as ecological farming, tourism and IT-mediated distance services. Then, there were the semipermanent dwellers who worked in the urban and suburban regions but lived in the archipelago for at least 6 months of the year. The new archipelago people had an immediate negative effect on aquaculture. As the activity became more industrialized and high tech-oriented, largely through innovations in biotechnology and environmental protection, the new local population grew increasingly skeptical of its impact on the image of a clean and environmentally friendly archipelago life. At first, there were intensive conflicts within archipelago communities over the status of aquaculture between the older generation, who were generally positive towards the potential of aquaculture, and the younger generation, who wanted to get rid of it. By 2020, the generation shift in archipelago communities had turned aquaculture into a minor livelihood for the few entrepreneurs who were willing to experiment with small-scale and environmentally sound fish farming practices.

We will now turn to three *conventional event-based scenarios* for Archipelago Sea aquaculture, which focus on surprising events in parameters known to have an influence on aquaculture. In contrast to the trend-based scenarios, the event-based scenarios outline trajectories that may seem unpredictable and therefore speculative from the perspective of

existing models. The issue here is how the models are structured, or more precisely, the extent to which the models account for nonlinear developments. The event-based scenarios thus discuss not the trends in, say, VAT and fish consumption, but rather their extreme fluctuations.

4.5. Dramatic fluctuations in VAT

The level of VAT always had major implications for the profitability of aquaculture. By 2010, the first common EU tax policy had been developed with considerable emphasis on environmental issues. After a lengthy debate within the EU over whether indirect taxes should reflect specific policy aims such as environmental protection, the EU decided on considerable VAT breaks for renewable natural resource extraction, such as fishing and aquaculture. The Finnish Archipelago Sea experienced a revitalization of aquaculture when confident entrepreneurs began to invest in new aquaculture plants based on recently developed environmentally sound technologies. The entrepreneurs were also able to attract research and development funds from the EU for increasing plant size and production efficiency. In 2015, however, the newly appointed Commission gave contrary signals and made explicit political motions to 'neutralize' VAT with respect to specific policies. The markets reacted immediately and aquaculture business suffered suddenly and significantly.

4.6. An environmental policy-vacuum

During the first decade of 2000, the EU began to show an increasing interest in Baltic environmental policy. The HELCOM organization, which used to provide a platform for environmental protection and crisis management in the Baltic Sea, was dismantled in 2007 to minimize overlap with the EU-based environmental mechanisms on the Baltic Sea region. In contrast to HELCOM, the EU took an extremely stringent and implementation-oriented view of environmental matters in the Baltic. However, at the end of the decade, such policies were made ineffective by Russian attempts to secure its economic and political interests in the Baltic Sea. Russian oil exports through its Baltic Sea harbors conflicted seriously with EU-norms, and Russian leaders saw the defense of its oil exporting interests as a way of diminishing EU hegemony in the area. The conflict undermined the EU's ambitions and created an environmental policy-vacuum in the Baltic Sea. At the same time, the inability of the EU to successfully restore consumer confidence in meat after the Bovine Spongiform Encephalopathy (BSE) scandals increased fish consumption significantly in Europe. The Finnish fish farmers were able to benefit from the situation and to initiate a new phase of expansion without much opposition from any authorities. The general public felt that Russian oil tankers, not Finnish fish farmers, were to blame for the degeneration of the Baltic Sea. In a few years, aquaculture became the cornerstone of the Archipelago Sea economy.

4.7. Unexpected trends in fish consumption

The crisis of the European meat industry, triggered by the spread of BSE in the beginning of the decade 2000, boosted rainbow trout exports. A significant transformation of

consumption patterns occurred at a European scale. Within Finnish aquaculture, this resulted in new investments as well as pressure on Finnish environmental authorities to liberalize their policies. At the same time, fish farmers were divided on environmental issues. Many claimed that there was now a unique opportunity to boost the symbolic value of farmed fish. These producers feared that loosened environmental restrictions would undermine such a transformation. However, in the summer of 2006, the constellations changed radically. The appearance of a new, poisonous algae species in the Baltic Sea inflicted serious damage to consumer confidence in products originating in that body of water. Even if only a few fish farms actually experienced massive fish deaths, and only two cases of human illness directly related to the algae were identified, the change in consumer perception could not be prevented. By 2015, market fluctuations of this kind appeared to have become the norm of the enterprise. Demand was pulled down by serious algae blooms, the occurrence of the poisonous algae species, and other similar negative associations. It was pushed up again when the arguments for the healthiness of fish took hold. In the long run, the market fluctuations turned aquaculture into a relatively minor part-time enterprise, since plant sizes were kept small to allow for rapid adjustments to marked demand.

