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# A sea of many colours – How relevant is Blue Growth for capture fisheries in the Global North, and vice versa?

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A B S T R A C T

Blue Growth is a relatively new term that is meant to realize economic growth based on the exploitation of marine resources, while at the same time preventing their degradation, overuse, and pollution. This article discusses the relevance and usefulness of this new concept for the development of capture fisheries, a sector where growth largely seems impossible without ecological devastation. An analytical distinction between intensive and extensive growth is used to argue that certain development trajectories of capture fisheries might qualify as Blue Growth. Such trajectories of growth are illustrated with the development of the Swedish bleak roe trawl fishery in the Bothnian Bay and Norwegian whitefish fishery in the Barents Sea. Comparison of the cases highlights aspects that Blue Growth advocates might want to include if they choose to consider capture fisheries as a relevant economic activity. These aspects include: a) adding value through certification; b) technological development to make more efficient use of resources used up in the fishing operation, and to upgrade their fish as commodity; and c) specialization.

## 1. Introduction

> *"I have been feeling very clearheaded lately and what I want to write about today is the sea. It contains so many colours. Silver at dawn, green at noon, dark blue in the evening. Sometimes it looks almost red. Or it will turn the colour of old coins."* [1 p. 159]

'Blue Growth' was introduced at several high-level meetings during 2015, including the World Ocean Summit and the World Ocean Council, and builds directly on the efforts of the Rio + 20 conference in 2012 that advocated a 'green economy' perspective. The term is used in the discussion of how to best manage the exploitation of marine resources. It refers to economic growth within the marine sector that does not lead to the degradation of marine ecologies. The idea of Blue Growth now prominently features in proposals of, amongst others, the Food and Agriculture Organization (FAO) [2], the Norwegian government [3], and the European Commission (EC) [4].

Distinctive of the term is that it disclaims the incommensurability that is often presumed between capitalism and ecological sustainability [5]. Just as with other related ideas, such as 'Green Capitalism' [6,7], 'Green Growth' [8], or 'Ecomodernism' [9], Blue Growth is underpinned by a discourse [10] that frames a trajectory of development that can realize greater revenues from marine resources while at the same time preventing their degradation, overuse, and pollution.

Although Blue Growth is mostly defined as (economic) growth within the marine sector, some advocates use it to spearhead 'new' activities of the 'blue economy', because these activities are considered to have growth potential [11,12]. In this light, there seems to be little or no potential for Blue Growth in the so-called 'traditional sector' of capture fisheries [13]. Yet, other proponents of Blue Growth nevertheless choose to include capture fisheries. Some only consider the potential of capture fisheries for human consumption [14], while others include all types of capture fisheries [4].

The aim of this paper is to explore the ambiguous role of capture fisheries in propositions for Blue Growth by asking how relevant capture fisheries is for Blue Growth and vice versa? To answer this question the paper first highlights how and if proponents of Blue Growth include capture fisheries. It then considers the (limited) potential for growth in this marine sector by analytically distinguishing between extensive and intensive growth trajectories. Using this distinction, the paper illustrates growth trajectories in capture fisheries that could qualify as Blue Growth in two very different fisheries: The Swedish bleak roe trawl fishery in the Bothnian Bay and the Norwegian whitefish fishery in the Barents Sea. Comparing these cases highlights three aspects that are indicative for growth of capture fisheries in marine environments that qualify as 'fully fished' and/or 'overfished' [2]. These include: a) adding value through certification; b) technological development to make

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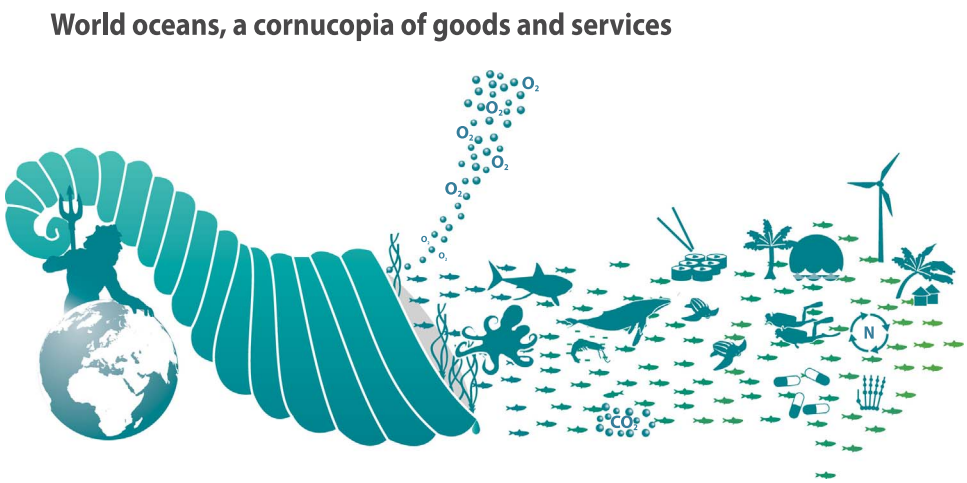


**Fig. 1.** Oceans as cornucopia [23 p. 7; GRID-Arendal].

more efficient use of resources used up in the fishing operations, and to upgrade their fish as commodity; and c) high level of specialization. Based on this analysis the paper concludes that it is not only possible but also important to consider the relevance of capture fisheries for Blue Growth initiatives.

