Flipping the Pyramid:
Lessons from Converting Top-down Management of Bleak-roe Fishing

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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 which are too inflexible to cope with changing ecological conditions are unlikely to prosper. The aim of this thesis is to contribute to the development of a better understanding of governance in a relatively small and clearly defined, but complex common-pool resource system. It also aims at providing insights into how different governance strategies affect individual users' incentives, as well as the adaptive capacity in such systems.

Since the beginning of the 1960s, the trawl fishery for vendace has been top-down regulated by the State. At the beginning of the 1990s, catches started to decrease dramatically. This happened despite extensive state regulation and despite the fact that the resource is fairly non-migratory and concentrated in a limited area. In the thesis, the institutional framework that contributed to this crisis is analysed in terms of provision of incentives and the capability to adapt to changing ecological circumstances. It was found that despite deliberate state regulation, the existing governance system worsened the resource crisis. In response to the poor performance of the fishery, a co-management system, with sharing of power and responsibilities between the National Board of Fisheries and the trawl fishermen, was implemented.

An extensive survey among trawl fishermen showed that, after three years of co-management, a change in individual behaviour has occurred. The fishermen had, to some extent, redirected their individual catch-maximising strategies towards long-term collective rationality. With regulations implemented through bottom-up, instead of top-down processes, the legitimacy for regulations had also increased considerably. The management system became more adaptive and created users, who had the capability to react to changes in the ecosystem. As a result, catches have increased extensively since co-management was implemented. In the thesis, it is demonstrated how and with what mechanisms this change, from top-down to bottom-up approaches in management, has affected the incentives for individual fishermen and, how this has affected collective action and, thus, the long-term ecological survival of the vendace resource.

It is concluded that, managing fisheries with unexpected changes and complexity in linked social-ecological systems requires actors (both fishermen and authorities), who learn from failures and, when necessary, initiate and achieve institutional change. The creation of social-ecological resilience can be looked upon as a process – a socially generated collective good – which is likely to result in better governance systems. In this context, the role of institutions in building adaptive capacity and supporting collective rationality is important.

Key-words: Bleak-roe fishing, common-pool resources, social-ecological resilience, governance, institutions, local management, collective action.

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Acknowledgements

There are lots of people I would like to thank for a wide variety of reasons, people who, in one way or another, speeded up or slowed down the completion of this thesis. Firstly, I would like to thank my supervisor, Professor Lars Carlsson. I could not have imagined having a better advisor for my PhD thesis, and without his common sense, knowledge and perceptiveness, I would never have finished the work. Thank you Lars for critical and constructive comments, and for all the time you have spent reading my manuscript. I also would like to thank Professor Nils-Gustav Lundgren, who has provided valuable comments on various parts of this thesis.

Secondly, a huge thank you to all previous and current members of the Political Sciences and the Economics Departments at Luleå University of Technology, particularly those of you who have put up with my drifting away from the academic subject during countless coffee and lunch breaks. Much respect to my officemates, and, hopefully, still my friends.

Thirdly, I would like to say a big "thank-you" to all the fishermen and officials who agreed to be interviewed for this thesis, and who had to put up with my interviewing technique (or lack of it!). A special thanks to Thomas Hasselborg, at the National Board of Fisheries Office in Luleå, and to Kjell Strömbäck, president of the Coastal Fishermen's Association in the County of Norrbotten, who have been extremely generous in their willingness to discuss and explain fishery issues with a novice PhD student.

Fourthly, I want to thank my parents for their endless support and absolute confidence in me. The knowledge that they will always be there to pick up the pieces is what allows me to, repeatedly, risk getting "shattered".

Finally, I would like to express my deepest gratitude to my family, Lotta, Oscar and Hugo, for giving me so much joy and for distracting me from my work, thereby giving me the strength to return to it. Most of all, I would like to thank my wife Lotta for her love, inspiration, patience and support. I hope that I can "repay" you in the future.

Thanks to my family for brightening my days.

Calle Rova
Luleå, October 2004

1 The Politics of Fisheries Governance

Since ancient times, fish has been a major source of food and fishing a provider of employment and economic benefits to those engaged. Worldwide, more than 15 percent of the total animal protein supplies consist of food fish supplies. International trade in fish products has increased to a new record of US$ 55.2 billion in the year 2000, having grown by eight percent since 1998 (FAO, 2002). As fish resources are not infinite, they need to be properly managed if their contribution to nutritional, economic and social well-being is to be sustained. The cautious strategy is to husband the resource in such a way as to provide a long-term sustainable base for production. If fish resources are overfished, they will not sustain either social or economic development. Scientists have repeatedly warned that overexploited stocks will take time to recover – if ever. Patience and perseverance are, therefore, essential qualities in fisheries management. As far as conservation is concerned, fishing pressure continues to increase and there are many examples of fish stocks becoming exhausted if they are not managed in a sustainable fashion. Many stocks are at present beyond safe biological limits and if current trends continue, many of them will collapse (European Commission, 2001). A fish population can be driven to extinction once the population is reduced below a certain critical minimum size (Berkes, 1989:24). As long as catches do not exceed that critical minimum size and do not exceed the rate of regeneration, the fish stock will be intact for future generations.

Over-fishing is not only an environmental problem; it is also economically inefficient in the long run. According to the European Commission's evaluation of the Common Fisheries Policy (CFP) in 2001, the policy has not resulted in sustainable exploitation of fish resources and needs to be changed. Its failings can be expressed in conservation, economic, and political terms (ibid). Thus, fish resources can be viewed as capital stocks that – if managed responsibly – can produce considerable and sustained social and economic benefits (FAO, 1997:14). In Europe, the fisheries sector is characterised by a shrinking resource base, overinvestment,

rapidly rising costs and economic vulnerability (European Commission, 2001). For example, in 1994 it was calculated that if fish resources were managed appropriately, the European Community's waters would yield a further US$2.5 billion-worth of fish a year. The FAO estimated the annual loss world-wide at US$15–30 billion; and American fishery managers estimated that the United States' catch would be twice as valuable as it was in 1994, if fish stocks in federal waters were allowed to recover from over-fishing (*The Economist*, March 1994:28). Thus, an environmentally *unsustainable* activity is one that "cannot be projected to continue into the future because of its negative effect either on the environment or on the human condition of which it is a part" (Ekins, 1994:28).

The members of the United Nation's Food and Agriculture Organisation (FAO) have concluded that the current operation of the world's fisheries cannot be sustained – i.e., it is an unsustainable activity (FAO, 2002). For example, fishermen continually strive to improve the technology they use, as well as their cost-effectiveness. New technological developments, such as geographical positioning systems (GPS), radar, echo-sounders, more powerful vessels and improved processing methods, all improve fishermen's ability to exploit fish resources more intensively. According to McGinn (1999), the technological capabilities of the world fleet as a whole increased by 330 percent during the 1970s and 1980s. Due to these technological improvements, pressure from different types of fishing is so intensive that 80 to 90 percent of the fish in some populations are removed every year (Safina, 1995:32f).

Over-fishing has two components: growth and recruitment over-fishing. The first occurs when, without initially affecting the overall population, fishermen take smaller than average-sized fish. This means that the fish are never allowed to reach adult age and, as a consequence, there are fewer and fewer recruits into the spawning biomass; in the long run, stocks collapse. Recruitment over-fishing means fishing beyond the replacement rate, which causes a reduction of the total population sizes (Peterson, 1993:252ff). Recruitment is the number of new fish produced each year by the mature part of the stock. A very low level of a stock is also likely to have negative

impacts on other dependent stocks, "and the losses may extend beyond the immediately affected stock" (FAO, 1997:6).

Excessive exploitation rates will not only decrease stocks, but also reduce size diversity. This can cause genetic selection that favours, for instance, smaller individuals, earlier maturing for spawning and decreased genetic diversity (Olsson, 1997:15).[1] Though all actors would benefit from restraining current catching activity to ensure reasonable catches in the future, most regulations and management of fish resources seem to have heavily discounted the future. In the industrialised West, practically every major fishery has witnessed stock depletion and reduced catches during the past few decades. In a global context, the sector barely stays afloat, at the same time as billions of dollars in subsidies are paid into the industry (McGinn, 1999:135; Stenson and Gray 1993:264). Obviously, current fisheries management practices are not working well.

Swedish marine fisheries are, like those in virtually every modern industrialised country, managed by central government through different kinds of control and regulation methods; Swedish fisheries are, thus, regulated by top-down management techniques. The political responsibility for managing fisheries rests with the Ministry of Agriculture, while the National Board of Fisheries is executing this task. In August 1994, the National Board of Fisheries was commissioned by the Swedish Government to draw up an action plan for the environmental aspects of Swedish fisheries. This action plan was to propose measures aimed at conserving biological diversity and sustainable use of the fish resource (Olsson, 1997:7; Finfo, 1999:7). The National Board of Fisheries has, for instance, established the following environmental objectives for fish stocks in its action plan:

> The variation of at present occurring species in Sweden and its natural geographical regions shall be preserved […] [Consequently], the fishing shall be exercised […] so that the harvest is not exceeding the natural production. The fishing shall not either have impacts on the

[1] Exploitation rate is the proportion of the numbers or biomass removed by fishing. For example, if the biomass is 1,000 tons and the harvest during a year is 200 tons, the annual exploitation rate is 20 percent. Thus, the mature part of the stock is labelled spawning biomass. This is a measure of the cumulative biomass of all fish that will spawn in a given year. Size diversity includes lower mean size and mean age.

> genetical variation […] Gears and fish conservation measures shall be designed so that the original biological value (integration) is only minimally affected (Olsson 1997:21).

From the perspective of ecosystems, ocean and coastal areas support a significant and unique component of the world's biological diversity (Holthus, 1999:170).[2]

Conservation of many renewable resources is characterised by open access problems, in which individual users have little incentive to conserve the resource in a sustainable manner if economic incentives are driving them in another direction (Jakobsson and Dragun, 1996:58). As mentioned above, Swedish marine fisheries are regulated by top-down management techniques. This approach originates from the assumption that individuals using fish resources are strongly motivated to overexploit them, and, thus, that those fishermen by themselves cannot or will not conserve the resource on which their livelihood depends.[3] This has been recognised as a problem in the fisheries sector.

Sustainable fisheries ultimately depend on the day-to-day actions of fishermen – from individual "small-scale" fishermen to "large-scale" industrial fishing companies – pursuing a variety of strategies aimed at securing their livelihoods and profits. To achieve sustainable fisheries, management practices and institutions have to recognise and relate to the dynamics of the fish resource in a way that secures the flow of fish. Thus, a management system needs to match the dynamics of institutions with those of ecosystems for improved social and ecological performance (Berkes et al., 2003). This is the inherent challenge for fisheries management. Accordingly,

[2] Biological diversity, or biodiversity, means variability among living organisms from all sources and the ecological complexes of which they are part; "this includes diversity within species, between species and of ecosystems" (FAO, 1997:70). Accordingly, in this study, sustainable use means "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity or of any of its components, thereby maintaining their potential to meet the needs and aspirations of present and future generations" (ibid.). With this definition, sustainability is a process and includes ecological, social and economic dimensions. The popularisation of the term "sustainable development" came with the Brundtland Commission's definition: "Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987:43). This "standard" definition has been challenged from many positions. For further discussion, see, for example, Lélé, 1991:607-621 and Sachs, 1993.

[3] For further discussion and explanation of open access problems, see Chapters 4 and 5.

fulfilling the environmental objectives that are established in the action plan of the National Board of Fisheries is dependent on political solutions. Thus, the basic problem in fisheries governance is how management institutions should be designed to function effectively and to successfully tackle ecological crises, to find good management regimes?[4] This is the major theme in this thesis.

1.1 Governance of a dynamic, diverse and complex natural resource

There are three fundamental and interrelated problems in fisheries for any policy maker to consider: (1) The *biological* problem – i.e., over-exploitation; (2) the *economic* problem – i.e., over-capitalisation and over-expansion; (3) the *environmental* problem – i.e., the negative environmental consequences of fisheries (Van Vliet and Dubnik, 1999:12). The causes of these problems are many and complex. For example, in marine fishing resource management can be affected by the actions guided by many different interests: such as those of small-scale fishermen (e.g., their livelihoods), industrial fishing companies (e.g., their profits), subsistence/recreational fishermen (e.g., culture and recreation), environmental organisations (e.g., unspoiled nature), government agencies and the public (as well as different combinations of the interests mentioned above). The nature of the resource – fish is a dynamic, diverse, and complex resource – in combination with economic, ecological and political interactions are often such that "stable, long-run balances are unlikely to occur" (ibid:13). Accordingly, sustainable fisheries governance requires ongoing processes that balance environmental, social, economic and cultural concerns.

It is a well-known fact that, independently of whether a fishery is formally regulated by political-administrative methods or not, the rich variety of actors and interests that is at play, structures every fishery system. Thus, questions like "who governs what, when, to whose benefit and why?" in a particular fishery cannot be

[4] A management regime is defined by an establishing law or document which defines a management institution which "empowers the institution, and set goals for it to achieve" (Holling et al., 1993:27).

answered by reference to formally spelled-out rules and regulations. It is an empirical question. In this thesis, it is assumed that the extent to which it will be possible to tailor good management regimes for the Swedish coastal fisheries it will be a matter of *governance* rather than *government.*

Contrary to the notion of government, which typically refers "The government" or to actions performed by central parts of the State, the concept of governance is often associated with forms of governing where the focus has shifted from formal organisations and hierarchical management to informal organising, coordination and complex interactions among a wider range of actors (Björk et al., 2003).

> No single actor, public or private, has the knowledge and information required to solve complex, dynamic, and diversified problems; no actor has an overview sufficient to make the needed instruments effective; no single actor has sufficient action potential to dominate unilaterally. These are basically matters of the relation between governance and governing. (Kooiman, 2000:142).

According to Carlsson and Berkes (2003) the conceptualisation of governance is rather vague. However, two lines of research can be categorised: *Firstly*, the line of research that restricts the notion to "attempts by the State to adapt to its environment" (Pierre in Carlsson and Berkes, 2003). According to this view focus is on the State's institutional and political ability to govern, for example a fish resource, and how this capacity relates to the interest of other actors; *Secondly*, the line of research that emphasises governance as a concept for the "societal coordination of social systems" (ibid). This direction is not as state-centric as the first one and puts the emphasis on self-governance. A key concern in this line is processes of networking and partnership (Stoker, 2000:93).

An important distinction between governance and government is that the former considers the concepts of transaction costs and behaviour that link institutions to individuals, "concepts that remain external to the narrower terms of *government* and *control*" (Hanna, 1999:276). Governance can, thus, be seen as a way that incorporates a more complete understanding of multiple levels of action and the different kinds of variables that can be expected to influence performance in a natural

resource system. Hence, governance conceptualises fisheries management differently than traditional top-down government, "the governance approach takes into account that the fishing industry forms an interactive socio-economic and ecological system embedded in institutions, social networks, and cultures" (Kooiman et al., 1999:260). For example, trust can sometimes be built over short periods of time provided that general surrounding conditions are favourable (Baland and Platteau, 1996:334).

The performance of a fishery is extremely dependent on a number of variables and factors in the ecosystem, as well as in the social system. In management, there is a general need to incorporate these factors, for example; to investigate water temperature, salinity levels, discharges and environmental degradation, as well as to understand how shifts in plankton production and food change affect the resource? There is also a need to study how technological, social, and economic changes influence performance. For example: how do technological improvements affect efficiency; how do changes in the social system affect collective action; and, in what way will a reduced demand for fish products affect individual fishermen's choice of strategies? Finally, there is a need to investigate how all these factors and variables are connected and how they are affecting each other as well as the overall performance in the fishery. All these considerations "must" be included in a governance structure.

In the literature, there are numerous examples of "traditional societies" that have succeeded in regulating harvesting and access to different common-pool resources (CPR) with *bottom-up governance* – i.e., self-governing. Users have created self-governing institutions (rules and norms) to overcome collective action problems.[5] Much of this research has focused on locally situated small user groups and communities (see, for example, Baland and Platteau, 1996; Bromley, 1992; Ostrom, 1990; Pinkerton, 1989; Tang, 1991). These case studies show how institutional arrangements and the incentives they generate can be successful, or harmful, in the development of sustainable management practices for CPRs.

[5] Common-pool resources and collective action are further discussed in Chapter 4.

It is further discussed why people in these resource systems put their collective interests above their short-term individual interests. Notwithstanding the fact that many of these traditional management systems have some form of common management, they have often been undermined by privatisation and government policies driven by the idea that they are under open access.

In a "pure" self-governing system, fishermen are in sole control of their fishery. However, in a modern and complex society, many external factors can affect resource use. When a market develops for, e.g., fish products, it can put pressure on the resource, resulting in an increased production for sale that undermines "traditional management". Increased pressure and integration with the surrounding society can also undermine management. Traditional societies may possibly fail to adopt rules other than those "answering the rather immediate need to regulate access to the local CPR, and this failure may possibly take place even when vital resources are threatened with depletion or degradation" (Baland and Platteau, 1996:210).

Furthermore, the technological development during the last century has played a major part in the degradation of fish resources. In the past, fishermen did not have the technical ability to destroy species of fish dwelling at some distance from the shoreline (ibid:190). Technical progress allows much more intensive exploitation and the risk of resource degradation is considerably greater than it was before. With more efficient technology, fishermen may realise the need for conservation measures too late – viz., when the resource has been rapidly depleted to such an extent that the incentives to conserve the remaining resource stock have vanished. According to Baland and Platteau (1996), outside assistance is needed, particularly when ecological change is rapid. This assistance is believed to be needed to restore productivity so that the users can be motivated to use the resource in a sustainable manner.

To succeed with local bottom-up management of CPRs, an essential prerequisite is that resource users correctly perceive the potential benefits of collective action, "which requires that they are well informed not only about the state of the resource but also about the possible impact of use behaviour on its stock"

(Baland and Platteau, 1996:290). Further, personalised relationships in small groups can easily create negative feelings such as envy and rivalry as well as uncertainty. The implication of this diagnosis is that "even in relatively small groups such as village communities, collective regulation through a central authority may be desirable" (ibid:315). A locally managed fishery can also have difficulties to handle external disturbances. For example, climatic factors that affect the resource negatively. Hence, local management might fail because local conditions do not provide sufficient guarantee for effective CPR-related collective action, owing to changes and new challenges from the surrounding society, deep-rooted features of the social structure, or due to particular features of the resource (e.g., the migratory nature of many fish stocks). It is, thus, argued that it is doubtful whether totally autonomous self-governance is a realistic option for a complex and diverse fishery in a modern industrialised society – i.e., it is uncertain whether these institutions would be capable to tackle the range of management responsibilities demanded by modern fisheries (Symes and Phillipson, 1999:64). If a local user group is considered to be incapable of sustainable collective action to manage a fish resource more authoritarian or bureaucratic methods are, thus, likely to be unavoidable (Baland and Platteau, 1996:379).

Top-down governing (hierarchical governing) of fish resources often relies upon centralised command and control decision making and is based on legal and administrative tools. It has been argued that there are four misconceptions that generally underlie centralised state management of fish resources: (1) The focus is often on central tendencies instead of on probability, distributions, and extreme events; (2) In such policies, there is often a belief that problems from different systems, for example, different fish resources in the same area, do not interact; (3) Resource managers often assume that change will be incremental and linear; and, (4) A belief in an optimal steady state of the resource system that will deliver maximum sustainable yield (www.resalliance.org). These problems often apply to ocean fisheries that are based on fish species that migrate over large distances.

The reasons behind the failures of many top-down systems to manage natural resources are numerous and complex. The most important of them – which usually have the effect of reducing the incentives of local users for managing resources in an ecologically sound manner – are high information costs, lack of adequate monitoring devices, lack of trained personnel, or financial resources, and subordination of environmental concerns to shorter-term economic or political interests (Baland and Platteau, 1996:346). As has been emphasised, management of fisheries is a "diverse, complex and dynamic phenomenon" (Kooiman, 1999:3), and, these complexities of the ongoing ecological process often results in imperfect knowledge.

Accordingly, the basic problem of fisheries is one of governance. Top-down governing emphasizes legal incentives, while a bottom-up perspective emphasizes normative incentives that influence fisheries and fishermen. The critical aspect of fisheries governance depends on "the abilities of the many actors involved identifying common problems, of reaching a consensus on priorities, and, in the next instance, sticking to regulatory measures" (Jentoft et al., 1999:239).

To sum up, governance regimes may include governments, but will also involve other actors and non-state agencies. They do not rest solely on the authority and sanctions of government. In principle, it is possible to govern without government, but in a complex contemporary society it would be very difficult or even impossible. Each regime, governing use of a CPR needs to be constructed for the relevant time, place, issue, and context for that particular resource. Implementation of policy takes different shapes and forms in different cultures and institutional settings (Hill and Hupe, 2002). Thus, there are no basic and fixed governance structures that apply to all types of fisheries; "all involve tradeoffs between stability and flexibility, authority and representation, social and individual" (Hanna, 1999:280). Each system is, thus, unique and requires its own solutions. To cope with the dynamics in the ecological system, each system needs to reflect on how to best incorporate stability and consistency, while retaining flexibility and adaptiveness.

1.2 Fisheries governance as a bridge between Social and Ecological systems

This study analyses social and ecological systems as an inter-linked system and focuses on the inter-dependence between these two. In this study, ecological systems (ecosystems) are defined as "self-regulating communities of organisms interacting with one another and with their environment" (Berkes et al., 2003:3), while social systems deal with property rights, land and resource tenure systems, and systems of knowledge relevant to environment and resources (Folke and Berkes, 1998:20).

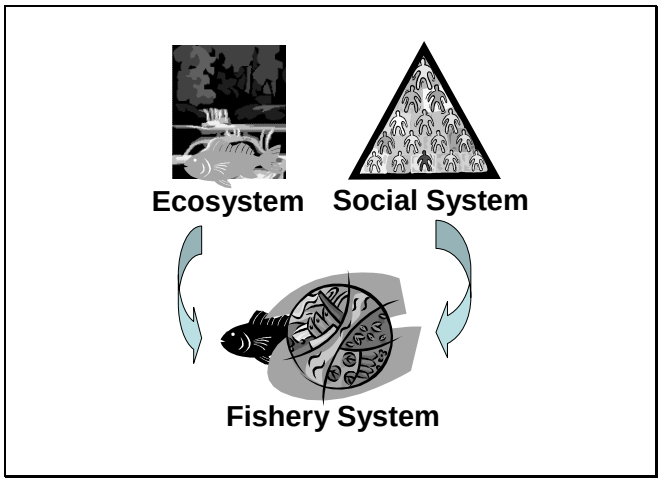

Figure 1. *Social and ecological system as an inter-linked system in fisheries.*

Many theoretical positions are based on a fundamental distinction between nature and society, and in so-called "conventional resource management" the two systems are normally analysed separately, thus, treating the human system as external to the ecosystem. As a result, science is believed to be objective, value-free and quantitative. For example, the practical knowledge of those engaged in fishing on a daily basis is assumed to be of little value from a conventional resource-management viewpoint. Historically, fisheries research has been driven mainly by biological considerations and without efforts to integrate stakeholders in the management process and also without comprehension of the inter-disciplinary complexity of fisheries management. Fishing in coastal areas is the focus of interest in this thesis. Coastal areas are characteristically multi-use and multi-stakeholder systems that need

"integrated approaches to manage trade-offs and conflicts in these socio-ecological systems" (Hammer et al., 2003:527).

To meet these challenges, coastal fishing requires management solutions that appreciate the links and interplay between various socio-economic driving forces and the consequences for the ecological system. Hence, natural resource problems are not isolated scientific or technical problems, but are rooted in a human failure to understand the links between social, ecological, and economic systems. Consequently, to achieve a sustainable use of fish resources it is believed to be important to relate management practices based on ecological understanding to the social mechanisms behind these practices, and, hence, to include the interactions of social systems with natural systems. This is the assumption upon which this thesis is funded. It is also a matter of designing appropriate institutions. However, it is probably not "revolutionary" to assume that fishermen's common learning-processes concern actual fishing features, not formal institutions. As an Icelandic skipper puts it: "Even a novice fisherman […] with minimal experience of fishing, is likely to know more about the practicalities of fishing than the teachers of the Marine Academy" (Pálsson 1998:53).

Since fishermen are likely to have reliable information about what goes on in the resource system and in management of fish resources, it seems reasonable to find ways to draw upon the knowledge of those directly involved in fishing on a daily basis. This knowledge is often based upon long time-periods of engagement in the social-ecological system, but historically, fishermen's practical ecological experiences have not been used by conventional resource management. At the same time, the problem with managing fisheries has been exacerbated by insufficient knowledge about the functioning of marine ecosystems and the side-effects of fishing (European Commission, 2001:9). However, the use of incentives that affect fishermen's behaviour and create opportunities for both conservation and economic efficiency is gradually drawing more attention.

To sum up, the demands of refined fisheries management systems require more than addressing purely biological single-species issues. This management also

needs to address and attempt to resolve an array of social concerns and multiple-use issues. The “top-down single species approach”, which considers the target species as independent self-sustaining populations, is insufficient. Nor is such a management approach well-suited for quick responses to local circumstances and urgent situations. In fact, it could as well be that these management approaches have contributed to the continued decline in fish stocks by forcing fishermen to compete for resources without creating a sense of resource stewardship (Blyth et al., 2002:493). Thus, often fishermen do not feel sufficiently involved in policy-making and this lack of involvement undermines support for conservation measures adopted. According to the European Commission, the fishing sector will become less and less sustainable and economically viable if current management approaches are not changed (European Commission, 2001:13). How can this be explained? What are the mechanisms behind these failures?

The United Nations Food and Agriculture Organisation has recognised that a sustainable use of fish resources can only be achieved if the impacts of the ecosystem on the living resources and the impacts of the fishery on the ecosystem are explicitly identified and, as far as possible, understood (FAO, 2002:55). This embeddedness of fisheries resources in a wider ecosystem also requires that researchers and policy makers consider fishermen as an integral part of the ecosystem and that both ecosystem in balance and human well-being must be achieved. Certainly, there is a need to redirect management and policies towards a more holistic approach where fisheries are treated as an integral part of dynamic social-ecological systems, thus adding social aspects to ecosystems management. In any case, currently conventional fishery management is challenged and are in a state of flux and there is a general call for new policies.

To meet this challenge, the adoption of an ecosystem-based management approach could be one way. Ecosystem-based management implies that a fish resource “is treated as an inseparable component of a complex network of processes and functions at different spatial and temporal scales” (Hammer et al., 2003:528).

Thus, ecosystem-based management puts emphasis on the importance of social-ecological embeddedness in fisheries management. What kind of policies is needed?

1.3 Ecosystem dynamics and resilience in fisheries management

> [T]he idea that the oceans represent the last great wilderness or frontier for man to discover and explore is now being replaced by the notion that man having a large, but still poorly understood impact on marine life (Gislason et al., 2000:469).

Estimating the current stock of fish in a particularly fishery, or the effect of the withdrawal of a specific species is always an uncertain task, "given that many other factors that are exogenous to policy design also affect the stock" (Dolsak and Ostrom, 2003:9). *Firstly*, over the years, fishing may lead to evolutionary changes in the genetic composition and science does not have enough knowledge to make quantitative predictions of these longer-term impacts. Knowledge is even more limited with respect to marine ecosystems, particularly with regard to their critical functions and threshold effects. *Secondly*, ocean processes are subject to large-scale variations that create uncertainty. For example, even for the most intensively studied fish populations, we know little about the variability related to stock and recruitment. *Thirdly*, the lack of general rules on the ecosystem level increases complexity; for example, insights gained in one ecosystem are difficult to generalise and export to other systems. *Finally*, the data from "unfished" situations are often unavailable because, in most cases, biologists do not arrive on the scene until after a fishery has developed, thus, we have poor knowledge about so-called unexploited situations (Gislason et al., 2000:469; Hanna, 2003:71).

Hence, the challenges for management of fish resources arise from the natural variability of ecosystems, the inherent dynamics of fish stocks and management arrangements that are not responsive to change. In a wider context, ecosystems are complex, non-linear systems with threshold effects; they are shaped by cross-scale interactions and historical dependencies with limited predictability.

However, changes do not only occur in ecological systems, but also in the human system, for example, for political, social and economic reasons. Humans are a part and a force in ecosystem development because we depend on ecological systems

for our survival and we constantly affect the ecosystems in which we live, i.e., there is a need for a wider and deeper understanding of the inter-dependence and interactions between human activities and ecological systems in fisheries management (McMichael et al., 2003).

One of the most important concepts for 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 tolerate without collapsing into a qualitatively different system? Disturbances can trigger ecosystems to shift to other states with a corresponding change of ecosystem functions. A resilient fishery can withstand shocks and remain in a functionally similar state – thus, increased resilience move the resource system away 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 (Berkes, 2002:313f).

Even the absence of shocks and disturbances in form of "emergent behaviour", such as 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, in order to analyse fisheries, linking inter-relationships between complex ecological circumstances with human activities

is essential in order to maintain the capacity of fisheries. The concept of resilience is discussed more in detail in subsequent parts of this thesis. The question is, how is the concept related to management?

1.4 Failures with a linear single species approach to fisheries management

While conventional top-down government may be successful in the short run, this success can cause inadvertent changes in the functioning and resilience of the ecological system. This is because top-down management strategies often aim at removing disturbances and reduce variability in the ecosystem.[6] From such a perspective, resources are believed to be manageable and yield is regarded predictable. Thus, conventional resource-management presumes that a maximum sustained yield of fish resources can be calculated and that disturbances can be controlled and excluded from the resource system (Berkes and Folke, 1998:12). Such management policies emphasise stability through equilibrium, low variability, resistance to and absorption of change, whereas a management policy influenced by resilience emphasises the boundary of a "steady state", as well as "events far from the balanced position, high variability, and adaptation to change" (Holling, 1986:297). Consequently, from a resilience point of view, there is no sustainable optimal and steady state of an ecosystem – it is an unachievable goal (www.resalliance.org). This fact challenges most contemporary management systems of fish resources.

There is always a risk that the resource system and its management institutions become more rigid and less responsive to environmental feedback. The logic of such conventional management seems to be to create social and economic benefits in the short term, however, at the expense of ecological resilience. This image of a unique optimal path to a sustained resource is a static and unrealistic view, which might lead to an even more inelastic system, and eventually to a resource crisis. Conventional resource-managers seem to share a belief in the feasibility of designing close-to-optimal rules by which to govern and manage CPRs for a large domain, utilising top-

[6] Variability can also be called diversity (in genes, species and culture). It is the basis of survival and allows communities to cope with environmental changes (Begossi 1998:148).

down regulations. However, if the resilience (i.e., buffering capacity) of a resource system declines, flexibility is lost, and both the social and ecological systems become more vulnerable to unexpected events and crises. For instance, if the management system applies fixed rules for achieving constant yields (e.g., fixed sustainable yield of fish), independent of scale, this leads to an increasing lack of resilience. Such a system can suddenly break down when it is confronted with disturbances that previously could be absorbed (Holling et al., 1993:2).

According to Holling, environmental problems can become aggravated by conventional resource management, thus resulting in reduced resilience. A static and inelastic system cannot change when this becomes necessary. Such systems may "freeze" (Holling, 1986) the ecosystem "at a certain stage of dynamic change, making it more fragile and inviting unpredictable feedbacks from the environment" (Berkes and Folke, 1998:100). What are the mechanisms behind such a development?

1.5 Fishery systems as an adaptive renewal cycle

As indicated above, the "resilience management paradigm" is built upon the underlying assumption that social-ecological systems are complex and adaptive, as well as subject to constant change, surprise, thresholds and uncertainty. Ecological systems develop through regular cycles.

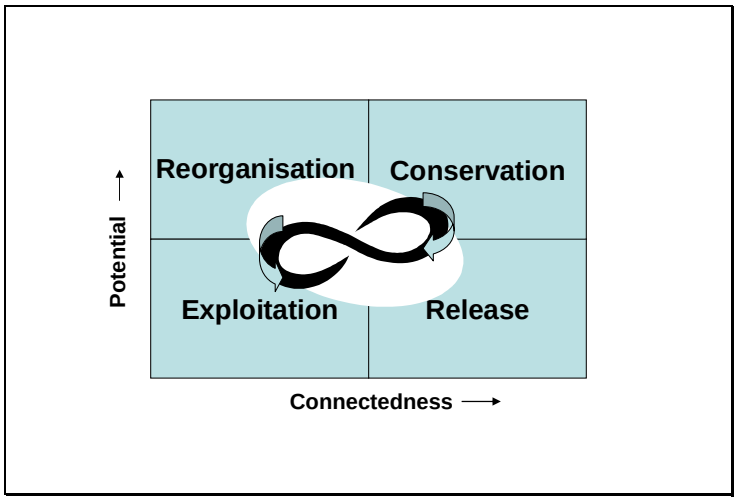

Figure 2. *The four ecosystem functions and the flow of events among them* (Holling, 1986).

As shown in Figure 2, four primary stages are often emphasised: *exploitation*, *conservation*, *release*, and *reorganisation*; each phase creates the condition for the next phase (Holling, 1986). This adaptive renewal cycle is an effort to capture some of the commonalities in various kinds of cyclic change (Berkes et al., 2003:17).

The concepts "potential and connectedness" (in Figure 2) can, in an ecosystem, be understood as the accumulated resources of biomass and nutrients and the degree of connection between controlling variables, respectively. Low connectedness is associated with diffuse components loosely connected to each other and which behaviour is dominated by outward relations and affected by outside variability. Conversely, high connectedness is associated with aggregated components the behaviour of which is dominated by inward relations. The left of side of the cycle contains stages where the potential can leak away and where a flip into a less productive and organised system is most likely (Holling et al., 2002b:403). Thus, in the reorganisation and exploitation phases, a fishery system can turn into a different state that is less efficient. The adaptive cycle focuses upon processes of destruction and reorganisation which gives a more complete view of system dynamics that links together system organisation, resilience and dynamics (ibid).

