Flipping the pyramid: lessons from converting top-down management of bleak row fisheries

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Abstract

The fishing of vendace (*Coregonus albula*), in the northern part of the Gulf of Bothnia, is a good illustration of the presumption that institutional arrangements that are too inflexible to cope with changing ecological conditions are unlikely to prosper. Since the beginning of the 1960s, the trawl fishery for vendace has been top-down regulated by the state and, in the beginning of the 1990s, the catches started to decrease dramatically; there was a considerable fear among state authorities that the vendace resource was about to be depleted. This happened despite extensive state regulation and despite the fact that the resource is non-migratory and concentrated in a rather limited area. The regulations were designed in such a way that it encouraged catch-maximizing behaviour among the fishermen during the bleak-roe season; thus, all the prerequisites of a CPR "dilemma" were present. The vendace case illustrates that also a rather limited resource concentrated in a limited area might be difficult to manage in a sustainable way by top-down regulation performed by the State. If a resource, like the vendace, that is subject to human activity loses its resilience this would automatically indicate the socio-economic system, as manifested in management practices, has already lost its ability to adapt.

As a response to the poor performance of the fishery officials at the National Board of Fisheries considered different strategies to achieve a sustainable fishery in year 2000. Before the fishery started in 2000; a co-management system, with sharing of power and responsibility between the National Board of Fisheries and the trawl fishermen, was implemented. An extensive survey among almost all trawl-fishers shows that after three years of co-management a change in the individual behaviour has occurred; fishermen have redirected their individual catch-maximizing strategies towards long-term collective rationality. With regulations implemented through bottom-up instead of top-down processes, the legitimacy for regulations has also increased considerably. At the same time, the management system has become more adaptive with responsible users who react to changes in the ecosystem, and the catches have increased extensively since co-management was implemented. The resource has recovered and the catch statistic for 2003 is almost as high as the record years in the 1980s. This paper explains how this "flip" in management system have affected the incentives for individual fishermen and how this change affects collective action and, thus, the long-term ecological survival of the vendace resource.

Keywords: Bleak-roe fishing; Resilience; Adaptiveness; Local-management.

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The fishing of Vendace (*Coregonus albula*), in the northern part of the Gulf of Bothnia (i.e. Bothnian Bay), is a good illustration of the presumption that institutional arrangements that are too inflexible to cope with changing ecological conditions are unlikely to prosper (Rova, 1999). Vendace (*siklöja* in Swedish) is a local species of whitefish that belongs to the salmon family. The roe from the fish, known as bleak-roe (*löjrom* in Swedish), is of high commercial value. In the study area, fresh-water species like vendace are caught in salt-water fishing in this region (the Swedish County of Norrbotten) because the water is highly desalinated, owing to the input of fresh water from the major rivers.[1]

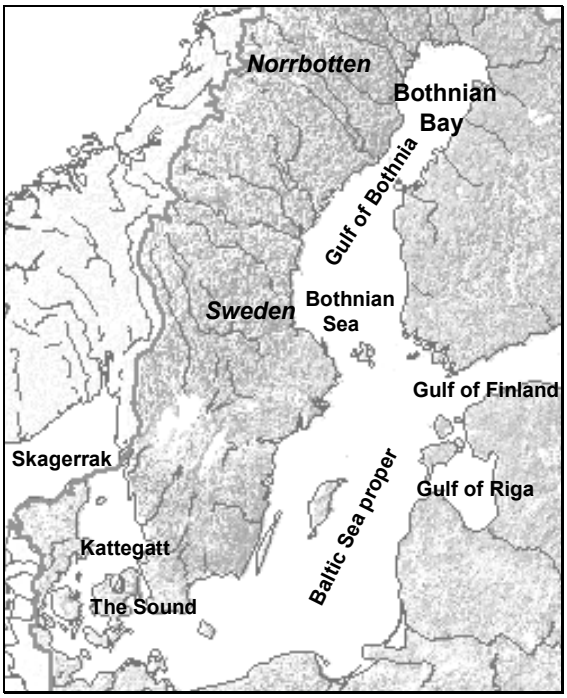

Figure 1. The Swedish coast is more than 2 000 km long and goes from the Torne River at the Finnish border in the north to the Ide Fjord at the Norwegian border in the west.

Coastal fishing in coastal areas, as in Norrbotten, is characteristically a multi-use and a multi-stakeholder system that needs integrated methods to handle trade-offs and conflicts in the socio-ecological system (Hammer et al. 2003:527). To meet these challenges, coastal fishing

[1] The Baltic Sea is the largest brackish water area in the world (ICES, 2003).

requires management solutions that take into consideration the links between various socio-economic driving forces and the consequences for the ecological system.[2] This embeddedness of fisheries resources in a wider ecosystem requires also that researchers and policy makers consider fishers as an integral part of the ecosystem and that both ecosystem and human well-being must be achieved (McMichael et al. 2003).

Changes, or disturbances, are a natural part of ecosystems development and one of the most important concepts in understanding sustainable use of renewable natural resources is that of resilience. Resilience, as defined by the *Resilience Alliance* (2002), is a measure of the amount of change a system can undergo and still retain the same control on function and structure; The degree to which the system is capable of self-organisation; And, the ability to build and increase the capacity for learning and adaptation (www.resalliance.org). Thus, resilience can be seen as a measure of robustness and buffering capacity in the face of disturbance, i.e. changing conditions. For example, how much disturbance can a fishery endure without collapsing into a qualitatively different system? Disturbances can trigger ecosystems to shift to other states with a corresponding change of ecosystems functions. A resilient fishery can withstand shocks and remain in functionally similar state – thus, increased resilience move away the resource system from thresholds. Reduced resilience increases the vulnerability of a resource system to smaller disturbances that it could previously handle and there is a high risk of shifting into a qualitatively different state – hence, loss of resilience moves the resource system closer to thresholds. Even, in the absence of shocks and disturbances in form of "emergent behaviour", gradually changing conditions can evoke threshold levels causing an abrupt response in the system. Once thresholds have been exceeded, changes can be irreparable. Due to their complexity, the predictability of ecosystems is limited and restoring an ecosystem to its previous state can be expensive, complex and sometimes impossible. Sustaining ecological resilience is strongly linked to and dependent on social mechanisms in management (Berkes et al. 1998, 2003).

Consequently, the combined impact of ecological and societal processes on ecosystems is at the heart of this approach and, to analyse fisheries, linking interrelationships between complex ecological circumstances with human activities is essential in order to maintain the capacity of fisheries. How can this be done?

[2] In this paper, ecological systems (ecosystems) are defined as "self-regulating communities of organisms interacting with one another and with their environment" (Berkes et al. 2003:3). Social systems deal with property rights, land and resource tenure systems, systems of knowledge relevant to environment and resources. (Folke and Berkes, 1998:20).

The importance of ecosystem-based and adaptive management practices in fisheries

The social systems, as well as the ecological system, are subject to constant change, surprise and uncertainty; policies alter, people change their attitudes and new groups might have new claims on joint resources. The basic problem is that while social-ecological systems constantly change and are dynamic uncertain processes management systems are often remarkable inflexible. For a fluctuating and chaotic resource, such as a stock of fish, that are subject to constant change management has to deal with this complexity. For instance, it is important that depletion of a particular resource serves as a signal for change in management responses. The critical aspect is the ability of management institutions to receive and respond to those signals.