## 2. Blue Growth and capture fisheries

Blue Growth is adopted by a diverse group of actors involved in fisheries exploitation and management, including governments, corporations, and non-governmental organisations. Despite the different backgrounds and agendas that these actors pursue, the idea of Blue Growth is based on a set of understandings that all of them underwrite in one way or the other. In what follows the most important of these understandings will briefly be described, starting with three definitions of Blue Growth:

> "[…] *smart, sustainable and inclusive economic and employment growth from the oceans, seas and coasts*" [4 p. 8].

> "[…] *economic activity* […] *in balance with the long-term capacity of ocean ecosystems to support this activity and remain resilient and healthy*". [15 p. 7].

> "[…] *the sustainable growth and development emanating from economic activities in the oceans, wetlands and coastal zones, that minimize environmental degradation, biodiversity loss and unsustainable use of living aquatic resources, and maximize economic and social benefits.*" [12 p. 4].

What these definitions share is the idea that economic activities and growth are not antithetical to ecological conservation and sustainability but rather complementary, or even reinforcing. The assumption about the commensurability of economic growth and ecosystem health differentiates the Blue Growth discourse from sustainability discourses which problematize 'traditional' economic growth based on capitalism [16–18]. Not surprisingly, critics of Blue Growth question this assumption [13,19–22].

Moreover, as will be seen shortly, the Blue Growth concept is emphasizing market-based incentivization as central mechanism to commensurate economic growth with sustainability of marine environments. With this focus the discourse differentiates itself again from other sustainability discourses that see governmental interventions as necessary for accommodating both economic and ecological wellbeing [10]. Admittedly, the lines differentiating Blue Growth ideas from other sustainability ideas can often not be neatly drawn. This is also apparent from the three definitions highlighted above. The EC and FAO definitions include 'social wellbeing' and 'inclusive growth', while these aspects are absent in the definition provided by the Economist Intelligence Unit. Yet, despite these differences there is a core of ideas, concepts and categorizations – a discourse – that are shared by most Blue Growth advocates, and which will be briefly described in the following.

### 2.1. Technological optimism

A central aspect of the Blue Growth discourse is its technological optimism. The way to commensurate economic growth with ecological sustainability is through new technological advances and innovations. The idea is that so-called 'green' technology is more energy efficient and less harmful to the marine environments:

> *"Green technologies include low impact, fuel-efficient shipping methods; innovative multi-trophic aquaculture production systems using environmentally friendly feeds; reduced energy use and greener refrigeration technologies; and improved waste management in fish handling, processing and transportation."* [23 p. 8].

Along a similar line, the European Commission in their documentation points out that *"biotechnological developments may have beneficial effects by reducing energy and water requirements, recycling costs of chemical products and greenhouse gas emissions."* [4 p. 22]. The optimism about technological possibilities creates the impression that with Blue Growth economic developments can be 'decoupled' from the marine environment i.e. more efficient technology helps to increases economic productivity without using more natural resources [see also 9]. For the Economist Intelligence Unit [15] this raises the question to what extent Blue Growth initiatives are susceptible to 'blue washing'? Is the attention to Blue Growth nothing more than spin and a PR effort to create the false perception that products and services are environmentally friendly?

### 2.2. Blue cornucopia

The discourse around Blue Growth also frequently presents the marine environment as containing an *"underexplored and potentially lucrative opportunity for wealth creation"* [15 p. 15]. Several metaphors accompany this assumption whereby the oceans and seas are represented as *"development spaces"* [24 p. 3], an *"investment opportunity"* [15 p. 16], and finally and most tellingly a *"cornucopia"* (see Fig. 1). The distinctiveness of these metaphors becomes especially apparent when compared to images of the marine environment that are used in alternative discourses; images which include, amongst others, *'sanctuaries'* (Greenpeace), *'wastelands'* (Sea Anglers' Conservation Network), or a *'sea of plastic'* (Ocean Cleanup and The Plastic Soup Foundation).

### 2.3. The primacy of the market

Next to technological advances, the Blue Growth discourse considers the creation of market-based incentives as a crucial mechanism for harmonizing economic growth with protection of marine ecological health: *"Market mechanisms and innovative agreements now exist to provide financial incentives for people to protect economically valuable marine ecosystem services that traditionally have fallen outside the market."* [23 p. 6]. Interestingly, proponents argue that access to free markets and ecosystem services will also help to improve social equity and security. From these ideas follow that a transition to Blue Growth will be driven primarily from *"enlightened self-interest"* [23 p. 22].

Together these three assumptions – technological optimism; blue cornucopia; and the primacy of the market - represent the core ideas that underpin the Blue Growth discourse. As argued earlier, many questions about the causal mechanisms and outcomes of Blue Growth remain [15]. Moreover, the term Blue Growth downplays social sustainability – i.e. social justice, equity, fairness, human wellbeing and freedom - which is generally considered as the third pillar of human sustainable prosperity [16,17,25].