In the context of fish resources, the four stages can be described as follows. From exploitation (or growth) to conservation (or organisational consolidation) of a fish resource, stability initially increases, but the system becomes more and more over-connected until rapid change is triggered in the release stage. The stage from exploitation to conservation is predictable with quite a high degree of certainty and, in a fishery, production and accumulation are maximised. Release (or collapse) is a stage in which the system becomes increasingly fragile and requires rapid reorganisation. This phase of renewal is leading to reorganisation with consequences that are unpredictable or highly uncertain. This process is also called "creative destruction", because it opens up opportunities for innovations in the reorganisation phase.

When the resource system is reorganised, the cycle starts again at the exploitation stage (Berkes and Folke, 1998:307f). New systems that emerge may

replicate earlier cycles, thus, repeat the same adaptive cycle, or may "flip" into something entirely new. The ecosystems' capacity to buffer disturbances and passing thresholds is referred to as ecological resilience and in such a resilient ecosystem the adaptive cycle can be repeated endlessly. However, ecosystems tend to have multiple stable states and can, accordingly, be pushed by disturbances into different stability domains. A system with lower resilience tends to flip more easily into another stability domain (Berkes and Folke, 2002). Thus, with low resilience, the ability to maintain a fishery system's capacity to produce goods and services is challenged.

Release and reorganisation can be comprehended as equivalent to processes of innovation and restructuring in, for example, an industry or a society – "the kinds of economic processes and policies that come to practical attention at times of economic recession or social transformation" (Holling et al., 1993:5). This "back loop" from release to reorganisation is faster than the loop from exploitation phase to the conservation phase. Hence, the distressed systems move quickly through the reorganisation phase, back to exploitation. In the "slow" sequence from exploitation to conservation, connectedness and stability increase and the system's ecological resilience expand and contract as key properties of the systems slowly change (Holling et al., 2002a).

These adaptive cycles are also nested and linked to other adaptive cycles (i.e., social-ecological systems). This phenomenon is usually called "panarchy" (Holling et al., 2002b:402). In a fishery context, panarchy can be seen as the fact that different adaptive cycles in the sea and on land affect each other on different levels and on different scales. Thus, the "whole marine ecosystem" consists of many different cycles, with different conditions and behaviour, which are nested in each other. In fisheries, slow and fast structures, as well as large and small, interact. If one fish stock collapses, this affects other stocks, as well as other living aquatic resources. Connections between adaptive cycles can be important, for example, although human catch levels clearly influence fish populations, many other factors do as well: e.g., changes in food sources and predators, shifts in water temperature and weather patterns. Hence, global climate changes can affect salinity levels and water

temperature which, in turn, can trigger the local fishery system over a threshold level; political changes on a national level affect conditions for management practises on local levels, etc (Rose, 2002:241). These "external" events can initiate an undesirable course for the social-ecological system in the future. However, if the system is managed for resilience, by moving away from thresholds, it is more likely to move into a desirable future.

Hollings' theory of system crisis is built upon the assumption that it is only at points of deep crisis in both the ecosystem and the social system that fundamental conceptual and structural change is possible.[7] Breakdown in both systems may be a necessary condition for understanding system change. When perceived failures in the system exceed the perceived utility of its management, the legitimacy of management institutions is weakened to the point where they are open to fundamental change (Finlayson and McCay, 1998:311). Worldwide, such crises can be seen in many fisheries with rapidly shrinking resources, unemployment, economic inefficiency, massive subsidies and political controversy. The capacity to develop a new system when ecological and social/economic conditions make the existing system untenable – and obviously call for such a change – is usually labelled transformability (www.resalliance.org).

Thus, exploitation and resource management crises may have a constructive role to play in renewing the governing system and the ideas behind it. If the resource system is "released", its redesign, in which flexibility, innovation and, thus, sustainability will be promoted, is possible. In this context, resilience reflects the capacity of a system to buffer and survive many types of disturbances. Accordingly, the important measure of resilience is the scale of disturbances that can be absorbed before the system changes structure, through change in variables and processes that

[7] The idea that a deep crisis in both the ecosystem and the social system is necessary for a fundamental change in the system is similar to what is stipulated in Kuhn's theory of "paradigm shifts". In the classical Kuhnian model, the successful challenge comes from the periphery of the established body of scientists. For further discussion about the Kuhnian theory of the origins of paradigm shifts, see, for example, Chalmers, 1994.

control system behaviour. Flexible and adaptive management practices are, therefore, more compatible with functions of the ecosystem, than a static and inelastic system. Obviously, the opportunity to renew and redesign the management system is dependent on the system's capacity to learn and adapt. If it has this capacity; "crisis may have a constructive role to play" (Folke and Berkes, 1998:9).

1.6 Social resilience

As has been emphasised, promoting resilience is concerned with the knowledge required to facilitate robust governance systems that can cope with environmental and social changes. This means that it is necessary for societies and governing institutions to have the "capacity to adapt to unforeseen circumstances and risks" (Adger, 2003:3). In this study, social resilience is defined as "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change" (Adger, 2000:347).

Capacity to deal with ecosystem dynamics requires relevant knowledge in the social system. This knowledge can develop as a collective learning process that evolves with ecosystem change (Folke et al., 2003). "Knowledge of ecosystem dynamics develops as a collaborative effort and becomes part of the organisational and institutional structures" (Olsson et al., 2004:87). Learning how to respond to environmental feedback is essential and may help to increase the understanding of ecosystems' functioning and can, therefore, enhance the capacity to deal with unexpected change (ibid).

In this context, the level of social resilience in a social-ecological system is a key factor in promoting individuals to adapt to ecological change. According to Adger, ecological and social resilience "may be linked through the dependence on ecosystems of communities and their economic activities" (Adger, 2000:347). This is most evident within social systems that are dependent on a single resource (ibid:350). Resilience is, thus, dependent not only on ecological diversity and buffering capacity, but also on institutions that shape social interaction. For example, issues of justice related to access to resources and security, trust and social capital are directly related

to the promotion of resilience. Adger also emphasises the “fairness in representation”, meaning that, e.g., resource users should participate in decision making. There must be fairness in both procedures and institutions which is a great challenge for environmental governance (Adger, 2003). This can lead to a multi-level governance system that supports resilience instead of top-down stability.

To sum up, if a social-ecological system has the capacity to absorb disturbances and moving thresholds – hence, remain in functionally similar state, then the system is resilient. Adaptive management can be the path to succeed with this demanding task.

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

As has been emphasised, the social systems, as well as the ecological system, are subject to constant changes, surprises and uncertainty; policies are altered, people change their attitudes and new groups might have new claims on joint resources. For a fluctuating and chaotic resource, such as fish, which is subject to constant change, management has to deal with this complexity. One solution is to adapt management to ever new circumstances.

If an institutional arrangement is too inflexible to cope with changing social and ecological conditions, it is unlikely to prosper. Thus, a conventional approach with the idea of dominating ecosystems by fixed rules and exploitation rates is not likely to be sustainable in the long-run. For instance, it is important that signs of depletion of a particular resource serve 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 is a concept that captures the intricate and sometimes unpredictable interactions between people and ecosystems as they evolve together. Adaptive management requires social and institutional learning, that is, organisations can learn just as individuals do. The approach emphasises *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). Thus, the focus is on the ability of the management system to respond to feed-backs from the environment, particularly during times of change and reorganisation.

The capacity of a management system to adapt to signals and learn to interpret signals from the resource stock – through flexible institutions – determines whether the system can deal successfully with a resource crisis. Flexible systems that proceed through learning-by-doing are better adapted for long-term survival than systems that have set prescriptions for resource use. It is also important that different problems are solved on different levels. Due to the ecological circumstances and the type of stakeholders involved, for example, management of bleak-roe fishing in the northern part of the Gulf of Bothnia – which will be discussed in this thesis – requires another management scale than for cod in the Baltic Sea.

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 crises, as well as success, can also play an important role for 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 poor and useful institutional memory will not be created to avoid future crises and thresholds.

To sum up, as opposite to the conventional management approach with its emphasis on predictability, single equilibrium, stability, smooth changes and linear processes; the adaptive ecosystem-based management paradigm emphasizes 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, thus, is quite a complex and uncertain task, especially when we become aware of the limits of knowledge that we possess, instead of assuming that we are dealing with a simple, linear and predictable resource. However, over time, both the ecological and social system change and the challenge

is to build capacity in management systems to respond and adapt to these changes. The essential question is whether a fishery system has the ability to move to new or different management arrangements when uncertainties and disturbances require such a change? Has the system enough flexibility and adaptive capacity to reorganise itself without major declines in central functions (ecological, social and/or economic)? Such quality can be labelled as the transformability capacity of social-ecological systems.

In this thesis, the bleak-roe fishing in Norrbotten is a matter of concern. Hence, to be sustainable, (by means of managing disturbances, shocks, thresholds and uncertainties) fishery systems, like the bleak-roe fishing, 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 require. To accomplish this is not easy, however. For example, in a fishery context, state subsidies and different kinds of compensation can serve as incentives not to change – i.e., preserving *status quo*.

However, most fishery systems cross political boundaries, whether local, regional, national or international. In addition, the ecological prerequisites of a system are 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 resources, proper functioning is sustained when the management system is "allowed" to develop and renew itself, and ecological resilience is combined with social/institutional resilience (Rova and Carlsson, 2001:324). This is the *working hypothesis* in this study, exemplified by the case of coastal fishing in the Swedish County of Norrbotten.

1.8 Bleak-roe fishing in Norrbotten

The fishing of vendace (*Coregonus albula)*, in the northern part of the Gulf of Bothnia, is a good illustration of the type of problems that have been described in this Chapter (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*, is of high commercial value. In the study area, fresh-water species like vendace are caught in salt-water fishing in this area (the Swedish County of Norrbotten) because the water is highly desalinated, owing to the input of fresh water from major rivers.[8]

For commercial fishermen in northern Sweden, catches of vendace are of primary importance, both regarding landed weight and economic yield. The trawl fishery in Norrbotten started in the 1960s and led to strong increases in bleak-roe catches, and, since trawling started, the economical importance of bleak-roe fishing for commercial fishermen in Norrbotten has been significant. Nowadays it accounts for approximately 67 percent (mean value) of the annual turnover for the trawl fishermen (see Appendix). It is also one of the most important species, by catch and value, of Swedish commercial fisheries in general (Olsson, 1997:13).

Bleak-roe fishing is a seasonal fishery and the fishing season is by law restricted to the period between the end of September until the end of October (the exact date varies from year to year, but usually fishing is allowed from September 20th until October 31st). Despite the fact that the fishing period is just over a month, the long-term survival of the commercial fishing fleet in Norrbotten is very much dependent on this fishery.

For a long period of time, bleak-roe fishing has been extensively regulated by the state with a "classical" top-down management approach. Bleak-roe fishing is characterised by its multi-stakeholder quality. There are a number of different authorities involved in managing and regulating the fishery, and there are also many recreational fishermen that utilise the resource.[9] Recreational bleak-roe fishing does not have much in common with the traditional picture of an angler fishing for

[8] The Baltic Sea is the largest brackish water area in the world (ICES, 2003:9).
[9] See Chapters 8 and 9.

recreation. It is more like intensive subsistence or part-time fishing. Recreational fishermen are allowed to use six nylon nets with a total length of 180 metres, and no fishing license is needed (Hasselborg, 1997-04-16).

In the 1990s, the economic importance of bleak-roe fishing declined due to decreased catches (Hasselborg, 1999-06-22). During this time, the National Board of Fisheries estimated that the stock was below a sustainable level, or would be, if fishing continued with the same intensity. The recommendation was that fishing capacity should be reduced (Thoresson and Sandström, 1997:5-18). Given that the bleak-roe fishery is rather geographically limited and fairly regulated, the seriousness of the crisis is somewhat puzzling. Notwithstanding the facts that good statistics have been available to regulating authorities and action plans were approved; how can it be explained that this resource crisis occurred 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? If the discussion in the previous sections is right, the answer should be found in a significant lack of social-ecological resilience. Whether this has been the case is discussed in the subsequent sections of this thesis.

However, it has also been noted that in the year 2000, the downward trend was broken and catches started to increase. This development has continued during the last few years. Following the same logic, this change has not only occurred in the ecological system, but also in the social system; how can this change be understood in terms of governance? Have these changes affected the vendace resource? How and through what mechanisms have these changes affected the resource?

2 An analytical case study: institutional change in bleak-roe fishing

Many problems of unsustainable management of natural resources worldwide are due to a limited number of basic governance shortcomings, such as ill-defined property right definitions leading to open access, or insufficient enforcement of existing rules.

This is, however, not the situation in the bleak-roe case; the property rights system has been well-defined with extensive state governance since trawling started in the early 1960s.[10] Formal rules implemented by state agencies have been supervised in a rather limited area by a comprehensive control system (by the National Board of Fisheries and the Coast Guard). In addition, there is no indication of deliberate infringements of rules and regulations. Sweden has a low level of corruption and a high level of scientific knowledge and competence. Even with these favourable conditions, and despite good intentions, it seems like top-down management has produced an unsustainable fishery, seemingly governed by catch-maximising intentions among fishermen. What are the main determinants for this ecological and institutional failure?

Institutions are the rules or customs that facilitate coordination among people by helping them in dealing with each other. Collective action refers both to the process by which voluntary institutions are created and maintained and to the groups that decide to act together. The term “property” covers the range of institutions governing access to a particular stream of benefits. Property regimes are usually divided into four categories: open access, state, common, and private property.

Experience has shown that institutions of collective action and property rights play an important role in how people use a fish resource, which, in turn, shapes the outcomes of the fishery. The migratory nature of fish resources and the large area to monitor make regulations heavily dependent on voluntary contributions and cooperation of fishermen. The challenges for management of fish resources arise from the fact that these institutions needs to match the inherent dynamics of fish stocks (non-linear processes). There is a need to enrich the understanding of linkages

[10] Property rights are further discussed in Chapter 5.

between fishermen/authorities and ecological systems. Without this understanding, there is a risk that decision-making will be driven by short-term maximisation without adequate concern for long-term consequences. To address these complex issues requires an inter-disciplinary approach that combines insights and methodologies. An understanding of the factors that facilitate effective institutions and appropriate property regimes in one resource sector can be valuable for developing policies and governance structures for another resource.

Presumably, conditions have not been favourable for a local management system of bleak-roe fishing. The current generation of fishermen have no experience of self-management. They have performed their fishing in an environment with extensive state regulation where the state has taken full responsibility for when and how bleak-roe fishing should be performed. Today, there is not one single group of fishermen that participate in bleak-roe fishing. Recreational bleak-roe fishing is open for all as long as one follows prescriptions regarding gear use. The trawl group consists of fishermen from almost all coastal communities in Norrbotten. Thus, the user group is not heterogeneous and the pre-conditions for joint collective action among the users are probably not advantageous. Another factor that affects the fishery is the development in technology. The technological development of trawls, vessels and equipment has been extensive since the 1960s and, as a result, the increase in catch effectiveness for each vessel has been considerable.

The bleak-roe fishery that is analysed in this thesis is a strategically selected case. Contrary to most of the case studies that are generally described and analysed in CPR studies, this case both illustrates the development of a resource crisis as well as a deliberate attempt to shift focus from top-down government to governance, all performed in a modern and industrialised society. Another feature that makes the bleak-roe case critical is that this fishery seems to have more “favourable” conditions for succeeding with state government than with “pure” bottom-up governance. For instance, vendace is a rather non-migratory resource in a rather limited area and property rights are well defined. There is a comprehensive management system with access to biological expertise, as well as to monitoring capacities by the Swedish

Coast Guard. On the other hand, the resource users are not heterogeneous and have no experience of self-management. Under such circumstances, how can the previous failure be explained and how can prospects for governance be understood?

2.1 The aim of this study

The aim of this study is to contribute to the development of a better understanding of governance in a relatively small and clearly defined, but complex common-pool resource system. It also aims at providing insights into how different governance strategies affect individual users' incentives, as well as the adaptive capacity in such systems. The bleak roe case is also believed to provide a good illustration of a deliberate attempt to handle a resource crisis by transforming a conventional top-down management system into a "new governance system", guided by the intentions to make the fishery become more effective (in terms of generating annual incomes to fishermen) and also more sustainable than the previous one. This thesis is based on the assumption that there is a general need to invent and test new management practices to govern fish resources. These lessons are believed to be useful for policy making.

The strategically features of this single case is important because it illustrates traditional top-down state governance failures, despite the fact that conditions seem to be favourable for such a system. In order to understand the general problems of coastal fisheries, it is essential to establish an understanding of cases like the bleak-roe fishery. Managing fisheries with unexpected changes and complexity in linked social-ecological systems requires actors (both fishermen and authorities) who learn from failures and, when necessary, initiate and achieve institutional change. The creation of social-ecological resilience can be looked upon as a process – a socially generated collective good – which, hopefully, results in better governance systems. In this context, the role of institutions in building adaptive capacity and to support a collective rationality is important. It is, hence, necessary to analyse the causal connection between the origin of the resource crisis in the bleak-roe fishery that

affected the fishing community in the 1990s and initiation of the new management system that was implemented in the year 2000.

Accordingly, the important research questions and the questions that this thesis will answer are:

1. *How could a resource crisis occur for a resource like vendace, despite heavy state regulation, formal central control, access to scientific knowledge, and in an industrialised society without corruption? How can such a crisis be overcome?*
2. *What are the consequences of the changes in governance implemented in the year 2000?*
3. *Has this new governance strategy for vendace been successful in the sense that it has promoted collective action among the fishermen and produced a more sustainable and effective fishery?*
4. *In terms of governance of a common-pool resource in a complex, diverse and modern society; what kind of governance system is suitable for a resource like vendace?*
5. *What are the general implications from this case for management of coastal fisheries?*

2.2 Method

To be able to accomplish the National Board of Fisheries' environmental objectives for fish stocks, stated in their action plan for biological diversity (presented on page 3), and to maintain the vendace resource capacity to provide annual benefits always in the future – i.e., effectiveness – the resource has to be utilised on a sustainable basis. To reach this "sustainability target", the social-ecological system needs to possess three qualities, i.e., resilience, adaptability and transformability. Consequently, effectiveness and sustainability are the *evaluation criteria* in this study.

Indeed, without intensive fishery, marine ecosystems would be different than today. Without a regular removal of a substantial share of each year class, the

unexploited situation would be something else than what we consider “normal” today. However, in this study, sustainability will be measured as the resource system’s ability to maintain a capacity to produce goods and services without forcing fundamental structural changes in the ecological system and risking the long-term survival of the resource.

This study will, consequently, analyse the management policy of bleak-roe fishing, how institutional arrangements affect collective action, why earlier political solutions seem to have failed and, finally, whether the current management system is flexible and adaptive enough or if, and how, it can be developed to become more adaptive? The answer to these questions can be assumed to be relevant to many other resources with similar characteristics, such as groundwater basins, grazing areas, irrigation canals and forests. In other words, what relevant policy lessons can be drawn from this case?

According to officials, intensive trawling is the main reason why catches of vendace have been decreasing in the 1990s (Fiskeriverket, 2003, and 2001:41; Thoresson et al., 2001:30; Statistics Sweden, 1996:194). Thus, the “pure” biological and environmental aspects that might affect the resource are left outside the scope of this study, as are the economic conditions of individual fishermen and fishing companies. Since it can be assumed that the biological behaviour of vendace has not changed, the study is based on the assumption that it is institutional failure that has resulted in the overexploitation. Still, even if biological behaviour had changed, an adaptive and flexible institutional system should also be able to change when ecological changes call for this.

This study is a case study which is intended to deepen our understanding of activities and chains of events determining specific outcomes. It can, thus, be seen as an intensive study of a single case which has significance beyond its boundaries; illustrating a topic of wider interest (Hague and Harrop, 2001:71). A case study approach is a suitable strategy when “how or why questions are being posed, when the investigator has little control over events and when focus is on a contemporary phenomenon within some real life context” (Yin, 1994:1). In relation to theoretical

questions and in the absence of overarching theory, case studies can generalise answers and are the building blocks from which theories are constructed. The purpose for an investigator is to make analytical generalisations from case studies to develop theory (ibid:10). Another advantage with case studies is their multi-method capacity to handle many different sources – i.e., documents, interviews, direct observations, etc. As will be discussed in the next section, this multi-method strategy has been used in this study.

There are two ways in which a case can generate a wider knowledge: Firstly, a case can be useful because it is representative, i.e., it is a typical example of a wider category. Secondly, the case investigated is selected because it is unusual in some way, helping us to understand "exceptions to the rule" (Hague and Harrop, 2001:72). With its history of conventional top-down management resulting in a resource crisis, bleak-roe fishing in Norrbotten is a typical example of the first representative category and will, thus, generate knowledge that can be generalised and add on to the theory building.

To get answers to the questions presented above, it is necessary to outline existing and previous institutional arrangements for the vendace resource. Successful governance of natural resource management dilemmas requires an understanding of institutional issues, especially those concerning externalities, property rights, and collective action, as well as the dynamics of the ecological system.

Hence, to analyse bleak-roe fishing we need to focus on: (1) the institutional arrangement – what the earlier and current institutional arrangements look like and which incentives they generate and have generated among resource users. Institutions are important because they govern the use of natural resources and create incentives for sustainable or unsustainable use. Accordingly, "they are a central component linking social and ecological resilience" (Adger, 2000:348); (2) we have to focus on the characteristics of the resource system, which is a complex common-pool resource system with potential collective action problems. To accomplish this, there is a need to discuss institutional theory and CPR theory. This is done in the following four

chapters. Data collection has been guided by the *Institutional Analysis Development Framework* (IAD framework).[11]

An underlying question in this work is how to motivate individual appropriators to co-operate and use the vendace resource in a sustainable way? To get an answer to this question it is crucial to understand how institutions work and how they influence the behaviour of individuals (Hilton, 1992:285). This study investigates the process and results of changing an existing top-down management system into an alternative one with the use of interviews, documents and participant observations. The structure of this thesis is shown in Figure 3.

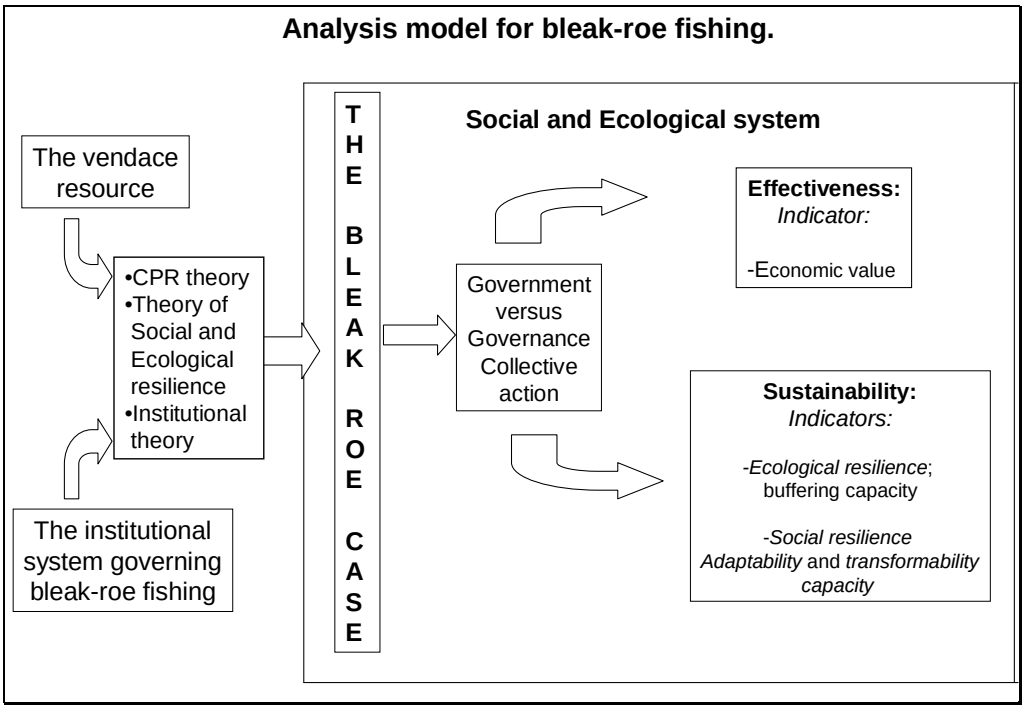

Figure 3. *Analytical model for bleak-roe fishing.*

Effectiveness and sustainability are the variables to be estimated when evaluating bleak-roe governance. A basic condition for this analysis is the presumption that bleak-roe fishing should continue to produce economic value for the trawl fishermen in Norrbotten and, thus, securing the culture of a coastal fishing fleet in Norrbotten.

[11] A comprehensive view of the IAD framework is presented in Chapter 7.

There is also a need to estimate the level of resilience, adaptiveness and transformability capacities in the system.

However, the concept of resilience is analytically useful, but difficult to measure qualitatively or quantitatively (Bollig, 2003:9). There is no easy way to decide whether a specific institution contributes to resilience or prevents new adaptations. Change is one of a few reliable phenomena of integrated ecological and social systems. One way to measure resilience can, thus, be the fact that "more resilient systems are able to cope with a higher level of disturbances and have the adaptive capacity necessary to re-organise when change is unavoidable" (Quinlan, 2003:4). Consequently, "less resilient systems become increasingly vulnerable to disturbances that were previously within coping limits" (ibid).

In the bleak-roe case, two coupled frames of resilience that scale from individual fish to human societal-level learning can be measured: (1) At the vendace stock level (i.e., ecological level), *resilience* is defined as the ability of the stock to recover from variation in stock size, spawning biomass and reproduction rates. Due to the fact that a fish resource is a fluctuating resource some level of variation is normal as long as central functions are maintained. For example, if the stock of vendace and reproduction rates decrease for a couple of years and then recover, the system is resilient. (2) At the social/institutional level, resilience is evaluated according to the social system's capacity to change, reduce vulnerabilities and support adaptation to new ecological, social, and economic circumstances. Thus, it is a measure of *adaptability* and *transformability* capacity; for example, if knowledge about the stock – changes in the stock and in the ecological system – and harvesting methods are discussed among users and officials. If they learn from this knowledge, the adaptability capacity is regarded as good. If the institutional/social system can re-organise, using this knowledge when new circumstances (social, political and environmental changes) make it necessary, the transformability capacity is also regarded as good.

One can expect that due to the fluctuating nature of fish resources it should, thus, be an ongoing process of learning-by-doing. In this context, social resilience can

be seen as a measurement of the abilities of governance structures to adapt and innovate when new conditions make this necessary. It is important to note that, "because of its institutional context, social resilience is defined at the community level rather than being a phenomena pertaining to individuals" (Adger, 2000:349). Social resilience is, thus, related to collective action and social capital of societies and groups of users. Another important point to emphasise is that both the, so-called, "formal and informal (rules-in-use) institutional arrangements" have to be analysed, because it is important to understand and describe how they interact and what outcomes they produce.

2.3 Data collection

This study is built on data collected from three main sources: (1) Semi-structured in-depth interviews with 31 of totally 39 fishermen who hold trawl fishing licenses have been conducted. These interviews have been strategically selected to be fairly proportionate to the total number of trawl fishermen in each coastal community. They were also selected to be representative, with regard to age structure among the commercial fishermen. Additionally, interviews with officials at the National Board of Fisheries office in Luleå have also been performed; (2) These interviews have been complemented with various written material, such as meeting proceedings, program documents, reports, official statistics 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 observations and participant observations in bleak-roe fishing and in meetings with the trawl fisher group and officials.

It is always debatable whether interviews reflect "the true story" or if a person interviewed gives answers that he or she believes the interviewer wants to hear. Another possible shortcoming could be that the persons interviewed will answer the questions in a way that they believe would favour the group, or in the same way that interviewees think that the rest of the group will answer. If so, the answers do not reflect the opinion of each person.

However, in this case, each interview lasted between 1.5-3 hours and the discussions were very extensive. The opinions put forward by fishermen in the interviews have been confirmed in meetings with the trawl fisher group and officials where the author has had the privilege to participate. In connection with these meetings, informal discussions also confirmed what had been revealed earlier. Additionally, spending hours on a trawler together with fishermen resulted in long and openhearted discussions that probably are likely to reflect the, so called, “true opinion”. I also participated in a two-day long session in court (some of the fishermen were accused of unlawful salmon fishing) together with the fishermen which resulted in a number of informal discussions. Altogether, the interviews are believed to be a valid reflection of the opinions of the fishermen.

2.4 Outline

This thesis is structured in the following way. The first part (Chapters 3, 4, 5, 6 and 7) provides a review of key issues affecting governance of common-pool resources (CPR).

In Chapter 3, it is discussed why an institutional perspective on fishery management is essential. This chapter provides an introduction and describes why institutions matter in governance of renewable natural resources. Chapter 4 and 5 deals with different types of institutions and property rights in connection with collective action and CPRs and brings forward a number of this study’s key concepts and perspectives. It describes the fundamental institutional problems in governance of a CPR. Thus, to explain why there potential institutional problems in CPR use and why – to overcome the various collective action problems inherent in resource management – it is necessary to take institutions and the incentives they generate seriously. Chapter 5 also discusses how different property rights systems – i.e., governance system – would affect CPR systems, such as bleak-roe fishing.

Chapter 6 deals with experiences from sustainable CPR systems, thus, how actors in these resource systems – through institutional arrangements and the incentives they generate – have overcome collective action problems and developed

sustainable management practices for CPRs. The fundamental principles of the Institutional Analysis and Development framework (IAD) are discussed in Chapter 7. Hence, the important variables in the institutional analysis of the vendace resource are introduced. This chapter explains which, and why, these variables are important in analysing institutional arrangements in CPR use.

In the second part, Chapters 8, 9, 10, 11, and 12, the bleak-roe case is investigated and analysed. Chapters 8, 9 and 10 consist of a description and an analysis of the historical development in the social-ecological system, leading to a resource crisis in the late 1990s and, finally, to a new management system in the year 2000. The previous management system of bleak-roe fishing is placed into the IAD framework and the institutional arrangement is analysed in detail. An answer to the question why this system has been unable to produce a sustainable and effective fishery is also presented. Chapters 11 and 12 analyse the current management system and is structured in a similar way. Accordingly, these chapters give an answer to the question whether management of bleak-roe fishery is effective and sustainable, or not? Further, it is discussed whether there are any management systems that are more suitable in management of vendace. Finally, in Chapter 13, the conclusions and their implications for policymaking are discussed.

3 An institutional perspective on fishery management

> Sometimes problems are such that institutions need to be reformed, whereas in other instances new institutions must be established. In some cases, we may not even know what to do, but we are convinced that institutions are both the problem and the answer that we need to identify (Jentoft, 2004a:137).

As described in the first chapter, fishery management is characterised by conflict, change, complexity and uncertainty qualities, which require appropriate institutional arrangements (Noble, 2000:76). Institutions, in the sense of rules-in-use, provide the means by which societies can act on their social-ecological knowledge to produce a livelihood from a resource. If institutional arrangements are static and inelastic, rather than flexible and adaptive, there is a risk that the resource will be unable to buffer and survive disturbances. On the other hand, to enjoy legitimacy and trust among stakeholders, they should be stable and settle "the rules of the game" with some form of stability over time (North, 1990). This is, to some extent, a paradox and a challenge for ecosystem-based management. The severeness of the resource crisis in bleak-roe fishing during the nineties indicates that the institutional arrangement was not in coherence with the social, physical and biological conditions for the "vendace system".

Institutional analysis is central for political science because, to a great extent, the roots in political science are in the study of institutions (Peters, 1999:1). Discussions of institutional impacts on resource use have a long history within social sciences and particularly within political science. For example, Aristotle observed that "what is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest" (*Politics*, Book II, Chapter 3 in Ostrom et al., 2002:8).[12]

[12] Even in antiquity, political philosophers studied the nature of individual behaviour and the need to direct that behaviour toward collective purposes and through governing institutions. "The first political philosophers began to identify and analyse the success of these institutions in governing and then to make recommendations for the design of other institutions based upon those observations [….] [These recommendations] constituted the beginning of political science through the systematic analysis of institutions and their impacts on society" (Peters, 1999:3). Similarly, in the same institutional tradition, Thomas Hobbes argued for the necessity of strong institutions, while John Locke developed a more contractarian conception of public institutions (ibid.).

Institutions include a whole array of features, decision-making arrangements, including property rights regimes, incentive structures and cultural factors that affect outcomes. This emphasis on the importance of institutional questions is often called "new institutionalism", in which a central role is assigned to norms and values within organisations for explaining behaviour.

New institutionalists differ among themselves on many questions, but they agree on two fundamental issues. First, *institutions shape politics.* Institutions influence political outcomes because they shape actors' identities, power and strategies. Second, *institutions are shaped by history*. Institutions embody historical trajectories and turning points: what comes first influences what comes later: "Individuals may choose their institutions, but they do not choose them under circumstances of their own making and their choices in turn influence the rules within which their successors choose" (Putnam, 1993:7f). Although this approach is known as new institutionalism, in many ways it reflects a traditional image of institutionalism encountered in sociology and organisation theory. Thus, for example Max Weber identified how cultural rules tend to constitute the basis for collective action in both the market and political behaviour (Peters, 1999:26). The importance of appropriate institutions for successful management of fish resources is discussed in the next section.

3.1 The importance of appropriate institutions for successful management

The effective functioning of a management system for bleak-roe fishing, as well as other renewable natural resources, depends on the existence of appropriate institutions. Without appropriate institutions and, accordingly, without incentives for individual fishermen to limit their landings, a situation can occur in which catches voluntarily reduced by one fisherman only result in increased catches by another. Too many fishermen take too much from the sea, and even if individual fishermen understand the importance of sustainable use of the resource, the short-term rational action for the individual fisherman is to maximise his catch. The temptation to over-extract from the resource is compelling and the "rule of capture" prevails. As a result,

the resource is mismanaged and, ultimately, due to the loss of resilience, the vendace resource might be exhausted. The outcome of a single fisherman's behaviour depends not only on his or her actions, but also on the actions of other fishermen using the same grounds. Consequently, fisheries could not exist without an appropriate institutional arrangement, because fishermen "would simply not know how to behave" (Jentoft, 2004a:138).