Adaptive management deals with the intricate and sometimes unpredictable interactions between people and ecosystems as they evolve together, and is based on social and institutional learning, that is, organisations can learn as individuals do. It emphasizes learning-by-doing, and takes the view that resource management policies can be treated as "experiments from which managers can learn" (Holling 1978; Walters 1986, in Folke and Berkes, 1998:21). The focus is thus on the ability of the management system to respond to feed-backs from the environment. The capacity of a management system, through flexible institutions, to adapt to signals and learn to interpret signals from the resource stock determines whether the system can deal successfully with resource crisis. Flexible systems that proceed through learning-by-doing are better adapted for long-term survival then systems that have fixed prescriptions for resource use. It is also important that different problems should be solved on different levels with nested cross-scale institutions. Obviously, due to the ecological prerequisites and the stakeholders involved, for example management of bleak-roe fishing in the northern part of the Gulf of Bothnia requires other management scale than cod in the Baltic Sea. The management structure should be sensitive to changes in the ecosystem, and have the ability to release and reorganise in cases of resource depletion – i.e. combining ecological resilience with institutional.

From a management perspective, adaptability can be interpreted as the capacity of actors in the resource system to manage for resilience and to prevent the system from passing thresholds. Disturbances and crisis, as well as success, can also play an important role for a successful management in the future, by creating learning experiences (feedbacks). Consequently, if the social-ecological system has low resilience the capacity of institutions to adapt and shape change is also low – i.e. the capacity of managers to respond to surprises and disturbances by creating solutions is low and useful institutional memory will not be created

to avoid future crisis and thresholds. As opposite to the "conventional management" approach with their emphasizes on predictability, single equilibrium, stability, smooth changes and linear processes; the adaptive ecosystem-based management paradigm emphasize unpredictability, multiple equilibrium, resilience, threshold effects, non-linear processes, and multiple scales in which these processes happen (Berkes et al. 2001:23). Managing fish resources are, thus, a quite complex and uncertain task when we are aware of the limits of knowledge that we possess and instead of assuming that we are dealing with an simple, linear and predictable resource. The pertinent question is whether a fishery system has the ability to move to new or different management arrangements when uncertainties and disturbances require a change? With other words, whether the system has enough flexibility and adaptive capacity to reorganise themselves without major declines in central functions (ecological, social and/or economic functions)? This can be labelled as the transformability capacity of social-ecological systems.

To be sustainable, (by means of managing disturbances, shocks, thresholds and uncertainties) fishery systems, like bleak-roe fishing in Norrbotten, need to possess three qualities: 1. *Resilience* – i.e. buffering capacity to absorb disturbances and still maintain the central functions; 2. *Adaptability* – i.e. learning by doing accumulates knowledge to manage resilience; 3. *Transformability* - i.e. the capacity to change the existing system when ecological, social and/or economic conditions so requires. To accomplish this is not easy however, for example, in a fishery context, subsidies and compensation can be seen as incentives not to change – i.e. preserving *status quo*. Further, it might not be sufficient with adaptive small-scale social-ecological system if these act in isolation. Most fishery systems cross political boundaries, whether local, regional, national or international. The ecological prerequisites of a system are, as well, nested in other systems, and, the nested cross-scale nature of fishery management requires changes in policies and in the involvement of users and different institutions. Consequently, given the varying and fluctuating nature of fish stocks, proper functioning is sustained when the management system is "allowed" to develop and renew itself, and ecological resilience is combined with institutional resilience (Rova and Carlsson, 2001:324). This is the *working hypothesis* in this paper.

The aim of this paper

This paper will contribute to the development of an understanding of governance in a relatively small and clearly defined but complex common-pool resource system. It will also provide insights on how different management strategies can affect individual users'

incentives and adaptive capacity in such systems. The bleak-roe case is a good illustration of an attempt to handle a resource crisis by transforming a conventional resource management into a "new system" with intentions to be more effective (generate annual incomes to fishers) and more sustainable than the previous one. The important questions are, accordingly, whether the present management system of bleak-roe fishing possesses the three qualities of sustainable management or not? How does this institutional arrangement affect collective action among the fishers? To reach an answer to these questions it is also necessary to analyse the causal connection between the origin to the resource crisis that affected the fishing community in the 1990s and the new management system implemented in year 2000. How can it be explained that a resource crisis happened despite extensive top-down regulation by the state and despite the fact that the resource is non-migratory and concentrated in a rather limited area? How did the previous institutional arrangement affect collective action among the fishers?

This paper is built on data collected from three main sources: (1) Semi-structured in-depth interviews with 31 of the totally 39 fishers who hold trawl fishing licence have been conducted. Additionally, interviews with officials at the National Board of Fisheries office in Luleå have also been performed; (2) Program documents and other official documents concerning Swedish fisheries and particularly bleak-roe fishing have been analysed; (3) Other data sources have also been used such as telephone interviews, direct- and participant observation in bleak-roe fishing and in meetings with the trawl fisher group and officials. With the use of interviews, documents and participant observation this paper investigates process and results of changing an existing top-down management system into an alternative one.

Ecological and environmental prerequisites for the vendace system

The Bothnian Bay differs in several ways from the Baltic Sea. Compared to the Baltic Sea, its nutrient content is lower, its water is colder, it is covered by ice during several months every year (the ice can be up to one meter thick) and the growth season is shorter. The growth season is hardly half as long as in southern parts of the Baltic Sea. Thus, the biological production is quite low compared to southern parts of the Baltic Sea. Cold water species like vendace dominates in the Bothnian Bay. Commercial fishing in the Gulf of Bothnia is based mainly upon vendace, salmon and whitefish.

Vendace is mainly restricted to the Bothnian Bay and the northern Bothnian Sea. In summertime, during feeding migration, the vendace population is spread over the Bothnian Bay and in the autumn it migrates to near shore spawning areas mainly situated at the Swedish side of the Bay, where the fisheries also are most extensive. According to the National Board of Fisheries, the vendace population consists probably of several populations and the spawning areas are, due to advantageous topographic prerequisites, situated on the Swedish side of the Bay. However, the official authorities are unsure whether vendace consists of one or several populations; they often writes that vendace "most likely" consists of several populations (Thoresson et al. 2001, Fiskeriverket, 2001, and Finfo 2002:9).

According to officials at the Boards Institute of Coastal Resources in Öregrund they do not know for sure whether it is one or several populations and neither do they know where the exact spawning areas are located; hence more samplings and analyses is needed (Meeting with the vendace management group 2003-09-08). A majority of the trawl fishers (64 percent) believes that it is one population of vendace in the coastal areas of Norrbotten (Interviews 2003 and 2004).

The migration distances are typically less than 90 km. After spawning, vendace pass the winter in the inner archipelago where it stays during spring and early summer. During the summer vendace migrates to outer isles and to the sea where it is mixed again. New recruits grow fast and after the first year they often reach a length of 10 cm. However, the growth increments differ between the archipelagos; up to three years age the growth is best in the northern and southern parts but the causes for this are not investigated. After two seasons' vendace is usually sexually mature (Thoresson et al. 2001 and Finfo 2002:9).