This article will not further review the debate on Blue Growth or consider its content in more detail, but focus on another common feature of the Blue Growth discourse: its ambivalent treatment of capture fisheries. Some proponents of Blue Growth opt to not include capture fisheries in future policy efforts [26]. This position is taken by the EU, who has clearly identified five economic activities which, in their view, have potential for Blue Growth. These include aquaculture, coastal tourism, marine biotechnology, ocean energy, and seabed mining. What is remarkable here is that the initial report, on which the Blue Growth initiative of the EU is based, included capture fisheries as an activity to consider [4,14]. The FAO, who is another major advocate of Blue Growth, does earmark capture fisheries as a Blue Growth activity, together with aquaculture. Other actors and initiatives do consider capture fisheries but pay it scant attention, choosing to focus more on aquaculture [2,27]. The different stance on capture fisheries between the EU and the FAO, who are both major advocates of Blue Growth and instrumental in operationalising this concept, is striking. The contrast can be explained if one considers how the prospect of growth in capture fisheries is outlined in the Global North versus the Global South.

The potential for growth in capture fisheries in the Global North is limited. Here the sector grew strongly after the end of the Second World War through mechanization of the labour process and financial investments [2]. During the last decades, however, it has become clear that due to overfishing, the sector in the Global North has reached its ecological limits [2,28–30]. Several marine scientists [29,30] therefore argue that fisheries are left with no room for further growth due to continued management failures [31]. In this view, the only development trajectory left open is downsizing the fisheries sector through further restrictions and bans [32]. Other scholars are less pessimistic about the state of the world's oceans, and continue to see growth potential for fisheries that currently are ecologically sustainable [33–36]. Next, capture fisheries in the Global North is relatively insignificant in economic terms. In 2011 the European fish catching sector contributed to less than 0.03% of the EU Gross National Product which illustrates the limited role that capture fisheries play in the European economy [37]. It seems likely that for these reasons the EU downplays the importance of capture fisheries for realizing Blue Growth.

The FAO does include capture fisheries first of all because it considers Blue Growth from a global perspective. As the FAO indicates 90% of all small-scale fisheries are situated in the Global South [38]. The significance of capture fisheries for the national economies and societies in the Global South is thus very different compared to capture fisheries in the Global North. Due to its reliance on a common property, the costs of entering a fishery in the Global South are often low. Fisheries therefore functions as a 'last resort' for the poor to supply in basic needs [39]. Limiting growth in the multi-gear, artisanal, small-scale fisheries of the Global South would lead to a drop in social and food security for poor populations in these parts of the world. To conclude, from a global perspective capture fisheries forms a major sector and crucial activity for rural development and livelihood security. This is the reason why the FAO includes this sector in her efforts to operationalise and apply Blue Growth globally.

Despite the (perceived) limited prospects for growth of capture fisheries in the Global North, this sector will play a crucial role in any effort to establish Blue Growth in this part of the world too. Firstly, because capture fisheries continue to have a deep and lasting impact on marine ecologies [28,40], and, in so doing, they impact other marine sectors that depend on these ecologies for their development and growth. To give some examples here, capture fisheries might not only cause the collapse of specific species; it can also restructure entire food webs in oceans and seas [41]. It goes without saying that the reconfiguration of marine ecologies will substantially affect other marine sectors, such as aquaculture, that depend on species in these ecosystems. But the influence can also be more direct. The growth that is realized in aquaculture is often based on capture fisheries. The fishmeal that is used to grow fish in aquaculture, especially carnivorous fish species such as salmon, seabass, seabream and shrimp, is made from marine species fished by capture fisheries [42,43].

Secondly, and for good reasons, recent governance schemes as a response to this interconnectedness aim for a more integrated approach towards the use of primary resources and natural environments. Efforts such as the EU's Marine Strategy Framework Directive (MSFD) are based on so called 'ecosystem-based management', which in its effort to establish ecological sustainability considers all impacts by human activities on natural environments.

Thirdly, the exclusion of capture fisheries in Blue Growth initiatives is based on a generic assessment of the potential for growth in the marine sector. While for fisheries globally the opportunities for growth and development are restricted [32], regional and local fisheries might still have some potential for growth [33–36], in particular when fishers and the seafood chains can shift from producing unsustainable fish for low prices towards sustainably caught fish with added value [44].

Taking these considerations into account the inclusion of capture fisheries appears a necessary requirement to advance Blue Growth. Yet to be able to realistically assess these growth potentialities, science and management need to pay close attention to the diversity in practices of capture fisheries and their equivalent development trajectories. An issue that is explored in more detail in the next sections.

## 3. Some analytical tools to differentiate (Blue) Growth trajectories in fisheries

The previous section argued for the consideration of capture fisheries in any efforts aimed to realize Blue Growth. It also recognized, however, that the potential for growth in a heavily constrained sector, is limited. It is therefore essential that both scientists and policymakers distinguish the various viable and realistic growth trajectories that are left open for capture fisheries.

Growth in capture fisheries has typically been associated with growth in the size of fishing operations. Fishing companies developed through economies of scale, i.e. the efficiency gains coming from harvesting more fish with improved catch methods. A quick historic overview of economic development of fisheries in high-income countries leaves little room for an alternative view [2]. Under these conditions fishers have significantly increased their fishing capacity through mechanization and adoption of new technology. The majority of the total catch in many countries, especially in the Global North, is landed by fewer and bigger ships [45].

It is true that the industrial development of fisheries, often highlighted in graphs that demonstrate increase in catch and effort, is the most visible trajectory of growth. Less visible, but no less real, is an alternative development trajectory in fisheries that is based on

**Table 1**
Typology of extensive and intensive growth in capture fisheries.

| Extensive growth | Intensive growth |
|---|---|
| Growth in fishers' population | Use of diverse and complementary fish catching methods |
| Expansion of fishing grounds, i.e. to fish further away and deeper. | Use of modern technology to make more efficient use of resources to create efficiency gains. |
| Growth in output (amount of fish caught) keeps pace with growth in input (resources used up). | Output grows relatively more than input, which leads to increase in the productivity per unit effort. |

piecemeal investments and incremental growth. This alternative trajectory can be described as 'growing through remaining small' [46].