Ostrom has concluded that observation of institutions tends to make two errors. The first is the assumption that rules-in-use always are the same as formal laws or procedures. The second is the assumption that no institutions exist except for those formally created through government action. These two errors display a lack of understanding of how to create, maintain, and use social capital (Ostrom, 1992:22). The migratory nature of fish and the huge area to be monitored in coastal and ocean fisheries make it very important that institutional arrangements have legitimacy among users. Monitoring has proven to be difficult, and conflicts of interest can always arise, for instance, over the right to use a fishing ground. The most extreme form of such a controversy was the "cod war" between the UK and Iceland in the 1950s and 1970s. "This dispute was the first time that two liberal democratic states, both members of the North Atlantic Treaty Organisation (NATO), had reached the stage of exchanging fire power over the issue of over-fishing" (Gray, 1998:1).

Also the ability to solve conflicts depends on the shape of the institutional arrangement, the framework within which fishermen can try to work collectively to achieve a desired goal. A particular institutional arrangement usually develops as a response to a situation in which joint outcomes are preferable to outcomes that could be achieved independently by the actors – in our case, a sustainable and effective use of vendace.

In fisheries management, the regulatory aspect of institutions is generally the one emphasised, but institutions do not only create restraints. They confer rights as well as responsibilities, for example, by providing fishing licenses. Institutions also define what is appropriate for a particular person to do, what is required of the fishermen, what is morally acceptable and justified, and so on. Consequently,

institutions include different patterns of interaction between individuals, demonstrated in, for example, the way that business, administration and the legal system are managed, but also relating to religion, traditions, ideologies and norms of behaviour in society (Lundgren, 1987:12f). Unlike orthodox neo-classical theory, this view of institutions emphasises the importance of *informal* as well as *formal* patterns as determinants of human action. Consequently, the depletion of fishery resources relates to the weakness of social structures (thus, values as well as institutions and technical practices) under market, political and technical changes (Bailly and Collet, 1999:3).

The bureaucratic aspect is, accordingly, not the only relevant aspect of institutions. As North puts it, "[w]e are interested not in the institutions per se, but in their consequences for the choices individuals actually make" (North, in Pejovich, 1997:87). History, socio-economic factors and socio-cultural factors determine institutional performance; this having the consequence that the same formal institutions may operate differently in different contexts (Putnam, 1993:8). Therefore, only understanding formal institutions is not sufficient for determining the outcomes from a management regime. "History matters. It matters not just because we can learn from the past, but because the present and the future are connected to the past by the continuity of a society's institutions" (North, 1990:vii). Norms and culture change more slowly than formal rules, and this makes a transition from one management regime to another sometimes more problematic than it first appears. It can be problematic because informal norms and culture can transform externally decided formal rules, so that the external imposition of a common set of formal rules will lead to widely divergent outcomes (Putnam, 1993:180). Thus, it can be conjectured that in order to create appropriate formal institutions that enjoy legitimacy among the collective of bleak-roe fishermen, the rules must be sensitive to the social context and the specific local circumstances in which they operate.

An underlying question in this work is: how to motivate individual appropriators to co-operate and use the vendace resource in a sustainable way? Accordingly, it is important to understand the functions of institutions in fisheries and

how they support effective decision making to meet the goals of sustainability and effectiveness. Institutional analysis is, thus, a suitable analytic approach because it focuses on the design and performance of institutional arrangements (Hilton, 1992:285; Imperial, 1999:453). It is crucial to understand how institutions perform and how they influence the behaviour of individuals working within them, because most political action takes place in institutions (Peters, 1999:150f).

As has been mentioned above, an institutional framework is both formal*;* rules, such as constitutional arrangements and laws, and informal*;* such as co-operative and reciprocated norms that develop between groups and individuals within a social system (Dowding and King, 1995:7). There are three levels of rules that cumulatively affect the actions taken and outcomes obtained: operational rules, collective-choice rules, and constitutional-choice rules (Kiser and Ostrom, 1982).[13] Thus, institutions are the set of rules actually used by a group of individuals to manage repetitive activities that produce outcomes affecting those individuals and potentially affecting others (Ostrom, 1992:19). According to Peters (1999), there are several components that make an approach to political and social activity "institutional".

- Institutions are in some way a structural feature of society and/or policy. This structure can be both formal and informal. An institution transcends individuals to involve groups of individuals in some sort of patterned interactions that are predictable, based upon specified relationships among the group of individuals (Peters, 1999:18). Thus, an institution is not necessarily a formal structure, but instead is better understood as a collection of norms, rules and routines.
- A second feature of an institution is the existence of some form of stability over time. For instance, if some of the individuals participating in bleak-roe fishing decide to have a meeting once a week at the same time and place, in a sense that would begin to take on the characteristics of an institution.

[13] These three levels of rules and how they affect bleak-roe fishing are further discussed in Chapter 7.

- An institution must also affect individual behaviour. There should be some form of mechanism through which the institution influences the behaviour of individuals, and there should also be systems through which individuals are able to form and reform institutions. However, it may not be an institution if the members do not assign some importance to the meeting and try to attend (ibid:18ff). Thus, institutions imply the existence of constraints and sanctioning of the behaviour of its members. For example, if all individuals participating in a meeting decide both to refrain from bleak-roe fishing once a week and that infringement of this "rule" should result in exclusion from participating in the meeting with the other fishermen, it will both constrain and sanction the behaviour of the fishermen.
- Finally, there should be some form of shared values and meaning among the members of the institution (ibid.). Thus, if all members of a fishing meeting are aware of the importance of refraining from bleak-roe fishing once a week to secure future catches, fishermen can take action to prevent further over-fishing, and the probability is also high that these actions will have high legitimacy among the fishermen.

Hence, in this study, institution is defined as "socially constructed codes of conduct that defines practices, assigns roles, and guides interactions; the set of rules actually used" (Berkes, et al., 2001:257). It is important to bear in mind that institutions also have enabling qualities and, consequently, confer rights as well as responsibilities. Furthermore, institutions are never fully self-controlled because they do not exist in a social and institutional vacuum; instead, they are linked to each other and form "nested systems" that are themselves institutions (cf. ecosystems). Thus, every management system is incorporated into a wider institutional framework (Ostrom 1990; Imperial, 1999; Jentoft, 2004a). Institutional change can often take time because new institutions are not implemented in a vacuum and the existing institutions might resist change. In management of renewable natural resources, such as fish, an institutional change often requires an internal or external crisis to call into question the existing institutional order. When this happens, its effectiveness is often

debated and its legitimacy reduced. However, those who benefit from the existing institutional order might fight hard to defend the Status quo, because they will not necessarily give up easily (Jentoft, 2004a:141).[14]

To sum up, institutional design and performance are affected by formal and informal structures in society. As described in the first chapter, institutional design and performance are also depending on the special physical and biological conditions that characterise different natural resources.

In the next chapter, relevant theories of common-pool resources and how these theories apply to fish resources are discussed; particularly how these theories apply to the study of the vendace resource in Norrbotten. The study of common-pool resources examines the linkages between resource management and social organisation, analysing how different institutional arrangements and property rights deal with appropriation of renewable natural resources and how they affect collective action. Thus, in the next chapter, it is discussed why a common-pool resource like vendace, might constitute a potential collective action problem. Possible solutions to this "dilemma" will also be discussed.

[14] This phenomenon is further discussed in Chapter 7.

4 Coping with tragedies: fish as a Common-Pool Resource

Fish stocks can be seen as *common-pool resources* (CPRs) which have two important characteristics. The first is *excludability*: the physical nature of the resource, or the legal and other instruments that govern it, are such that controlling access by potential users may be costly and, in the extreme, virtually impossible. Fish resources, such as vendace, pose obvious problems for regulating access and if methods are not developed to keep non-authorised fishermen from using the resource, the strong temptation to free-ride on the efforts of others will lead to a sub-optimal investment in improving the resource, monitoring use, and sanctioning rule-breaking behaviour (Ostrom, 1996:7). Generally, monitoring fisheries has proven to be both very expensive and, in some cases, even impossible.[15] However, excludability does not mean that it is always impossible to exclude potential users, but that it can be very expensive.

The second basic characteristic of CPRs is *subtractability:* each user is capable of subtracting from the welfare of other users. As with private goods, the resource units of CPRs share the characteristic that one person's consumption subtracts from the quantity available to others. Thus, the nature of the resource is such that the level of exploitation by one user adversely affects the ability of another user to exploit the resource. The quality of being subtractable or rivalrous, in a way that exhaustion of the goods is a real possibility, contrasts CPRs with pure public goods, where exclusion is also difficult, while consumption is non-rivalrous. Consider the view of the sea from a city. Everyone who lives in the city can benefit from that view, but, in contrast to a CPR, such consumption does not affect the ability for others to consume the goods (Moberg, 1994:226f). CPRs share, with private goods, the subtractability of resource units, and with public goods, the difficulties of exclusion (Ostrom, 1994:7). The challenge for CPRs "is that in addition to problems of provision or supply there is the prospect of depletion" (McKean, 1992:249).

[15] Imagine, for example, the total cost of fencing an inshore fishery or an entire ocean!

Consequently, CPRs are subject to problems of overuse and potential extinction, unless harvesting and use limits are created and enforced. It should be noted, however, that it is the resource units of a CPR that are subtractable. CPRs should, therefore, be characterised as resource systems with a flow of resource units or benefits, for example, the fish stock of vendace is what generates a flow of fish over time (ibid). Thus, resource units (flows) are what individuals produce or appropriate from a resource system (stock).

This distinction between the resource stock and the flow of resource units is useful in connection with renewable resources, because as long as the number of resource units appropriated from a CPR does not exceed the regeneration rate, the resource stock will not be overused (Ostrom et al., 1994:8). The notion of resilience is one way of conceptualising this. For example, imagine there are 1,000 vendace in the stock and each year they increase by 10 percent, that is, by 100 fishes. If the total catch is 100 vendace, the stock will fall to 1,000 again. The 100 fishes caught every year are, thus, a sustainable yield, i.e., the largest amount of fish that can be appropriated from the stock without risking the long-term survival of the resource (Turner et al., 1994:205). Anything beyond this level is over-fishing. Accordingly, the numbers of vendace caught are a flow, appropriated from the stock of vendace. If one fisherman lands a ton, this fish is not available for other fishermen.

This is known as the *appropriation problem,* i.e., the problem of regulating the withdrawal of fish (units). Equally important is the, so called, *provision problem*, which has to do with the fact that all resource systems for human use must be taken care of by means of cultivation, regulation, monitoring, etc. (Ostrom, 1990:30ff). This is a matter of making people, users and others, to provide time and other resources for the maintenance of the system. Sustainable use of CPRs, thus, is not only a matter of regulating withdrawal, but also of contribution to the system. This is why institutions are so essential.

However, as described in the first chapter, it is important to bear in mind that stock and flows of fish resources are difficult to define with great precision, due to the fluctuating nature of the resource and due to the fact that many exogenous factors

affect the stock. Fish resources move around and they are, therefore, difficult, or impossible, to count accurately. The relationship between the replacement rate and withdrawal rate may change over time because of factors that are beyond the effects of policy design.

A CPR *dilemma* can occur when individuals have to co-operate to achieve a goal that is both in their collective and individual interest, when the costs for individuals of co-operating may exceed at least the short-term benefit of not co-operating (McKean, 1992:248). For example, it may be that the vendace resource is threatened through over-fishing because the short-term individual rationality of the fishermen has led to an outcome that is not rational from the perspective of the group of fishermen in Norrbotten.[16] Thus, the challenge is whether fishermen can change from being individualistic contestants fighting over scarce resources to partners in a "flourishing fishery".

If anyone can use a resource, no one has an incentive to conserve its use or to invest in improvements. If this resource also generates highly valued products, like bleak-roe, the probability is high that its use will lead to over-consumption. Fishermen harvesting in an ecosystem-degrading manner can expect to receive the same price as their counterparts pursuing the same resource in a more sustainable manner. If the fish stock decreases, the increased costs of harvesting affect not only the fisherman who harvested the fish (and who generated the cost), but all fishermen who fish that stock. Under such circumstances, the stock is not used optimally because individual fishermen do not consider the user-cost they are imposing on fishermen in future periods (Anderson, 1986, in Ostrom et al., 1994:250).

The bleak-roe from the vendace resource is of high commercial value, and the fishermen who extract bleak-roe for sale do not want it for themselves (certainly not very much of it), but rather as a source of cash income. Indeed, there would be little fishing if the people who caught the fish were the only ones who consumed it. A "tragic situation" can, therefore, occur whenever individuals make independent

[16] A more comprehensive discussion about CPR dilemmas is presented in Chapter 5.

choices, and the maximisation of short-term self-interest (in this case, cash income) yields outcomes that leave the collective worse off than would feasible alternatives (Ostrom, 1998a:1ff).

Elinor Ostrom discusses three similar models that are commonly applied to CPR use (Ostrom, 1990): Garret Hardin's article *The Tragedy of the Commons* from 1968; different versions of *The Prisoners' Dilemma;* and the one in Mancur Olson's *The Logic of Collective Action* (1965). In the following sections, these models will be applied to the bleak-roe fishery.

4.1 The Tragedy of the Commons

> The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons [….] As a rational being, each herdsman seeks to maximize his gain […] [T]he rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another [. . .] But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit – in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons (Hardin, 1968:1244).

Imagine the fishermen in Norrbotten instead of the Hardin herdsmen. Each fisherman finds it more profitable to catch more vendace than the fishing stock can support, because each will receive all the profit from an extra fish, but will bear only a fraction of the cost of over-fishing. The fishes in the sea are without value for the fisherman, because there is no guarantee that the fishes will be there the next time if they are left behind today (Gordon, 1954:124). Rather than leaving fish to grow and reproduce, the incentive is to harvest the stock – that is, to appropriate resource units – before others do. The result will be a tragic loss of the resource for the entire community of fishermen. Hardin's conclusion was that "freedom in the commons brings ruin to all" (Hardin, 1968:1244). His framework has come to symbolise an unavoidable degradation of the environment whenever many individuals use a scarce resource in a commons. Thus, it has become the most widely accepted explanation for over-exploitation of resources that are commonly held (Feeny et al., 1990:2).

Hardin's conclusion of tragedy for the resource follows from his assumptions of open access, lack of constraints on individual behaviour, conditions in which demand exceeds supply and resource users who are incapable of altering the rules (ibid:12). Hardin concluded that to avoid the tragedy, the commons should be privatised or kept as public property to which rights to entry and use could be allocated (Hardin, 1968:1245). Thus, the "tragedy" is basically an institutional problem and there are, according to Hardin, two institutional alternatives for managing the commons: centralised government and institutionalised private property.

To sum up, Hardin's framework is based on the assumption that rational individuals are trapped in dilemmas, which they cannot escape from without incentives or sanctions from the outside. In his view on the commons, the fisherman always has an incentive to catch one more fish (Carlsson, 1995:1). Thus, the "Tragedy of the Commons" highlighted the divergence between individual and collective rationality. To the extent that the bleak-roe fisheries have the qualities of a common resource, it is, thus, doomed to suffer the "Hardin tragedy".

4.2 The Prisoners' Dilemma

"Prisoners' dilemma" is the story of two prisoners who are interrogated separately.[17] It is a game in which, without intervention by some higher authority, collective decisions produce outcomes harmful to the group as a whole. The prisoners face this dilemma once only and in isolation from other aspects of their relationship (Hardin, 1982:3). Although communication among the prisoners is forbidden or impossible, both possess complete information regarding alternative penalties. Each prisoner is rational, knows the other is rational, and knows that the other knows he is rational. Each prisoner also knows how the other values the outcomes (Kuhn, 2003).

Both prisoners know that if they "co-operate" and neither confesses, each will receive a suspended sentence of one year. If one prisoner confesses and turns state's witness, he will be paid and released, and the other will receive a ten-year sentence. If

[17] The prisoners' dilemma was developed around 1950 by Merrill Flood and Melvin Dresher (Hardin, 1982:7).

both confess, each gets a six-year sentence. Consequently, whatever the other one does, each is better off confessing than remaining silent. However, the outcome obtained when both confess is worse for each than the outcome they would have obtained if both had remained silent.

> If you are narrowly self-interested, you are better off confessing no matter what your partner does. Since you both must see the issue this way, you may both spend six years in jail. But if you could act together as a group with a single mind, you would act in the group's interest and hold out so that you both would spend only a year in jail. If, however, you reason from the fallacy of composition while your partner acts from self-interest, you will rest ten years in jail […] (Hardin, 1982:3f).

The structure of the Prisoners' Dilemma-game is a useful tool for demonstrating the conflict between individual rationality and group rationality. Individually, "rational" decisions by each prisoner make both worse off (Runge, 1992:23).

Picture the prisoners' dilemma as two bleak-roe fishermen. There is an upper limit (regeneration rate) to the number of vendace that the two fishermen can catch each year. The regeneration rate per year is 10 tons of vendace. They can behave "legally" and take only what they are allowed according to the regeneration rate, or they can "cheat" and take too much. The individual rational strategy for each fisherman is to catch as many fishes as he thinks he can sell at a profit. Irrespective of what the other fisherman does, he thinks: "I will catch as much as I can". With this strategy, he makes more profit in the short run. If both fishermen limit their catches, they will obtain five tons of vendace per year, whereas if they both choose the individual strategy, they will obtain seven tons in the short run. If one of them limits his catch while the other catches as many fishes as he wants, the one with the individual strategy obtains seven tons, and the other fisherman obtains five tons in the short run. But, of course, if both fishermen choose the individual strategy, they will obtain zero profit in the long run, because the resource will become exhausted.

The purpose of the prisoners' dilemma is to point out the paradox that individually rational strategies can lead to collectively irrational outcomes. In our example, 7 + 7 tons of vendace exceed the stock's regeneration rate (sustainable yield) by 4 tons (10 – 14 = -4). This paradox seems to challenge a basic belief that rational humans can achieve rational results (Ostrom, 1990:5).

4.3 The Logic of Collective Action

> [U]nless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, *rational, self-interested individuals will not act to achieve their common or group interests*. In other words, even if all of the individuals in a large group are rational and self-interested, and would gain if, as a group, they acted to achieve their common interest or objective, they will still not voluntarily act to achieve that common or group interest (Olson, 1965:2).

As emphasised by Ostrom (1990), the essence of The Logic of Collective Action is closely related to the two other frameworks regarding the difficulty of getting individuals to pursue their joint welfare, as opposed to their individual welfare. Olson challenged the assumption that collective advantages are enough to generate collective action in pursuit of those. His basic assumption is that individuals who cannot be excluded from obtaining the benefits of a collective good have little incentive to contribute willingly to that good. If that is the case, individuals can "free-ride" on the efforts of others. The probability of free-riding increases if the group becomes bigger (Moberg, 1994:229).[18] It is not individually rational to engage in the production of collective goods if the group is sufficiently big, because, in the eyes of each individual, it does not matter if "just I free-ride" (Carlsson, 1996:48).

With the presumption that bleak-roe fishing has exceeded the regeneration rate during a number of years, the collective rationality for the fishermen (in this case, the fishermen in Norrbotten) would be to limit their catches until the stock has recovered, and, thus, promote a collective goal. However, individual rationality in the short run keeps the catches at the same level as earlier, because "it does not matter" if one fisherman continues to fish at the same level, provided that all the others limit their landings.

All three models, The Tragedy of the Commons, Prisoners Dilemma, and The Logic of Collective Action, assume that over-consumption and/or over-exploitation will occur without rules that limit individual consumption or exploitation, and that

[18] Collective actions can be defined as "actions taken by members of a group to further their common interest" (Bogdanor, 1987:113). However, "people can act jointly without common interests, and they can definitely pursue common enterprises outside the realms of formal organization. [Therefore] Collective action is not a unitary concept" (Carlsson, 2000:10).

collective action is a prerequisite for providing collective goods (Moberg, 1994:228). From this perspective, it can be seen as almost pathetic when individuals really act in an unselfish way.

> A man who tried to hold back a flood with a pail would probably be considered more of a crank than a saint, even by those he was trying to help. It is no doubt possible infinitesimally to lower the level of a river in flood with a pail [.…] But […] the effect is imperceptible, and those who sacrifice themselves in the interest of imperceptible improvements may not even receive the praise normally due to selfless behaviour (Olson, 1965:64).

Thus, when a group of individuals is using a CPR, each individual always has an incentive to withdraw more resource units than is optimal from the viewpoint of the collective. These types of models are, therefore, useful tools for explaining how rational individuals can produce outcomes that are not collectively rational. Fishermen will try to take what they can, when they can, before anyone else does. A fisherman who tries to conserve the stock by leaving fishes in the sea has no reason to think that he will gain by his investment; someone else, according to these frameworks, will probably catch the fishes he has left. The fundamental assumption behind these three models is the "free-riding problem". If a person cannot be excluded from the benefits that others produce, that person is motivated not to contribute to the joint effort, but to free-ride on the effort of others and, if all members choose to free-ride, the collective benefit will not be achieved (Ostrom, 1990:6).

Consequently, without appropriate regulation and well-defined and enforced systems of property rights, fishermen have an incentive to twist the rules or to cheat. This problem can be called the "*1/n* problem": in a collective with *n* members, the individual member pays just 1/n of the cost for his consumption, exploitation or benefit (Moberg, 1994:239). The fishing of vendace in Norrbotten can be viewed in the same way. The individual fisherman gets all the benefits from his over-fishing, but the costs of this behaviour are divided among all the fishermen using the resource. Simply put, these models describe how individuals' rational behaviour is leading to a situation that can be seen as a social dilemma; their choices result in a situation that is not rational for the group (Rothstein, 2003). At the same time that all

involved would be more favoured by reciprocity cooperation, they choose their own individual strategies. However, as opposite to what these three models assume, many interactions in "real life settings" have a more long-enduring structure with people considering their long-term payoffs in addition to the short-term gains. Many times, they learn how to cooperate to achieve long-term payoffs (Axelrod, 1987). In resource use, like bleak-roe fishing, users are hardly ever fully aware of the impacts of different harvesting strategies or which strategies other fishermen will use. This might lead people to behave in ways different from how they would if the interactions were one-shot rather than long-term.

4.4 Repeated interaction and uncertainty in resource use

> Throughout their history, humans have devised a number of approaches and strategies to reducing (perceived) uncertainty or the physiological impacts of uncertainty, and to function and thrive in a partially unknown world (Kinzig et al., 2003:330).

To overcome social dilemmas in CPR systems, for example over resource allocation and ecological crises, users can over-time learn to behave collectively rational (Axelrod, 1987). Bleak-roe fishing can be seen as a repeated "game" that is played every autumn and opportunities for co-operative behaviour may arise. The actors are likely to be aware of the fact that the outcome of the fishery depends on the strategy chosen by all fishermen. Bleak-roe fishing is a good example of strategic interaction – i.e., what is best for one individual, in general, depends upon other individuals' actions. There is a possibility for fishermen in repeated "games" to work out strategies and to react on other users' behaviour. The sequential nature of the relationship allows for strategies that are dependent on the actions chosen in previous plays of the game (Kuhn, 2003). However, this requires institutional structures that generate incentives for co-operation among fishermen. Additionally, in "the bleak-roe game" also the unpredictable nature plays a major role – i.e., the game is one of imperfect information.

In a complex resource system, like the vendace system, there is uncertainty regarding the amount of disturbances, "bad" surprises and instability the ecological system can cope with before the stock collapses. Without this knowledge, it is

unlikely that, for example, fishermen have complete “control” over the impacts of different decisions and strategies – they never know for sure what will trigger a surprise or disturbance. “The likelihood of a bad surprise must be traded off against the lost benefit (economic and social) from fishing” (Kinzig et al., 2003:332). Hence, it is important to balance trade-offs in decision situations. As emphasised earlier in this thesis, learning and particularly learning-by-doing can be a “key-link” in this process. It requires that, for example, fishermen learn from crises and surprises, but also that they have access to a common arena for cooperation and joint decision-making. If fishermen learn, this can result in a necessary behavioural change that, in turn, can affect the resource-base positively. For example, if bleak-roe fishermen have learned, over time, that trawling in a particular area affects recruitment negatively, or that catches in certain bays consist of a too high share of juveniles, they are likely to draw the conclusion that a change in behaviour, by not trawling in these areas, will affect the stock of vendace positively. ”This conflict between maximizing the opportunity for learning and minimizing the likelihood of 'bad' surprises is fundamental to the scientific endeavour, yet has no easy solution” (ibid:333). However, if functional uncertainties in complex ecosystems are triggered, they can result in a “bad” surprise, for example, a collapse of a fish stock, and if this surprise is irreversible, the consequences can be devastating.

To sum up; the assumptions that The Tragedy of the Commons, Prisoners Dilemma, and The logic of Collective Action make are several; (1) payoffs are known and fixed; (2) all players behave rationally; and (3) each player knows the set of players, strategies and payoffs from all possible combinations of strategies. Unfortunately, real-life settings are more complicated and complex than that. Still, the basic structure of these models can be valuable when analysing CPR-use if we assume that fishermen are (1) self-interested users that respond to the information and incentives available to them, and (2) if we recognise that institutions (as defined in this thesis) determine fishermen’s incentives and information (Galaz, 2004:421).

4.5 Why fishermen can wantonly overfish the seas – and how CPR dilemmas are created

The lessons from research in the field are that resource use depends on multiple groups of factors that are critical to the organisation, adaptability, and sustainability of common-pool resources (Dolsak et al., 2003:9). Linkages among these factors and CPR use are presented in Figure 4.

The external *economic environment* affects fishermen's preferences and assets, particularly through markets for goods and services originating from the fish resource and "markets providing alternative sources of income to resource users" (Jodha, 1985, in Dolsak and Ostrom, 2003). Consequently, the *legal* and *political environments* structure the institutions that govern resource use. Also the external legal framework can contribute by creating institutions governing CPRs; assign legitimacy to users that enable them to create their own institutions and implement them successfully; and define how various institutional levels interact (Dolsak and Ostrom, 2003:20). The external political environment structures the policies selected and devised in the legal environment.

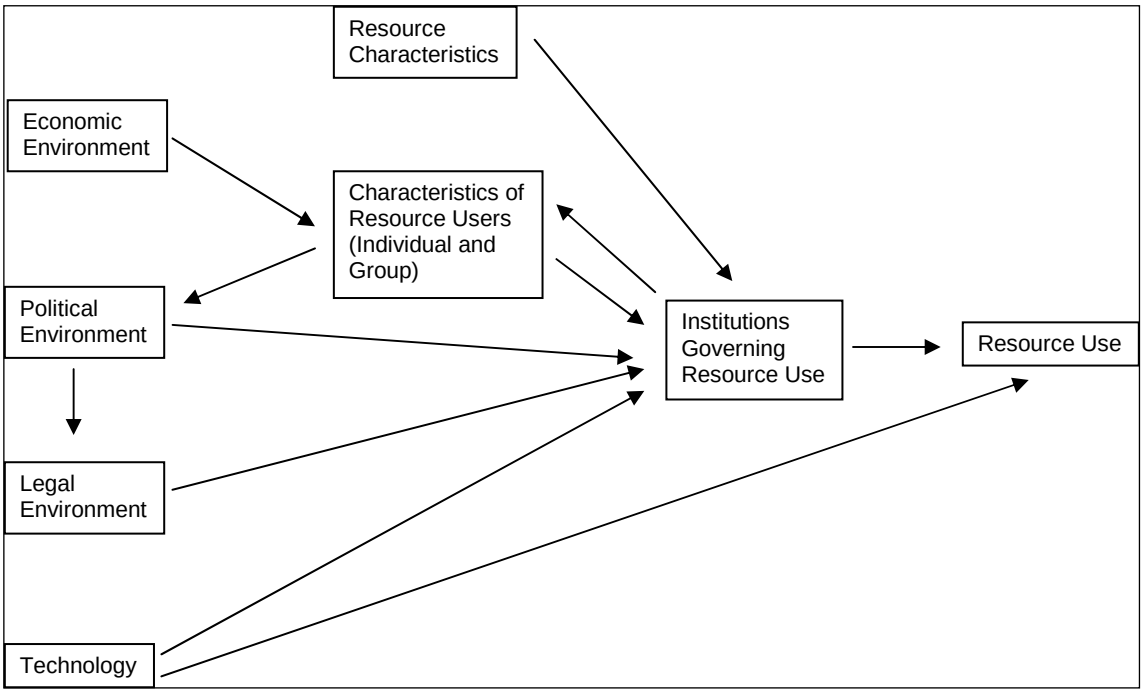

Figure 4. *Factors affecting common-pool resource use* (Dolsak and Ostrom, 2003:10).

Technology has an effect on the institutions governing resource use directly, by providing the means employed in resource use and extraction, as well as indirectly, for example by providing methods for monitoring such use. *Institutions governing resource use* are, thus, affected by *resource characteristics* of that particular common-pool resource. The more homogeneous and small-scale the resource system is, the easier it is believed to be to design institutions governing it and to prevent overuse and depletion. Consequently, a complex resource system with interactive use and negative externalities is more difficult to manage properly (Dolsak and Ostrom, 2003:11).

Also the *characteristics of individuals and groups of resource users* affect institutions governing the resource, for example by their preferences, assets and by characteristics of the group, thus, by group cohesion, trust, homogeneity, size, etc. Resource use is then affected by institutions and the available technology. Moreover, the characteristics of resource users can be affected by the institutional design, just as the characteristics of resource users can affect the political environment (ibid).

To sum up: a common-pool resource use is not isolated from the surrounding society; instead it is nested in the political, legal, and economic environment that both are a part of the CPR system and of the surrounding society. In complex societies, like in Sweden, institutions interact with one another both horizontally, i.e., on the same level of social organisation, and vertically or across levels of social organisation (Young, 2002:264). Thus, since society consists of layers of institutions, centrally decided ecosystem-based management policies might have problems in penetrating all the way through the institutional layers of society. For example, policy decisions made at the National Board of Fisheries in Gothenburg might have difficulties to be "accepted" and to be put into practice in the day-to-day decisions by the local bleak-roe fishermen in Norrbotten. Moreover, technology, qualities of users and the resource also affect resource use and the possibility to manage the resource in an effective and sustainable manner. The complexity of CPR use and how possible dilemmas might be tackled will be further discussed in the next chapter.

5 Common-Pool Resource dilemmas

As already indicated, a so-called CPR dilemma exists if a common-pool resource is not managed in an effective and sustainable manner. However, not all CPR problems are dilemmas. According to Gardner et al., (1990), there are some necessary conditions for a CPR situation to turn into a CPR dilemma:

1. *The subtractability of the resource units*. Resource units that are used by one fisherman are not fully available to another. The amount of resource use varies between bleak-roe fishermen.
2. *Multiple appropriators*. More than one individual or group of individuals withdraw or harvest resource units from the resource. For example, both commercial and recreational fishermen use the vendace resource in Norrbotten.
3. *Sub-optimal outcomes*. Given a particular configuration of the physical system, technology, rules, market conditions, and attributes of the users, the strategies of the appropriators lead to sub-optimal outcomes from the perspective of all users. If the users of vendace appropriate the resource in an unsustainable way, this will exhaust the resource. In the long run, the strategy is sub-optimal from the view of the collective of fishermen.
4. *Constitutionally feasible alternatives*. A CPR dilemma can occur when the institutional arrangement surrounding the resource is inefficient. This means that, given existing institutional and constitutional arrangements, at least one set of co-ordinated strategies exists that is more effective than the current set, and this alternative should be constitutionally feasible (Gardner et al., 1990:336f). Applied to bleak-roe fishing, there are alternatives that are more effective, to the collective of fishermen, in managing the vendace resource than the current situation.

All the criteria above are relevant for constituting a CPR dilemma in bleak-roe fishing in Norrbotten. Vendace is a renewable resource with a flow of resource units, and the size of catches by one fisherman affects another user's opportunities. Many individuals and different groups (commercial and recreational fishermen) use the

resource, and the size of landings varies among fishermen. Conditions three and four distinguish a CPR dilemma from a "simple CPR situation" (ibid:337). Intensive trawling has been seen as the main reason why catches of vendace were decreasing in the 1990s, and this may indicate that the third criteria is close to being fulfilled, or is already fulfilled (Statistics Sweden, 1996:194). With the introduction of nylon nets and bottom trawling in the 1950s and 1960s, the number of fishermen decreased, but every fisherman, or group of fishermen, had a significant capacity to catch more fish (SOU, 1993:103 p. 15ff). Thus, the individual strategies would result in a fishery that probably is, or was, beyond the regeneration rate for vendace. If this is true, each fisherman's individual strategy contributes to sub-optimal outcomes for the collective of fishermen. These strategies can, therefore, lead to an extinction of the resource in the long run, as well as the destruction of the fishery.[19] The last condition, concerning constitutionally feasible alternatives, addresses the need for alternative strategies for managing the resource.

Institutions have to deal with two fundamental management problems that arise from the two basic characteristics of CPRs (excludability and subtractability): (1) how to control access to the resource, and (2) how to institute rules among users to solve the potential divergence between individual and collective rationality. Consequently, institutions must contain a mechanism through which the institution shapes the behaviour of individuals and there must also be mechanisms through which individuals are able to form and reform institutions (Peters, 1999:34).

The problem is to what extent this can be done, but also whether such a management system would be flexible and adaptive enough to change when this is necessary. When a dilemma exists, a solution of the dilemma requires a change in appropriation and/or provision activities (Ostrom et al., 1994:16). Thus, it is both an appropriation and a provision problem. Hardin claimed that only two property rights regimes, centralised government and private property, would sustain commons over

[19] However, as mentioned in the first chapter, decreasing catches can also be the result of natural fluctuation in the stock size. The sustainable harvest rate may, therefore, differ from year to year because of the variability in annual spawner production (Karås et al., 1994:10).

the long run. However, in managing common-pool resources, it is important to distinguish between the characteristics of a resource and the property rights regimes governing the use of the resource. In the next section, different types of property rights are discussed and applied to the topic of this thesis.

5.1 A change in property rights as a solution to the Hardin tragedy in fisheries?

> Because of the tragedy of the commons, environmental problems cannot be solved through co-operation… and the rationale for government with major coercive powers is overwhelming [….] [E]ven if we avoid the tragedy of the commons, it will only be by recourse to the tragic necessity of Leviathan (Ophuls, 1973, in Ostrom, 1990:8f).