One factor of the marine ecosystems in the Bay that have become increasingly important during the last years is the boost in grey seal population. An adult male grey seal can weigh over 300 kg and causes major damage on fishing tackles particularly on salmon/whitefish traps and for recreational/subsistence fishery of vendace in the Bay. It has

been estimated that if the total grey seal population in the Baltic are 10 000 seals they will consume 20 000 ton fish per year (Fiskeriverket, 2001:115). How this affect specific stocks is however unknown. Since 1990 until 2002 the average growth rate of the grey seal population in the Bothnian Bay is approximately 11 percent per year and in 2002 there were around 1 700 grey seals in the Bay (Helander and Karlsson, 2002:24).

Chemical contamination is a problem restricting consumption of Baltic fish. For example, effluents from pulp and paper mills causes' negative influence on fish reproduction and recruitment. Another example is dioxins that are a group of highly toxic substances that affect reproduction and immune defence in fish. High concentrations of dioxins are found in fish with natural high fat content and particularly high concentrations are found in samples of salmon and herring from the Bothnian Bay. Sweden has a special exception from the EU regulation concerning dioxins in food which has resulted in the remarkable situation that a Swedish hen is not allowed to feed from, for example, Baltic herring. However, a Swedish inhabitant can still eat herring for dinner. Since the 1980s no further decrease in dioxins levels in Baltic fish stocks has been recorded and this is a serious threat to the environment and to fisheries in Sweden (Stockholm Marina Forskningscentrum, 2003).

To sum up, the complex of ecological and environmental factors affecting a coastal fish resource like vendace calls for a combination of local and national management strategies to handle local and large-scale ecological and environmental changes. Have management of bleak-roe fishing succeeded with this demanding task?

Prerequisites for trawling

For a long period of time, bleak-roe fishing has been extensively regulated by the state with a "classical" top-down management approach. The political responsibility for managing fisheries in Sweden rests with the Ministry of Agriculture and the National Board of Fisheries is executing this task. Since Sweden joined the EU in 1995, the Swedish sea fishery has been formally regulated by international agreements within the framework of the Common Fisheries Policy (CFP).

Trawl fishing for vendace is almost entirely performed in the five archipelagos belonging to the county of Norrbotten - i.e. Piteå; Luleå; Råneå; Kalix; and Haparanda archipelago. Due to the economical value, this fishery aims almost exclusively for producing bleak-roe. The amount of roe is less than 5 percent of landed weight and only a small amount

of the fish meat is used for human consumption. The major part is used as animal food or, is simply rejected (Interviews 2003 and 2004).[3]

In the Bothnian Bay, fishing with trawl is allowed within two sectors, one outer area, outside the baseline (4 nautical miles) and one area inside this baseline. In the outer area trawl fishing is permitted the whole year. However, almost no mature vendace is caught in this area. The mature vendace is caught in the inner area where trawl fishing is only permitted from end of September to end of October. The value of the catch in this inner area is approximately 97 percent of the total catch value for vendace. Trawling in this area is often performed on shallow waters; e.g. the mean depth in Luleå archipelago is no more than 9 meters. No trawl fishing is allowed on private waters or within 400 meters of the shoreline – this also includes the shoreline at islands, for example, in the outer archipelago.

In Sweden it is normally forbidden to trawl in the inner area and therefore it is necessary for all trawlers within this fishery to obtain a permit to trawl. Trawling licences is permitted by exemption from the National Board of Fisheries, and after the County Administrative Board has expressed their opinion. Trawling licences are valid for a maximum of three year. It is also obligatory with a commercial fishing licence which is valid for a maximum of five years before it has to be renewed. Additionally, all boats with a length over 5 meters used in commercial fishing need a vessel permit. Thus, to participate with a trawler a fisherman needs trawl license, commercial licence and a vessel permit.

Bottom trawling in pair is the prevailing catch method used by commercial fishers. Two trawlers compose a "trawl-team" hauling one bottom trawl between the two vessels. This, so called, "pair-trawling" is the only trawl method allowed in bleak-roe fishing. In a trawl-team, both trawl vessels are obliged to keep a daily logbook and only trawlers with a maximum length of 14 meters are allowed to participate in bleak-roe fishing (Thoresson, 2002; Thoresson et al. 2001; Fiskeriverket, 2003).

A downward trend in the ecological system

At the first half of last century - when cotton nets, hoop nets and seines where used - catches of vendace were between 50 and 100 tons per year. With the introduction of the effective nylon nets in the 1950s an increase in catch-effectiveness occurred. A large increase in catch effectiveness took place when the trawl fishery for vendace started at an experimental stage in 1960. Obviously, this was quite of a success. Catches increased considerably in the 1960s as

[3] Commercial fishers can make some profit from non-mature vendace by selling it to mink farmers in Finland. However, non-mature vendace is much less valuable than bleak-roe.

the number of trawling groups expanded. From mid-1970s to the mid-1980s catches were between 600 and 800 tons per year. In the late 1980s and the early 1990s the catches increased to approximately 1 000 tons per year, but in 1991 the catches started to decrease. The overall downward trend continued during 1990s and the total landing of vendace in 1999 was only 237 tons. Governmental authorities where, and are still, of the opinion that fishing had exceeded a sustainable level due to hard pressure on the resource (Sandström, 2000; Thoresson et al. 2001; Fiskeriverket, 2001; Finfo 2001:11).

Many trawl fishers where of another opinion; all fishermen interviewed believed that the main cause for the decline was unsuccessful spawning during several years and a result of a natural fluctuation; 40 percent believed that these facts in combination with fishing pressure had caused the decline. Consequently, 60 percent where of the opinion that fishing pressure did not affect the stock at all and that spawning, natural fluctuation and a combination of other factors (e.g. water temperature, salinity and autumn storms) had caused the decrease in the stock. Many of the interviewed based their opinion on stories that they have heard from their ancestors; e.g. that before trawl fishing started vendace had disappeared from the archipelago several times and that vendace is extremely dependent on other surrounding factors in the environment (Interviews with fishers 1999; 2003 and 2004).

The total stock (total biomass) of vendace where about 12 000 tons in 1973. Throughout the 1970s the total stock fell downwards and where approximately 5 000 tons in the end of the decade. In the 1990s, catches where still high but the total stock had been reduced by over 50 percent to approximately 3 000 tons and this downward trend continued with a stock around 2 100-1 300 tons in 1992-1996. The total stock where down in less than 1 000 tons in 1998. A small increase occurred in 1999 with a total biomass of 1 400 tons (Thoresson, 2002). However, compared to the figures in the early 1970s this was a rather insignificant increase.

On top of that, the mean age of the stock had also decreased significantly. The trend has been that an increased proportion of the stocks being landed each year which had lead to an erosion of the quantities of mature fish. This affects the spawning biomass (i.e. the mature part of the stock) in a negative sense. Since the late 1990s, a large share of the vendace catch have consists of young individuals, for example in 1999, as much as 31 percent of the catch (in weight) was juveniles born the same year. Nowadays, vendace older than 7 years and larger than 20 cm is unusual (Thoresson et al. 2001). To reduce the number of undersized and non-mature vendace being ensnared in the trawls, the Board decided that nets must have a bigger mesh on the trawls for bleak-roe fishing in 2000.