During the post-war decades, small and medium-sized fishing enterprises were mostly believed to vanish in the intensified race for fish and the search for efficiency gains. Small-scale fishers have been portrayed as 'threatened' and 'vanishing' as early as the 1960s and 1970s [47]. Yet, this type of fishing and the growth it represents can still be found. Even more so, the type of knowledge and skills these fishers embody has today often become regarded as valuable resources to make fisheries more sustainable [25,48]. Next to this trajectory of growth, there is also the growth in population of fishers. This type of growth is no longer relevant for fisheries in the Global North, but still remains the primary driver of development in the Global South [49].

A distinction between two types of growth – extensive and intensive growth (see Table 1) [50–52] – can help to elucidate the variety of growth trajectories. Extensive growth refers to a process whereby a quantitative increase of the means of production – the input – keeps pace with growth in output. Intensive growth on the other hand occurs when input and output do not keep pace, but where more input leads to relatively more growth of output. Intensive growth refers, in other words, to more efficient use of inputs, which increases the productivity per unit effort. Translated to fisheries, extensive growth includes growth in number of fishers or expansion of the fishing grounds, while intensive growth includes technological progress leading to efficiency gains. The two types of growth are used to make an analytical distinction which means that empirically they will often be combined in various ways. Consequently, assessing the potential for Blue Growth for these different growth trajectories remains a matter for empirical investigation.

## 4. Cases

Two fisheries are presented in this study to illustrate ways in which capture fisheries can still grow in the Global North: the Barents Sea whitefish fishery and the Bothnian Bay bleak roe fishery. These two fisheries were chosen according to a Most Different-Similar Outcome (MDSO) comparison [53]. The differences between these fisheries relate to scale of operation, management regimes, catch profiles, and how they market and sell their respective product. Despite these differences both fisheries fulfil requirements of Blue Growth as they are highly profitable and also considered to be ecologically sustainable. This is a very rare combination in fisheries, considering that many fish stocks worldwide are in decline. In what follows these two cases will be compared to illustrate how they employ different growth strategies.

### 4.1. Norwegian Barents Sea whitefish fisheries

The Barents Sea is situated off the northern coasts of Norway and Russia, almost enclosed from the rest of the Arctic Ocean by the archipelagos of Svalbard, Franz Josef Land and Novaya Zemlya. The Barents Sea is one of the most productive fishing grounds on the planet; it is home to the world's largest cod stock [2,54,55], and also a source of high profits within the Norwegian capture fishery sector [56].

For a long time, fisheries in the Barents Sea was purely coastal. This changed during the sixteenth century when offshore fishing and hunting of marine mammals became important industries, involving not only Norway but also countries such as Great Britain, the Netherlands and Spain. The size of the offshore fisheries grew considerable during the 19th century, until the 1960s when the herring stocks collapsed [57–59]. Despite the overfishing, this was also the time when trawlers started to operate in the Barents Sea. The overall catch, however, only improved again during the 1990s, possibly as a response to stricter regulative measures [55,57,58,60].

The diminished fish stocks of Barents Sea motivated the initiation of the Joint Norwegian-Russian Fisheries Commission (hereafter called the Joint Commission). The Joint Commission was established in 1974 and has since then successfully regulated the fishing quotas, but also introduced minimum sizes for cod, haddock and Greenland halibut, mesh width, sorting grids, criteria for closing fishing grounds, and satellite monitoring of vessels operating in the Barents Sea [61,62]. Today the Joint Commission stipulates the total quota for various important fish stocks - cod, haddock, and capelin, but also other species such as king crab - after advice from the International Council for the Exploration of the Sea (ICES) [see e.g. 63–65]. The whitefish industry studied here targets cod (*Gadus morhua*), saithe (*Pollachius virens*), and haddock (*Melanogrammus aeglefinus*), which are all certified by the Marine Stewardship Council (MSC). Cod and haddock have been certified since 2010 and saithe since 2008. The MSC performs yearly audits to assess the sustainability of these stocks [66–68].

Remembering the two growth trajectories outlined above, the Barents Sea fisheries have grown extensively as well as intensively. To start with the former, over the last decades many fisheries in the region have expanded their fishing grounds. They fish longer and further away from the shore and their home harbours. This extensive growth is closely coupled to intensive growth, since the longer trips are possible because larger vessels have been turned into 'floating industries' where catching, processing, freezing, and storage takes place on board (see Fig. 2). Because of these innovations, the boats can be out at sea for several weeks before they have to go ashore to unload their catch. With these capacities, the Barents Sea fishers can fish further north, most likely even moving into the Arctic Ocean as the icecap melts away. As the ice retreats, new fishing grounds become available for exploitation. Although this could potentially enlarge catches, it is also highly uncertain how the melting will impact marine ecologies and fish stock dynamics [40,69]. On the other hand, as has been indicated, the Barents Sea fisheries is regulated strictly, which means that the amount of fish that can be caught is limited through quotas and landing obligations [70–73].