The presumption that an external power is necessary to avoid the tragedy of the commons has led to recommendations that central governments must control natural resources in order to enforce co-operation upon users. Bleak-roe fishing in Norrbotten, with its long history of extensive state regulation, is a typical example. Another common suggestion is that private ownership should be introduced, reflecting the idea that privatisation is the only answer (Gray, 1998:2).

Historically, fishermen could often be left to get on with the business of fishing as long as there were plenty of fishes to catch. The old rules no longer apply, however. Open access is no longer a practical option, and some other form of institutional arrangement must govern the harvesting of a fish resource like vendace. The "tragedy scenario" is basically an institutional problem, which occurs because open access prevails, i.e., "nobody's property or responsibility" (Jentoft, 2004a:140). *Property* is a claim to a benefit stream (for instance, catches of vendace), while a *property right* can be understood as a claim to a benefit stream that some higher body, usually the state, agrees to protect. One example is the control of fishing licenses. In an open-access situation, there is no property, only the opportunity to use something (Bromley, 1992:11). Property rights define actions that individuals can take in relation to other individuals regarding, for instance, the use of a fish stock, and rules and rulers are required to establish, monitor, and implement a property system (Ostrom, 1996:6).

An individual or a group can have two types of property rights in fisheries: operational rights include the right to enter the fishery and to catch fish; collective-choice rights specify who will be entitled the rights of management and of exclusion, thus, who may participate, and how, in changing operational rights (Dominguez-Torreiro et al., 2003:214). The distinction between rights at these two levels is important because it emphasises the difference between using a right and participating in the definition of future rights to be used (Ostrom and Schlager, 1996). In general, property systems are not completely self-enforcing and "they depend for their definition upon a constellation of legal procedures, both civil and criminal" (Arrow, 1972:357).

In the mid-1970s, a dramatic change in property rights relating to fish occurred, when coastal fishing nations extended their jurisdiction to 200 nautical miles from shore.[20] This was regarded necessary because open access of the seas had permitted the rapid reduction of many fish stocks (Pinkerton, 1989:276). Unfortunately, assigning fish stocks to a particular country did not prevent the "race to fish" among domestic fleets (Grafton et al., 1996:90; McGinn, 1999:138).

There are a number of property rights regimes, and each has a different set of advantages and disadvantages in connection with management of CPRs. The physical attributes of the resource often affect the design of the institutional arrangement that manages the resource, but some form of property right system obviously must govern the use of a scarce renewable natural resource. Four ideal and analytic categories of property rights are commonly defined in analysis of CPRs: open access, private property, state property and communal property (Feeny et al., 1990:4). How do these types apply to bleak-roe fishing?

5.1.1 Open access fisheries

Open-access regimes include the "classic" cases of offshore ocean fisheries and the global atmosphere (Ostrom, 1996:4). It can be seen as the "null" condition of no

[20] This change did not formally come into force until the UN Convention on the Law and Sea was finally ratified by the required 60 countries in November 1994 (McGinn, 1999:137f).

property claims. No limits on who is authorised to use a resource exist in this type of system and, consequently, access to the resource is unregulated, free and open to everyone (cf. Eggertsson 1998:56). With the exception of the effort limitation in fishing tackles, recreational bleak-roe fishing is, during the fishing season, characterised by open access for users and potential users. In open-access regimes and under circumstances in which demand exceeds the capacity of the resource to sustain itself, the probability is high that "tragedies of the commons" occur. Open-access systems allow people to fish at will, and many such systems have been created as a consequence of the destruction of existing communal systems. One example is the imposition of colonial rule in sub-Saharan Africa (Feeny et al., 1990:6).

Under open-access regimes, boats continue to enter the fishery well after fish yield and profits begin to fall. As stocks decline, the fishermen often buy bigger and faster boats, with more advanced equipment and gear. This can create a vicious cycle of over-fishing and over-capacity. If this continues, profits will decline until people start to go out of business, fewer people take up fishing and fishermen have no incentive to increase their efforts. At this point, the catch in the damaged fishery may stabilise, but at a level below its sustainable potential. However, if fishermen then make politicians subsidise and maintain over-capacity, the fishery can collapse.

5.1.2 Fisheries as Private property

As already mentioned, a frequently recommended solution to problems associated with management of resources, such as vendace, is their privatisation. Private property rights are often exclusive and tradable between individuals and companies. The costs of controlling and monitoring these rights can be very high, especially for a migrating resource such as fish. Private ownership usually means, in regard to mobile resource units, individual ownership of withdrawal rights. For example, fishing rights are usually associated with quantity, time, or location; thus, rights that are attached to resource units and not to a resource system (Ostrom, 1996:20). Consequently, the individual fishermen do not own the fish stock or a particular part of the ocean, just the right to harvest units of fish.

From an economic viewpoint, a fish stock is a productive asset which has to be maintained and managed efficiently in order to generate the highest yield (Bac, 1998:263). However, from an ecological point of view, private property rights can also cause serious problems. There is no guarantee that the market will favour conservation and sustainable management. If the yield from the sustainable flow of resource units is lower than the yield from harvesting the whole stock, there is always an economic incentive to harvest the whole stock and maximise the profit. For relatively slow-growing and late-maturing species, such as whales, the most economic rational behaviour might be to deplete the resource rather than to use it sustainably (Feeny et al., 1990:9). Likewise, there is no guarantee that long-term ecological values will be protected by the market and private property rights, because, from the economic decision makers' viewpoint, the future value of any resource will be discounted to nearly zero in 15-20 years. Thus, under certain conditions, it is economically rational to drive a resource stock to extinction and to move to another site. Sometimes, the reality of the market is that discounting of resource values rewards "frontier economics behaviour" (Holling et al., 1998:348). This is a well-known phenomenon in fishery in which the success (i.e., profitability) of a well-managed fishery tends to trigger its own extinction by attracting additional capitalisation and fishing efforts until all resource rents are dissipated (Clark, in Berkes and Folke, 1998:350).

5.1.3 Fisheries as State property

With state property, or state governance, rights to the resource are vested exclusively in the government. Government efforts to reduce fishing often start with targeted gear restrictions, expanded area closures and shorter fishing seasons. These measures are often supplemented with entry barriers and restrictions on commercial fishing licenses (Merrifield, 1999:5). Thus, the government makes decisions concerning access to the resource and the level of exploitation or conservation, as with the vendace resource in Norrbotten. State property also includes resources that are held in trust for the public by the state, and to which citizens often have access, such as a

nation's territorial seas and national parks. However, problems of excluding some would-be users are not necessarily overcome by declaring the resource to be state property. Likewise, state property is no guarantee for sustainable use. Without complete information and appropriate regulations by the state, and without confidence in the regulations among the users, there is a risk that the resource will be used as an open-access resource. If fishermen do not understand the intention of regulations or perceive them as being imposed arbitrarily by officials, they are not likely to look on them favourably or follow them voluntarily. Given that the officials who make decisions do not have the same time-horizon or sphere of interests as private owners, the general public, or the government itself, this is not surprising (Feeny et al., 1990:11).

Relevant examples are numerous. For example, in a survey 2002 with commercial and subsistence fishermen in Sweden, the fishermen themselves estimated that 15 percent of the total catch is poached. Thus, due to low confidence in regulations, approximately 45,000 tons of fish per year are landed illegally in Swedish waters (Ellegård and Eggert, 2002:9). Another example is provided by New England regional fishery that was regulated by more than 100 different restrictions, having the result of a widespread violation of the law (Feeny et al., 1990:12f). People can become frustrated when the government intervenes in a matter that, in their opinion, concerns themselves and no one else, such as developing new mesh sizes and closed seasons for a fishery. In such a situation, people may see the institutional arrangement as illegitimate and treat the resource as an open-access resource – as may have happened with bleak-roe fishing in Norrbotten. If this is the case, and it is combined with subsidies paid to commercial fishermen, the resource can be confronted with a "tragic situation".

5.1.4 Fisheries as Communal property

Historically, many communal property systems have been mistaken for open-access systems and potential victims of the unavoidable tragedy of the commons (Feeny et al., 1990:5). With communal property, the resource is managed and used by an

identifiable community of interdependent users. These users have the right to utilise something in common and often possess a legal right to exclude non-members. They are also entitled to an annual stream of benefits; all of which are associated with a general need of group management of the stock and the annual flow (Bromley, 1992:11).

Communal property can be seen as a cultural artefact that is socially constructed and contested and not as a natural or necessary condition (McCay, 1993:2). The social and political characteristics of the appropriators, and how they relate to the larger political system, affect the ability of the group of users to organise and manage communal property. Pressure on the resource from technological change, population growth and new market opportunities have contributed to the breakdown of many historically successful communal management systems (Feeny et al., 1990:7f).

> [R]esources that had been under a *de facto* common-property regime enforced by local users were converted to a *de jure* government-property regime, but reverted to a *de facto* open-access regime [….] Similar results have occurred in regard to inshore fisheries taken over by state or national agencies from local control by the inshore fishermen themselves (Ostrom, 1996:6).

Open-access resources can be transformed over time into communal resources that exclude outsiders and limit competition among local users (Pinkerton, 1989). Not all examples of successful communal regulations are, thus, historical or based on long-standing tradition. For example, in Turkish coastal fishing, a successful system has evolved within 15 years, in which co-operatives are greatly aided in their management by a national law that acknowledges their collective legal existence with the right to sue to protect their property (McKean, 1992:259).

The notion of social capital, which stresses the relationship between sustainability and social norms, provides a potential escape from Hardin's solution to tragedy. It is, thus, important to keep in mind that common property is not the same as open access, and is not equivalent to everyone's property. Finally, it should be noted that, given the ecological and social complexity of CPRs, no single broad type of property rights uniformly succeeds or fails to halt major resource deterioration

(Dietz et al,. 2003:1908). Hence, tragedies will occur in the absence of adequate management, whether this management is performed by governments or local communities.

5.2 Property-rights regimes are not free of costs

As mentioned above, a successful regulation of uses and users in connection with CPRs, such as vendace is not universally associated with any particular type of property-rights regime; all the regimes described above have been associated both with success and failure. However, an open-access system has the greatest likelihood of ending up in a "CPR dilemma". Communal property regimes often have pre-industrial roots and are built on conditions that can be difficult to fulfil in the complex modern world. Private property rights mostly apply to fixed resources, such as forests and fields. For a resource with the characteristics of vendace, it can be hard to define who owns what. However, a state property regime for a natural resource with many users, in which regulations are implemented with top-down processes, is vulnerable to legitimacy problems that can result in a situation where resource use becomes de facto open.

The evaluation criteria for this study are ecological sustainability and efficiency. A "pure" private property rights solution for the bleak-roe fishery is no guarantee that vendace will be managed in a sustainable way. One such solution might be to sell Individual Transferable Quotas (ITQs), but the basic problem remains. If the system lacks legitimacy among the fishermen, there is an obvious risk that individual fishermen – particularly those without quotas or who consider their share too low – would continue with catch-maximising strategies and rule-breaking behaviour. Furthermore, it is debatable whether it is possible to determine appropriate quotas for fish resources, due to their fluctuating nature. The practical problems and the *transaction costs*, i.e., costs that are associated with upholding property rights, especially the monitoring of all fishing vessels and small boats in the northern part of the Gulf of Bothnia, would probably be very high. If such costs exceed the benefits, then nothing is won.

The extent to which a resource system can facilitate exclusion and reconcile individual and social incentives depends on its ability to keep transaction costs at a reasonable level. Every type of property-rights system, however, entails transaction costs in monitoring and control.

An open-access system usually has very low transaction costs, but these rise with increased regulation, especially if the regulations lack legitimacy among the users. Usually, governments have responded to declines in fish stocks with command-and-control regulations. Governments typically try to reduce over-fishing through different types of restrictions: the length of the fishing season, the size of the allowable catch-restricted fishing areas, the number of fishermen, vessel size and equipment.

As already mentioned, ocean and coastal fisheries can be enormous and almost impossible to monitor, and the larger the resource system, the greater the costs of controlling the boundaries to ensure that no outsiders appropriate from the resource (Ostrom, 1990:293). If private property rights are to be of value, possessors of the rights must be able to exclude others from using the resource, as this allows the owners to capture the rents paid by the users. A transition from harvesting rights to completely private ownership would be closely related to how the incentives are perceived by potential resource-owners.

New technology may help to “fence” fish; for example, satellites are already capable of monitoring fishing vessel locations. If monitoring and control do not work, and/or if the rules lack legitimacy, there is a risk that users will systematically break them. If so, the system will be de facto open, with free access to the resource and no limits on use. Consequently, to restore the legitimacy of the statutory regulation, the transaction costs in monitoring and control will be extraordinarily high, unless those who govern find some creative mechanism to keep them down (Ostrom, 1992:31). The problem is illustrated in Figure 5.

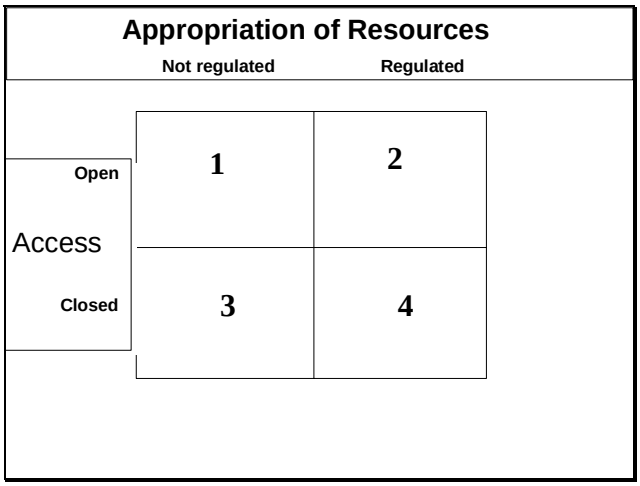

Figure 5. *Common-pool resources classified by appropriation and access* (Carlsson, 1999:15).

Figure 5 classifies bleak-roe fishing in two dimensions: opportunity of access and intensity of appropriation. In square 1, the probability is high that a "tragic situation" will occur. Access and intensity of use are free and unregulated. Fishermen try to catch as many fishes as they can and, if the fishery generates good earnings, the probability is high that more people will be attracted to the fishery. Square 2 shows a situation in which an unlimited number of users are allowed to withdraw a limited amount of resource units, while square 3 represents a situation in which the numbers of fishermen and/or vessels are limited, but individual harvests are not. This type of fishery can be classified as "limited-user open access" (Ciracy-Wantrup, in Grafton et al., 1996:91). These regulations often impose restrictions on fishing methods and vessel characteristics, but not on individual catches.

The *commercial fishermen* of bleak-roe are located in square 3. Licenses are obligatory, but there are no restrictions on the intensity of use during the fishing season. If regulators want to limit the total catch, they must calculate the average take of all boats and adjust the length of the open season. However, fishermen affected by the shortened season will still have the same incentives to pursue fish, without regard to crowding and stock-depletion costs. Fishermen have the ability to continue to race each other in pursuit of the biggest catch possible. As the number of fishermen or their capacity increases, the season gets shorter.

For *recreational bleak-roe fishermen*, access to the resource is open and free, but intensity of use is regulated through restrictions on fishing tackles, which limit users to six nets with a total length of 180 metres. Accordingly, recreational fishermen are located in square 2. If the resource is scarce, an increasing pressure for more regulation can occur, as in squares 1, 2 and 3. The most "expensive" square is 4, where intensity of appropriation, as well as access, are regulated. If intensity of appropriation is restrained (for example through quotas), and this restriction lacks legitimacy among the users, the costs of controlling and monitoring these regulations will probably be very high. Without incentives to change their catch maximising behaviour, the probability is also high that no effective institutions will be generated. Thus, if users do not believe that rules are effective; and/or cannot be monitored; and if they conflict with "local norms and values", the enforcement costs will grow rapidly and people can become free-riders on the system and, finally, management plans fail and the resource might become exhausted (Acheson et al., 1998:406).

Conversely, if the regulations are more easily applicable and "make sense" to fishermen, they will be easier and cheaper to monitor, and will, therefore, have lower transaction costs. If effective managerial institutions are to be implemented at a reasonable cost, individual fishermen must be convinced that these rules are functioning well so that today's sacrifices will result in benefits in the future. How can this be done? How to persuade people to put their collective interests above their short-term individual interests? To answer these questions, the next chapter contains a discussion of institutional variables that have proven important in affecting users' incentives to manage CPRs successfully.

6 Experiences from sustainable common-pool resource systems

The rational choice approach, on which neoclassical economics and game theory are based, do not take into consideration the fact that an individual fisherman's behaviour and interests is embedded in social and cultural relationships where action follows "from positions individuals hold as members of social groups, communities and organizations" (Jentoft et al., 1998:426). Our understanding of CPRs, and the institutions governing their use, comes from a number of studies of resource management in, for example, fisheries, irrigation systems, forests and groundwater basins (Ostrom, 1990, 1992; Pinkerton, 1989; Ostrom, Schroeder, and Wynne, 1993; Bromley, 1992; and Ostrom, Gardner and Walker, 1994). These case studies show how institutional arrangements and the incentives they generate can be successful in the development of sustainable management practices for CPRs, and, thus, why people in these resource systems put their collective interests above their short-term individual interests. In these resource systems, users have, sometimes by themselves and sometimes with the assistance of external authorities, created a wide diversity of institutional arrangements for dealing with CPRs where they have not been prevented from doing so by central authorities (Ostrom, 1998a:1).

The interesting aspect, from the perspective of bleak-roe fishing in Norrbotten, is how these experiences correspond to the concepts of resilience in management of natural resource systems. How does this assumption of the importance of resilience in the ecological system, as well as in the institutional arrangement, correspond to experience from long-enduring CPR systems?

It is important to bear in mind that the design principles summarised in this section are stated generally, and that all long-enduring CPR systems have developed their own methods, due to the specific local circumstances of each system (Ostrom 1993:4). Thus, there is no single widely accepted theory of what makes CPR institutions sustainable and no design principles provide a blueprint to be imposed on all resource management regimes (Agrawal, 2002). As emphasised in Chapter 1, much of this research has focused on locally situated small user groups and

communities. By design principle, Ostrom means “an essential element or condition that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use” (Ostrom, 1990:90). Thus, they are conditions for achieving institutional robustness in CPR use.

In this study, the design principles that are discussed in this section should be regarded and will also be used as a guide to get a better understanding of sustainable management of CPRs. This is accomplished by comparing management of bleak-roe fishery with the experiences of factors that have been critical in supporting successful governance in other cases.

According to Elinor Ostrom (1990, 1992, 1993), who is the one who first systematised the design principles for long-enduring management of CPRs, the types of institutional variables that affect users’ incentives to manage CPRs successfully are as follows.

1. *Clearly defined boundaries*. The boundaries of the resource system and of those individuals with the right to use the resource should be clearly defined, for example; which fishermen have permission to participate in bleak-roe fishing, and what are the boundaries for the resource system of vendace? If these boundaries are unclear, no one knows what is being managed, or for whom. Without defining boundaries and closing the system to outsiders, the free-rider problem will always be present. Thus, users face the risk that any benefits they produce by their efforts will be harvested by others who have not contributed to those efforts. In addition to closing and defining the resource system, rules limiting use and/or mandating provisions are necessary (Ostrom, 1992:69). This is needed whenever a resource is scarce, and can be seen as a first step in organising for collective action.
2. *Proportional equivalence between benefits and costs.* The rules that are restricting time, place, technology, and/or quantity of resource units should be related to local conditions and to provision rules requiring labour, material and/or money (Ostrom, 1990:92). For example, when, where and how should

the fishermen catch bleak-roe, and/or how much vendace are they allowed to catch? The resource system should also effectively allocate the resource units available during different seasons, and other relevant local conditions. Thus, rules to appropriation, benefits and costs have to take into account the unique features of each system (Ostrom, 1992:70).

3. *Collective-choice arrangements.* Individuals participating in appropriation of the resource should be involved in a group that can modify and change operational rules. This is important because individuals who interact directly in the resource system can modify their rules and better fit them to the specific characteristics of their system (ibid). Thus, it is necessary to have rules that correspond to the local conditions for bleak-roe fishing, and an institutional arrangement in which local fishermen can participate in modifying the operational rules.
4. *Monitoring.* The fishermen involved in bleak-roe fishing, or people accountable to them, would be those who monitored the fishery (Ostrom, 1993:2). The reason for this design principle is further discussed under point five.
5. *Graduated sanctions.* Users who infringe on operational rules are likely to obtain graduated sanctions from other users, or from officials accountable to these users, or from both (ibid). In long-enduring systems, monitoring and sanctions are performed by the participants and not by external authorities. In the beginning, the level of the sanctions used is often very low, but the level increases when it is needed (Ostrom, 1999-09-29). Consequently, cheaters can be observed at low costs by those who most want to deter cheaters. If the local bleak-roe fishermen performed monitoring and sanctions, the costs of controlling the resource system would probably be low.

Thus, it can be assumed that if bleak-roe fishing were designed after these five principles, they would help the fishermen to create a robust CPR system, in which they design their own operational rules. These rules would then be enforced by the fishermen or those accountable to them, using graduated sanctions that define rights

and duties related to the fishery. It would also be important that these rules were sensitive to the local conditions that distinguish bleak-roe fishing in Norrbotten, instead of using general rules for the entire fishery sector in Sweden, or (even worse) for the entire fishery sector within the EU. Free-riding and monitoring problems would be solved in an interrelated manner if fishermen would contribute in the design and monitoring of the institutional arrangement. According to these principles, they would be motivated to monitor the system in order to assure themselves that other users are following the rules (Ostrom, 1992:73).

These design principles correspond very well with the concept of resilience. It seems quite clear that small and well-defined CPR systems without free-rider problems are better able to receive and respond to signals from the ecosystem. If appropriation rules are related to local conditions, it is more likely that the management system will be sensitive to changes in that specific ecosystem than would general rules for the whole fishery sector. Experiences from long-enduring CPRs and the theory of resilience in management systems both emphasise the importance of local knowledge and the participation of local users in the management of a renewable natural resource.

A local fisherman with experience and knowledge of vendace would probably observe signals from the resource system at an earlier stage than could the state authorities, which must wait for catch statistics and for the estimation of the stock. Likewise, if fishermen were involved in the design of rules and the management of vendace, they would probably take more responsibility for the resource and, thus, be more willing to respond to signals from the system. With a “short” implementation structure, adjustment of operational rules to new conditions would be enhanced. Local fishermen could reorganise the management system more quickly than a “classic top-down government arrangement”, which aims at making fishery regulation as general as possible. If the fishermen performed monitoring and imposed sanctions, it would be easier to detect and sanction “cheaters”, and this would make the management system more flexible and adaptive to changes in the ecosystem. With an implementation structure in which bottom-up processes construct rules, and

with fishermen themselves monitoring the resource system, the incentive to follow rules would most likely be higher, and this would make it easier to adjust the rules when changes in the ecosystem occur.[21] Resilience in the management system would, thus, increase.

Still, all this may not be sufficient for the system to function effectively in a large, complex society. The bleak-roe system would also need support from its wider surroundings, including government authorities and officials. Accordingly, the following design principles consider this aspect of managing CPR systems.

6. *Conflict resolution mechanisms*. Users and their officials should have fast access to low-cost, local arenas in order to resolve conflicts between users, or between users and officials (Ostrom, 1993:2). Some mechanism for discussing and resolving what is, or is not, a rule-breaking behaviour is needed (Ostrom, 1992:74). In our context, there would be no "all-knowing" officials who seek to resolve all types of conflicts between fishermen, and between fishermen and officials, in the bleak-roe arena. The research about CPRs has shown that conflict-resolution mechanisms are often informal and those who are selected as some form of leaders are also the people who often resolve conflicts (Ostrom, 1990:101). To function effectively, those involved in bleak-roe fishing would have some form of conflict-resolution mechanism for discussing and resolving what constitutes an infraction, and what type of sanction different sorts of rule-breaking behaviour would bring about. With the opportunity to discuss and resolve conflicts in the local arena, the legitimacy of the rules would probably increase.
7. *Minimal recognition of rights to organise*. The rights of user groups to create their own institutions are not challenged by external governmental authorities (Ostrom, 1993:2). For example, a local organisation of bleak-roe fishermen would have the right to define who could use a fishing ground and the kind of

[21] A state property regime of a natural resource with many users, and in which the regulations are implemented with top-down processes, is vulnerable to legitimacy problems. For further discussion about bottom-up and top-down processes, see, for example, Sabatier (1993) and Chapter 1 in this study.

equipment that could be used. If government officials recognised the legitimacy of these rules, the fishermen themselves may be able to implement the rules. If, on the other hand, only external government officials had the authority to make the rules, decisions by this local group of bleak-roe fishermen might not be enforced by the police or the formal courts. In that case, it would be difficult to hold either user-group officials or users accountable for their actions (Ostrom, 1992:75). Indeed, the government could even challenge the resource management system more directly. If a fisherman broke the rules of a local management system, and government officials supported this behaviour, other fishermen would be unlikely to obey and follow the rules. "Why", they would be likely to ask, "should I appropriate the resource in a sustainable way when other fishermen can use the resource in a unsustainable way without sanctions?" Consequently, it will probably be very difficult for local users to sustain a rule-governed CPR over a long period of time (Ostrom, 1990:101).

The last design principle is especially applicable to common-pool resources that are a part of larger, more complex systems, such as bleak-roe fishing in Norrbotten.

8. *Nested enterprises*. Generally, most activities in the resource system are organised in several layers of nested enterprises, for example, appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities (Ostrom, 1993:2). The experience of long-enduring CPR systems shows that they are usually organised into many levels of nested organisations. All appropriators using, for example, a bleak-roe fishing bank might form the basis of another level of organisation, which might encompass all fishermen in the county, together with government officials. All these levels would be nested in externally organised political jurisdictions, and an individual fisherman could take advantage of having different levels of organisation (Ostrom, 1992:76). Small-scale work teams would help to prevent free-riding, because it would be easier for members to monitor each other, while "large-scale enterprises allow systems to take advantage of economics of scale when

relevant and to aggregate capital for investment" (ibid). The resource system will not survive in the long run if rules are created on one level without appropriate rules on another level. Without a comprehensive view on the resource system, the system will be incomplete and will not function properly.

According to these principles, the *vendace system* should have clearly defined boundaries. The *group* that participates in bleak-roe fishing should, as well, be clearly defined. In a relatively small group, the likelihood that members have more frequent and personalised relationships is higher as is the likelihood that people are informed about each other's actions and preferences. The feeling of identity is also likely to be stronger in a small group, compared to a larger one. However, the effects of personal antagonism and rivalries can be more devastating in a small group, compared to a large one (Baland and Platteau, 1996:299). The *institutional arrangement* should have locally devised access and management rules, graduated sanctions, availability of low cost arenas for conflict resolutions, and accountability of monitors and other officials to the fishermen. The *relationship between the resource system and institutional arrangement* should be that landings of vendace are restricted so that it matches the regeneration of the resource. The *external environment,* in form of central governments, should not undermine local authority and there should be nested levels of appropriation, provision, enforcement and governance (Agrawal, 2001).

According to Agrawal (2001, 2002), there are two major aspects of resource use that are not included in these design principles: First, there is only a limited attention to specific resource characteristics which may be relevant to how and whether users are able to sustain effective institutions. For example, extensive migration behaviour of fish resources can make them less suited to merely local management. Second, these design principles pay only limited attention to the external social, institutional, and physical environment. The institutional arrangement for an economically valuable product like bleak-roe can, for example, be undermined by external market pressure. Furthermore, the fact that technological changes and developments can make the harvesting much more effective can also undermine the

institutional arrangement. Indeed, with the extensive technological development in fishing tackles during the last century, this has been the case in many fisheries.

To sum up, there is no "general law" that common-pool resources are doomed to the "Hardin tragedy", and that individual rational strategies always lead to collectively irrational outcomes, in fact, this only happens under very special conditions. Hardin's model has major limitations and only applies when users cannot communicate and have no way of developing trust in the management regime or in each other (Stern et al., 2002:456). There are many examples of long-enduring CPR systems in which individuals are motivated to sustain the resource on which they are dependent. In many cases, the recipe has been self-organisation, self-governance and sensitivity to local circumstances.

Finally, it should be emphasised that the discussed design principles correspond very well to the notion of resilience in management of renewable natural resources. A CPR system designed according to the principles would be more flexible and adaptive to changes in the ecosystem. The decision-making process would be faster, and, thus, the ability to adjust to changes in the ecosystem, as well as the legitimacy of the rules, would probably increase. If local users were responsible for management of the resource, their willingness to respond to changes, and to appropriate the resource in a sustainable way, would be greater than in a top-down regulated system where short-term individual rationality is superior to long-term collective rationality. What incentives does the institutional arrangement produce for the bleak-roe fishery?

To get an answer to this question, the next chapter elaborates on the fundamental principles of the IAD framework, and, thus, brings forward the important variables in the institutional analysis of the vendace resource that will be analysed in the empirical part of this thesis. The IAD framework is of assistance in the analysis of whether the institutional arrangement, as it was configured earlier and came to be tailored after the resource crisis in the 1990s, works in accordance with the theory of resilience and adaptive management; thus, with the goals of efficient and sustainable use of the vendace resource.

7 A methodological framework for analysing bleak-roe fishing

To sum up the previous chapters, institutional analysis is an endeavour to study problems that a group of individuals face, and how the rules they adopt might address and solve appropriation and provision problems. This requires an in-depth understanding of the nature of the problem, the nature of the actors, and the institutional setting in which they are embedded. For the purpose of analysis, we need a framework that includes and captures the social and cultural processes that are essential to fisheries management.

As mentioned in Chapter 2, a theoretical framework called *The Institutional Analysis and Development Framework* (IAD) will be used. This framework has proved to be useful in analysing CPRs, such as fisheries (Ostrom, 1990; Ostrom et al., 1994; Tang, 1991; Imperial, 1999). Figure 6 displays how the framework is designed; it also indicates the intellectual structure of this study.

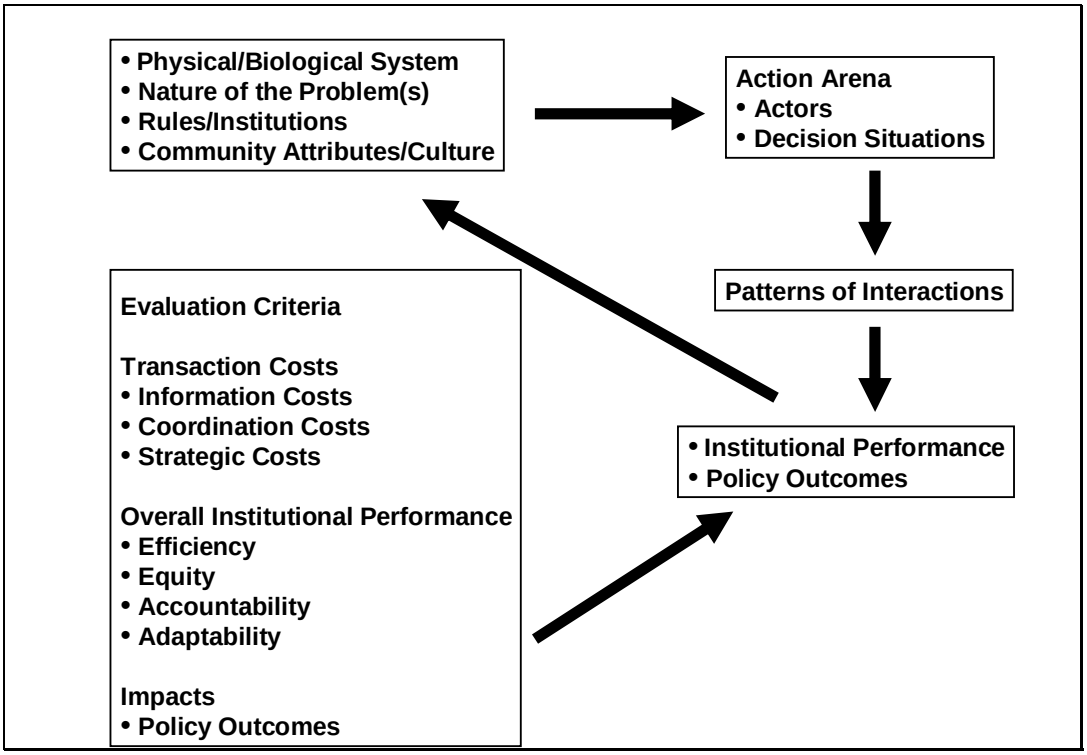

Figure 6. *The institutional analysis and development (IAD) framework.* Modified by Imperial (1999) from Ostrom et al., (1994).

A framework, such the one that is displayed in Figure 6, is neither a model, nor a theory. Instead, frameworks help to think about phenomena and revealing patterns which lead to models and theories (Rapoport 1985, in Berkes and Folke, 1998:15). Thus, a framework can help generate important questions of relevance to the analyst. The purpose of using the IAD framework is to make it possible to organise knowledge and guide the investigation about problems, or potential problems, in connection with collective action and CPRs, in this case, vendace. It is a useful tool for analysing institutional arrangements in a fishery for several reasons:

- The full range of transaction costs associated with implementing policies is recognised.
- It highlights the contextual conditions that can influence institutional design and performance; for example, physical, biological, social, economic and cultural conditions.
- The IAD framework has no normative bias regarding the institutional arrangements used to implement different policy programs. Accordingly, it does not assume that a top-down centralised institutional arrangement is more effective in structure than a decentralised institutional arrangement with bottom-up approaches, or the other way around.
- It recommends using a mixture of criteria to identify the strengths and weaknesses in the different institutional arrangements that can be used to implement policies.
- The centre of attention is on rules, rather than on policies which broaden the analysis to address a much wider range of organisational relationships (Imperial 1999:453).

The IAD framework is a tool for showing how components of an action situation can be used to construct an appropriation dilemma. It is used as a general organising tool that helps to generate questions in situations affected by a combination of factors derived from a physical/biological world, a cultural world and a set of rules (Ostrom et al., 1994:37f).