The spawning biomass has consequently been reduced considerably during this period. The all-time low was 1999 when the total spawning biomass of vendace where down to 347 tons (Fiskeriverket, 2001; Thoresson et al. 2001). If catches are at a sustainable level, the stock is rather constant. With reference to our earlier discussion, the ecological situation for the vendace resource can be viewed in the following way. The drastic decline in catches in late 1990s indicates that fishing in the late 1980s and early 1990s was probably above a sustainable level. The total stock of vendace had been reduced substantially and the resource had been moving in a downward direction. If the management system is adaptive and effective it should be able to cope with this type of situation and reorganise management, something that obviously has not been the case.

The development and conditions for commercial fishers

The number of commercial fishers holding trawl permits has also varied over the decades. In 1963 there where 22 trawl-teams (44 trawlers) participating in bleak-roe fishing. The number increased throughout 1960s and reaches a peak in 1970s with a maximum of 44 trawl-teams (88 trawlers). In the 1990s a substantial reduction in trawl permits occurred; the number of trawl-teams in bleak-roe fishing where 34 in 1992 and only 19 in 1999.

Thus, to deal with the large decline in vendace the National Board of Fisheries has tried to limit the input in bleak-roe fishery. However, it is important to bear in mind that the effectiveness in the trawl fleet has increased during this time. In general, it is calculated with an increase in efficiency by 2 percent per year and this is also valid for bleak-roe fishing (Thoresson et al. 2001). The intensity of commercial fishing is not restricted during the fishing season.

Commercial fishers can obtain financial aid within the framework of the EU system of structural support. Accomplishment of structural programs is done by the National Board of Fisheries in consultation with the County Administrative Board and the administration for Objective 1 regions (Fiskeriverket, 2004). Subsidies are also given through unemployment insurance, which in the case of fishing is, to a large degree, an “off-season” subsidy. Finally, commercial fishers can obtain tax relief to make the economic conditions for fishing more favourable (Fiskeriverket, 2001). Sweden has an old practice of support for technical and temporary activity stops; that is mainly explained by its geographical situation and climate, which makes compensation for activity stops necessary for the maintenance of fishermen’s income. The total remission of fuel tax is the only measure common to all Member States in

the Union and, hence, for Swedish fishers. Swedish fishing companies have also VAT payment exemption (European Commission, 2001).

The development and conditions for recreational fishers

There are both commercial and recreational fishers on the arena. Recreational fishers are allowed to use six nets with a total length of 180 meters; intensity of use is thus regulated through effort limitation. The new fishing law (1993), which restricted the number of gears for recreational fishers, resulted in a decrease of recreational bleak-roe fishing. Additionally, the large increase in seals has also resulted in a substantial reduction. The fixed gears used by recreational fishers are destroyed by seals and they also frighten away the fish from gears. This is confirmed in interviews with trawl fishers; they use fixed gears in theirs salmon and whitefish fisheries and have huge problems with seals (Interviews 2003 and 2004).

While the commercial fishers struggle to fill their trawls, it seems that recreational fishers are more willing to withdraw from fishing in times of declining catches. In discussions with three recreational fishers in 1999, they all said that they had not participated in bleak-roe fishing in 1998 due to the scarcity of the resource - "it wasn't worth the effort" (Interviews 1999-08-16–1999-08-28). This view was confirmed in interviews with commercial fishers in 2003 and 2004, they expressed the opinion that recreational fishers only participate when they have the chance to get plenty of fish and "make money" from the fishery. All trawl fishers interviewed where of the opinion that a major part of recreational fishers draw back from the fishery in bad times. They also expressed the opinion that the large recreational/subsistence bleak-roe fishery that took place in the 1970s and 1980s probably never will be back. Nowadays "it is a few old men that participate in bleak-roe fishing and the younger generation is not willing to take over" (Interview nr. 6 and 14, 2003). This was a common opinion among the trawl fishers. A huge majority, 90 percent, of the trawl fishers where of the opinion that recreational catches did not affect the stock of vendace at all and 80 percent where of the opinion that it did not affect the trawl fishery in any way. Instead, the reduction of recreational fishers was considered as a problem for some of the interviewed because they usually recruit new commercial fishers from that group. However, when this fishery was at its maximum there could be problems at the bays with trawlers driving across gears, etc. According to some of the interviewed, the recreational fishers could earn a lot of money during this time by selling the roe on the "black market" (Interviews 2003 and 2004).

Also the officials are of the opinion that recreational bleak-roe fishing has decreased substantially. The National Board of Fisheries Institute of Coastal Research calculated that 10

percent of total catches came from non-licensed fishing in 1992 and in year 2000 it was down to approximately 5 percent (Sandström, 2000). According to the Boards Research Office in Luleå, this trend has continued over the last years (Hasselborg 2003-08-28).

The trawl fishers attitudes to regulations

In 1999, many commercial fishers where worried that the pressure on the resource had been too hard, and that bleak-roe fishing had been pushed, unsustainable, over the regeneration rate. There where also criticism of the bureaucratic system and its comprehensive regulations. In a local newspaper, a commercial fisher described the regulations and bureaucracy as "a confiscation of my naturally right to fish" (NK 98-07-16).[4] Another commercial fisherman questioned the transfer of decision-making from the County Administrative Board in Luleå to the National Board of Fisheries in Gothenburg (in 1993). According to him, the people employed in Gothenburg are novices regarding fishing in the Gulf of Bothnia: "[T]hey do not understand how trawl-fishing should be performed without risking the survival of the resource…. today's bleak-roe fishing lacks conscience" (NK 99-09-30). Furthermore, he expressed the opinion that too many of those involved in bleak-roe fishing look only at today's catches, and that this can lead to catastrophic consequences for the long-term survival of the vendace resource (NK 99-09-30). Another commercial fisher expressed similar views in a local newspaper: "I have not spoken to one single fisherman who is of the opinion that the fishery should continue in the same way as today. No one is more interested then us in bleak-roe fishing remaining an option in the future" (NSD 99-09-30).

According to the trawl fishers interviewed the management system in the 1990s was slow and bureaucratic with conflicts and antagonism between fishers and officials. As much as 90 percent where of the opinion that it had been a great deal of conflicts over the years. One of the interviewed puts it in the following way; "what ever they did we complained". Another fishermen expressed the shortcomings of management as follows; "the management system have not been flexible enough; the nature of fish resources make it sometimes necessary with quick decisions and actions which certainly not have been the characteristic of bleak-roe management". Some of the interviewed where of the opinion that it was always a couple of years delay in regulations which had, for example, resulted in restrictions when it was plenty of fish and consequently; "how can we respect such management?" Another expressed a similar opinion; "when the Board decides it will either be a total stop in fishing or

[4] *Norrbottens Kuriren* (NK) and *Norrländska Socialdemokraten* (NSD) are the two major local newspaper in the County of Norrbotten.

free fishing and both alternatives are equality insane". This resulted in distrust for regulations; for example the inclination for rule compliance was not always so high and if a trawl-team broke the rules by trawling in closed areas the other fishers did not bother about it, "it was a matter between the involved trawl-team and the authorities". One of the main reasons for the distrust between fishers and officials was that, according to the fishers, authorities ignored the local knowledge and didn't listen to the fishermen's opinion; "the knowledge among fishermen is considerably higher than by academic researchers and it should be cooperation between fishers and biologists" (Interviews, 2003 and 2004). Hence, a situation had been created in the 1990s where the commercial fishers didn't have confidence in regulations and if some trawl-team violated the law it was regarded as an issue purely between the trawl-team and the authorities. The strategy in command was thus to "run for the fish and to catch as much as possible" in this centralised top-down management system.