Intensive growth has been important in other aspects as well. To begin with, technological innovations and mechanization made the fishing industry much more efficient in terms of productivity per unit effort. This has a downside too because it resulted in less opportunities for employment. Despite that large fishery companies mainly operate and develop through economies of scale, and produce bulk products, they are not per definition 'price-takers'. With large freezing facilities on land they are able to store their catch and sell it later when it is more profitable, which often can be up to six months or even more after the fish has been caught. This makes large fishery companies much less sensitive to market fluctuations than individual fishers who are often forced to sell their freshly caught fish. Moreover, the quick freezing on board also makes it easier to market and sell the fish globally. An employee working within a large Norwegian fishery company explains their market strategy:

> "[…] *frozen fish is a commodity that, if no one wants to buy it there and then, well, then you could just put it in storage, and then we sell it later.* […] *and then we have a bigger market power than a smaller* [company]. *Their negotiation power is in a way* [limited], *but we are a big supplier."*

Due to Norwegian legislation, fisheries' growth strategies are


**Fig. 2.** Norwegian Trawler.

primarily driven by intensification. But, room for intensive growth is limited. To give an example, fishing companies are required by law to deliver a certain amount of their catch to several land based process facilities along the Norwegian coast. With this rule fish gets landed in coastal communities to secure employment opportunities across the country. From a purely economic viewpoint, this rule prevents companies from centralizing their processing industry and hence profit from efficiency gains [72]. Furthermore, intensive growth is also severely limited because catching more fish requires more quota. Big companies with a big share of the total quotas are unlikely to obtain more quotas – even if they could afford buying them from smaller companies – because the government wants to prevent monopolization. An employee at a large Norwegian fishing company comments:

> *"*[To be able to grow] *then some have to sell* [their boats] *and then we have to be accepted to buy* [quotas], *and then we have to apply at the Ministry* [of Trade, Industry and Fisheries] *to get permission to buy these boats. And it is not certain that we get that, since we're already so big. So, it's a little bit restricted, what opportunities we have to grow any further, considering the regulations. But we can of course buy… also buy quotas abroad*. […] *But it's* [the developing opportunities abroad] *very limited. Because we don't take part in fishing in foreign waters, we only take part in fishing in the Norwegian* [Economic Exclusive] *zone or within other countries' zones where Norway have got a share* [e.g. Greenland]*."*

Taking these restrictions into account, the current growth strategy of large fishing companies is to access or create new markets, to be more energy efficient, and to reduce fish waste to save costs by e.g. producing fish oil and fish meal from parts of the fish that otherwise would be scrapped. In the words of two employees:

> *"We are fully aware of that we use a lot of fuel, which has an impact* [on the environment]. *We emit nitric oxide, we emit $CO_2$, and we are aware of this.* […] *and then we have the emissions from the boats. We have for example ammonia, we had Freon. We have now rebuilt all ships.* […] *We want the smallest impact on the ocean as possible.*
>
> *We follow the regulations, and we don't take more than we can. That's important. And, not the least,* [that we] *take care of more and more of the fish."*

A crucial aspect of this strategy is to get the catches certified according to the MSC requirements. Without this sustainability certification companies are no longer able to target the markets they prefer. According to an interviewee the company cannot sell their fish if it is not certified:

> *"Redfish and… Greenland halibut, cod and haddock from the North Sea is not MSC* [certified]. *Today we don't manage to sell this fish. We have to, well, Greenland halibut is fine, but cod and haddock that aren't MSC is very hard to sell. And the price will be lower."*

The employee continues:

> *"It* [MSC] *is a requirement. The supermarket chains demand MSC* […] *and then we also have the catch certificate. The catch certificate indicates if it* [selling the fish as MSC] *is allowed. We are completely dependent on MSC approval."*

The certification process could thus be understood as a necessity. At the same time, all interviewees emphasise the importance to not overfish and that it is in their interest to keep fish stocks healthy to ensure they have something to fish in the future. Aims that are clearly in line with the objectives of the MSC certificate.

> *"We do live of what we harvest from the sea. And if we don't do this sustainably, then we saw off the branch one is sitting on."*

What is interesting, especially from a Blue Growth perspective, is that the employees do not see sustainability and economic growth as incommensurable. Rather to the contrary:

> *"Sustainability, it is that we manage the resources that we have been given and that we are fishing in a sustainable manner. That means that we do not throw away small and juvenile fish, we don't do that kind of stuff. We don't fish the small fish.* [That's] *pointless to us. We fish what gives us money in the bank, it's as simple as that."*

### 4.2. The Swedish bleak roe trawl fishery

In the most northern part of the Baltic Sea, the Bothnian Bay, lives the vendace (*Coregonus albula*). The vendace females produce a bleak roe, which is considered to be an exquisite delicacy and is served in high-end restaurants and on special occasions, such as the Nobel price banquet. The roe's unique taste is produced by the specific environmental conditions of the Bothnian Bay [74]; although vendace normally resides in freshwater it can also survive in the Baltic due to the low salinity there.

The vendace is targeted for its roe by a small-scale Swedish trawl fishery (see Fig. 3). The trawling is done in pairs; two vessels drag one trawl along the sea bottom. Most vessels are below 12 m long, but some are up to 14 m long. This trawl fishing has been ongoing since the 1960s. Before that time, fishers caught vendace with passive gears. These gears, such as gill nets and fyke nets, are still used but it is the trawl fishery that catches most vendace by far. As a result of the trawling, the catches increased until the mid-1990s, but then declined

**Fig. 3.** The Swedish bleak roe trawl fishery (photo Emma Björkvik).

due to high fishing pressure eventually leading to overfishing [75]. Not only were catches record low, they also consisted of a large proportion juvenile fish [76,77].