The IAD framework does not limit an analyst to the use of one theory. It is based on a limited version of rational choice and is sufficiently broad to be compatible with a great number of theories, for example, collective action theory, transaction cost theory, game theory and constitutional choice theory (Carlsson, 1995:13). In this thesis, a theoretical framework that consists of the concepts *social-ecological resilience*, *common-pool resources* and *institutions* is used.

The IAD framework can be used to analyse different types of institutional arrangements and CPRs with a case-study approach. The framework can also be used to examine the institutional arrangements used to implement ecosystem-based management programs (Imperial, 1999:450). It is through institutions that management systems work and, accordingly, the efficacy of fisheries management is largely a question of institutional design. In institutional analysis, it is important to clearly identify the shape of a given institutional structure and the incentives generated by that structure because institutions never exist in a cultural and social vacuum (Hilton, 1992:285; Jentoft, 2004a:141).[22]

In analysing an institutional arrangement, the focus is on the participants, their purposes and resources, and how they are linked, both to each other and to outcomes in the world. It is, thus, a multilevel of analysis where action arenas are linked across different levels of analysis and where rules often are nested in another set of rules that, for example, decide how the first set of rules can be changed, and so forth. The IAD framework provides concepts that identify key attributes of the institutional arrangement that manages a specific resource. The analyst identifies the types of actions that actors can take, the type of information available to them, how different actions lead to different outcomes, and how rewards and punishments are allocated in light of the outcomes achieved and the actions taken. Then, the analyst forecasts the actions and aggregate outcomes that are most likely, given the structure of incentives.

[22] The IAD framework has its roots in classic political economy, neoclassical microeconomic theory, institutional economics, public choice theory, transaction-cost economics and non-cooperative game theory (Ostrom et al., 1994:25).

7.1 The action arena

The first step in using an IAD framework is the identification of a conceptual unit called the *action arena,* in which individuals adopt actions or strategies (Tang, 1991:43). In this case, it is bleak-roe fishing in Norrbotten that is the unit of analysis. Action arenas are assumed to be understood by reference to a crucial problem and not by reference to political decisions or policies (Carlsson, 2000:13). How the action arena is "working", according to the evaluation criteria used by the researcher, is, therefore, an essential point in an IAD analysis. The action arena can be seen as a mix of actors, whether individuals or organisations, which interact and make decisions which effect the functioning and the well-being of the vendace system. It is also important to bear in mind that the boundaries of "the vendace ecosystem" may overlap or be embedded in other ecosystems, as well as management issues, or problems may have a different set of institutions that interact and affect the management of bleak-roe fishing.

The action arena includes a *decision situation* component and an *actor* component. The notion – decision situation – refers to the space where individuals interact, solve problems, exchange goods, or fight (Ostrom et al., 1994:28). To analyse the structure of a decision situation, it is useful to identify seven components that generate a set of incentives for those involved. These components are: participants, positions, actions, potential outcomes, transformation functions, information and payoffs (Ostrom, 1998b:5). *Participants* include the actors who become participants in a situation; this component links actors, given the way they are conceptualised, to a decision situation. *Positions* associate participants with an authorised set of actions in a process. All participants can hold the same position, or every participant can hold a different position. *Actions* define the set of actions that participants in particular positions can take at different stages of a process, for example, decisions to fish or not to fish during a defined time period. *Potential outcomes* describe the outcomes that participants can potentially affect through their actions, for instance, the quantity of fish caught in a fishing spot. Accordingly, these are the potential outcomes of individuals interacting with one another in a regularised

setting. *Transformation functions* link actions and outcomes to intermediate or final outcomes, for example, fishing in one year and the availability of fish in the next. *Information* refers to what is available to a participant in a certain position at a certain stage in a process. However, many situations, as in many fisheries, generate incomplete information, because of the physical/biological relationships involved, or because rules prevent making all the information available. The seventh component, *Payoffs*, assigns positive and negative weights to outcomes and the actions leading to outcomes; one example of the latter is the costs of travelling to a fishing spot (Ostrom et al., 1994:29ff).

Within a decision situation, the actor can be thought of as a single individual or as a group functioning as a corporate actor (Ostrom, 1995:7). The assumptions about the actors who participate in the CPR situation are built upon four key characteristics: (1) the type of preferences held regarding potential actions and outcomes, (2) how information is processed by the actors, (3) the heuristic formula used for making decisions upon a particular course of action (selection criteria), and (4) the resources that an actor brought to a situation (Ostrom, 1998b:5). The view of the actor is similar to the assumption in classical political economy that an individual's choice of strategy, in any particular situation, depends on how he or she perceives and weighs the benefits and costs of various strategies and their likely outcomes. Furthermore, the assumption is that individuals are fallible learners, and fallible learners can often make mistakes. Institutional arrangements differ, however, as to whether the incentives involved promote individuals to learn from these mistakes. Thus, different institutional arrangements used in governing and managing CPRs offer individuals various incentives and opportunities to learn.

Another problem for actors is that information search is often expensive, and human information-processing capabilities are limited. Consequently, individuals must often make choices based on incomplete knowledge of possible alternatives and likely outcomes (Ostrom, 1995:7ff).

7.2 Four sets of attributes that structure and affect the action arena

To understand how an ecosystem, like the Baltic vendace, is managed and functioning, it is important to understand how formal (e.g., laws, regulations, permit decisions, etc.) and informal (e.g., norms, values, culture, etc.) rules interact with one another. The IAD framework identifies four sets of attributes that are systematically related to each other. Consequently, these attributes also structure and affect the action arena. These attributes are: (1) the *physical/biological attributes of the resource* and the technology used to appropriate its yield; (2) *the nature of the problem(s)*; (3) *the attributes of the community* of participants; and (4) *rules-in-use*, or, in other words, the set of institutional arrangements used (Tang, 1991:43).

As previously described, rules-in-use are not necessarily formal rules (written laws or regulations). Rules refer to enforced prescriptions about what actions are required, prohibited, or permitted, and an institution is understood as the set of rules actually used by participants in an action arena (Ostrom, 1992:19). From a policy perspective, institutional arrangements are the most important of the four contextual attributes (Tang, 1991:43). Individuals choose actions in light of existing incentives. By changing the rules, it is possible to intervene to change the structure of incentives facing individuals in an action situation and, thus, to motivate actors to adopt different strategies and behaviours that could change outcomes. Interventions are understood as a system of rules that are:

> [U]sed by individuals for determining who and what are included in decision situations, how information is structured, what actions can be taken and in what sequence, and how individual actions will be aggregated into collective decisions (Kiser and Ostrom, 1982:179).

There are three levels of rules that cumulatively affect the actions taken and outcomes obtained: operational rules, collective-choice rules, and constitutional-choice rules.

1. *Operational rules* define who can participate in which situations – what the participants may, must, or must not do, and how they will be rewarded or punished (Tang, 1991:43). These rules affect day-to-day decisions made by the participants, for instance, when, where and how to catch vendace, how, and by whom, should bleak-roe fishing be monitored, and so on. The processes of

appropriation, provision, monitoring, and enforcement occur at this level of rules (Imperial, 1999:455). In other words, operational rules regulate use of the commons.

2. *Collective-choice rules* affect operational activities and results as they determine who is qualified to participate, and the specific rules to be used, in changing operational rules. At this level, individuals are no longer entirely free to decide for themselves how to make use of the resource. These rules establish conditions for collective choice within the group of users that is most involved with the resource. Consequently, at this level are activities such as policy making and management. For example, how to change the operational rules in bleak-roe fishing and who is qualified to make these decisions.
3. *Constitutional-choice rules* are decision structures outside the direct group that impose on how the commons are organised and used (Bromley, 1992:46). They affect operational activities by determining who is qualified to participate, and the rules to be used, in crafting the set of collective-choice rules, which, in turn, affect the set of operational rules (Ostrom et al., 1994:46). Thus, modification and governance of constitutional decisions and collective-choice rules take place at this level (Ostrom, 1990:52).

It is important to bear in mind that these rules are nested in each other and also in a wider institutional context. This idea of embeddedness is one of the keystones of institutional policy analysis (Imperial, 1999). In order to be effective, these rules have to be compatible with the special circumstances of the resource – for example, the fluctuating nature of the vendace resource and the economical importance of bleak-roe fishing for commercial fishermen in Norrbotten. Whether collective-choice rules can help to solve collective action problems in a CPR situation depends on their ability to: (1) formulate operational rules that meet the needs of appropriators; (2) detect and impose sanctions against rule violations; and (3) hold officials accountable to appropriators (Tang, 1991:44). Within the environment of the community's prevailing attributes, it is the content of rules, together with the physical/biological attributes of the resource in question, which affect the structure of incentives that

actors face and respond to. In other words, the sum of these "variables" describes the institutional setting of a given activity. Obviously, an action arena is changeable over time. The important question is how these rules, combined with the physical/biological and cultural world, affect the action arena (Ostrom et al., 1994:37). For example, why do the bleak-roe fishermen act in one way, rather than another?

As already mentioned, the decision situation is also structured by the attributes of the physical/biological world. Many problems of the commons are rooted in natural or technological constraints. For example, the difference between resources that are subtractive in nature, such as CPRs and private goods, as opposed to those that are not subtractive, such as public goods, strongly affects how rules affect outcomes. This can be compared to a game:

> [I]magine, for a moment, switching the balls used in American and European football. The strategies available to players in these two games, and many other sports, are strongly affected by the physical attributes of the balls used, the size of the field, and the type of equipment (Ostrom et al., 1994:44).

Strategies in regulating fisheries are strongly affected by the physical/biological facts that fish stock, typically, is a migratory resource, and that technological developments improve the ability of fishermen to exploit it more intensively. However, technology can also improve sustainable use of renewable natural resources. For example, to avoid catches of non-mature vendace, the development and promotion of new and more selective trawls can be effective.

In a CPR analysis, the importance and interest in physical/biological resource attributes and technology stems mainly from three considerations.

- The first is the capacity of the resource base to support multiple users at the same time, without one interfering with another, or diminishing the aggregate level of benefit (the yield of a resource) available to the group. Physical/biological limits and technology provide information for devising rules to maintain jointly beneficial use.
- The second consideration is the degree to which institutional arrangements permit exclusion of individual users and limit access to the resource. The

opposite of exclusion is complete openness, or open access. The degree of exclusion depends on both the physical/biological nature of a resource and available technology. Historically, the degree of exclusion has often been dependent on technology; for example, the development of barbed wire, to a great extent, overcame the problem of fencing open ranges (Bromley, 1992:45).

- The third consideration is the physical/biological boundaries of the commons, which determine the minimal scale on which effective co-ordination can occur. These boundaries derive from nature or technology, rather than rules (ibid).

The attributes of a community that are important in affecting the structure of an action arena include a set of generally accepted norms of behaviour, the level of common understandings about the action arena, the extent to which the preferences are homogeneous, and distribution of resources among the users (Ostrom et al., 1994:45). The attributes of the community can also be called the cultural world. Thus, these four attributes (rules-in-use, attributes of the physical/biological world, the nature of the problem(s) and attributes of the community) and the complexity of relations between them can be observed as patterns of interactions.

7.3 Patterns of interactions, evaluation criteria and outcomes

Patterns of interaction result from the choices of strategies by the members of the group, and rules do not guarantee the emergence of a particular pattern of behaviour, because between rules and behaviour lie the mental calculations of individuals who make choices (Bromley, 1992:49). For example, what are the appropriators' time horizons likely to be? Are their interests roughly similar or heterogeneous? The physical/biological features of the resource, technology and the relevant institutional arrangements result in individual choices, from which emerges some pattern of interaction. From a research perspective, the *outcomes* generated by patterns of interaction can then be assessed by using predefined *evaluation criteria.*

To supply information in the framework about outcomes, it is necessary to (1) stipulate the evaluative criteria (i.e., in this study sustainability and effectiveness) and

(2) search for consequences that affect users of the resource (and others involved), according to the criteria. The IAD framework focuses on the transaction costs associated with relationships in institutional arrangements and uses an array of different criteria to analyse the overall performance of the institutional arrangement. Consequently, this approach contains no implicit or explicit biases regarding how policies should be implemented. It is also important to bear in mind that there are no direct causal linkages between institutional performance and policy outcomes in ecosystem-based management, because participants may prefer an institutional arrangement with low transaction costs, even though it may not result in optimal outcomes from an ecosystem perspective (Imperial, 1999:456ff). Thus, when it comes to implementation, optimal policy often fails because the transaction costs are too high or because political and economic factors intervene, for example in ocean fisheries and global climate control.

The transaction costs are likely to increase as jurisdictional complexity increases and the actors' interests become more and more heterogeneous. There are three sets of transaction costs associated with policy implementation; *information costs*; *coordination costs*, and *strategic costs*. Accordingly, *information costs* arise from searching for and organising information. Very often, decisions are made on the basis of insufficient information which will increase the uncertainty of the validity of the decisions made, which can result in reduced legitimacy and, thus, increasing management costs (Nielsen, 2003:429). In the bleak-roe case, this is an important aspect because participants in local management programs need to obtain scientific and "local" knowledge and information to manage the resource appropriately. Local management often gains by developing low-cost mechanisms to improve communication, make decisions, and resolve conflicts between scientists, bureaucrats, fishermen groups, and the public, in order to minimise or avoid information asymmetries.

The costs associated with development and implementation of a resource management plan is named *coordination costs*, for example; the costs of negotiating, monitoring, and enforcing agreements for a bleak-roe management plan. *Strategic*

costs result from strategic interactions by participants in the action arena. They also originate from asymmetries in information, power, and/or other resources so that some obtain benefits at the expense of others, for instance, free-riding and rent seeking, etc. Another behaviour that can result in strategic costs is what used to be called "turf".

> Turf refers to the exclusive domain of activities and resources over which an agency has the right to exercise operational or policy responsibility. All else being equal, the individual or organizational preference is likely to be towards maintaining or increasing turf, since it secures the agency's strategic position and enhances long-term survival (Bardach, in Imperial, 1999:457).

The most common threats to an agency's turf are: job security or career enhancement; challenges to an agency's professional expertise; loss of policy direction; undermining traditional priorities; and, anxiety over accountability (ibid). Consequently, those who benefit from the institutional order will be in a stronger position to defend the existing institutional arrangement because they will not necessarily give up easily. In our case, the agency with the right to exercise operational and policy responsibility is the National Board of Fisheries. Accordingly, if there are any conflicts over turf, they are likely to be in that particular agency.

Studying transaction costs is a beneficial way to examine the performance of institutional arrangements, but, it is also pertinent to study the overall institutional performance over a sustained period of time, using a variety of criteria. Four interrelated criteria are commonly used in an IAD analysis: *efficiency* (market and administrative); *equity* (fiscal equivalence and redistributional equity); *accountability* and *adaptability* (Imperial and Yandle, 1998; Ostrom et al., 1994; Blomquist, 1992; in Imperial, 1999:457). There are two approaches to view *efficiency*: on one hand, as efficiency in terms of market; thus, what effect does the institutional arrangement for bleak-roe fishing have on wealth generation and productivity, and, on the other hand, efficiency as administrative efficiency; hence, what are the costs of administering bleak-roe fishing? The next criterion, *equity*, can also be viewed from two different perspectives; fiscal equivalence puts

emphasis on the fact that those who benefit from a resource, or service, should bear the burden of financing it. Consequently, those who derive relatively greater benefits from the vendace resource are expected to pay more. Redistributional equity emphasises the equality of the process, as well as the results and, it is important to bear in mind that an efficient program is not automatically a fair program because one user's costs can be another user's benefits (ibid). *Accountability* is important in ecosystem-based management programs because participants and officials must be held accountable for their actions. It is also necessary to have some form of mechanism for sanctioning the behaviour of participants. These sanctioning methods can be informal or formal, as long as they are consistent with the rule structure.

The final evaluative criterion is *adaptability*. Based on research, it has become clear that there is no single institutional design that can ensure successful management of all CPRs across a wide range of environmental and social conditions (Ostrom et al., 2002:456). As described in the first chapter, adaptive management can be seen as the scientific version of "learning-by-doing" and often relies on feedback learning. Given the varying and fluctuating nature of fish resources, such as vendace, proper functioning is sustained when the management system is "allowed" to develop and renew itself, and ecological resilience is combined with institutional resilience. However, we should not automatically assume that institutions are always willing, or have the capacity, to change their rules or structure when a change in the surrounding environment or in the ecosystem occurs and obviously calls for such an adjustment. If the management system is static and inelastic and, thus, not responding to changes in the ecological system, there is an obvious risk that the institutional system will suffer. In addition, to enjoy legitimacy and trust among participants, it is also important that the management system is relatively stable and set "the rules of the game" with some form of stability over time.

The key question is how predicted outcomes conform to the evaluative criteria. As described in the first chapter, the overall evaluation criteria for this

study are *effectiveness* and *sustainability* when using the vendace resource; goals that coincide with the environmental objectives for fish stocks established by the National Board of Fisheries in their action plan (see Chapter 1). To be able to make conclusions from certain outcomes, it is important to establish a comprehensive view of the action arena, instead of just analysing single variables. Such a view of the formal institutional arrangements surrounding bleak-roe fishing is presented in the next chapter. The empirical part of the thesis starts with the presentation that follows.

8 Formal institutions governing bleak-roe fishing

The aim with this chapter is to present the historical development and the formal rules governing management of fish resources in Sweden. The chapter deals with the formal structures and the historical context in the 20th century that are affecting Swedish fisheries and, thus, the "vendace arena". This chapter is aimed at establishing an understanding of the "environment" within which the management of fisheries work, and have worked, particularly in the Swedish county of Norrbotten. As emphasised in the previous chapters, formal institutional arrangements in a society are not only important through the rules and regulations they provide, but also through the incentive structures that these institutions generate among individual fishermen. Hence, these formal settings are important because they often affect individual fishermen's incentives in resource use.

The second part of this chapter gives a brief overview of the physical and biological conditions of the Baltic Sea, and particularly the Bothnian Bay. The aim is to emphasise the complexity of the vendace system and to make clear the physical and biological factors that are affecting the "vendace arena".

8.1 Fishing regulations in Sweden: a long history of centralised state management

Even before the 13th century, the Swedish State was expanding its power over fishing in Norrbotten, particularly over the salmon fisheries in the big rivers, in order to increase tax revenues. King Gustav Vasa (1496-1560) continued this centralisation of state power, and during his reign (1523-1560) the state expanded its control and taxation of natural resources, partly through its implementation of a national economic policy, but also by using its control of the church to mould public opinion (Söderberg, 1996; Behre et al., 1985). The state consolidated its power over the fish resource in Norrbotten in the 15th century (Lundgren, 1987:34). Hence, the institutional arrangements concerning our topic, characterised by state control (state property) over the fish resource in Norrbotten, started to develop more than 500 years ago.

However, while Swedish fishery has changed considerably over time, significant changes have taken place during the last century. The state has maintained its power over the resource and the users, even though the technology has changed considerably. Due to technological developments, the total number of catches and landings of fish have increased substantially between 1945 and 1995 (SOU 1998:24, p. 79; Gustavsson, 1997:19). It should be noted, however, that in 1996, a decline in the total volume of catches occurred: the total catch of 330,000 tons was 12 percent less than in 1995, when the largest catch was recorded (Gustavsson, 1997:11). This slight downward trend has continued. Preliminary, overall landings in 2003 amounted to 280,600 tons (landed weight), worth a total of SEK 869,6 million. Corresponding figures for 2002 were to 284,800 tons, worth a total of SEK 1,073,8 million (Statistics Sweden, 2004). Total landings of fish species in the Baltic Sea during the last decade vary between 600,000 and 1,000,000 tons, of which more than 90 percent are herring, sprat and cod. Freshwater species amount to 8,000 to 12,000 tons according to the official statistical data provided by member countries to ICES and FAO; however, some of the freshwater species are the basis for quite substantial catches in the coastal area and their stocks are not assessed by ICES.[23] Vendace is one of the most important non-ICES species (Finfo 2001:11).

The number of full-time commercial fishermen in Sweden has decreased from approximately 20,000 in 1945 to 2,055 in 2003 (SOU 1999:3, p. 18; Fiskeriverket, 2004:28).[24] There are also a few thousand part-time fishermen, about 300,000 recreational fishermen who fish with nets for private consumption, plus nearly 2,000.000 anglers. In a study commissioned by the National Board of Fisheries and carried out by Statistics Sweden in 2000, the total catch taken in the sea by recreational fishermen amounted to 34,500 tons per year (Finfo 2000:1, p.6f).

[23] ICES stands for International Council for the Exploitation of the Sea, and FAO stands for Food and Agriculture Organization of the United Nations.

[24] A commercial fisherman is defined as a person who possesses a commercial fishing license and/or enjoys at least SEK 30,000 per year in annual income from fishing and/or having a commercial fishing license (Finfo 2002:7 p. 8).

The average age of the fishing population is high and recruiting new fishermen is seen as major challenge for the future; the average age of a Swedish commercial fisherman is 50 years and on the Swedish East Coast as many as 55 percent of the fishermen are older than 50 years (Fiskeriverket, 2001:91, and 2004:28). The average age of the interviewed trawl fishermen in bleak-roe fishing (2003) is 47 years (see Appendix). In 2001, the total number of fishing vessels was 1,851 and 65 percent of them had a length of less than 10 metres. Vessels are considerably smaller on the East Coast than on the West Coast, where 84 percent of the vessels with a length of 24 metres or more have their home ports (Finfo 2002:7 p.5). Vessels with a length of less than 12 metres are defined as *coastal vessels* and fisheries performed by these coastal vessels are defined as *small-scale fisheries* (Sandström, 2000:11). In the year 2000, these coastal vessels accounted for 43 percent of the total number of landings, but these landings were only three percent of total catches by Swedish fishermen. Totally, small-scale coastal fisheries and fishing in lakes amounted to 5.4 percent of the total quantity caught and these landings amounted to 24 percent of total catch value in Swedish fisheries (Fiskeriverket, 2001:12).

In general, coastal fishing is regarded as having a minor impact on the environment, and the main focus is on fishing for human consumption. Larger vessels – i.e., those that are longer than 12 metres – are also engaged in large-scale "industrial" fishing with the emphasis on fish suitable for animal feed. Quite substantial quantities of, for example, herring and sprat are converted into oil or fish meal. In coastal fishing, the risk of by-catches of seals, birds and non-target species constitute a major problem (Thoresson and Sandström, 1998:36). Altogether, it is obvious that technological development and other changes in society have meant that the "arena" is constantly changing.

8.2 Formal rules governing Swedish fisheries

Since Sweden joined the EU on 1 January 1995, the Swedish sea fishery has been formally regulated by international agreements within the framework of the EU's Common Fisheries Policy (CFP), and responsibility for resource management has

largely been transferred to the EU (Gustavsson, 1997:7). The legal basis for the CFP is found in the Treaty of Rome, paragraphs 38–47, in which fisheries are included in the agricultural sector. As early as 1966, the European Community presented a proposal to the Council for a Common Fisheries Policy. Four years later, the first regulations were implemented. However, agreement on a complete CFP was not reached until 1983, when a Community system for the conservation and management of fishery resources was established for a 20-year period (Radoy, 1987:22). The purpose of the CFP agreement is stated in Article 1 of Council Regulation (EEC) NO. 170/83. Its goals are:

> [e]nsuring the protection of fishing grounds, the conservation of the biological resources of the sea and their balanced exploitation on a lasting basis and in appropriate economic and social conditions […] and safeguarding the particular needs of regions where local populations are especially dependent on fisheries and related industries (in Song, 1995:40).

The CFP includes a body of rules and mechanisms that cover the exploitation, processing and marketing of fish resources and aquaculture. These can be summarised under four main headings: (1) conservation and sustainable management of fishery resources; (2) organisation of the markets; (3) structural policy; and (4) relations with non-member countries and international organisations. In 2002 the CFP was reviewed and new rules on conservation and sustainable exploitation of fishery resources came into force on 1 January 2003. These rules aim at achieving a reduction in fishing effort, a reduction of the fishing fleet, actions to prevent illegal fishing and discards, etc. This reform was regarded as necessary because several fish stocks are considered to be below safe biological levels. The integration of environmental considerations into the CFP is based on the following guiding principles:

- The CFP should help achieve environmental policy objectives, without prejudice to the social and economic objectives of the European Union.
- The CFP should be based on the principles of precaution, prevention, rectification at source and the polluter-pays-principle.

- To the extent permitted by scientific knowledge, the CFP should aim to implement an ecosystem-based approach.
- The European Union should maintain the same level of commitment to these principles in its own fisheries management decisions and at the international level (European Commission, 2004).

However, it is not only international agreements within the CFP that affect catches and policies in Swedish fisheries. Swedish fisheries are also influenced by other international agreements, such as those which govern the activities of the International Baltic Sea Fishery Commission (IBSFC), North East Atlantic Fisheries Commission (NEAFC), International Council for the Exploitation of the Seas (ICES), North Atlantic Salmon Conservation Organisation (NASCO), the Helsinki Commission (HELCOM), United Nations Food and Agriculture Organisation (FAO), World Trade Organisation (WTO), Organisation for Economic Co-operation and Development (OECD), and other agreements with neighbouring countries and partners (Fiskeriverket, 2004; OECD, 1996:195).

The National Board of Fisheries (*Fiskeriverket* in Swedish) is the central governmental agency working with fisheries and fish conservation in Sweden. The Board seeks to promote a responsible use of fish resources and, accordingly, for the purpose of maintaining an abundant and diversified fish stock. Other important tasks are to contribute to the development of an efficient fishing industry, including aquaculture, but also to provide increased fishing opportunities for the public and, furthermore, to ensure the supply of good-quality fish to the consumer.[25] Research carried out by the Board of Fisheries provides the scientific basis for the preservation and exploitation of all commercial fish resources (SOU 1998:24 p. 106ff). The Swedish Coast Guard (*Kustbevakningen* in Swedish) and a control branch of the National Board of Fisheries carry out most of the monitoring and enforcement of Swedish fisheries. Four areas are controlled:

- Omission of reporting catch and landings.

[25] The Board of Fisheries falls under the jurisdiction of the Swedish Ministry of Agriculture and is headed by a Director General, who also chairs the Board of Directors.

- Landings of protected stocks.
- Fishing without license.
- Misreported catch areas.

Violations of the first two areas of concern are detected by follow-up of log books and sales data, while the other two are controlled by the Coast Guard, which performs sea inspections and landings controls. From January 2004, vessels over 18 metres long are surveyed by radar and a satellite navigation system (VMS) while before 2004, only vessels over 24 metres long were surveyed (Eggert and Ellegård, 2003:527; Fiskeriverket 2004-04-29). During 2002, the Swedish Coast Guard carried out 341 sea inspections, 1,104 landings controls and 740 quality controls in commercial fisheries. Totally for 2002, the Swedish Coast Guard carried out 19,103 controls of fishing activities, where commercial fisheries accounted for 72 percent and recreational and subsistence fishing accounted for 28 percent (Kustbevakningen, 2003).

It is not only the EU and the National Board of Fisheries that have responsibilities in the administration and design of Swedish fishing policy. The County Administrative Boards, the Fishing Unit of the Ministry of Agriculture, the National Environmental Protection Board, the National Administration of Shipping and Navigation, the National Food Administration, the National Juridical Boards for Public Lands and Funds, the National Board of Trade, and the Swedish Coast Guard, all have additional roles (SOU 1998:24 p. 106ff).

A substantial part of coastal fisheries, as well as fishing in lakes and rivers, are not regulated by the CFP, however. Fishing within 12 nautical miles from the coast is, generally, regulated by national laws, and bleak-roe fishing in Norrbotten, which is mostly performed within the coastal line, falls into this category. The CFP applies to marine waters outside the coastal line, and does not include recreational fishing. However, some CFP-regulated species are caught within 12 nautical miles and, hence, affected by the CFP. As a member of the EU, the overall character of the CFP does affect the design of Sweden’s fishing policy even in these areas. For instance, the EU decides the levels of subsidies paid to commercial fishermen, which naturally

affects the economic prerequisites for commercial fishing in all Swedish waters. Therefore, in practice, the national authorities regulate bleak-roe fishing in Norrbotten under the “CFP umbrella”.

8.3 The new Swedish fishing law

In general, the most common regulation methods in Swedish fisheries are gear restrictions, area closures and seasonal restrictions. The most important regulation measures are an overall TAC (total allowable catch) quota for each commercially important species (not for vendace, however!), minimum landing size, minimum mesh size, requirements for log book reporting, protected areas and by-catch rules (Eggert and Ellegård, 2003:527).

The government design regulations regarding fishing and environmental issues (FIFS, 1995:23, 19 §). The specific authorities responsible for fisheries management and sustainable use of fish resources are the National Board of Fisheries, the Fishing Unit of the Ministry of Agriculture, the Counties Administrative Boards in each County, and the Coast Guard (SOU 1998:24 p. 19, 329). The government’s authority is mostly delegated to the National Board of Fisheries, through the second chapter 7 § of the Regulation of Fishery (ibid:209). Before 1993, the County Administrative Boards had extensive powers to regulate fisheries, but these responsibilities have also been transferred to the National Board of Fisheries. Through a new law in 1994 (1993:787), the responsibility for administering licenses for commercial fishing was passed to the National Board of Fisheries. The aim was to improve management of fish resources in Sweden, to promote sustainable use and, at the same time, to make management more transparent (Ds, 1995:47 p 82). For example, to avoid catches of non-mature vendace, a high priority was given to support the development of more selective trawls (SOU 1998:24 p. 236).

The law was also intended to help the integration of Swedish fishing into the CFP. Nevertheless, the National Board of Fisheries is still responsible for the implementation of the Swedish fishing policy (Sveriges Rikes Lag, 1993:787, and

1994:1716). According to regulation 1996:145, the National Board of Fisheries shall work towards sustainable use of, and biological diversity in, fish resources. The County Administrative Boards shall also work towards sustainable use, together with the development of competitive fishery companies (SOU, 1998:24 p. 107, 241).

In order to regulate commercial fishing, there is a system of licenses and vessel permits, which, as a rule, are required if commercial fishing is to be carried out legally. When the Swedish Parliament passed this law (Act 1993:787), it resulted in a separation of professional and non-professional fisheries for the first time in Sweden. The difference between the categories is the possession of a fishing license. Accordingly, if a person is not in possession of a license, this person is regarded as a non-professional fisherman. Since 1 September 1994, vessels of five metres and over may only be used in professional fisheries if they have been granted a vessel permit (OECD, 1996:195).[26]

In the Gulf of Bothnia, the vendace trawl fishery is regulated by a system of special licenses. To obtain a commercial license, some conditions must be fulfilled, such as the possession of relevant competence and permanent resident ship in Sweden. In addition, fishing must be the main occupation and provide the main income for the applicant, and, finally, there must be commercial and biological space for increased fishing (BB 17:30-32 §). Earlier, the determination of biological space was estimated from a general point of view, and not for a particular species of fish. However, in 2003, the law was changed and nowadays it is possible to grant a license, taking into consideration the specific fishery the candidate intends to perform and, consequently, with considerations to how this additional fishing will affect the resource in question. Since the law was implemented, and until the end of 2003, the National Board of Fisheries has granted 14 new licenses with restrictions on species (Fiskeriverket, 2004:27).

[26] A fishing vessel is defined as “a vessel used in fisheries or the handling of catches or otherwise used to assist the fishing fleet” (OECD, 1996:199). Since 1 January 1995, all Community fishing vessels also need European Community “identity papers” (European Commission, 2004).

Without a fishing license, a person may only use a limited number of gears. As a general rule, hand-tackles can be used and 180 metres of net, as well as up to six cages (OECD, 1996:196). The fishing unit of the County Administrative Board has the right to express its opinion, but not to make any decisions in the process of allotting commercial fishing licenses. According to the National Board of Fisheries, these licenses are necessary because it is assumed that there is no biological or commercial space for increasing landings in Swedish waters (FISF, 1993:19). The purpose of commercial fishing licenses is not only a biological issue; it is also intended to improve the general conditions for commercial and coastal fisheries. The right to limit the use of different kinds of gears for recreational fishing was introduced with the new law in 1994, which, thus, expanded the regulations for recreational fishing (SOU 1993:103 p. 130). The limitation of fishing tackles applies to all kinds of non-commercial fishing (FISF, 1995:23 21 §).

The Coast Guard is responsible for the surveillance of commercial and recreational fishing in coastal waters, including control of tackles and landings (Regulation 1994:1716). Control and analysis of logbooks, landing declarations and sales notes comprise the monitoring procedure for commercial catches and landings. In the harbours, the sorting of catches and their quality are done through random sampling.

8.3.1 Effort controls and quota controls

The method used in regulating many Swedish fisheries is through a, so-called, “effort control”. Fishing effort is the combination of all the inputs into fishing: the number of vessels in the fleet, the dimensions and hold capacity of the vessels, the amount of gear used, the number of fishing days at sea, and so on. Effort controls aim at limiting this total fishing effort (that is, the overall impact of all inputs taken together), which, in turn, should restrict the exploitation rate of the fishing. There is a fundamental difference between effort controls and quota controls. While the latter is an attempt to limit the *output* from the fishery, namely the catch, effort controls seek to limit the

inputs.[27] As a result, effort controls do not directly limit catches, while quotas do not directly limit efforts and exploitation of fish resources. In both cases, there may be indirect effects. With effort control, restrictions are also often placed on *how, when and where* inputs are used (for instance, through closed seasons, closed areas and restrictions on gear use). However, such restrictions can actually lead to increased efforts when fishing is allowed, rather than a reduction in total efforts. The aim of Swedish fishing policy is to make these effort limitations as general as possible (SOU 1993:103). Thus, the action arena is regulated through a method in which the central authority regulates in detail how, when and at what intensity fishing shall be carried out. This also applies to the bleak-roe fishery.

8.3.2 Reactions on the new Swedish fishing law

Before the new fishing law was implemented in 1994, fisheries were regulated on three levels: by the Government, the National Board of Fisheries and the County Administrative Boards. The reason was partly historical. County Administrative Boards had long been issuing local fishing regulations, while the National Board of Fisheries had authority over migratory fish stocks. This structure of "overlapping" regulations and laws was causing uncertainties regarding which law or regulation applied to different situations (Ds 1995:47 p.75).