Adaptive capacity and resilience in the vendace system

The catch statistics and the decline in the vendace stock indicate that the decline was beyond the critical maximum size and not a result of a natural fluctuation. The situation had deteriorated to such an extent that larger vendace had become rare and the economic benefit from bleak-roe fishing was dependent on catching small fish. Due to lower mean age of the stock of vendace, resilience in the vendace system has probably declined substantially during this time – i.e. reducing the buffer capacity in the system by fishing too many juveniles. According to the officials, the major cause has been a high fishing pressure, primarily due to more efficient fishing methods resulting in a substantial overfishing (Fiskeriverket, 2003, and 2001:41; Thoresson, et al. 2001:30).

The lack of adaptive capacity and capacity to change (i.e. transformability) in the social-ecological system governing bleak-roe fishing has, probably, resulted in a resource crisis with reduced resilience in the 1990s. Most likely, this loss of resilience can be traced back to as early as from the 1970s when the vendace stock started to fall in a downward direction. If a resource, like the vendace, that is subject to human activity loses its resilience this would automatically indicate that the socio-economic system, as manifested in management practices, has already lost its ability to adapt (Rova and Carlsson, 2001). For example, demand for bleak-roe creates short-term pressures to over-utilise the resource. However, eventually a point will be reached, at which the costs of fishing exceeds the value of the catch, and when catches decrease, the fishing effort should also decrease. If this is the case, the resilience of the adaptive renewal cycle will be maintained and the risk for resource

collapse reduced. Thus, the system should be reorganised as a result of a trial-and-error process of social-ecological adaptation. Obviously, this has not happened fast enough in the vendace case. How can this be explained?

What can we learn from top-down management of bleak-roe fishing?

Both the commercial and recreational bleak-roe fishers in Norrbotten have an opportunity to "run for the catch" when fishing are allowed. The high demand for and value of bleak-roe (probably) creates strong incentives for catch-maximising behaviour. The state authority had strengthened its power over the resource as a consequence of a new fishing law in 1993, continuing the historical pattern of increasingly centralised control over the vendace resource. The method used in regulating bleak-roe fishing is effort control, in which the central authorities regulate in detail how, when and at what intensity fishing is undertaken. Furthermore, the central authorities also take some responsibility for the commercial fishers' economic survival, through various subsidies.

A mentality may have evolved whereby an individual fisher just tries to maximise his catch, because the state is seen as a guarantee that the vendace resource will be used sustainably. It is a system in which the users do not need to take any responsibility for the design of a sustainable fishing policy. It had all the features of a so called "Common Pool Resource (CPR) dilemma" (Gardner et al. 1990, and Ostrom et al. 1994). Consequently, an individual catch-maximising strategy is superior to a collective sustaining strategy, and all the prerequisites of a "tragic" situation were present (Hardin, 1968). It seems like government policy can play a strong role in shaping a "tragedy of the commons" by, for example, offering subsidies for new vessels and by keeping fishers in business in times of decreasing catches, which retards adaptation of the management system. Furthermore, if the management system is designed in such a way that it ignores local knowledge and involvement by local users it can create a hostile attitude towards regulations. It is reasonable to assume that when local users cannot affect management they have none incentives to engage in the resource. Why should they engage in something that will take time, effort and probably money if they cannot be sure that it will be worth while or that they at least can affect the situation? These facts in combination with the subtractable nature of the resource can easily result in a "tragic situation" and this seems to have been the case for bleak-roe fishing. Fishers were waiting for action from the authorities instead of putting their collective interest above their short-term individual interests. The management system was not only centralised and inflexible; it also

generated incentives to use the resource in a catch-maximising way. How can this be explained?

The institutional arrangement did not correspond to Ostrom's eight design principles for long-enduring CPRs (Ostrom, 1990; 1992; 1993; 1999-09-29). Moreover, bleak-roe fishers do not constitute a homogeneous group. Different groups have different intentions, preferences and strategies in their fishing. According to the first design principle, the individual's right to use a resource should be clearly defined, and the absence of such a definition in recreational fishing is a serious problem. Anyone can participate as a recreational fisher. Without clearly defined boundaries, the free-rider problem will always be present, and since bleak-roe is a valuable product, this creates catch-maximising incentives for recreational fishers. If recreational users can enter and withdraw from the arena whenever they like, the likelihood that commercial fishers will develop some form of sustainable management practices is probably very low. Why should they? If the commercial fishers were limiting their catches and the fishery started to recover (and "seal-safe" gears is developed), it would be worthwhile for recreational fishers to enter the arena again.

In addition, bleak-roe fishing accounts for more than half of the annual turnover for commercial fishing. Individual fishers' incentive to limit their catches is therefore probably very low when short-term individual strategies are in command. In a market economy, decreasing supply creates higher prices, which only increases the resources attractiveness to its harvesters, which puts further pressure on the resource. The Swedish fishing law worsen the situation. To obtain a commercial licence, fishing must be the main occupation and provide the main income for the applicant; this put pressure on fishers to continue fishing in times of resource scarcity. Historically, fishers in Norrbotten have been versatile persons earning theirs livings from many different sources of income, for example farming, forestry and fishing. In times with decreasing catches they could easily shift their main source of income and the resource had a chance to recover. Today, 58 percent of the trawl fishers do not have any other income than from fishing and for the remaining fishermen it's important that the main part of incomes comes from fishing (Interviews, 2003 and 2004). The flexibility in the social-ecological system is thus very low. Subsidies aggravate the situation. Without them, fishers would probably go out of business when catches decreased. With diminishing returns, fishers would have no incentive to increase their effort, and the fishery might stabilise and start to recover. With subsidies and the maintenance of over-capacity, the fishery could easily collapse. Recreational fishers have more scope to vary intensity of use. If a recreational fisher is not rewarded for his effort, he can always retreat from fishing for some years until

the catches increase. This causes a paradox: the people who are most dependent on bleak-roe fishing also have the strongest incentive to behave in a way that destroys the resource.

To sum up; in last century, the bleak-roe case had all prerequisites of a system where short-term individual catch-maximising strategies were in command. These conditions resulted in a distrust of management and finally in a serious resource crisis. This raises the interesting question whether a "classical" top-down management system with individual catch-maximising strategies can be transformed into an adaptive management system with a collective sustaining strategy? Can this be done in a system without any historical experiences of local engagement in management?

Changes in the vendace system

As we have seen, the probability was high that the vendace resource was doomed to the "Hardin tragedy" if the institutional arrangement for bleak-roe fishing was not changed. Obviously, the system was ineffective and unsustainable. The trend was towards a point of deep crisis in the social-ecological system. As described earlier, it was not only the commercial fishers who where and are worried about the long-term survival of the vendace resource.

Due to the severe situation in 1999 and as a general call for prevention of further over-fishing, the National Board of Fisheries proposed extensive restrictions in trawl areas which to a great extent provoked the trawl fishers. A rather common opinion among the fishers is that these restrictions would have been a serious threat against a future trawl fishery (Interviews 2003 and 2004). According to one of them, it would have destroyed the possibilities to perform trawl fishing for bleak-roe in the future because "there where extreme limitations in every bay and [as a result] we decided that every man who could speake tolerably well should make a phone call to the Board and protest against the restrictions" (Interview nr. 4, 2003). As a response to the bad performance and as a response to the threat of withdrawal of trawls areas, the fishermen themselves, through the *Swedish East Coast Fishers Association* (SOC), exerted considerable pressure to develop a system with sharing of power and responsibility between the Board and the trawl fishermen. In August 2000, the Board decided that no further restrictions should be implemented before a test with local management had been evaluated (Thoresson et al. 2001).