Efforts to recover the stock failed, mainly because the Swedish national authorities were not able to reduce the fishing pressure [78]. To end this situation, a co-management group that included fishers, researchers and representatives from the Swedish authorities formed in 2000. After three years of co-management, in which the fishers had implemented various measures to improve the stock, the catches started to increase again [75].

Today's bleak roe trawl fishery is still managed by this co-management arrangement, with the national Swedish authorities having the overarching legal responsibility including giving out fishing permits. Although the co-management arrangement has helped to recover the stock, its exact impact on fish stock dynamics remains uncertain. The dynamic development of the vendace stock is highly dependent on various environmental factors, such as salinity and water temperature [79], which cannot be directly controlled through governance and planning.

The bleak roe fishery generates substantial profits [45], thanks to the roe's high price per kilo (ca. 200 Euro/kg) and, as will be explained shortly, its certification by the MSC [80]. The vendace stock is currently harvested close to, or a little above, the Maximum Sustainable Yield (MSY) and the current spawning stock biomass is larger than the long-term average [81]. The spawning stock biomass is, however, estimated to decline and the fishers agreed to reduce their catches in 2016 with 4% in accordance with the biological advice [81].

As will be seen shortly, the bleak roe trawl fishery is also a strictly regulated fishery, only allowing catches for a short period each year. For this reason, most fishers complement vendace trawling with fishing for other species such as herring and salmon during other periods of the year. Nevertheless, the bleak roe trawl fishery is doubtlessly the most profitable fishery that these Bothnian fishers are engaged in. In addition, the fishery is of great importance for villages along the northern coast of the Bothnian Bay. Many people in these villages are employed in the bleak roe production during the fishing season and there is no risk that the production will relocate to another region as the roe's name 'Kalix löjrom' is protected through the EU laws of Protected Designation of Origin (PDO). This means that bleak roe can only be called 'Kalix löjrom' if it has been caught, processed and prepared in the designated area [82].

The bleak roe fishery is characterized by intensive growth, because there are very few possibilities for extensive growth due to Swedish and EU fishery regulations. Trawling for vendace is allowed only during five weeks every autumn and restricted to a limited number of hours every day. The number of vendace fishers is controlled through a permit system. Currently, 35 fishers have a permit. Moreover, trawling can only be performed within certain areas, with some places where there is a high abundance of juvenile vendace closed for trawling. Most fishers that have been interviewed think that these regulations are relevant and one of them put it like this:

> *"Rules and restrictions are necessary, because the human race always want more and more."*

It is not only regulations that prevent extensive growth. The vendace biology also controls overfishing to some extent. The female vendace carry roe during the autumn, which means that fishing for the roe during other seasons of the year is pointless when the aim is to obtain the roe. Furthermore, the vendace swims through the whole vertical water body during night time, while in the daytime the fish gathers at the bottom. To maximize the catch with the bottom trawls, the fishers agreed that fishing should only be done during daytime. As one fisher explained, in the past there used to be no rules on trawling hours per day. As a result, many fishers started to fish before dawn and, in so doing, scared the vendace away from the fishing grounds:

> *"Before the government had implemented any rules, everyone rushed away and started to trawl in the dark. But the vendace was not down at the bottom then so we scared it away and everyone was left with less to catch."*

It is interesting to notice how some fishers despite these restrictions still look for ways to improve their catch. For example, some fishers start their fishing trip early, not to trawl but to find the fish with their echo sounders. Through this activity the fishers are able to monitor a larger area, i.e. their expanding the amount of fishing area that they can cover during one fishing trip. This strategy would therefore count as an example of extensive growth. At the same time, the strategy is also contributing to intensive growth because doing this the fishers make sure that their catch per trawling effort is high.

Intensive growth of this fishery is further limited by the companies' capacity to process and extract the roe after the vendace has been landed. To preserve a high quality, and to live up to its PDO status, the roe has to be ready for consumption within 24 hours. Next, processing and preparing the roe requires skilled labour which is why it cannot easily be mechanized. It means that a fisher has to be assured that the fish he lands can also be processed immediately. He needs, in other words, access to and control over the required labour force and processing facilities. Due to limitations of both, many fishers are not always able to maximize their catch. Sometimes they need to stop fishing before the trawling day is finished due to the risk that they will catch more vendace than can be processed in time.

One fishing company called 'Guldhaven' has invested in a processing facility to match their maximum fishing capacity with processing capacity. In this facility they employ more people than any other bleak

**Table 2**
Extensive and intensive growth in Swedish Bothnian Bay fisheries and Norwegian Barents Sea fisheries.

| | Extensive growth | Intensive growth |
|---|---|---|
| Swedish Bothnian Bay fisheries (Guldhaven) | • Buying vendace catches from others. | • Using search devices to locate the fish before trawling.<br>• MSC certification<br>• PDO certification<br>• Processing the vendace fish for human consumption |
| Norwegian Barents Sea fisheries | • Expansion of fishing grounds through meltdown of Arctic icecap. | • Use of modern technology to find fish, and to process and freeze the fish on-board and in storage facilities on land.<br>• MSC certification |

roe fishery company. They have also begun to market vendace fillets for human consumption. Usually the vendace only supplied the roe and was then sold as fodder to mink farms, or as fish meal. Guldhaven tries to get a higher price for the fish by marketing it as a delicacy and high-quality food product. The MSC-certification is important in this regard. One of the owners explains that the MSC-certification probably did not matter much for the bleak roe, as it was a well-established product on an exclusive market already before the certification. But the MSC-certification is crucial for marketing the vendace fillet as a product for human food consumption:

> *"I think that when it comes to Kalixlöjrom* [bleak roe]*, it* [the MSC-certification] *does not really matter as it already is a luxury product with PDO status* […] *but now when we started to market the fish in itself, it* [the MSC-certification] *has a big importance. Because the large wholesalers want to buy MSC-certificated fish and the large supermarket chains buy almost only MSC-certificated fish today."*

Guldhaven also strives to develop their capacity to deal with potential declining vendace catches, while maintaining the maximum processing capacity. One strategy, which they already realized, is to diversify their products. Next to bleak roe and vendace fillets, they also started to process and sell fermented herring (called 'surströmming' a traditional Swedish food) and smoked salmon. Another strategy, in case vendace catches decline, is to buy the catch from other trawling fishers or local fishers without trawling permits. Many, often younger, fishers who are not allowed to trawl for vendace, catch small amounts with their gears. Due to the small catch quantities, they are not able to market the fish on their own but Guldhaven buys their catch to reach maximum processing capacity. Lastly, the company also tries to cut labour costs through further mechanization. They invested in machinery that is able to fillet vendace, and other species, faster and more efficient than human labour. This means that larger quantities of fillets can be produced to a lower cost.

To conclude, Guldhaven strives to both maximize their catches and the profit per landed kilogram fish. Crucial for maximization of the catch is that they maintain processing capacity also in the face of changing stock dynamics. The owners are well aware of the fact that the vendace catches one day can decrease. At the same time, they also recognize that further investments for growth starts with bigger catches, or as one of the owners puts it:

> *"It is a tricky balance, more investments require more catches"*

Yet, they are also realize that their fishery can only grow long-term if they exploit the vendace stock sustainably:

> *"No-one more than us want the fishery to work. We are the last ones that want to see a crash in the fishery".*

Sustainability is in fact something that the company owners interpret as Blue Growth:

> *"Well, growth… that is to use the planet's resources in a sustainable manner and then transform them to something that may be consumed"*

## 5. Discussion

As pointed out previously, advocates of Blue Growth in the Global North pay scant attention to the potential development of capture fisheries. The implicit idea seems to be that the capture fishery business has no more room left to grow. The study of the two fisheries presented here confirms that opportunities for continued development are indeed slim. The marine ecologies on which fishers depend are vulnerable [2,28,30], government regulations are strict [83], and the price of fish is often low. Despite these limitations fishers in both cases manage to recognize and utilize opportunities for development. Moreover, the type of development that they realize aligns with ambitions and assumptions from the Blue Growth agenda: use of marine resources that is profitable and at the same time ecologically sustainable.

As the case descriptions highlight both fisheries grow through a combination of intensive and extensive growth (Table 2). To recall, the former primarily refers to growth in catch and geographic expansion of fishing grounds, while the latter refers to increases in productivity or profitability per unit catch effort. As Table 2 demonstrates both fisheries primarily develop through intensive growth.

Based on these results it is argued here that the Blue Growth discourse as it is currently applied in the Global North, especially by the EU, fails to pay sufficient attention to the variety of growth trajectories in capture fisheries. While it is true that any extensive growth for capture fisheries is severely limited (perhaps even nil), there does exist potential for intensive growth. The cases demonstrate that fishers are shrewdly aware of this and try to realize development of their businesses through a combination of reducing costs of the labour process and adding value to their catches, while all the time creatively or reluctantly complying with restrictions [84].

Comparison of the cases highlights three aspects that are indicative for growth of capture fisheries in marine environments that qualify as 'fully fished' and/or 'overfished' [2]. Blue Growth advocates might want to include these aspects if they choose to consider capture fisheries as a relevant economic activity. These aspects include: a) adding value through certification; b) technological development to make more efficient use of resources used up in the fishing operations, and to upgrade their fish as commodity; and c) specializing. These aspects are discussed in more detail below.

First, the cases indicate how strict fisheries regulation in both Norway and Sweden limits opportunities for extensive growth. If fishers do not have the ambition for expanding their business beyond national boundaries (as in these cases) they are forced to find ways in which they can make their catch as profitable as possible. Marketing fish for human consumption is one important strategy for such an intensive growth trajectory. In both fisheries the MSC-certification of catches is considered crucial for economic reasons, albeit not directly for reasons of sustainability. It seems that for both fisheries the MSC certification has not implied a transformation of their fishing practice, nor of their perception of what sustainability could mean in their line of business. The prime motivation to get the certificate is an economic one; with the label they can sell their fish for a higher price. This finding resonates with the study of Bush et al. [85] who conclude that MSC certificates are mostly accredited for fisheries that already satisfy the sustainability

requirements of MSC. Although the potential of MSC-certification for transforming unsustainable fisheries might thus be limited, it remains a highly important opportunity, almost a necessity, for growth, as the cases reveal. Reflecting upon these observations in relation to the Blue Growth discourse points out that it is important to qualify what is understood under 'the primacy of the market'. Indeed, markets are important motors for growth. But there is not one market. Which type of markets facilitate Blue Growth and which do not? So far these issues are not yet explicitly considered.