Before 1994, individual fishing licenses for commercial fishermen were not compulsory. However, a fishing license was a pre-condition for receiving economic assistance through general price supplements, and only licensed fishing vessels were entitled to state aid (loans and grants, for example), as well as permission to fish in foreign fishing zones. This meant that, to a large extent, licenses were a necessary condition for commercial fishermen's economic survival. The price supplement was

[27] Some Swedish fisheries are, however, regulated by output controls through Total Allowable Catches (TACs), which aim to constrain the catch of a particularly species. The system of TACs within the CFP was set up as a means of allocating resources and fishing rights, particularly for migratory fish stocks used by several member states (Oliver in Gray, 1998:68).

abolished on 31 December 1993, and from 1 January 1994, there is, in principle, a free market for fish products in Sweden (OECD, 1996:197).

The aim of the new law was to simplify the former "whirlpool" of regulations. While local regulation by the County Administrative Boards was abolished, this has caused criticism. For example, Hultkrantz (1997) argues that, from a biological point of view, this change was negative, because responsibility and respect for a sustainable use of fish resources have been reduced. Moreover, the National Board had not analysed the consequences of the new law before it was implemented (DS 1997:81, p. 107).

Before 1994, the board of directors at the National Board of Fisheries was composed of representatives from all the groups involved. This composition has since changed: the board now contains only politicians. Still, the result, according to Hultkrantz (1997), has been that the commercial fishermen, through the Fishermen's Federation, have increased their position through politicians who are acting with an eye to regional employment. Thus, policy decisions are made essentially for political reasons, instead of for conservation reasons.

> Within the group of decision-makers, there is a strong consensus on the need to safeguard a viable domestic fishery industry giving policy a strong flavour of mercantilism [….] and weak political guidance is given to the authorities when it comes to resource conservation policy (Ds 1997:81 p. 189, own translation).

Opinions differ, however. The new regulation is also said to have caused antagonism between authorities and fishermen. Many coastal fishermen consider their freedom as having been restricted by the administrators; that fishermen's knowledge is ignored; and that the authorities exclude fishermen from participation in decision-making (Carlberg, 2004:10). It is a central assumption in democratic theory that groups directly affected by government decisions should have "a say" in making them. It is also a central assumption in the "design principles" presented in Chapter 5. If the criticism is accurate, it could be that both commercial and recreational fishermen will lose confidence in the management system, and that they will feel little moral compunction in breaking fishing regulations.

To sum up; for a long period of time, Swedish fisheries have been extensively regulated by the state with a "classical" top-down management approach, and, whatever the indirect effects, it is clear that the National Board of Fisheries has strengthened its power over fishery regulations, and that the politicians have strengthened their influence over the National Board of Fisheries. Thus, formal political power over fish resources has been strengthened and the decision-making process has been centralised as a result of the new law. The ecological conditions for the Baltic Sea and the Gulf of Bothnia are described in the next section.

8.4 Ecological and environmental conditions for the vendace resource

The Baltic Sea (i.e., the Baltic Sea proper; the Gulf of Finland; the Gulf of Riga; the Bothnian Sea; the Gulf of Bothnia; and the Bothnian Bay) is the largest brackish water area in the world.

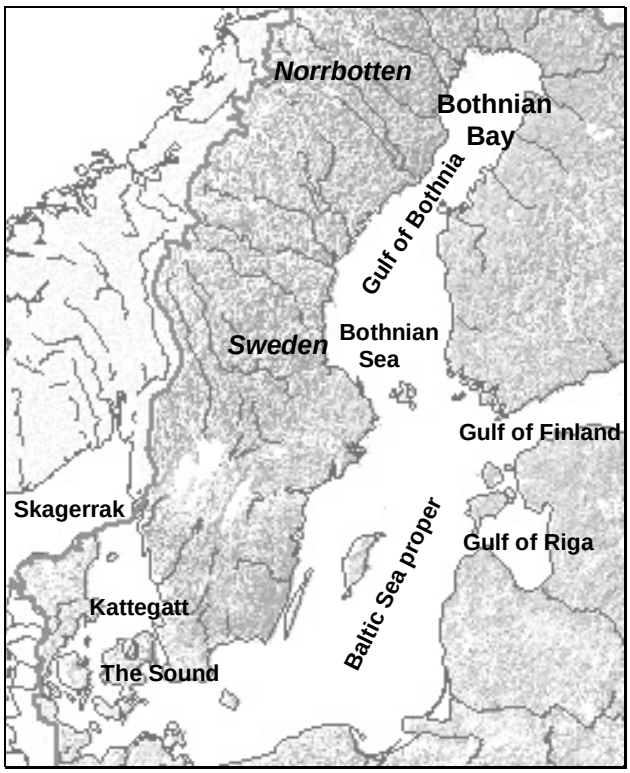

Figure 7. *The area of the Baltic Sea is the largest brackish water area in the world. The Swedish coast is more than 2,000 km long* (ICES, 2003).

More than 200 large rivers bring fresh water in to the Baltic. The Baltic marine area has a surface area of 415,000 km² and a volume of 22,000 km³. The total catchment area is over 1.7 million km³ and the population living in this catchment area consist of nearly 85 million people. The Baltic is almost totally sheltered by land and is connected to the North Sea by the narrow and shallow straits between Denmark and Sweden. The average depth of the Baltic Sea is 56 metres, with a maximum depth of 459 metres in the Landsort Deep (ICES, 2003).

The Baltic Sea is both very old and very young. It is a depression in three billion-year old primary bedrock and is also a creation of the last glacial period about 12,000 to 14,000 years ago. Land pressed down by the ice is still rising from the sea and in the Bothnian Bay, the land elevation is almost one metre per century. The process of land elevation in the northern parts of the Baltic creates constantly changing coastal environments, not to be found anywhere else in the world. It is an ecologically young sea area with comparatively few species and with relatively simple food webs. However, species succeeding in colonising the Baltic are often quite large in numbers – i.e., many individuals (Stockholm Marine Research Centre, 1998).

Environmental problems, in the Baltic Sea and coastal areas of the Gulf of Bothnia, are principally caused by overfeeding from agriculture and industry; environmental pollution; and over-fishing (Finfo 2003:5, p. 6). This is a combination of natural, unfavourable conditions (e.g., discharge of freshwater, etc.) and the continuous pressure of pollution and overexploitation. In coastal areas, the number of actors is high and activities that can affect fish stocks are many, for example, land-use, agriculture, forestry, transportation, industry and recreation (Finfo 2002:9 p. 4.). This can cause input of nutrients, leading to oxygen depletion in bottom waters, as well as pollution with persistent organic substances and metals, which, in turn, can cause habitat destruction and other threats to biodiversity.

Commercial fishing activities can affect ecosystems in many different ways. Fishing causes mortality of target species and also by-catches of fish and other animals. The fishery of one particular species for consumption can result in discards,

either due to regulations (undersized fish or a full quota), or because there is no market for the fish. In areas that are intensively trawled, such as the coastline in Norrbotten, fishing causes an impact on organisms in and on the bottom as the gears are towed (Olsson, 1997:16f.).

As displayed in Figure 7, the Swedish coast is more than 2,000 km long and runs from the Torne River at the Finnish border in the north, to the Ide Fjord at the Norwegian border in the west. This very long coastal line provides great variations in the marine physical and chemical environment. The salinity decreases from south to north. In the Bothnian Bay, which is the northern part of the Gulf of Bothnia, the water has a salinity of no more than 2–3 ‰, owing to the input of fresh water from the major rivers. Near the coast, the salinity may be even lower. To the south, the salinity of the surface water gradually increases. Even more saline and, hence, heavier water flows through the Belts from Kattegatt and settles in the deepest parts of the Baltic. The yearly variations in salinity are largest in the southern part of the Baltic Sea where currents transport saline water from the Kattegatt and the Skagerrak. This boundary layer divides the lighter water nearer the surface from the deeper water, which, in the far south, at least, can have a salinity of up to 10-15‰, or occasionally, even higher. On the west coast, this deeper water has a salinity of 32-34‰, not much short of the roughly 35‰ found in the open oceans (Finfo 2002:9; Olsson, 1997:11f.).

These variations in salinity have the effect that the number of marine species decreases from south to north. Virtually only freshwater species (like vendace) are to be found in the northern part of the Gulf of Bothnia. For many species, it is a life in a “border zone” with conditions that provide either too low or too high salinity. In many of the coastal and archipelago waters of the Baltic, the fish fauna consists, at least partly, of freshwater species. Pike is one example. Conversely, certain salt water species can withstand brackish water. Herring alone is responsible for some 40 percent of the total fish biomass of the Baltic, with cod and sprat together accounting for another 40 percent. However, even though the fish species can tolerate differences in salinity quite well as adults, the fertilisation phase is usually more sensitive and has

much narrower tolerance limits – thus, the environmental conditions needed for reproduction are the most limiting for the geographic distribution of the Baltic fish species (Finfo 2002:9 p. 5; Olsson, 1997:11f.).

Due to the warm summers of recent years, high discharges of freshwater have led to decreases in salinity in the Bothnian Sea and Bay. During 2002, the discharge of freshwater was slightly lower than normal. Despite this, salinity was still lower than normal. These changes in salinity have probably caused changes in plankton production (Umeå Marina Forskningscentrum, 2002).

Thus, some plankton productions have increased and some have decreased which, in turn, will affect the food supply for different fish resources. The distribution of fish is also affected by temperature. It is perhaps the most important factor, as fish seek temperatures optimal for growth. Species needing warm water, such as the perch families, are found mainly in shallow inshore waters, while cold-water fish, such as cod, remain at a distance from the coast. Seasonal variations in temperature are large, compared with those in oceans. The variation in surface temperature between summer and winter is quite substantial; it can differ 14°C and in the archipelagos more than 20°C between summer and winter. The Bothnian Bay is normally covered by ice during several months every year (Finfo 2002:9 p. 5).

However, the warm weather during the last few summers has led to extremely high surface temperatures in the water. For example in 2002, the surface temperature in the Bothnian Sea was 6°C higher than average (Umeå Marina Forskningscentrum, 2002). How this is affecting the vendace resource is still unknown, however.

8.5 The ecological and environmental conditions 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 metre thick) and the growth season is shorter. The growth season is less than half as long as in southern parts of the Baltic Sea.

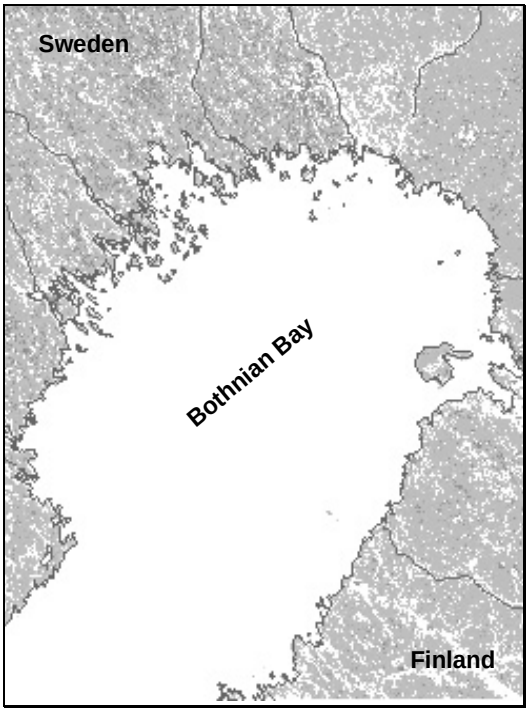

Figure 8. *The Bothnian Bay*

The large rivers in the area are providing the Bay with considerable amounts of fresh water and this inflow is sufficient to replace the entire water volume in about 15 years. Since there are considerable water transports from the Bothnian Sea into the Bothnian Bay, the actual retention period is only about five years and this explains the high oxygen concentrations and rapid changes in salinity. Thus, the biological production is quite low, compared to southern parts of the Baltic Sea. Most of the pollution load originates from industrial plants, population centres and rivers flowing into the Bay (North Sweden, 2004).

Many of the organisms in the Bay live close to their limit of tolerance with respect to salinity and temperature, for example, the production of large bottom-living algae is about half of that in the Bothnian Sea. Due to the low salinity, there are no mussels in the Bay and macroscopic bottom-dwelling animal species are far lower than in the rest of the Baltic Sea. This is also valid for marine fish species. Cold water species, like vendace (*Coregonus albula*), Baltic herring (*Clupea harengus*), and whitefish (*Coregonus lavaretus*), dominate in the Bothnian Bay. Warm water species, like perch (*Perca fluviatilis*) and roach (*Rutilus rutilus*), increase in importance

towards the south (North Sweden, 2004). Commercial fishing in the Gulf of Bothnia is, for the most part, based 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 nearby shore spawning areas, mainly situated on the Swedish side of the Bothnian Bay, where the fishing also is most extensive. According to the National Board of Fisheries, the vendace population probably consists of several populations and the spawning areas are, due to advantageous topographic circumstances, situated on the Swedish side of the Bay. However, official authorities are unsure whether vendace consists of one or several populations; they often use the expression that vendace "most likely" consists of several populations (Thoresson et al., 2001; Fiskeriverket, 2001; Finfo 2002:9).

According to officials at the National Board's of Fisheries 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 are needed.[28] A majority of the trawl fishermen (approximately 64 percent) believes that it is one population of vendace in the coastal areas of Norrbotten. The trawl fishermen are also quite determined regarding the location of spawning areas for vendace (see Appendix). With reference to the previous chapters in this thesis, "local knowledge" may have an important role to play in these issues, and, this will be discussed in a subsequent chapter of this thesis.

The migration distances are typically less than 90 km. After spawning, vendace passes the winter in the inner archipelago where it stays during spring and early summer. During the summer, vendace migrates to outer islands and to the sea. 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 until three years of age, the growth is best in the northern and southern parts of the coastal areas in Norrbotten, but the causes for this are not investigated. After two seasons, vendace is

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

usually sexually mature. It is an effective plankton feeder and has an advantage in relation to, for example, herring, because it also consumes not fully developed plankton (Thoresson et al., 2001; Finfo 2002:9).

One factor of the marine ecosystems in the Bay that has become increasingly important during the last few years is the boost in grey seal population. An adult male grey seal can weigh over 300 kg and causes major damage to fishing tackles, particularly to 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 is 10,000 seals, they will consume 20,000 tons of fish per year (Fiskeriverket, 2001:115). Since 1990 and until 2002, the average growth rate of the grey seal population along the Swedish Baltic coastline was 8.7 percent per year, and in the Bothnian Bay it is increasing by approximately 11 percent per year. In 2002, there were around 1,700 grey seals in the Bothnian Bay. Totally in the Baltic Sea, an inventory in 2002 concluded that there were roughly 13,000 grey seals (Helander and Karlsson, 2002:24). How seals affect specific stocks is unknown, however.

Chemical contamination is a problem restricting consumption of Baltic fish. For example, effluents from pulp and paper mills continue to have negative influences on fish reproduction and recruitment. Another example is dioxins, which are a group of highly toxic substances that affect reproduction and immune defence in fish. High concentrations of dioxins are found in fish with naturally 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 while a Swedish hen is not allowed to feed from, for example, Baltic herring, a Swedish inhabitant can still eat herring for dinner. Since the 1980s, no further decrease in dioxin 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).

A positive environmental aspect is that, contrary to the last ten-year period, with decreasing concentrations of oxygen levels in the Baltic Sea and Bay, the levels increased during 2002 and reached the same levels as in 1993. The discharge of

freshwater into the Gulf of Bothnia has been higher than average during the last few years and a freshening of the Bothnian Bay has occurred. This affects the plankton productivity positively which, in turn, will affect the food supply for fish stocks positively (Umeå Marina Forskningscentrum, 2001 and 2002).

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 both small-scale and large-scale ecological and environmental changes. There is also a great deal of uncertainty regarding the vendace resource – e.g., where the spawning areas are located, if it is one or several local populations of vendace, how the increase in seal population affects the vendace, and how different environmental problems are affecting the resource. These uncertainties put great demands on the institutional arrangement that governs a coastal resource like vendace.

In the next chapter, the negative development in the vendace arena, that caused the earlier mentioned crisis, is analysed. To what extent has, or has not, the bleak-roe fishery been managed in a sustainable way?

9 Top-down governing of bleak-roe fishing

As has been emphasised in Chapters 1 and 2, compared to many other state-regulated fisheries, the conditions for succeeding in regulating bleak-roe fishing are quite favourable, but, even so, the result was a resource crisis in the late 1990s. In one way or another, the institutional arrangement obviously produced incentives for fishermen to harvest the resource in an unsustainable manner. What are the mechanisms behind this failure? This chapter contains a presentation of the development in bleak-roe fishing from the beginning of the 1960s, when trawling for vendace started, until the recent crisis in the social-ecological system, leading to new management strategies in the year 2000.

9.1 Conditions for trawling

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 (Figure 9).

Figure 9. *The catching area for vendace*

Due to the economic value, this fishery aims almost exclusively at producing bleak-roe. The amount of roe is less than five percent of landed weight and only a small portion of the fish meat is used for human consumption. After the extraction of roe, the major part of the landed fish is used as animal food, or is simply, disposed of. Commercial fishermen 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. A fisherman gets approximately SEK 550 per kg bleak-roe (in 2003).

In the Bothnian Bay, fishing with trawl is allowed within two sectors, one outer area, outside the baseline (four 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 the end of September to the end of October. The fishing season is normally restricted to the period from September 20th to October 31st (FISF, 1993:31, Chapter 4:8-9 §). 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 in shallow waters; e.g., the mean depth in Luleå archipelago is no more than nine metres. No trawl fishing is allowed on private waters or within 400 metres of the shoreline – this also includes the shoreline of 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 engaged in this fishery to obtain *trawling licenses*. These are approved by the National Board of Fisheries, and after the County Administrative Board have expressed their opinion. Trawling licenses are valid for a maximum of three years. It is also obligatory with a commercial *fishing license,* which is valid for a maximum of five years before it has to be renewed. Withdrawal or non-renewal of a license can be considered if the fisherman breaks the laws (Ds, 1998:2 p. 22f). Additionally, all boats with a length over five metres and used in commercial fishing need a *vessel permit*. In 2003, changes in the Law resulted in a stiffening of penalties for violations. It is also possible for the National Board of Fisheries to withdraw commercial licenses and vessel permits for a limited period of time (Fiskeriverket,

2004). To summarise: to fish vendace with a trawler, a fisherman needs a trawling license, a commercial license, and a vessel permit.

Bottom trawling in pairs is the prevailing catch method used by commercial fishermen. Two trawlers form 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 metres are allowed to participate in bleak-roe fishing. Most of the trawlers have a maximum length of 12 metres and are, thus, regarded as small-scale coastal vessels (Thoresson, 2002; Thoresson et al., 2001; Fiskeriverket, 2003).

Small-scale fishing with seines is also performed in the Kalix and Haparanda archipelagos during the winter. This fishery has, however, decreased substantially during the last decades, due to a reduced demand for vendace as a food resource. Earlier, there was a demand for Swedish vendace in Finland, but increasing catches in Finnish lakes has resulted in a decreasing demand for vendace caught on the Swedish side of the Bay. Today, approximately three “teams” (thus, six commercial fishermen) perform this winter fishery. In the past, trawl fishing of vendace was allowed also in the spring, but nowadays it is prohibited, due to decreasing catches and resource scarcity. One reason for this prohibition is to protect the more valuable bleak-roe fishery. Also “off-season” trawling in late autumn (after bleak-roe fishing) was permitted earlier, but is now forbidden.

9.2 A downward trend in the ecological system

In the first half of last century – when cotton nets, hoop nets and seines were 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. When the trawl fishery for vendace started at an experimental stage in 1960, a large increase in catch effectiveness took place. Obviously, the new method was quite a success. As shown in Figure 10, catches increased considerably in the 1960s as the

number of trawl groups expanded. From the mid-1970s to the mid-1980s, catches were between 600 and 800 tons per year.

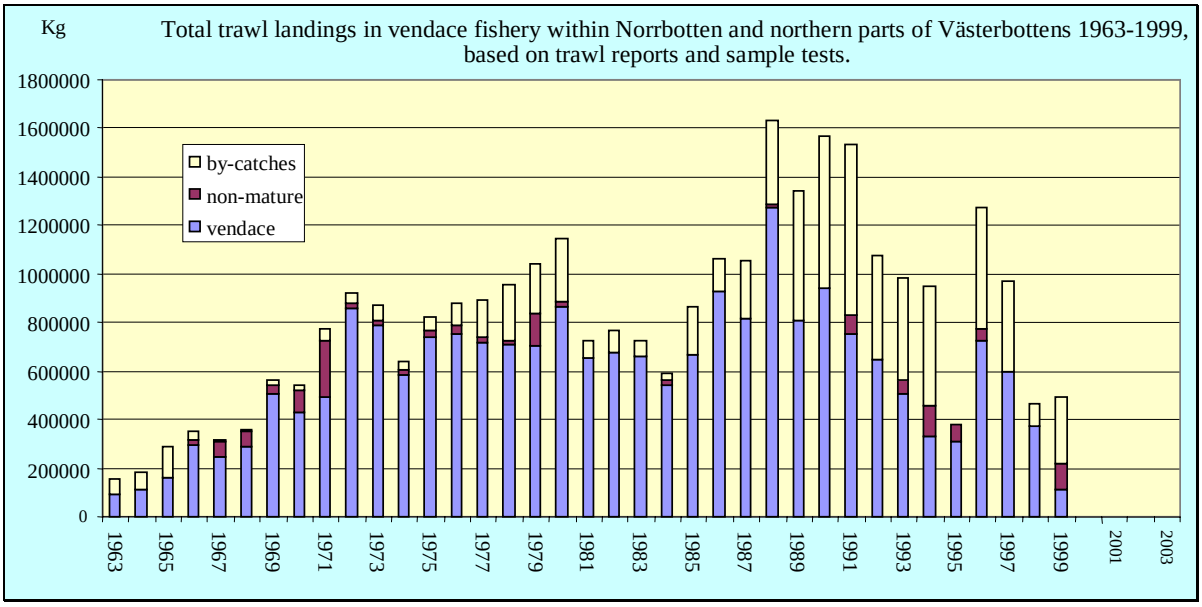

Figure 10. *Total trawl landings in vendace fishery 1963-1999.*[29]

In the late 1980s and the early 1990s, catches increased to approximately 1,000 tons per year, but in 1991, catches started to decrease. The overall downward trend continued during the 1990s and the total landing of vendace in 1999 was only 237 tons. Governmental authorities were, and still are, 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 fishermen were of another opinion, however. When the fishermen were asked how they had come to this conclusion (see Appendix, question no. 24), they referred to stories that they had heard from their ancestors, e.g., that also 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. Table 1 shows the most common answers to this question.

[29] The diagram is 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 provided by the National Board of Fisheries Research Office in Luleå 2004-04-15).

Table 1. *The trawl fishermen's view of the impact of trawling on the vendace resource* (see Appendix).

24. Do you believe that the decrease in the stock of vendace during the 1990s is a result of a too high fishing pressure? If not; what is the cause of the resource crisis?	•**Yes**: 0 •**Yes, in combination with unsuccessful spawning**: 12 = 38.7 % •**No**: 19 = 61.3 % *Comments:* •Unsuccessful spawning: 19. •Unsuccessful spawning dependent on natural conditions (e.g., water temperature, salinity levels, autumn storms, etc.): 11. •Unsuccessful spawning dependent on natural conditions and pollution of the environment: 5.

All fishermen interviewed believed that the main causes for the decline were unsuccessful spawning during several years and natural fluctuations; approximately 40 percent believed that these facts, in combination with fishing pressure, had caused the decline. Consequently, the majority were of the opinion that fishing pressure did not affect the stock at all and that spawning, natural fluctuations and a combination of other factors (e.g., water temperature, salinity and autumn storms) had caused the decrease in the stock.

On the other side of the Bothnian Bay, i.e., Finland, the trawl fishery for vendace started in the late 1960s and led to significant increases in catches. Contrary to the fishermen on the Swedish side of the Bay, the Finnish trawl fishermen used, so called, midwater trawls. The catches continued to increase until the mid-1970s (approximately 800 tons), when they began to fall dramatically. By the time the catches started to decrease, as many as roughly 100 trawl vessels participated in the Finnish vendace fishery. Since the beginning of the 1980s, virtually no regular trawl fishery for vendace has been performed on the Finnish side of the Bay. In the year 2000, it was estimated that total Finnish catches of vendace in the sea (including recreational and subsistence fishing), was 100 tons (Thoresson 2002; Thoresson et al., 2001).

In 1973, the total stock (total biomass) of vendace was estimated of about 12,000 tons (Thoresson, 2002). Throughout the 1970s, the total stock volume

decreased and was approximately 5,000 tons at the end of the decade. As shown in Figure 11, no sample tests and no estimation of the population were done in the 1980s and, consequently, no data is available for the 1980s.

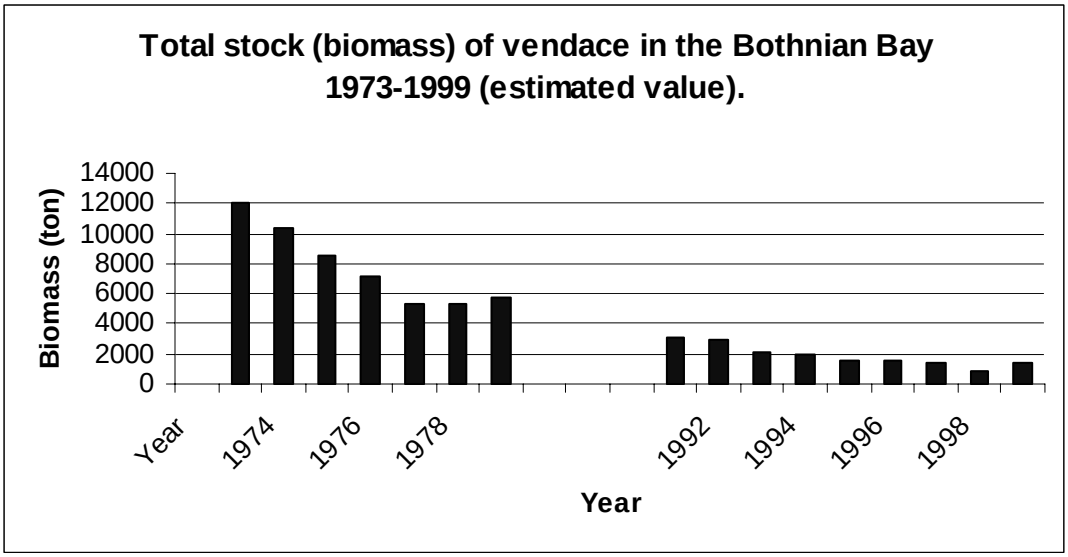

Figure 11. *Estimated value of the total stock of vendace in the Bothnian Bay 1973-1999* (data provided by The National Board of Fisheries Institute of Coastal Research 2002, by Hasselborg 2004-04-15).

According to the National Board of Fisheries Institute of Coastal Research, the validity of the earlier data (1970s) is not as high as the latter (1990s), but the available figures clearly illustrate the overall trend (ibid). Thus, it is safe to assume that the downward trend continued, due to the smaller stocks at the beginning of the 1990s. During this time, catch levels were still high; however, having the effect that the total stock had been reduced by over 50 percent to approximately 3,000 tons. This downward trend continued, and while the stock was 2,100 tons in 1992, it was reduced to 1,300 tons in 1996. In 1998, the total stock had been reduced to less than 1,000 tons. In 1999, there was a small increase to a total biomass of 1,400 tons. However, compared to the figures in the early 1970s, this was a rather insignificant increase.

On top of this change in volume, the mean age of the stock had also decreased significantly. The trend has been that an increased proportion of the total stocks being

landed each year. This has led to an erosion of the quantities of mature fish, and affects the spawning biomass (i.e., the mature part of the stock) in a negative way. Since the late 1990s, a large share of the vendace catch has consisted of young individuals, for example, in 1999, as much as 31 percent of the catches (in weight) were juveniles born the same year. Nowadays, vendace older than seven years and larger than 20 cm is unusual (Thoresson et al., 2001). To reduce the number of undersized and non-mature vendace that are ensnared in the trawls, in 2000, it was decided that nets must have bigger mesh on the trawls for bleak-roe fishing.

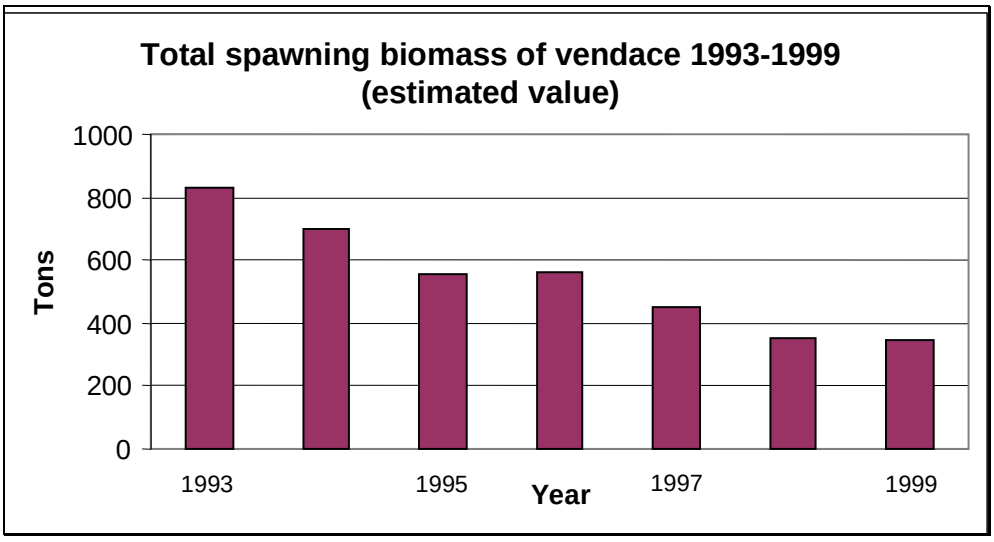

Figure 12. *Total spawning biomass of vendace during 1993-1999* (Source: Hasselborg et al., 2001).

The spawning biomass, consequently, has been reduced considerably during this period. As illustrated in Figure 12, the "all-time low" was in 1999, when the total spawning biomass of vendace was down to 347 tons (Fiskeriverket, 2001; Thoresson et al., 2001).

9.3 The development and conditions for commercial fishermen

The number of commercial fishermen holding trawl permits has varied over the decades. In 1963, there were 22 trawl-teams (44 trawlers) participating in bleak-roe fishing. As shown in Figure 13, the number increased throughout the 1960s, and reached a peak in the 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 was 34 in 1992 and only 19 in 1999.

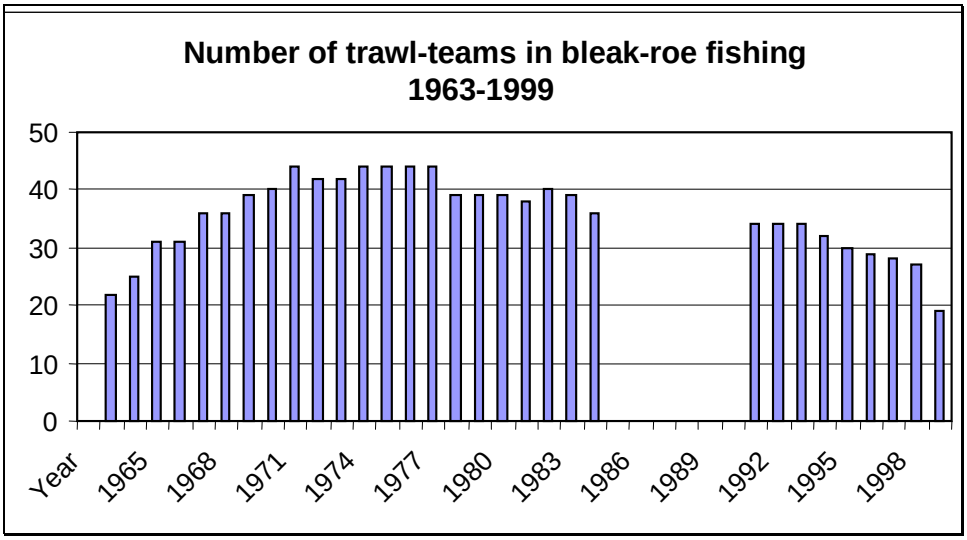

Figure 13. *The* n*umber of trawl-teams that has participated in bleak-roe fishing during 1963-1999* (Source: Hasselborg 2004-04-15).[30]

Thus, to deal with the large decline in the vendace resource, the National Board of Fisheries has obviously 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, fishing authorities and others calculate with an increase in efficiency of two 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 – i.e., no quotas are used and, thus, all increases in efficiency affect each vessel's capacity to catch more vendace.

Commercial fishermen can obtain financial aid within the framework of the EU system of structural support. During the time period from 1995 to 1999, commercial fishermen could obtain financial aid for measures within the limits of Structural Funds 5a and 6, and from the Community "PESCA" initiative, which

[30] Please note that one trawl-team consists of two trawlers – e.g., in 1999 there were 19 trawl-teams that consisted of 38 trawlers.

aimed at contributing to the maintenance and creation of employment in coastal areas. The Kalix and Haparanda archipelago was covered by "Objective six" of the structural funds because of their low population density (less than eight inhabitants/km²). Additionally, an initiative to improve the conditions for small-scale coastal fishing was implemented by the parliament in 1996-1997 and, in the next program period 2000-2006, a similar assistance is to be found as a support for the fishing industry and for "Objective one" regions in Sweden – i.e., the southern forest counties and the northern parts of Sweden (Fiskeriverket, 2001; SOU, 1998:24 p. 143).[31] Financial aid can be granted, for example, for the purchase of new vessels, modernisation of vessels, scrapping of vessels and for investments in fish processing industries. Accomplishment of structural programs is done by the National Board of Fisheries, in consultation with the County Administrative Boards, and the administration for Objective one regions (Fiskeriverket, 2004).