According to the Boards decision it was on SOC responsibility to create a suitable management organisation. However, it should be emphasised that no formal exercise of authority was delegated to SOC and that management of vendace was still within the limits of

the fishing law (FIFS 1993:31). It was also stated that control and supervision was on the Boards responsibility and should be carried out by the same routines as previously. Further, the management group have no formal right to impose sanctions (Fiskeriverket, 2000-09-25, Hasselborg 2004-01-22). A management group - with participants from the trawl fishers; the president of SOC; the Boards Research Office in Luleå; the County Administrative Board; and a biologist from the Boards Institute of Coastal Research - was created. The meetings with the management group are not particularly formal and, in practice, interested trawl fishers are free to participate (Meetings with the management group, 2003-09-08 and 2004-01-29). In the original plan, from the Boards Institute of Coastal Research, the intention was to delegate the full responsibility for control to the fishers during 2002 (The National Board of Fisheries Institute of Coastal Research 2000-08-25). Still, in 2004 this has not been done.

The management group and SOC made some rapid decisions:

- In order to deal quickly with changes during the fishing season it was decided that information should be spread by VHF- or by cellular telephone;
- They cut down the trawl period (by seven days) and they shortened the time for trawling during the day (06-17.00). Additionally, the management group also forbid trawling on Fridays and Saturdays (earlier there where no limits in time during the trawl period);
- Bays with high shares of juveniles where excluded from trawling and the group decided to stop trawling on other bays if the share of non-mature vendace was too high (the excluded areas was almost the same as the areas proposed earlier by the Board!);
- To prevent catches off non-mature vendace, a decision was made stating that all trawls must be equipped with selection panels;
- As a complement to the Boards samplings it was decided that every trawl-team should do their own samplings and sending forward the result to the Boards Office in Luleå (Ostkustfiskarna PM. 2000-09-12. Thoresson et al. 2001).

These measures have been quite stable with only small adjustments since 2000. For example, in the fishery 2003 the fishers own samplings where done on a daily basis and the time for trawling where reduced further (06-15.00). It has also been many and loudly discussion whether they should open up some of the closed areas or not. Another “hot” issue is whether the management group should have formal rights to impose penalties or not (Meetings with the management group 2003-09-08 and 2004-01-29, interviews 2003 and 2004, Hasselborg

2004-01-22). So, considerably changes in the social system has happened but have it been any changes in the ecological system?

An upward trend in the ecological system

With reference to ecosystem functions, the situation for the vendace resource, since the beginning of the 1990s until the new management was implemented, can be described as shown in Figure 2.

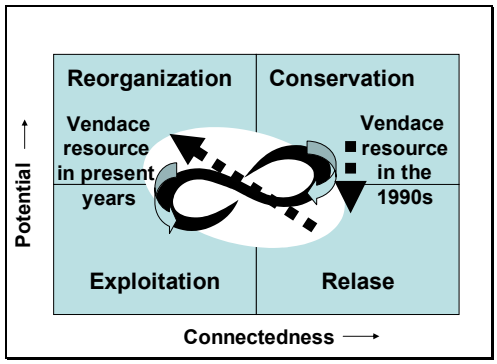

Figure 2. The vendace system in relation to four ecosystems functions (after Holling, 1986).

In the early 1960s, when trawling of vendace started, the resource was located in the exploitation (or growth) phase and slowly went to the conservation (or organisational consolidation) phase in the 1970s and the 1980s. In this phase, stability initially increases, but the system becomes more and more over-connected until rapid change is triggered in the release stage. In an ecological sense, exactly this happened, perhaps as early as in the 1970s when the total stock of vendace slowly started to decrease. From the mid-1990s, rapidly falling catches and a dramatic stock decrease indicates that the resource was in the release phase. As earlier described, also the social system was in the release phase with pressures for a reorganisation of the management system – i.e. a flip to another state of management. The stage from exploitation to conservation is predictable with quite high degree of certainty and, in a fishery, production and accumulation maximises as it did in the vendace system during the 1970s and 1980s. Release (or collapse) is a stage in which the system becomes increasingly fragile and requires rapid reorganisation. This happened in the vendace system in 2000. This phase of renewal is leading to reorganisation with consequences that are unpredictable and highly uncertain. However, as shown in Figure 3, the downward trend in the ecological system was broken.

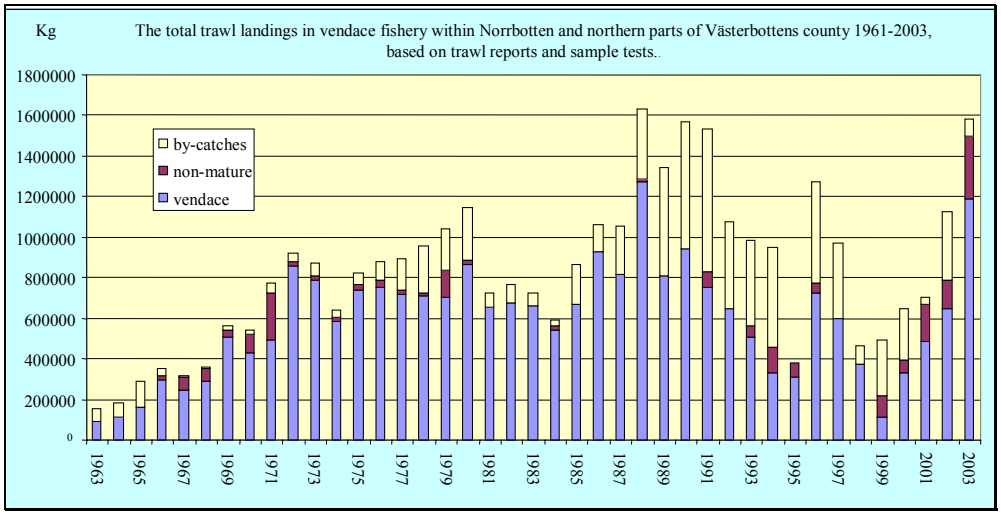

Figure 3. Total trawl landings in vendace fishery 1963-2003 based on trawl reports and sample tests. Usually, by-catches consist of herring, whitefish and smelt. Non-mature is, accordingly, not sexually mature vendace i.e. juvenile vendace (data from Hasselborg at the National Board of Fisheries Research Office in Luleå 2004-04-15).

In year 2000 the catches started to increase and the catch statistics for 2003 is on the same high level as the record years in the 1970s and 1980s. Certainly, one can say that the resource have boosted extremely. With consideration to the decreasing in trawl-teams the situation is even more remarkable. The number increased throughout the 1960s and 1970s with a peak of 44 teams (88 trawlers). From 1999 onwards there have been approximately 19 teams. These teams have as well been restricted in areas and in time and still landed this high catches. Surely there has been an increase in efficiency.