A third category of scenarios is that of *unconventional event-based scenarios*. We decided to omit this category, in order to avoid confusion between the notions of 'unconventional' and 'event-based.' There are, however, no principal obstacles to constructing such scenarios. Any of the unconventional trend-based scenarios in Section 5.6 could, for instance, be varied so as to admit strong fluctuations in development (for instance, in the Norway–EU relations in Scenario 2), so as to make the scenario more event-oriented and less trend-oriented.

5. Conclusion

The main implication of this case study is a plea for plurality in strategic efforts to outline future options for Finnish aquaculture policy. In our assessment, Finnish fish farmers and officials responsible for fisheries management constitute an epistemic coalition that has grown accustomed to mapping out its future options with conventional approaches that assume more or less linear development. This makes the core group of fisheries experts ill-prepared for future contingencies. We have no illusions about creating alternative epistemic coalitions overnight. What we do see a need for, however, is self-reflection by fisheries experts. In the long run, it would serve the fisheries community well to facilitate the emergence of novel epistemic coalitions based on unconventional approaches to aquaculture management and to promote tolerance toward revising the conventional models to account for surprising futures.

Epistemic coalitions sympathetic to scenarios about contingent events would not make life any easier for policymakers. But the coalitions would help policymakers make more sense of their difficulties. Reducing or just being prepared for contingent events introduces a plethora of complexities and uncertainties to policy design. The policy prescriptions that flow from

unconventional and event-based scenarios such as those outlined in this article would obviously contain mutually incompatible elements. This, however, is nothing new to modern environmental policy issues, which are more often than not characterized by uncertainty and complexity. In fact, scenarios for coping with contingency are a necessary prerequisite for policy design in complex and uncertain management systems, which have recently been explored in diverse fields ranging from sustainable development [68] and environmental institutions [69] to computerization [70] and organizational analysis [71].

Our argument for heterogeneous scenario-making practices is not only epistemological. There is also a moral reason for promoting plurality. All scenarios have a normative aspect concerning the optimality of measures taken to achieve desired ends. In scenario-making, epistemic closure is paralleled by a *normative closure*. This is not always realised because the prescriptive elements of scenarios are rarely brought under critical scrutiny. Even the most 'objective' assessments about the future are laden with normative positions.[6] Scenarios concerning Finnish aquaculture are no exception.

For instance, in its environmental protection program for fish farming (1996–2005), the Finnish Environment Institute working group presents pollution figures of fish farming as percentages of total regional pollution [62]. Thus, the nitrogen and phosphorous release of fish farming is compared with that of other actors within the regions in question. This gives an unfavorable picture of fish farming and the need for pollution reduction seems to be obvious. If, on the other hand, the numbers had represented shares of total nitrogen and phosphorous input into the Archipelago Sea, the picture would have been quite different. The major part of these eutrophying agents comes from the rest of the Baltic Sea and from the air. What is interesting is that the working group refused to present such calculations despite the insistence of fish farmer representatives. It appears that the majority of the working group thought that the way in which they present the current situation affects the legitimacy of the program targets for the future. For anyone unfamiliar with different ways of calculating pollution responsibility, the working group report will appear as an objective — and thus normatively neutral — account of reality (unless, of course, one reads the 'deviating opinion' of the fish farmer representatives in Attachment 4 to the report).

Our plea for pluralism is made with full acknowledgement of its vulnerability to criticism: either the scenarios are seen as containing irrelevant parameters of change or the variability of the parameters is criticized as being improbable. We can only defend ourselves with an epilogue on contingency.

Our motivation for writing this article was a long-standing professional interest in scenario methodologies [69,73–78]. However, at the height of writing the first draft in the spring of 2000, we were rewarded with a motivation of a more ambiguous nature when reality spoke to us the way we expected. On 27 May 2000, an aquaculture plant in Kumlinge, Åland was reported to have full contamination of the viral hemorhagic septicemia (VHS) virus. The entire stock at the plant was exterminated [79]. A few days later, the disease was found at the

[6] This is why we find the traditional division of scenarios into 'exploratory' (what might happen on the basis of forces at play?) and 'normative' (what ought to be done?) problematic [72].

Pyhtää plant on the coast of mainland Finland with similar results [80]. To make matters worse for Finnish aquaculture business, a long-time critic of Norwegian aquaculture decided to open his mouth at the height of the fish kills in Finland, claiming that medication delivered to fish during aquaculture was cancer-causing [81]. By the summer of 2000, the VHS virus scare was already having an impact on rainbow trout demand [82] and the precarious future of Finnish aquaculture had once again become one of the main media topics, both in news and opinion pages [83,84]. This time, however, eutrophication was not the problem.

Who would have thought of it?

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