The amount of financial support has risen considerably since Sweden joined the EU (Gustavsson, 1997:7; SOU 1999:3 p. 27). For example, state-financed expenditure on fisheries has tripled and fishing expenditures in the Swedish national budget have increased by 80 percent (Ds, 1997:81 p. 21). To a large extent, commercial fishermen in Objective one regions (i.e., north Sweden) have not used this opportunity for structural support and financial aid (Fiskeriverket, 2004). According to some of the fishermen in Norrbotten, it is a complicated and bureaucratic process and as a self-employed fisherman "you do not have the time or skills to succeed with an application" (Fisherman, no. 11), and "the support from authorities in these issues is non-existent" (Fisherman, no. 28).

The amount of support for small-scale coastal fisheries is difficult to calculate. However, it is possible to establish the fact that of the total support to the fishing fleet, 90 percent went to vessels with a length of over 12 metres. Subsidies are also given through unemployment insurance, which in the case of fishing, to a large

[31]For these Objective six regions, the rate of financial support from the various structural funds is the same as for Objective one regions, which are characterised by gross domestic product (GDP) that is less than 75 percent of the Community average.

degree, is an “off-season” subsidy. Finally, commercial fishermen 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 fishermen. Swedish fishing companies have also VAT payment exemption (European Commission, 2001).

9.4 The development and conditions for recreational fishermen

As has been mentioned, there are both commercial and recreational fishermen in the vendace arena. Recreational fishermen are allowed to use six nets, with a total length of 180 metres, intensity of use is, thus, regulated through effort limitation. Due to the absence of quotas or other output limitations, both recreational and commercial fishermen can adopt a maximising strategy.

The new fishing law (1993), which restricted the number of gears for recreational fishermen, resulted in a significant 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 fishermen are destroyed by the seals, which also frighten away the fish from gears. This is confirmed in discussions with the trawl fishermen, who also have huge problems with seals, as they use fixed gears in their salmon and whitefish fisheries. While the commercial fishermen struggle to fill their trawls, it seems that recreational fishermen are more willing to withdraw from fishing in times of declining catches. In discussions with some recreational fishermen 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). As displayed in Table 2, this view was confirmed in interviews with commercial fishermen in 2003 and 2004. They expressed the opinion that recreational fishermen only participate when they have the chance to get plenty of fish and “make money” from the fishery.

Table 2. *Trawl fishermen's view of recreational fishing* (see Appendix).

21. Is recreational bleak-roe fishing affecting the supply of vendace?	•**Yes**: 3 = 9.7 % *Comments:* All fishing affects the supply, but the extent of recreational bleak-roe fishing today is harmless: 3 •**No**: 28 = 90.3 % *Comments:* •Earlier, it did affect, but not today: 3 •The boost in grey seal population has made it almost impossible for recreational fishing: 10
22. Is recreational bleak-roe fishing affecting commercial fishing? If it does, how?	•**Yes:** 5 = 16.1 % *Comments:* •If they sell bleak-roe too cheap or if the quality of the roe is bad, it can affect the market negatively: 4 •**No**: 26 = 83.9 %
23. Do recreational bleak-roe fishermen change their behaviour in times of resource scarcity? If they do, how; by "reducing their effort", "increasing their effort" or continuing "as usual"?	•**Increasing their effort**: 2 = 6.4 % *Comments* •If they want to earn money by selling the roe they must increase their effort: 2 •**Reducing their effort**: 29 = 93.5 % *Comments:* •"The seal problem": 25 •They quit: 23 •It is only "old" people who are still fishing: 5 •Even now, when the resource have recovered, recreational fishermen have not returned: 5 •The young recreational fishermen have quit: 3 •Some will probably return now, due to the good catches last few years: 5 •**Continuing as usual**: 0

Almost all trawl fishermen interviewed (approximately 93 percent), are of the opinion that a major part of recreational fishermen quit fishing in bad times. Many also express the opinion that the large recreational/subsistence bleak-roe fishery that took place in the 1970s and 1980s, probably never will come back. Nowadays, "it is a few old men who participate in bleak-roe fishing and the younger generation is not willing to take over" (Fisherman, no. 19).

A huge majority, 90 percent of the trawl fishermen, is of the opinion that recreational catches have not affected the stock of vendace at all. Over 80 percent of them think that recreational fishing for vendace has not affected the trawl fishery in any way. Instead, the very reduction of recreational fishermen is considered a problem for some of the interviewed, because they used to recruit new commercial

fishermen from that group. It should be noted, however, that some fishermen are of the opinion that when the recreational fishery was at its maximum, there were problems in the bays with trawlers driving across gears, etc. According to some of the interviewed, the recreational fishermen could earn a lot of money during this time by selling the roe on the "black market" (Fishermen, no. 8, 10, 12, 14, 17, 18, 19, 22).

Almost all official catch statistics are based on information from commercial fishing, and this makes it very difficult to estimate the size and the extent of recreational bleak-roe fishing. In a study commissioned by the National Board of Fisheries, and carried out by Statistics Sweden in 2000, the total catch of all types of fish in the sea by recreational fishermen amounted to 34,500 tons per year (Finfo 2000:1). In all Swedish waters, it was estimated in 1995, that recreational and subsistence fishing amounted to approximately 79,000 tons, compared to approximately 398,000 tons for commercial fishing, which puts almost 17 percent of the total Swedish catches outside the National Board of Fisheries' stock assessments (SOU, 1998:24; Regeringens proposition 1997/98).

The picture is another for bleak-roe fishing. Also the officials are of the opinion that recreational/subsistence 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 the year 2000, it was down to approximately five percent (Sandström, 2000). According to the National Board of Fisheries Research Office in Luleå, the trend has continued over the last few years (Hasselborg 2003-08-28).

9.5 Attitudes towards regulations

In 1999, many commercial fishermen were worried that the pressure on the resource had been too hard, and that bleak-roe fishing had been pushed, unsustainably, over the regeneration rate (NK 1997-10-03; 1999-09-30; NSD 1999-09-30).[32] There was also criticism of the bureaucratic system and its comprehensive regulations. In a local

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

newspaper, a commercial fisherman described the regulations and the bureaucracy as "a confiscation of his natural right to fish" (NK 1998-07-16). Another commercial fisherman questioned the transfer of decision-making from the County Administrative Board to the National Board of Fisheries in Gothenburg (in 1993). According to the fisherman, 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 1999-09-30). 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 have catastrophic consequences for the long-term survival of the vendace resource (NK 99-09-30). Another commercial fisherman 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 than we are in bleak-roe fishing remaining an option in the future" (NSD 99-09-30).

According to the trawl fishermen interviewed in 2003 and 2004, the management system in the 1990s was slow and bureaucratic with conflicts and antagonism between fishermen and officials.

Table 3. *The trawl fishermen's opinion about the conflict situation with the authorities* (see Appendix).

12. Has there been any conflicts between fishermen and authorities in bleak-roe fishing? If it has, can you give any examples?	•**Yes**: 28 = 90.3 % *Comments:* •The authorities do not have the right competence and make wrong decisions: 18 •Authorities do not listen to the fishermen's knowledge: 16 •The authorities are slow and bureaucratic: 8 •**No**: 3 = 9.7 %

As shown in Table 3, as much as 90 percent were of the opinion that there had been a great deal of conflicts over the years. One of the interviewed puts it in the following way; "whatever they did [the authorities] we complained" (Fisherman, no. 17).

Another fisherman expresses the shortcomings of management as follows; “the management system has not been flexible enough; the nature of fish resources sometimes makes it necessary to have quick decisions and actions which, certainly, has not been the characteristic of bleak-roe management” (Fisherman, no. 19). Some of the respondents are of the opinion that there always tended to be a delay of a couple of years in regulations which, for example, had resulted in restrictions when it was plenty of fish. “How can we respect such a management” (Fisherman, no. 29). Others expressed a similar opinion; “when the Board decides there will either be a total stop in fishing, or free fishing, and both alternatives are equality insane” (Fisherman, no. 12).

This mistrust for the institutional arrangement that governs bleak-roe fishing in the 1990s sometimes resulted in distrust for regulations. For example, the inclination for rule compliance was weak, and, if a trawl-team broke the rules by trawling in closed areas, the other fishermen did not bother about it; “it was a matter between the involved trawl-team and the authorities”, as one fisherman expressed it (Fisherman, no. 28).

One of the main reasons for the distrust between fishermen and officials was that, according to the fishermen, authorities ignored the local knowledge and did not listen to the fishermen’s opinion; “the knowledge among fishermen is considerably higher than academic researchers’ knowledge and there should be co-operation between fishermen and biologists” (Fisherman, no. 7).

Hence, a situation had been created in the 1990s, where many commercial fishermen did not have confidence in regulations, and, if some trawl-team violated the law, it was often an issue purely between the trawl-team and the authorities. Therefore, it is reasonable to assume that, in this top-down governing system, the strategy in command, thus, was to “run for the fish and to catch as much as possible”. Even though its impact might have been significant until the mid-1990s, there have been no surveys of recreational bleak-roe fishing in Norrbotten. However, an investigation into recreational fishing in the Stockholm archipelago found that 19 out of 20 fishermen were using illegal nets (Ds, 1997:81 p. 83). If a similar situation

prevailed in Norrbotten during the last century, the survival of the vendace resource could have been in even greater jeopardy. If that was the case, recreational fishermen would seem to have the ability to maximise their catches with a large number of nets and with only a small risk of being "caught red-handed". Moreover, if they carried out a "semi-professional" fishery for making money during this time, their catches could have been contributing to the drastic decline in the resource stock from the beginning of the 1970s and onwards.

The fact that there was, and still is, considerable fishing beyond what the official catch statistics indicate is well known (SOU, 1998:24; SOU, 1993:103; Andersson, 1998; Thoresson and Sandström, 1997; Ds, 1997:81). This "external fishery" includes recreational fishing and, probably, a significant "black market" in fish products. In one investigation, the researchers came to the conclusion that 40 percent of commercial fishermen had an average taxable income of less than SEK 5,500 per month during 1992, while the average income for Swedish workers was SEK 13,730 per month (Ds, 1997:81 p. 87). Furthermore, the value added per working hour in Swedish fisheries in 1995 was SEK 84, while the average in the economy was 281 SEK per hour. With this level of income, it is almost impossible to make a living. According to the investigation, the probability is high that the fishermen sell a large amount of their catches on the black market, particularly when it comes to high-value goods like bleak-roe (Ds, 1997:81 p. 28ff, and p. 81). Similarly, the Government's own fishing investigation in 1993 reached the conclusion that a significant fishery, external to the official statistics, existed and that a major part of this fishery was for commercial purposes, which affected the fish stock negatively (SOU, 1993:103 p. 57ff). As described in Chapter 3, the fishermen themselves estimated that 15 percent of total catches are poached. Thus, due to low confidence in regulations, approximately 45,000 tons of fish per year are landed illegally in Swedish waters (Ellegård and Eggert, 2002:9).

As has been shown in this chapter, the complex governing system for vendace was ridden by conflicts between fishermen and authorities, during the 1990s. At the same time, catches and the stock were reduced quite substantially. How did these

facts affect resilience and effectiveness in the vendace system? In the next chapter, the governing system is evaluated and an analysis of the origin of the crisis in the vendace system is done.

10 Resilience and effectiveness in the vendace system; how should the resource crisis be understood?

As has been described in Chapter 1, to successfully govern a fluctuating renewable natural resource, like vendace, the ecological system needs to have a sufficient amount of ecological resilience. To match this, the governing system (i.e., the social system) should be adaptive and have transformable capacities – i.e., be in possession of social resilience. The importance of legitimacy for governing institutions among resource users has been discussed in Chapters 3 and 4. To obtain legitimacy for regulations, it was assumed that, in order to support joint collective action in the group of resource users, they should have an influence and be involved in the management of the resource.

10.1 Resilience and effectiveness

The average catches during the 1970s amounted to 700 tons. The catches stayed at a high level until the mid-1990s. The total stock of vendace fell from the 1970s onwards, and, also the mean age of the stock has decreased substantially. It is true that one of the most important ecological characteristics of a fish resource is that it is a fluctuating resource. Decreasing catches may be the result of a natural change in the stock size that occurs with weaker and stronger age classes, and the sustainable harvest rate may differ from year to year because of variability in annual spawner production (Karås et al., 1994:10).

However, the overall trend in the vendace system has been that an increased proportion of the fish stock has being caught each year (i.e., increased fishing mortality rate), which has led to a diminishing of the quantities of mature fish. Since the late 1990s, a large share of the vendace catch has consisted of young individuals. On one hand, this can be seen as a successful annual spawner production resulting in strong year classes. On the other hand, it can be seen as over-fishing. Thus, if too many juveniles are caught, the fish stock can become non-viable, i.e., the vendace stock can die out without reproduction – this is also valid if the stock is below the critical minimum size. This will affect recruitment negatively (i.e., the number of

new fish produced each year by the mature part of the stock). In addition, not only fishing affects the variations of the vendace stock, but strong year classes also seem to increase food competition, which might reduce survival.

However, in our case, the catch statistics and the drop in the total stock size indicate that the decrease was beyond the critical maximum size and not only a result of a natural fluctuation. The situation had deteriorated to such an extent that larger vendace had become rare and the economic benefits from bleak-roe fishing depended on catching small fish. According to the officials, the major cause has been high fishing pressure, primarily due to more efficient fishing methods, resulting in substantial over-fishing (Fiskeriverket, 2003, and 2001:41; Thoresson, et al., 2001:30).

Table 4. *Sustainability and effectiveness in the social and ecological system for the vendace resource in the 1990s*.[33]

Sustainability	Indicators:
Resilience	**Preserved buffer capacity:** Increased fishing mortality rate and a substantial decrease in total stock size. Due to the decline in stock size and 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.
Social resilience	**Adaptiveness and Transformability capacity:** The governing institutions responded to the resource crisis with a reduction in trawl-teams, at the same time that each vessel's catch-capacity increased. Ignoring fishermen's local knowledge.
Effectiveness	Indicator:
The Economic importance	**Economic benefit:** Decreasing catches and incomes - larger vendace had become rare and the economic benefits from bleak-roe fishing was dependent on catching small fish.

As displayed in Table 4, resilience in the vendace system has decreased substantially during the 1990s – i.e., a reduction of the buffer capacity in the system by catching

[33] For an explanation of the indicators, see Chapter 2.

too many juveniles. At the same time, the governing institutions responded to the resource crisis with a reduction of trawl-teams, at the same time that each vessel's catch-capacity has increased. As shown in Table 3, many fishermen are of the opinion that the authorities ignored their knowledge and that the governing system was slow and bureaucratic. Obviously, the institutional arrangement that governed the vendace resource up until the crisis did not succeed in promoting social and ecological resilience in the resource system. Hence, it can be concluded that the adaptive and transformability capacities in the institutional system have been insufficient. Because of the economic importance of bleak-roe fishing for commercial fishermen in Norrbotten, extensively decreasing catches during the 1990s have had considerable negative consequences for individual fishermen. Thus, the effectiveness in the governing system was not good. The conclusion must be that the vendace system was not working in accordance with the evaluation criteria, i.e., the goals of sustainability and effectiveness.

The lack of adaptiveness and capacity to change (i.e., transformability), in the governing system, have 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 the 1970s, when the vendace stock started to decrease. If a resource, like vendace, which is subject to human activity, loses its resilience, this would automatically indicate that the socio-economic system, as manifested in management practices, in fact 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 catches, 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 of resource collapse reduced. The system should be reorganised as a result of a trial-and-error process of social-ecological adaptation.

Evidently, this has not happened fast enough in the vendace case. How can this be explained? The next part of this chapter analyses the origin of the crisis in the

vendace system in terms of how different factors are believed to affect the action arena. For this purpose, the case will be placed within the IAD framework.

10.2 Applying the IAD framework to the vendace resource

With reference to the IAD framework (see Figure 6), the *physical/biological attributes* of the vendace resource are typical of any fish resource, despite the fact that the resource is rather stationary, geographically. There are natural fluctuations in stronger or weaker age classes which makes it hard to predict a maximum sustainable yield. Each user is capable of subtracting from the welfare of other users, and the subtractive nature of the resource, thus, is a source of potential conflict – i.e., a "tragedy scenario". It is the roe from vendace that is of high commercial value, and catches of non-mature vendace are almost without value for the fishermen and, for this reason, it is a seasonal fishery. This is also a physical/biological condition that affects the fishery. The same goes for technological development, which, during the last century, has been extensive (for example, the development of bottom-trawling and the introduction of nylon nets). The result has been that each fisherman's capacity to catch fish has increased considerably.

The multi-stakeholder quality of the bleak-roe fishing can be seen as *attributes of community*. Up until the crisis, fishermen did not make up a homogeneous group. Different actors probably have different intentions, preferences and strategies in their fishing. The economic survival of commercial fishermen is highly dependent on income from bleak-roe fishing, while a recreational fisherman can withdraw from the fishery in times of resource scarcity.

The *rules/institutions* can also be characterised as a multi-stakeholder system. Bleak-roe fishing is formally regulated by the government, with its authority delegated to the National Board of Fisheries in Gothenburg. As described in Chapter 7, many other authorities are also involved. Since 1994, decision-making has to a great extent, been transferred from the County Administrative Boards to the National Board of Fisheries. As a consequence, the management of bleak-roe fishing has been even more centralised than before. As has been emphasised, the history of managing

fish resources in Norrbotten is one of centralised management by the state, and this tradition has, thus, continued. If the collective of fishermen had developed a collective rationality, in some form within the group, something would probably have been done about the decreasing catches in the 1990s – i.e., that they had develop their "own" rules for management of bleak-roe fishing. This will be discussed in the next chapter of this thesis. There seems, no doubt, that the fishermen were aware of the alarming catch statistics; they should have noticed it, not least, in their own wallets. While they waited for action from the government authorities, the future of the vendace resource became highly uncertain. The conclusion is that, in the 1990s, the governing rules-in-use for bleak-roe fishing in Norrbotten where the formal rules designed and implemented by the state authorities and not, so called, informal rules governing resource use among the trawl fishermen.

The focal point of this analysis is how the *action arena* is structured, and whether this arena is working in accordance with the notions of sustainability and effectiveness. The attributes that have been discussed previously structure the action arena. It has been demonstrated that the management system has been unable to cope with the large decrease in catches and considerable reduction of the total stock. The system seems to have been unable to change when changing ecological circumstances would had made this necessary. Instead of being flexible and adaptive, the management system continued to be centralised and bureaucratic, and appears to have generated incentives for fishermen to use the resource in a catch-maximising manner. Thus, bleak-roe fishing has all the characteristics of a "CPR dilemma". Apart from the limits on recreational fishermen's gear-use, it is possible for all participants to carry out catch-maximising fishing (no quotas are used). Thus, the distribution of resources among the community of users is only dependent on the individual fishermen's strategies, skills and good fortune.

Similarly, the existing rules obviously generated incentives for individuals to adapt a catch-maximising strategy and the governing authorities had the authority to take full responsibility for how fishing should be performed and for the survival of the vendace resource. They design, implement and monitor operational rules,

collective-choice rules and constitutional-choice rules. Under such circumstances, it is unlikely that the collective of users would develop its own rules for sustaining the resource. Why should they? Experts from the National Board of Fisheries decide how, when and with what intensity fishing should be carried out. Most likely, this system generates incentives for individual fishermen to take what they can, when they can, before anyone else catches it. With such incentives, a situation can occur in which catches voluntarily reduced by one fisherman only result in increased catches by another. As shown in the previous chapter, the rules and regulations had low legitimacy among the fishermen (discussed in Chapter 9), and affected transaction costs negatively.

Many factors in the ecological system for vendace are unknown (e.g., spawning areas, how vendace is affected of pollution, etc.), and this would increase the uncertainty regarding the validity of the decisions made, and, most likely, result in reduced legitimacy and an increase in management costs. Consequently, for the reasons mentioned above, the bleak-roe arena was not functioning in accordance with the notion of resilience, and short-term individual strategies – *the patterns of interactions* – produce an unsustainable fishery. What can be learned from this case?

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

Firstly, it seems that not only open access, but also government policy can play a significant role in shaping a "tragedy of the commons". For example, by means of offering subsidies for new vessels and by keeping fishermen in business in times of decreasing catches, adaptation of the management system retards. 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, which the bleak-roe system obviously did. It is reasonable to assume that when local users cannot affect management, they have no incentives to engage in the resource. 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.

Secondly, this study has pointed out that rules-in-use are not always the same as formal laws or procedures, and that while appropriators can produce their "own" sustainable management practices, this had not yet occurred in the bleak-roe fishery. Fishermen were waiting for action from the authorities, instead of putting their collective interest above their short-term individual interests. With reference to the discussion in Chapter 4, regarding "one-shot" games and "repeated interaction with uncertainty", the bleak-roe fishermen seem to have conducted the fishery as a "one-shot game". Thus, the governing system was not only centralised and inflexible; it also generated incentives to use the resource in an unsustainable way. The individual fisherman's primary objective was to maximise his catch. How can this be explained?

Bleak-roe fishermen do not constitute a homogeneous group. Different groups have different intentions, preferences and strategies in their fishing. According to Ostrom's first design principle (see, Chapter 5), 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 fisherman. 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 fishermen. If recreational users can enter and withdraw from the arena whenever they like, the likelihood that commercial fishermen will develop some form of sustainable management practices is probably very low. Why should they? If commercial fishermen were to limit their catches and the fishery started to recover (and "seal-safe" gears are developed), it would be worthwhile for recreational fishermen to enter the arena again.

Thirdly, a centralised top-down management system for fluctuating natural resources, like vendace, obviously has problems in reaching enough adaptiveness and transformability capacities, i.e., social resilience, in the governing system. This, in turn, affects ecological resilience negatively. While the resource was on in "downward loop", the management system was still acting as if there were plenty of fish to be caught. The National Board of Fisheries' answer to the alarming decrease

in catches was a withdrawal of trawl permits and a new regulation that aims to prevent non-mature vendace being caught in the trawls.

Bleak-roe fishing accounts for more than half of the annual turnover for commercial fishermen in Norrbotten. Individual fishermen's incentives to limit their catches are, 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, in turn, puts further pressure on the resource. Subsidies aggravate the situation. Without them, fishermen would probably go out of business when catches decrease. With diminishing returns, fishermen would have no incentive to increase their efforts, and the fishery might stabilise and start to recover. With subsidies and the maintenance of over-capacity, the fishery could easily collapse. The Swedish fishing law makes this situation worse. To obtain a commercial license, fishing must be the main occupation and provide the main income for the applicant; this puts pressure on fishermen to continue fishing in times of resource scarcity. Historically, fishermen in Norrbotten have been versatile persons, earning their livings from many different sources of income, for example, farming, forestry and fishing. In times of decreasing catches, they could easily shift their main source of income and the resource had a chance to recover. Today, 55 percent of the trawl fishermen do not have any income other than from fishing, and for the rest of the fishermen it is important that the main part of their income is from fishing (see Appendix).

Recreational fishermen have more scope to vary the intensity of their fishing than commercial fishermen have. If a recreational fisherman is not rewarded for his efforts, 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 biggest incentive to behave in a way that destroys the resource.

Fourthly, obviously, the institutional arrangement for the vendace resource does not correspond to Ostrom's eight design principles for long-enduring CPRs (Ostrom, 1990; 1992; 1993). Thus, it can be assumed that, if bleak-roe fishing were designed after these principles, it would generate incentives for fishermen to sustain

the vendace resource. With recourse to a short implementation structure, bottom-up processes for the construction of rules, and fishermen's own monitoring of the resource system, the incentive to follow rules would probably be higher. If incentives to follow rules were high, it would also be easier to adjust them when disturbances in the ecosystem occurred; resilience in the management system would, thus, increase. At this junction, it should have become clear that, as was assumed in the introduction, these design principles correspond very well with resilience theory. Experiences from long-enduring CPRs and the theory of resilience in management systems, both emphasise the importance of local knowledge and the participation of local users in management of renewable natural resources. A local fisherman with experience and knowledge of vendace is likely to have the capacity to observe signals from the resource system at an earlier stage than could government authorities, who must wait for catch statistics. Similarly, if fishermen were involved in the design of rules for the management of vendace, they would probably take more responsibility for the resource and respond more willingly to signals from the system. To achieve an adaptive and flexible management system, responsible users who immediately react to changes in the ecosystem – and who act according to collective rationality – are necessary.

Theory assumes that a small and well-defined CPR system, without free-rider problems, is better able to receive and respond to signals from the ecosystem. If appropriation rules are related to local conditions, the management system will probably be more sensitive to changes in this specific ecosystem than would general rules for the whole fishery sector. With a short implementation structure, the scope to adjust operational rules to new conditions would probably also increase, and local fishermen could reorganise the management system more quickly than under the prevailing institutional arrangement, which aims to make fishery regulations as general as possible. If the fishermen performed monitoring and imposition of sanctions, it would be easier to detect and penalise "cheaters", and if such incentives to follow rules were high, the system would be more flexible and adaptive when changes in the ecosystem occurred.

However, faced with management system not properly designed (that is, a system without resilience), it would be in the individual fishermen's interests to produce a sustainable fishery. The extent to which these assumptions hold for the vendace fishery will be discussed in the next chapter. After the severe resource crisis in the late 1990s, actions were taken in 2000 to cope with this situation. The next chapter deals with the content and result of these actions.

11 Changes in the vendace system

As shown in the preceding chapter, the trend in the vendace system was towards a point of deep crisis in the social-ecological system. Applied to the adaptive cycle presented in Chapter 1, the situation for the vendace resource since the beginning of the 1990s can be seen in Figure 14.

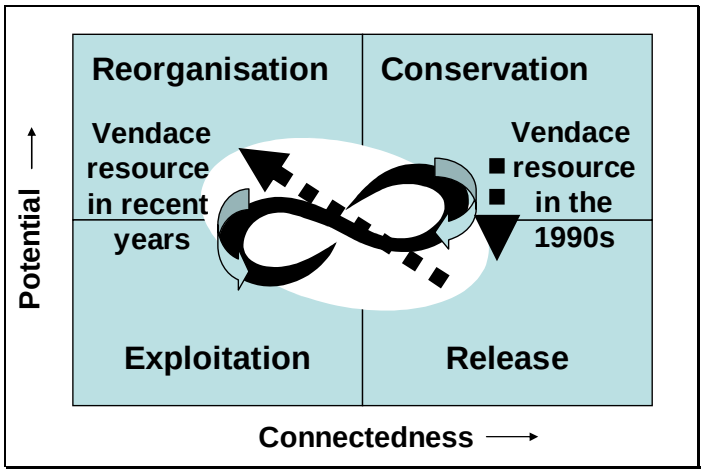

Figure 14. *The vendace system in relation to four ecosystem functions.*

In the early 1960s, when trawling of vendace started, the resource was in a state of slow growth – the exploitation phase – and towards the, so called conservation phase (or organisational consolidation) in the 1970s and 1980s. In this latter phase, stability initially increased, but the system became more and more over-connected until rapid change was triggered in the release stage. In an ecological sense, this is exactly what happened, perhaps as early as in the 1970s, when the total stock of vendace slowly started to shrink. From the mid-1990s, rapidly falling catches and a dramatic stock decrease indicate that the resource actually had reached the release phase. Also the social system was in the release phase and faced with significant pressure to reorganise the management system – i.e., a call for a "flip" to another state of governance.

The movement from exploitation to conservation is predictable with quite a high degree of certainty. In fishery, production and accumulation typically peak as

was also the case in the vendace system during the 1970s and 1980s. The subsequent release (or collapse) is a stage in which the system becomes increasingly fragile and requires rapid reorganisation, as happened in the vendace system in 2000. This phase of renewal led to a reorganisation with consequences that are unpredictable and highly uncertain. The described development in the vendace fishery corresponds very well with Holling's and Gunderson's theory of system crisis (see, Chapter 1), viz., that it is only at points of deep crisis in both the ecological and the social systems that fundamental conceptual and structural changes are possible.

The next step in this study will be to re-analyse the vendace system after the year 2000 when a new management strategy was implemented. As has been shown in the previous chapters, despite a rigorous state-regulated system, bleak-roe fishing had all the basic conditions of a system where short-term individual catch-maximising strategies are in command, i.e., the system had the pre-conditions for ending up in a "tragedy scenario". These conditions also resulted in a distrust of management and finally in a serious resource crisis.

This raises the interesting question whether a "classical" top-down governance system with individual catch-maximising strategies can be transformed, deliberately, into an adaptive management system, characterised by a collective strategy for sustainability? Can this be accomplished in a system, such as the vendace, which lacks recent experiences of local engagement in management? The current generation of trawl fishermen have no experience of self management, or to work collectively towards sustainable management practices. In this, and the next chapter, the "new management system" which was implemented in 2000, will be analysed. How has the new system handled these challenges, and how has it affected collective action and adaptive management practices?

11.1 What are the formal consequences of the changes in bleak-roe governance?

As has been described earlier, it was not only the commercial fishermen who were (and still are) worried about the long-term survival of the vendace resource. Also officials from the National Board of Fisheries were concerned. Due to the severe

situation in 1999, and to prevent further over-fishing, the Board proposed extensive restrictions in trawling areas which provoked the trawl fishermen. Three different strategies to prevent further over-fishing were considered: (1) to stop all trawl fishing during a fixed time period; (2) to reserve important areas for non-mature vendace; and (3) to construct a self-restraint programme together with the fishermen.

A common opinion among the fishermen is that these restrictions would have been a serious threat against a future trawl fishery. At a meeting in May 2000, the Board proposed extensive restrictions in trawling areas which caused an almost rebellious atmosphere among the trawl fishermen.[34] According to one fisherman, the proposed limits would have destroyed the possibilities to perform trawl fishing for bleak-roe in the future; "there were extreme limitations in every bay, and [as a result] we decided that every man who could speak tolerably well, should make a phone call to the Board and protest against the restrictions" (Fisherman, no. 4).

As a response to the poor performance and as a reaction to the threat of withdrawal of trawl areas, the fishermen themselves, through the *Swedish East Coast Fishermen's Association* (SOC), exerted considerable pressure to develop a co-management system with sharing of power and responsibility between the Board and the trawl fishermen. The Board's Coastal Research Institute drafted a proposal for a new management arrangement and, 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; Fiskeriverket, 2001). Thus, before the fishery started in 2000, a self-governing programme was implemented. According to the Board's decision, it was SOC's responsibility to create a suitable management organisation. However, it should be emphasised that no formal authority was delegated to the SOC and that management of vendace was, and still is, performed within the limits of the fishing law (FIFS 1993:31). The purpose of the project, according to the Board, is to carry out self-management "within the law" but, the fishermen should have the possibility to sharpen regulations (Fiskeriverket, 2001). It

[34] Meeting with officials from the National Board of Fisheries and with the trawl fishermen 2000-05-09.

was also stated that control and supervision was the Board's responsibility, and should be carried out according to the same routines as previously. Further, the management group should have no formal right to impose sanctions (Fiskeriverket, 2000-09-25; Hasselborg 2004-01-22).

A management group – with participants from the trawl fishermen, the president of the SOC; the Board's Research Office in Luleå, the County Administrative Board, and a biologist from the Board's Institute of Coastal Research – was created. However, the six trawl fishermen in the group have the full responsibility to coordinate and make decisions to sharpen regulations during the fishery. These six members have been elected by the trawl fishermen. However, all the meetings with the management group are not particularly formal and, in practice, interested trawl fishermen are free to participate (Meetings with the management group, 2003-09-08 and 2004-01-29).

Recreational and subsistence fishermen are not represented in the group and, accordingly, have no influence on management. Not surprisingly, approximately 93 percent of the trawl fishermen are of the opinion that – because of how few they are and that they are not very important – recreational fishermen should not be represented in management (Table 5).

Table 5. *The trawl fishermen's opinions whether recreational fishermen should participate in local management* (see Appendix).

19. Are you of the opinion that also recreational bleak-roe fishermen should participate in the experiment with local management? Why? Why not?	•**Yes**: 2 = 6.4 % *Comments:* •Recreational fishermen can participate if they want to, but their fishing does not affect the stock: 2 •**No**: 29 = 93.5 % *Comments:* •Today, recreational fishing does not affect the resource and there are so few recreational fishermen left: 21 •It can create antagonism between commercial and recreational fishermen: 7 •Recreational fishermen do not earn a living through fishing: 5

Other arguments among fishermen are that recreational fishermen are not economically dependent on the resource and that it will be: “firstly, difficult to find recreational bleak-roe fishermen and, secondly, difficult to find anyone who is interested and willing to engage in this issue” (Fisherman, no. 25).

In the original plan from the Board’s Institute of Coastal Research, the intention was to delegate full responsibility for control and management to the fishermen during 2002 (The National Board of Fisheries Institute of Coastal Research, Plan 2000-08-25). Still, in 2004, this has not been done.

Initially, the management group made some quick decisions before the fishing season in 2000:

- In order to deal quickly with changes during the fishing season, it was decided that information concerning the condition and changes in the resource should be spread by VHF or cellular telephone. For example, if the share of juveniles would be too high, or if other causes make a bay not-suitable for trawling, this information should be spread quickly among the fishermen.
- It was also decided to cut down the trawling period (by seven days) and the co-management group also shortened the time for trawling during the day (from 06.00 – 17.00). Additionally, the management group also forbade trawling on Fridays and Saturdays (earlier there were no limits regarding hours during the trawling period);
- Bays with high shares of juveniles were excluded from trawling and the group decided to stop trawling in other bays if the share of non-mature vendace was too high. (It should be noted that the excluded areas was almost the same as the areas proposed earlier by the Board; something that, at the time, caused significant negative feelings among the fishermen!)
- To prevent catches of non-mature vendace, a decision was made stating that all trawls must be equipped with selection panels; meaning that fewer juveniles would be caught in the trawls.

- As a complement to the Board's catch samplings (by random control of trawl catches and by test fishing), it was decided that every trawl-team should do their own samplings and send the results to the Board's Coastal Research Office (Ostkustfiskarna PM. 2000-09-12; Thoresson et al., 2001; Fiskeriverket, 2001).

These measures have remained quite stable, with only small adjustments since 2000. For example, in the fishery 2003, the fishermen's own samplings were done on a daily basis and the hours for trawling were reduced further (06.00 – 15.00). There have also been many and heated discussions whether the time had come to open up some of the closed areas. 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; Hasselborg 2004-01-22; see Appendix).