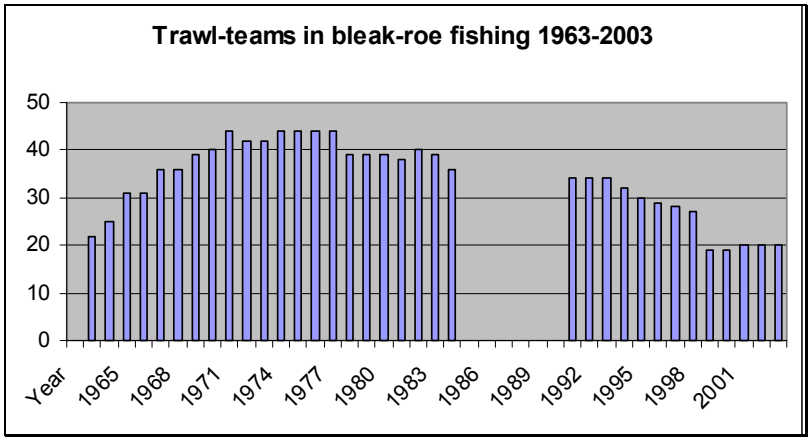

Figure 4. The number of trawl-teams that have participated in bleak-roe fishing during 1963-1999 (data from Hasselborg 2004-04-15). Please note that one trawl-team consists of two trawlers – e.g. 1999 there where 19 trawl-teams that consist of 38 trawlers.

The positive development has also occurred in the total stock of vendace. As shown in Figure 5, no sample tests and no estimation of the population where done in the 1980s and consequently no data is available for this time. According to the Boards Institute of Coastal

Research the validity on the earlier data (1970s) is not as high as in later years. However, it clearly illustrates the overall trend (Thoresson, 2002). We can assume that the downward trend continued due to the low estimation in the beginning of the 1990s. In the same way it seems reasonably to assume that the upward trend (since 1999) has continued in 2002 and 2003 because of the high catch statistics for these years. This view is confirmed by a biologist at the Boards Institute of Coastal Research.[5]

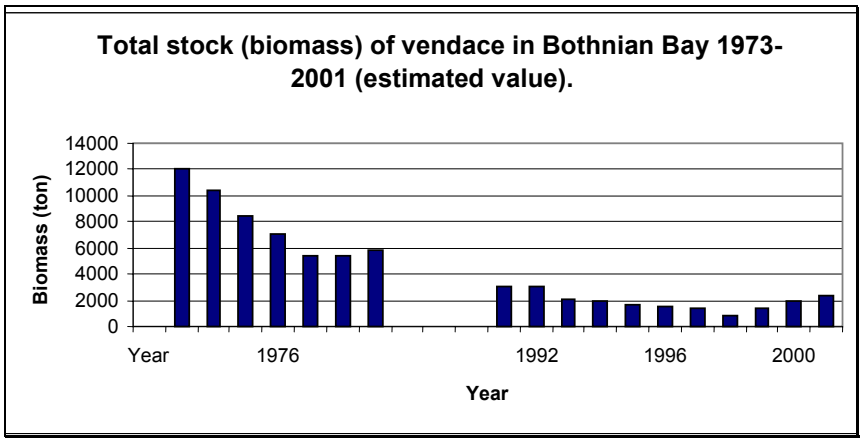

Figure 5. Estimated value of the total stock of vendace in the Bothnian Bay 1973-2001 (data from the National Board of Fisheries Institute of Coastal Research 2002; through Hasselborg 2004-04-15).

The boost in catches is of vital importance for the survival of a coastal fishing fleet in Norrbotten. Notwithstanding the fact that the fishery is restricted to short period in the autumn, catches of vendace are of primary importance regarding both landed weight and economic yield. For example, the catches during 1985–1986 amounted to more than 50 percent of the annual turnover for these fishers (Kustfiskets lönsamhet i BD-län 1985-1986). Nowadays, it stands for approximately 67 percent (mean value) of the annual turnover for the fishers interviewed (Interviews with fishers 2003 and 2004).

It seems like the trawl fishers were correct in their assumption that the spawning had been unsuccessful in the early 1990s and that many other factors than fishing pressure are of vital importance for the resource. Nowadays, many of the officials are also of that opinion, for example, Hasselborg at the Boards Office in Luleå believe that the warm summers and warm waters in last years have affected the stock in a positive sense. He also emphasize that the uncertainty around the biological prerequisites for the vendace resource is high and that he, and most of the other officials, are very surprised over the fast recovery (Hasselborg 2003-08-28). The Boards Institute of Coastal Research are of a similar opinion; they are not sure

[5] Meeting with the management group 2003-09-08.

whether it is one or several populations of vendace or where the recruiting areas are located and "it is time to study the surrounding factors that are affecting the resource" (Meetings with the vendace management group 2003-09-08 and 2004-01-29).

The trawl fishers' attitudes to local management

When asked about the functioning of the prevailing regulations in bleak-roe fishing the respondents had the following alternatives: badly, not so good, satisfactory, or all right; 77 percent answered that the regulations function "all right" while the remaining 23 percent answered "satisfactory". In another question, as much as 90 percent were of the opinion that the new management system function "better" than the previous one whereas the remaining 10 percent consider the new system as rather "equal" to the earlier management system (Interviews 2003 and 2004). Thus, compared to the previous one, the trawl fishers are quite pleased with the new management system. A quite common opinion is that when fishermen themselves (i.e. management group) make a decision it is "holy" and fishers have respect for them while the respect for the Boards decision are much lower and often resulting in violations. The probability for drastic and ill-considered decisions is also lower with local management. Further, for a fluctuating resource like vendace it is important with quick responses, and when ecological circumstances make it necessary, "we can call of the fishing in a certain bay without any formal decisions and no one is trawling in that area" (Interviews nr. 3, 4, 8, 10, 12, 13, 15, 19, 20, 24, 30).

However, there is also comprehensive criticism against authorities' behaviour. Many fishermen, particularly members of the management group, expressed a feeling that the Board have the "whip behind their back" in every decision and the risk is that it will be an end of local-management if the fishers make the "wrong decisions" – i.e. decisions not recommended by the Board. The fact that there is no exact time schedule for the project is contributing to this feeling. To create an effective and sustainable management system, the fishermen frequently expressed the opinion that they need some years of good working atmosphere. Otherwise, there is always a risk that the project is cancelled if decisions are going against the Boards opinion (Interview nr. 3, 4, 6, 7, 8, 9, 11, 13, 14, 15, 25, 26, 27, 30 31). Thus it isn't self-management if "we have to dance to the Boards tune" (Interview nr. 4). The National Board of Fisheries in Gothenburg decided on a meeting in February 2004 that the project will continue as before in 2004. But, no decisions where made for the period after the end of season 2004 (Aho, 2004-02-23). So, the uncertainty is continuing and trawl fishers can only plan for one year in advance. Despite this uncertainty, all trawl fishers interviewed want a continuation and 81 percent want an expanding of the project (for example by; more

power, some formal right to impose sanctions, a fixed time period for the project, etc). The relationship with the authorities has also improved with fewer conflicts and better understandings between fishers and officials (Interviews 2003 and 2004).

Collective action among the trawl fishers

A huge majority of the fishermen (77 percent) are of the opinion that the unity within the group has increased since local management were implemented (the remaining part answered that the unity always had been good). According to the answers, the main reasons are that with increased responsibility there is a need for closer contacts and cooperation; the group is also smaller and everyone known each other. The engagement in management has also increased (Interviews 2003 and 2004). One fisherman expressed the situation in the following way; "in the 1980s we were more of individuals and nowadays we have more solidarity within the group. It is more openness and we talk and meet one another more often; partly, this is dependent on the local management and partly on the fact that the trawl group is smaller" (Interview nr. 27).