Second, both cases also demonstrate, in line with the Blue Growth discourse, the pivotal role of technological development. There are, however, some differences that are important to consider. The companies use technology to improve their catch per unit effort and also to value-add their catch by making the processing and preservation less labour intensive on land (Sweden) and on-board (Norway). The efficiency gains from these innovations improve the companies' profits. The Swedish bleak roe trawl fishers use technology for the same reason, but its technology is less costly and less advanced than what is being used on the vessels in the Barents Sea. The Swedish fishers illustrate, however, that technological innovation is not the whole story. Besides technological improvements fishers also innovate with commodity improvements. For the bleak roe trawl fishers in Sweden this means getting the bleak roe certified as PDO, and also to try and sell not only the roe of the vendace but the whole fish.

Third, a common feature for both cases is the high level of specialization. Large companies in Norway are exclusively targeting whitefish from the Barents Sea (and adjacent seas). Bothnian Bay fisheries' prime source of income is the bleak roe. Their fishers do fish other species than vendace during the year, but the bulk of their income comes from the roe of the vendace. From these observations, it is important to consider how Blue Growth is linked to highly specialised fisheries, and consequently how Blue Growth impacts resilience in fisheries. It has been observed that maintaining and cultivating diversity in fisheries can be important for safeguarding the resilience of marine environments, but also fishers' livelihoods and coastal communities [86,87]. If Blue Growth can only be realized through specialised fisheries, it might risk losing resilience for the fisheries as a whole. A sudden decline in species abundance could lead to a collapse of these fisheries because they have become dependent on a single type of fishery and target species [64]. Yet, at the same time the results show how both fisheries are trying to spread risks through securing catches from other fishers, or through targeting other species.

## 6. The colour of the sea – Conclusion

*"The sea! the sea! the open sea! The blue, the fresh, the ever free!"* [88]

*"The sea, the snotgreen sea, the scrotumtightening sea."* [89]

Like Doerr [1], quoted at the beginning of this article, many marvel at the changing colours of the sea. Is it snotgreen, blue and fresh, or somewhere in between? From 1879 to 1881, Franz Boas, a young German physicist, tried to find an answer to this question. His dissertation *"Contributions to the understanding of the colour of water"* [90] eventually led scientists to argue that the colour of the sea depends on the absorption and scattering of light.[1] What is not so well known is that Boas experienced many difficulties in clearly discerning the colour of his samples, especially the difference in his Mediterranean Sea samples between green-bluish transmitted light and the bright blue reflected colour [92]. Based on this experience, he concluded that psychological predispositions of the observer were just as important for the attribution of colour to seawater, in these particular samples, as the presence of suspended particles. Shortly after his graduation Boas began to wonder if his inability to perceive colour differences was learned and therefore part of his culture. With this question in mind he left Kiel in 1883 for Baffinland in Northern Canada to study how Eskimos perceive the colour of ice and sea water [93].[2]

In analogy to Boas' insight this article has argued that whether certain uses of marine environments are considered blue (or green) depends for a great deal on how they are perceived. Proponents of Blue Growth in the Global North tend to exclude capture fisheries from their vision, possibly because they cannot perceive growth in a sector that is strictly regulated, and which depends on a vulnerable and dwindling marine resource. But how valid and useful is this omission of capture fisheries? Does capture fisheries really have no potential for Blue Growth; and reversely, does capture fisheries not affect Blue Growth in these parts of the world? These were the questions that the article set to answer.

The first part of this study built the claim that capture fisheries is an essential sector to consider when aiming to use marine resources sustainably. Using this assumption, the second part introduced an analytical distinction to discern growth trajectories in capture fisheries, and to consequently help assess the potential of this sector for Blue Growth. The use and relevance of this distinction for considering development of capture fisheries in the Global North was demonstrated with two contrasting cases: The Swedish bleak roe trawl fishery in the Bothnian Bay and the Norwegian whitefish fishery in the Barents Sea.

From this exercise can be learned that growth in capture fisheries is more diverse than what is conventionally assumed. Moreover, the comparison of the two fisheries highlights that despite differences in the scale of operation fishers and operators in both fisheries are concerned with making their growth 'blue', i.e. sustainable. They also succeed in doing so in several ways, which include a) adding value through certification; b) technological development to make more efficient use of resources used up in the fishing operation, and to upgrade their fish as commodity; and c) specialization.

Establishing congruity between economic growth and ecological sustainability in capture fisheries is arduous. Many marine ecologies are vulnerable due to persistent overfishing and the economic significance of capture fisheries is low. This article demonstrates, however, that the potential for Blue Growth in this sector should not be dismissed. Capture fisheries continues to have a major impact on marine ecologies. More attention to the strategies with which fishers develop their business, leading to diversity in growth trajectories, can help to (re)consider the potential of capture fisheries for Blue Growth.

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[1] When water is clear blue, light scatters and red, yellow, and green wavelengths are absorbed by water molecules. The ocean is green when there are phytoplankton (algae) in the water. Phytoplankton produce chlorophyll, a green pigment, to absorb red and blue wavelengths for photosynthesis. The type and density of phytoplankton populations thus determines the colour of seawater [91,92].

[2] Boas is now known as *"the father of American anthropology"* [94], and his field studies in Baffinland are considered *"cornerstones of modern anthropology"* [93, p. 20].

and Adaptation to Climate Change'.

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