During the first years of local management, the management groups own restrictions were fully respected (besides some small and unintentional infringements – e.g. 100 meters over a trawl-line). However, in 2003, one trawl-team violated the restrictions intentionally and trawled in a closed bay for a couple of hours. The problem is that formally this trawl-team did not break the law because these areas are closed by the local management but open according to the fishing law. Without any formal rights to impose sanctions the collective couldn't expect any actions from the authorities. Indeed, information were spread quickly among the trawl fishers The fishers acted immediately and held a meeting the next day with all trawl fishers who had the possibility to participate. A "vivid discussion" was held with the guilty trawl-team and no further infringements occurred in the fishery (Interviews 2003 and 2004). It is fascinating that an action, that the rest of the collective didn't bother about before local management were implemented, caused such irritation and engagement. All fishers interviewed had a lot to say about this happening (also the trawl-team involved) and were worried for the consequences in the future. The fishers are worried that if similar events are repeated the legitimacy for their own "holy" regulations will decrease and that the authorities will cancel the management project. This event raises the question whether the local management should have any formal right to sanctions or not. The fisher collective is divided in this matter. On one hand there are those who consider the formal right of sanctions as a necessity to prevent future infringements. On the other hand there are those who consider that formal sanctions should remain as a responsibility for official authorities. They often argue

that within the collective of fishers they are colleagues and no one should act like a police controlling the others (Interviews 2003 and 2004).

An interesting aspect is that when the collective of trawl fishers had an opportunity to create their own rules they almost immediately implemented the same restrictions they so loudly criticized before.

Local knowledge

The mean age of the fishermen interviewed is 47 year and the mean time as a trawl fisher is 22 year. Usually, they have participated in the fishery as a subsistence fisher or together with relatives before they received their own trawl licence (Interviews 2003 and 2004). Surely, they possess a lot of experience and knowledge.

As been described earlier fishermen had their own theories about the resource crisis in the 1990s. Thus, that many other factors than trawling are of significant importance. They build their opinion on the fact that vendace had "disappeared" from the archipelago even before trawling had started – i.e. when the fishing pressure was much lower. The fact that there has been a decrease also in bays excluded from trawling is seen as a sign that unsuccessful spawning is the main cause to the crises in late 1990s. Due to the fast recovery in the resource system, it seems like they to a certain extent were right. Still, the stock is quite small but has an upward tendency. The spawning has succeeded and catches are all time high. According to one fisherman; "to be honest the increase is not only a result of the local management; we known for sure that the resource was in an upward cycle since we saw the sign in form of loads of juveniles in our trawls meaning that the spawning had been successful… But, the biologists didn't understand that" (Interview nr. 4). Another respondent expresses a similar view; "In the late 1980s when we only had old vendace in our trawls the authorities were of the opinion that everything was fine… This is totally wrong because it indicates that the spawning has been unsuccessful for a couple of years and a substantial decrease will come. But the authorities didn't understand that. Quite right, in the 1990s it was a large decrease in catches… However, in the late 1990s when the spawning had succeeded they want to stop the fishery" (Interview nr. 8).

Opposite to the authorities' opinion a huge majority (81 percent) of the trawl fishers believe that trawling is not affecting spawning areas. According to them, vendace spawn close to land (also close to islands in the outer archipelago) and on very shallow waters were trawling is forbidden. Fishers' arguments are building upon many years of direct observations in nature and are resulting in a numerous different explanations; however, they reach the same conclusion (Interviews 2003 and 2004). For example, one quite common opinion is expressed

by a fisher in the following way; “some bays, for example Pålänge and around Storön, have been the best and most trawled areas since trawling started 1960. There has been a hard pressure on these bays for over 40 years and they are still the best; this would not be the case if trawling were damaging spawning areas” (Interview nr. 28). Nowadays, as pointed out earlier, biologists and representatives for the regulating authorities admit that their ecological knowledge for vendace is incomplete.

Resilience, adaptiveness and transformability in the local management system

Certainly, recreational and subsistence bleak-roe fishing is resilient, adaptive and have transformability capacity. They can easily vary intensity of use. In times with decreasing catches and if a recreational fisher is not rewarded for his effort, he can always retreat from fishing. Exactly this happened in bleak-roe fishing during the 1990s. However, when catches started to increase, these fishers did not enter the bleak-roe arena again due to changes in the social-ecological system; i.e. the boost in grey seal population and as a consequence of the new fishing law (1993).

As a result of the economical importance of bleak-roe catches for commercial trawl fishers the situation is different. In times of scarcity (of the resource) they increase their efforts. Over 90 percent answered that they are flexible and travelling around the coastal areas searching for vendace in bad times. When there are plenty of fish they stay near their “home ports”. In bad times, they also increase their time in fishing. However, a positive result of this are that they change bays if they get to much non-mature vendace (Interviews 2003 and 2004). There are no quotas in bleak-roe fishing but there is a “natural” catch limitation in handling catches. To get high quality roe from the fish, every vendace must be squeezed by hand within 24 hours. This takes time and every trawl fisher take care of his own catches - they often have relatives and temporary employed in extracting the roe from the fish – but it is a time consuming process. As long as bleak-roe fishing is performed by local small-scale coastal vessels this puts restriction on catches. Thus, catches are adapted to the capacity in squeezing. “In bad times you spend more hours at the sea and conversely in good times. Nowadays [2003] we will pull the trawl around 3-4 hours per day while, in the late 1990s, we pulled the trawl for at least 12 hours per day” (Interview nr. 11). Fishermen have learnt to live with the fluctuating nature of the resource. “We know for sure that after good times there will be bad times and so on. In good times we invest and repair vessels and in bad times we survive” (Interview nr. 14).

As mentioned earlier, the prerequisites to obtain a commercial fishing licence (fishing must be the main income, etc.) reduces adaptiveness and transformability in the system.

According to the fishermen interviewed the reduction in trawl licences that occured in late 1990s were good because it increased the flexibility in the system. The main arguments are that trawlers have been much more effective and that there will come worse times when they must survive. It is better that the numbers of licences are stable instead of adjusting the number after the fluctuating nature of the resource (Interviews 2003 and 2004).

To sum up: the most serious threat for a well-functioning self-management is the lack of independence. The local management is functioning within a comprehensive state regulation with restricted authority for the users. On the other hand, the resource system is clearly defined (with a rather non-migratory resource) and, after the extensive reduction in recreational/subsistence fishing, the user group is small and homogenous. It seems like there is a tendency towards developing a *collective rationality* within the group – more contacts and cooperation between the users; their own rules are "holy" and breaking them raises an outcry, etc. If this is the case it is remarkable due to the long history on centralised top-down management by the state. Another step in the right direction is the better understanding and cooperation between officials and the trawl group as well as within the group. It also seems like *resilience* has increased within the system. The resource has increased considerably and the number of users has been reduced substantially meaning that the buffer capacity probably has increased. Additionally, the increased engagement and concern (collective rationality) for the resource among the fishers, as well as the quick decisions on the local level, will also affect resilience, *adaptiveness* and *transformability* in a positive direction.

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