To sum up, changes have been made in the management that has dominated the vendace fishery for decades. At the same time, it should be emphasised that formal institutional changes, in terms of laws and regulations, have been insignificant. Bleak-roe fishing is still regulated by national law (FIFS 1993:31), and the only "power" that has been delegated to the collective of fishermen is the right to sharpen regulations. As has been shown in this section, the fishermen have also utilised this right and have imposed further restrictions immediately. Have these changes resulted in any changes in the ecological system?

11.2 Has the new governance strategy for vendace been successful by promoting a more sustainable and effective fishery?

Generally, short-time changes in an ecosystem are difficult to determine. When it comes to fisheries, catch statistics are a useful tool that is commonly used. As shown in Figure 15, the downward trend in catches of vendace was broken about the same time that the new management system was initiated. Is this a coincidence only?

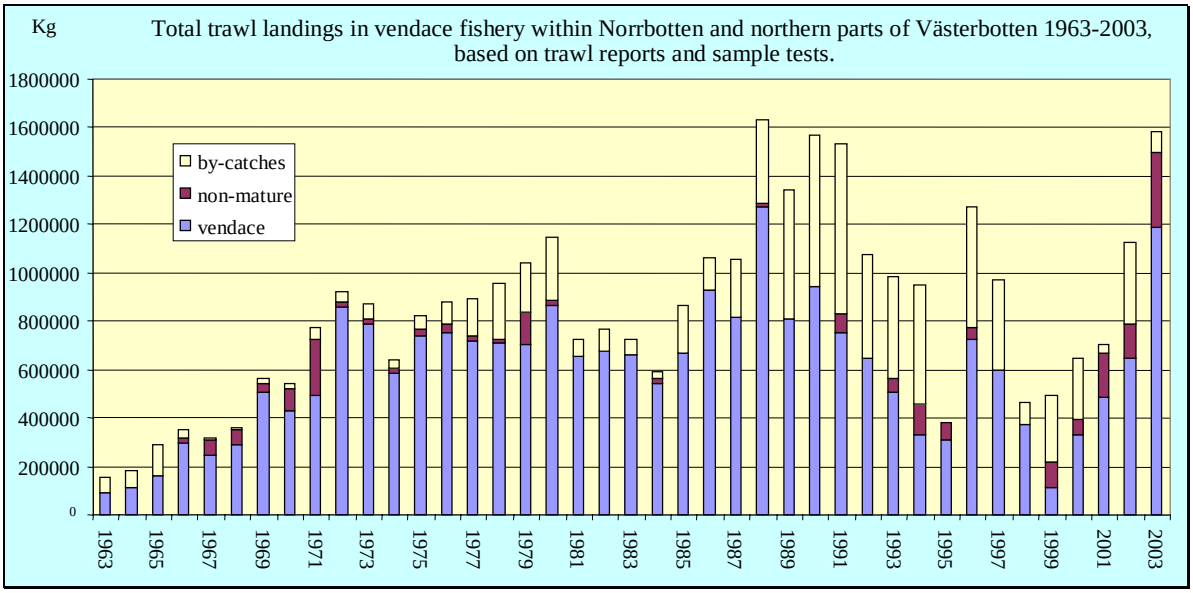

Figure 15. *Total trawl landings in vendace fishery 1963-2003, based on trawl reports and sample tests* (data from the National Board of Fisheries Research Office in Luleå 2004-04-15).

In 2000, catches started to increase and catch statistics for 2003 are on the same high level as the record years in the 1970s and 1980s. Certainly, one could say that catches has increased considerably. Perhaps this increase can be explained by an increase in effort? This is not a valid explanation though; in fact, considering the decrease in trawl-teams, the situation is even more remarkable.

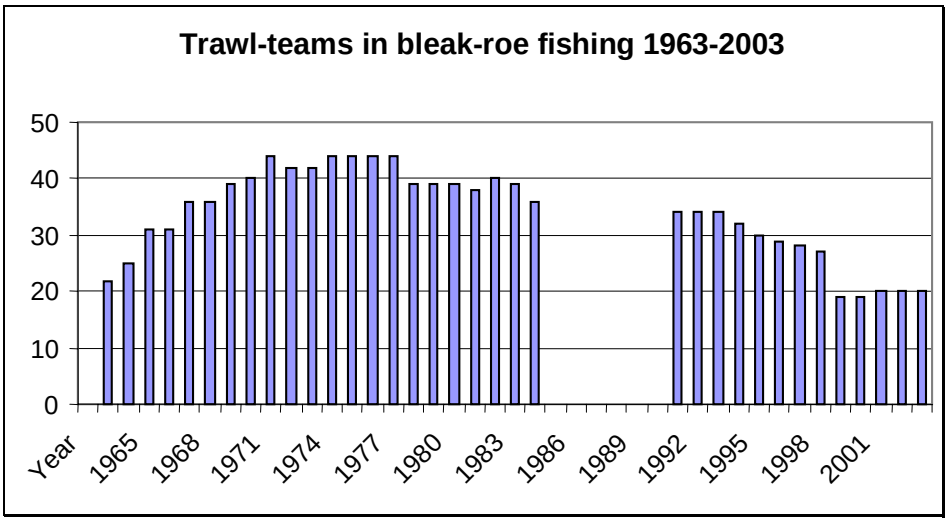

Figure 16. *The number of trawl-teams in bleak-roe fishing during 1963-2003* (Source: Hasselborg 2004-04-15).

From 1999 onwards, there were approximately 20 trawl-teams. For the period 1994 − 2003, the number of trawl licenses has decreased by 37 percent. The remaining teams have been restricted in areas, as well as in hours they could fish, but even so, they landed significantly high catches.

However, the mean age of the vendace stock is still low and a large share of vendace catches consists of young individuals.

The relative age structure of vendace in Luleå archipelago 1991-2002.

Year	0	1	2	3	4	5	6	7	8
1991	28,6	28,6	27	12,9	1,4	1,4	0	0	0
1992	0,5	18	47,4	27,3	5,2	1,5	0	0	0
1993	46	4	12	20	12	2	2	1	1
1994	51	21	5	10	7	4	1	1	0
1995	24,9	39,5	20,5	6,8	1,5	3,4	2,9	0	0,5
1996	6,5	55,3	23,6	6	5	3,5	0	0	0
1997	17	14	31,5	27	5	1,5	2	1,5	0,5
1998	22,8	20,7	26,6	19,6	5,4	2,7	0,5	1,1	0
1999	32,1	8,1	20,4	24,9	9	4,1	0,9	0,5	0
2000	24	52	12,3	6,9	3,9	1	0	0	0
2001	21,6	19,1	41,2	6,4	6,9	3,4	1	0,5	0
2002	37,3	52,7	6	2	0,7	0	0,7	0,7	0

Figure 17. *The relative age structure of vendace in Luleå archipelago 1991-2002* (Source: Hasselborg, 2004-01-22).

The relative age structure of vendace in Kalix archipelago 1991-2002

Year	0	1	2	3	4	5	6	7	8
1991	54,1	18,2	9,1	9,1	0	9,1	0	0	0
1992	0	19	47	27	4	2	1	0	0
1993	13,3	0	17,3	34,7	18,4	8,2	4,1	4,1	0
1994	55,2	8,3	5,2	13,5	7,3	4,2	2,1	3,1	1
1995	44,9	19,4	18,9	3,1	6,1	3,6	2,6	1	0,5
1996	15,2	69,5	8,6	4,6	2	0	0	0	0
1997	46,2	18,3	28,4	5,3	1	0	0,5	0,5	0
1998	30,9	22,2	25,8	13,4	4,1	2,6	1	0	0
1999	69,2	7,6	9,3	11	1,2	1,7	0	0	0
2000	20	68,8	9,3	2	0	0	0	0	0
2001	46,2	18,8	33,2	1,4	0,5	0	0	0	0
2002	24,7	63,9	7,2	3,1	1	0	0	0	0

Figure 18. *The relative age structure of vendace in Kalix archipelago 1991-2002* (Source: Hasselborg, 2004-01-22).

Figures 17 and 18 display the relative age structure in Luleå and Kalix archipelagos, respectively. In 2000 and 2001, the respective mean age in the total trawl catch was 1.14 and 1.23 years (Thoresson et al., 2001). In 1999, as much as 49 percent of the vendace catch (in weight) consisted of juveniles born the same year, and in 2001, the number was between 20 − 30 percent. A slight improvement has occurred for 2003. Totally, in the whole archipelago and for the whole fishery, catches consisted of 20.7 percent juvenile vendace.

The number of juveniles is highest in Haparanda and Luleå archipelagos; the share of juvenile vendace in catches (in weight) was 30.6 percent in Haparanda; 23.1 percent in Luleå and 14 percent in Kalix archipelago (Hasselborg 2004-01-22).

At the same time that catches have increase, the time spent in bleak-roe fishing for 2003 has been reduced by five percent (around 100 hours) compared to 2002. In comparison with the time period 1994 − 2001, the time spent in bleak-roe fishing has decreased by 63 percent in 2003. Since the fishermen became engaged in management, the hours spent in bleak-roe fishing have decreased from 5,100 hours in 1999 to 2,300 hours in 2003 (ibid). Surely, there has been an increase in efficiency.

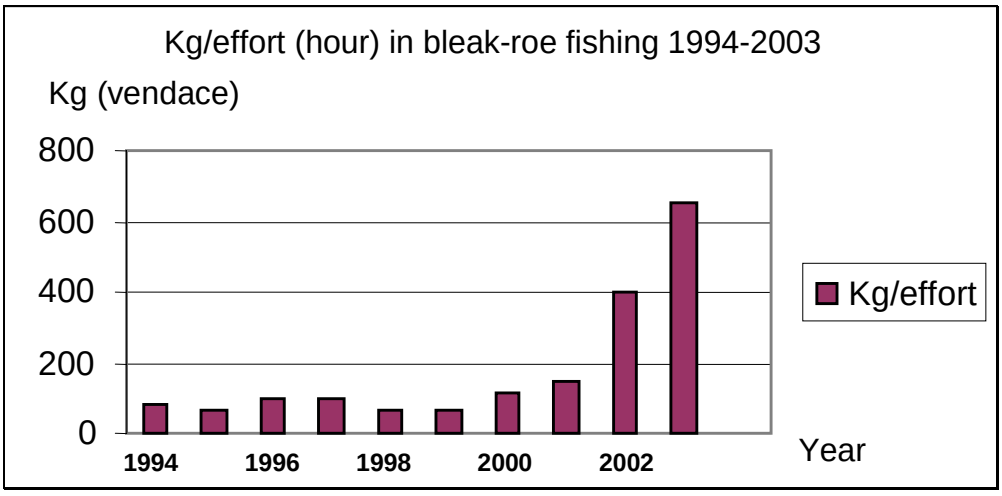

Figure 19. *Kg per effort (hour) in bleak-roe fishing 1994 − 2003, according to logbooks* (Hasselborg 2004-01-22).

As Figure 19 illustrates, the efficiency for the trawl-teams has also improved with an enormous increase in catches per hour worked in bleak-roe fishing. For example, in

1994, the amount of landed vendace was 83 kg per hour and total hours spent in bleak-roe fishing for all trawl-teams were 10,200. This means that, in general, every trawl-team landed approximately 26,000 kg vendace during 1994's fishery. In the catastrophic year 1998, the corresponding figure was 66 kg per hour and 27 trawl-teams spent 5,600 hours in the fishery. Thus, each trawl-team landed approximately 13,600 kg vendace.

The figures for the fishery in 2003 are considerably higher; 20 trawl-teams spent 2,300 hours in bleak-roe fishing and landed 651 kg vendace per hour. Compared to 2002, the efficiency has increased by 48 percent. Even more impressive is the increase from 1998 to 2003, which is 178 percent. It is not only the catches per hour in fishing that have increased substantially. Every trawl-team landed approximately 74,900 kg vendace and that is more than five times better than in 1998.

The highest efficiency per hour (in 2003) is in Kalix (772 kg/hour) and Piteå (758) archipelagos, followed by Råneå (622), Luleå (601), and Haparanda (512) archipelagos. The biggest catches are recorded in Storö and Pålänge bays in Kalix archipelago (ibid). Total time in bleak-roe fishing has gradually been reduced because of fewer trawl-teams, but also because of decisions by the fishermen. According to the authorities, the reasons for the positive development in catches are not only because of more efficient fishing, but also because the density of the stock has increased (ibid).

There has, in fact, been a positive development in the total stock of vendace. As shown in Figure 20, no sample tests and no estimations of the population were done in the 1980s and, consequently, no data is available for this period.[35] It seems reasonable to assume that the upward trend (since 1999) has continued in 2002 and 2003 judging from the high catch statistics for these years. This view is confirmed by biologists at the Board's Institute of Coastal Research.[36]

[35] For comments, see Figure 11 in Chapter 9.
[36] Meeting with the management group, 2003-09-08.

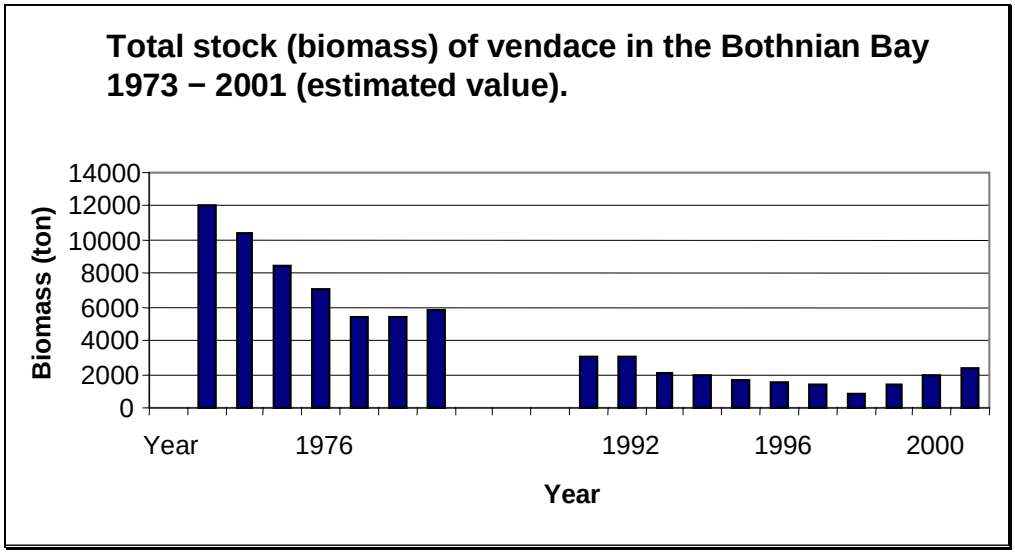

Figure 20. *Total stock of vendace in the Bothnian Bay 1973 − 2001.* (Source: The National Board of Fisheries Institute of Coastal Research 2002; through Hasselborg 2004-04-15).

Still (according to the estimation), the total stock is rather small compared to the 1970s. However, there is an upward trend and, due to successful spawning for several years, the development in the resource system indicates quite a bright future. The work with selection panels are continuing and many of the fishermen interviewed are very engaged in this issue. In fact, some of them invested in panels even before the question was on the authorities' agenda. An expert on selections in fisheries has been employed by the Board's Institute of Coastal Research (summer 2004) on a project basis to work with this issue. This is also praised among fishermen. "He has a good reputation in dealing with these questions and can hopefully help us to succeed with selection of non-mature vendace" (Fisherman no. 11, 2004-05-10). If they make progress with these selections, the future will be even brighter.

The considerably increase 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 a short period in the autumn, catches of vendace are, and have been, 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 fishermen (Länsstyrelsen i Norrbottens län). Nowadays, it amounts

to approximately 67 percent (mean value) of the annual turnover for the fishermen interviewed (see Appendix, question 5.).

It seems like the trawl fishermen were correct in their assumption that the spawning had been unsuccessful in the early 1990s and that many factors, other than fishing pressure, are of vital importance for the vendace resource. Nowadays, also many of the officials are of this opinion and officials at the Board's Office in Luleå believe that the warm summers and warm waters during the last few years have affected the stock in a positive way. However, it is also emphasised that the uncertainty regarding the biological prerequisites for the vendace resource is high and officials are very surprised at the fast recovery (Hasselborg 2003-08-28).

At the Board's Institute of Coastal Research, officials are of a similar opinion. They are neither sure whether it is one or several populations of vendace, nor where the recruiting areas actually are located, hence, "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). Certainly, there has been a positive development in the ecological system and an upswing in the economic importance of bleak-roe fishing, but what are the fishermen's reactions to the new management system? The next sections contain a presentation of these reactions, and an analysis of how, or if, the new governance system has promoted collective action among the fishermen.

11.3 The trawl fishermen's opinion of the local management system

As has been discussed in Chapters 3 − 7, the fishermen's opinion of the governing system is essential for the overall functioning. If the governing system is not considered adequate, there is a risk that the legitimacy for rules and regulations will be low and, hence, the incentives to follow these rules will also be low.

When asked about the functioning of the prevailing regulations in bleak-roe fishing, the respondents had the following alternatives: "bad", "not so good", "satisfactory", or "good". Approximately 77 percent answered that the regulations functioned "good", while the remaining 23 percent answered "satisfactory" (Table 6).

Table 6. *The trawl fishermen's opinions of local management* (see, Appendix).

7a. How do prevailing regulations of bleak-roe fishing function? **7b**. Are you of the opinion that, in general, the trawl fishermen follow rules and regulations in bleak-roe fishing today?	**7a**. •**Good**: 24 = 77.4 % •**Satisfactory**: 7 = 22.6 % •**Not so good**: 0 •**Bad:** 0 **7b**. •**Yes**: 31 •**No**: 0 *Comments:* •Today, when fishermen have implemented their own rules, they follow regulations; earlier, it was "only so-so" with observance of rules: 19
8. Are you of the opinion that routines and regulations for bleak-roe fishing are functioning "better", "worse" or "the same" today than before self-governance was implemented?	•**Better**: 29 = 93.5 % •**The same**: 2 = 6.4 % •**Worse**: 0 *Comments:* •It would work even better if fishermen had not felt pressure from the authorities to "make the right decisions": 15 •Quick decisions; the ability to stop fishing in a certain bay and "no one is trawling in that bay": 13

On another question, as many as 93.5 percent are of the opinion that the new management system functions "better" than the previous one, whereas approximately 6 percent consider the new system as almost "the same" to the earlier management system (Table 6). Thus, compared to the previous one, the trawl fishermen are quite pleased with the new management system. A common opinion is that when fishermen themselves (through the management group) make decisions they are regarded as "holy", and as a result, they have respect for these decisions, while the respect for the Board's decisions is much lower and often results in violations of rules. "It is more natural to respect restrictions, for example in trawl areas, when they have been decided by ourselves" (Fisherman, no. 23). Further, for a fluctuating resource, like vendace, it is important to have quick responses when ecological circumstances make this necessary, "we can call off the fishing in a certain bay without any formal decisions and [as a result] no one is trawling in that area" (Fisherman, no. 3).

However, as displayed in Table 7, there is also comprehensive criticism against authorities' behaviour. Many fishermen, particularly members of the management group, have the impression that the Board "try to steer the decisions"

and there is a risk that there will be an end to local management if the fishermen make the "wrong decisions" – i.e., decisions not recommended by the Board.

Table 7. *The trawl fishermen's opinions of the overall performance in the "vendace system"* (see Appendix).

29. Generally, how does the present management system for bleak-roe fishing function? What can be done to improve the system?	•**Good**: 29 = 93.5 % •**Not so good**: 2 = 6.4 % *Most frequent answers on how to improve management:* •The rules of the game must be fixed for some years in advance: 25 •There is a need to delegate more power from the authorities to the group of trawl fishermen: 14 •A formal right to open up and close all areas by the group of trawl fishermen: 6 •Right to impose sanctions: 12 •Still a bureaucratic system: 2

The fact that there is no exact time-schedule for the co-management project is contributing to this criticism, and also the fact that the initial intention was to gradually delegate power from the Board to the fishermen which, has not been done yet. Thus, it is not self-management if "we have to dance to the tune of the Board" (Fisherman, no. 4).

To create an effective and sustainable management system, the fishermen frequently express the opinion that they need a few years of good working conditions. Otherwise, they believe there is always a risk that the project will be cancelled if decisions go against the Board's opinion. The National Board of Fisheries in Gothenburg decided in a meeting in February 2004 that the project would continue as before during the rest of the year. However, no decisions or promises have been made for the period following the end of the 2004 season (Aho, 2004-02-23).

The uncertainty is continuing and trawl fishermen can only plan for one year ahead. "As long as there are plenty of fish, the project will, most likely, continue to the same extent as today. But, when catches fall [again], there is a risk that the Board will cancel the whole project" (Fisherman, no. 9). The respondents often argue that they know catches will fall again, because that is known among fishermen to be the natural behaviour of fish resources – after good times there will be bad times and *vice*

versa. When catches fall, there is a risk that the project will be cancelled if the framework is unclear. "If this project succeeds, many of those employed at the Board will loose power and, in the long run, maybe employment. Therefore, many at the Board are adversary to the project" (Fisherman, no. 15). Consequently, "they will probably take any chance they get to put a spoke in the wheel" (Fisherman, no. 11. 2004-01-27).

Fishermen seem to argue that the authorities want to retain control for their own sake and that those who work within these agencies have their own interests and concerns (compare the discussion about "turf" in Chapter 7).

Table 8. *The fishermen's opinions of the future for local management* (see Appendix).

14. Should the experiment with local management "continue the same", "be cancelled", or "be expanded"?	•**Continue**: 9 = 29 % •**Cancel**: 0 •**Expand**: 22 = 71 % *Comments:* • A few years of good working conditions are needed – i.e., a fixed time-period for the project: 18 •The best knowledge is among local users – i.e., more power to the management group: 17 •Formal right to impose sanctions is needed: 11
18. Who should have the decision right in trawl licenses matters?	•The National Board of Fisheries and the trawl group as a body, to which a proposed measure is referred for consideration: 13 = 41.9 % •The County Administrative Board and the trawl group as a body, to which a proposed measure is referred for consideration: 7 = 22.6 % •The National Board of Fisheries: 3 = 9.7 % •The Swedish East Coast Fishermen's Association (SOC): 2 = 6.4 % •The County Administrative Board:1 = 3.2 % •Do not know: 2 = 6.4 %

As shown in Table 8, despite this uncertainty, all trawl fishermen interviewed want a continuation and 71 percent want an expansion of the project; for example, by delegation of more power, formal rights to impose sanctions, but also through the means of deciding a fixed time period for the project. When it comes to the general wish to expand the project, a majority of the interviewed fishermen mentioned that they think "the rule of the game" should be fixed for some years ahead and that more power should be delegated to the management group (Table 8).

Approximately 65 percent of the respondents want the group of trawl fishermen to become a body, to which the issuing of licenses is referred for consideration before any decisions are made. Few fishermen want the full responsibility for issuing of license, while a majority would like the Board's office in Luleå, or the County Administrative Board, to have the formal right to decide, however, after consultation with the fishermen. The fishermen's arguments are that they have the local knowledge and also know who almost all the recreational/subsistence fishermen are. Thus, they know which fishermen who are serious and suitable to hold a trawl license. Without this knowledge, they believe license issuing can easily fail; "very serious and skilful fishermen, living in the archipelago and coming from 'fishing families', have been waiting seven to eight years for a license, while non-serious fortune-hunters have received licenses immediately" (Fisherman, no. 31).

11.4 Collective action among the trawl fishermen

A majority of the fishermen (77 percent) are of the opinion that the unity within the group has increased since local management was implemented and, almost all of the remaining fishermen, are of the opinion that there had always been good unity (see Table 9).

Table 9. *Unity within the group of trawl fishermen* (see Appendix).

11. Has the unity within the group of trawl fishermen "increased", "decreased" or is it "unchanged" since local management was implemented? If it has increased or decreased, why?	•I**ncreased***:* 24 = 77.4 % *Comments:* •Increased responsibility and closer contacts, i.e., more co-operation and discussions: 23 •Smaller group and more trust: 14 •**Decreased**: 0 •**Unchanged**: 7 = 22.6 % *Comments:* •The unity within the group has always been good: 6

With increased responsibility, there is a need for closer contacts and cooperation, fishermen believe. The group is quite small and, nowadays, everyone knows each

other (Table 9). The engagement in management has also increased. One fisherman expressed the situation in the following way:

> In the 1980s, we were more individualistic and, nowadays, we have more solidarity within the group. There 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 (Fisherman, no. 27).

Another fisherman expressed the opinion that, owing to local management, the trawl group has become more responsible: "nowadays, more of us have the feeling that we cannot just step on the accelerator the whole time" (Fisherman, no. 7). About 50 percent of the respondents are of the opinion that the relationship with the authorities has improved with fewer conflicts and better understanding between fishermen and officials. It is noteworthy that three of the respondents stated, that the reason for the improved relationship with the authorities is due to the fact that they had fewer contacts with officials than before (Table 10).

Table 10. *Conflicts between fishermen and officials since local management was implemented* (see Appendix).

13. Has the level of conflict between fishermen and authorities changed since local management was implemented? Please give examples!	•**Better**: 15 = 48.4 % *Comments:* •Increased cooperation with the authorities – i.e., increased influence: 10 •Fewer contacts with the authorities: 3 •**The same**: 16 = 51.6 % *Comments:* •The authorities try to steer the decisions: 11 •There is still too much bureaucracy: 6 •**Worse**: 0

Also in relation to question 13 (Table 10), fishermen expressed the view that the authorities "try to steer the decisions". It is likely that without this opinion among the fishermen, the number of respondents that had answered "better" would, probably, have been much higher.

During the first years of local management, the management group's own regulations were fully respected (apart from some small and un-intentional infringements – e.g., being 100 metres over a trawl-line, etc.).

Table 11. *Infringements of the trawl fishermen's "own" rules* (see Appendix).

9. Has any trawl-team intentionally infringed on the rules that are implemented by the trawl group?	•**Yes**, one single case (2003): 28 = 90.3 % •**Don't know**: 3* = 9.7 % (* These three interviews were done before the infringement the fishery 2003.)
10. Have there been any violations of your "own" rules? If so, what actions were taken?	*Comments in fishermen's answers:* •The group of trawl fishermen hold a meeting the next day: 24* = 85.7 % •We talk with them: 20 = 71.4 % •Worried that the legitimacy of their own rules will decrease if it happen again: 12 = 42.8 % •Our own rules are "holy": 12 = 42.8 % •The "guilty" trawl team was "given a lesson" and the discussions were "heated": 10 = 35.7 % * The three interviews that were done before the fishery 2003 is not accounted for in this question.

However, in 2003, one trawl-team intentionally violated the restrictions and trawled in a closed bay for a couple of hours (Table 11). The problem is that, formally, this trawl-team did not break any law. Despite the fact that the areas in question were declared closed by the local management, they were open according to the fishing law. It should be emphasised that without any formal rights to impose sanctions, the collective could not expect any actions from the authorities. However, information about the infringements was spread quickly among the trawl fishermen. They acted immediately and held a meeting the next day with all trawl fishermen who were able to participate. A "heated discussion" was held with the guilty trawl-team and there were no further infringements in the fishery 2003.

It should be stressed that an action, i.e., the infringement, that the rest of the collective did not bother about before local management was implemented, now caused significant irritation and engagement among the fishermen. "Yes, it was one infringement that caused an outcry against the guilty trawl-team; if it had been a

restriction imposed by the authorities, no one would have bother about it" (Fisherman, no. 22). "Violating our own rules is like breaking a promise to a friend" (Fisherman, no. 30). All fishermen interviewed (also the trawl-team involved) had a lot to say about this incident and expressed worries about future consequences of the incident. They know that the authorities keep an eye on everything they do and are worried that if similar events would be repeated, the legitimacy of their own "holy" regulations will decrease and, as a result, the authorities might cancel the management project. This event raises the question whether the local management should have any formal right to sanctions or not. The fishermen collective is divided in this matter.

Firstly, there are those who consider the formal right of sanctions as a necessity to prevent future infringements. They often argue that rights go together with responsibilities and, also when it comes to uncomfortable decisions, they think they should be able to handle the situation on their own. The underlying assumption is that local management will mean more involvement and greater responsibility. With the present absence of such rights, more unconventional methods are considered. "If an infringement on our own rules happen again, and we haven't got any formal right to sanctions, we have to consider giving them a good thrashing" (Fisherman, no. 27).

Secondly, there are those who think that formal sanctions should remain a responsibility of official authorities. These persons often argue that − within the collective of fishermen − they are colleagues and no one should act like a policeman controlling the others, and, if this happens, it would result in a disruption of the "good spirits within the group" (Fisherman, no. 31).

The most notable aspect regarding the new type of rule-making that came along with the co-management project is that when the collective of trawl fishermen was given an opportunity to create its own rules it almost immediately implemented *the same* restrictions it so loudly had criticized earlier.

11.5 Local knowledge in the social system

Many fishermen have participated in the fishery as subsistence fisherman, or together with relatives, before they received their own trawl license (see questions 1 and 2 in the Appendix). The mean age of the fishermen interviewed is 47 years and the mean time as a trawl fisherman is 22 years. Surely, the trawl fishermen possess a lot of experience and knowledge and, as described earlier, many fishermen have their own "theories" about the resource crisis in the 1990s. In particular, they argue that many other factors than trawling was of significant importance to explain the decrease in the resource (see Table 1 in Chapter 9). 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 for the crisis in the late 1990s. "It is strange, that in the southern part of the archipelago (i.e., southern parts of Piteå and Jävre archipelagos), where the fishing pressure has been the absolute lowest, vendace disappeared first" (Fisherman, no. 30).

Table 12. *Trawl fishermen's opinion whether vendace spawning areas are affected by trawling* (see Appendix).

25b. Are you of the opinion that the spawning areas for vendace are affected by trawling? Why, why not?	**25b**. •**Yes**: 3 = 9.7 % •**No**: 24 = 77.4 % *Comments:* •Vendace spawn in shallow waters and near land where trawling is not allowed: 19 •It cannot affect spawning areas, because, bays that were the best 40 years ago are still the best: 7 •**No opinion**: 2 = 6.4 %

As shown in Table 12, almost 80 percent of the fishermen believe that trawling is not affecting spawning areas for vendace. The argument is that vendace spawn close to land (also close to islands in the outer archipelago) and in very shallow waters where trawling is forbidden. This view is expressed by a fisherman in the following way:

> Some bays, for example Pålänge and Storön [i.e., Kalix archipelago], have been the best and most trawled areas since trawling started 1960. There has been hard pressure on these bays for over 40 years and they are still the best; this would not be the case if trawling would damage spawning areas (Fisherman, no. 28).[37]

Another fairly common argument among the fishermen is that the vendace resource is special, compared to many other fish resources. This, they seem to know for sure, based on their own and their ancestors' experiences. The argument is that relatively short-lived species are extremely dependent on successful spawning, meaning that once spawning succeeds it is like an explosion, while if it is unsuccessful for a couple of years, the stock will decrease substantially. "We have certainly tried to eradicate the resource during the bad years, by trawling everywhere, but suddenly, there is vendace all over the place, even on the Finnish side of the Bay" (Fisherman, no. 7). "By trawling, we are probably strengthening the 'curve' when the resource goes in a downward direction" (Fisherman, no. 24).

In discussions with fishermen about these issues, they often end up in statements that trawling is not the main reason for resource crisis, and that there are so many uncontrollable factors that affect spawning and that they are not controllable by the fishermen. One example is believed to be changes in the environment and contamination, but, according to some of the fishermen, the authorities do not listen when the fishermen are asking how discharges from different industries affect resources. "It is easier to blame a few coastal fishermen, than a large and influential industry" (Fisherman, no. 3). As pointed out earlier (see Chapter 8), biologists and representatives for the regulatory authorities admit that their ecological knowledge about vendace is incomplete. This incomplete ecological knowledge, together with the previous top-down management structure of bleak-roe fishing, have caused mistrust in the regulatory authorities among some fishermen; or as two of the respondents explain it:

> Surely, it would be great if nature was like the biologist's straight lines and diagrams, but, unfortunately, nature is not functioning like that. They should listen to us who have lived with

[37] As has been shown in Chapter 11, the highest efficiency in the fishery 2003 was, precisely, at the indicated bays in the Kalix archipelago.

> the resource for generations and know its fluctuations, instead of making general regulations for the whole country (Fisherman, no. 8).

> I do not understand the purpose of the authorities' interest in statistics and histograms, because, all, so-called, "new" information in this material we knew about at least two years earlier. In fishery, this [two years] is a "light year" (Fisherman, no. 14).

To sum up, the trawl fishermen have their own thoughts and "theories" about the behaviour of the vendace resource and the functioning of the ecological system. They are quite united in their opinions and, due to the fast recovery in the resource system, it seems that the fishermen, to a certain extent, were right. Still, the stock is quite small, but has a clear and upward tendency. The spawning has succeeded and catches are currently almost at an "all time high". According to one fisherman, the resource boost is not only a merit of local management.

> To be honest, the increase is not only a result of local management. We did know for sure that the resource was in an upward cycle, since we saw the signs in form of loads of juveniles in our trawls, meaning that the spawning had been successful […] However, the biologists did not understand that (Fisherman, no. 4).

Another respondent expressed 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 that there will be a substantial decrease in a few years. The authorities did not understand that. Quite right, in the 1990s, there was a large decrease in catches […] However, in the late 1990s, when the spawning had succeeded, they wanted to stop the fishery (Fisherman, no. 8).

These two quotations indicate that, because of their ecological knowledge, the fishermen felt confident that they would succeed with local management. Another interpretation of these quotations can be that the resource had recovered also without a local management system. Hence, that the vendace resource already was in an upward cycle.

11.6 The trawl fishermen's view of the future for bleak-roe fishing

As shown in Table 13, due to the improvements in technological efficiency and due to the fluctuating nature of the resource, the trawl fishermen seem to be quite satisfied with the present size of the trawl-group.

Table 13. *Trawl fishermen's opinion about admittance of new members to the trawl-group* (see Appendix).

15. During the last few years, the number of trawl licenses has been substantially reduced. Is this "good" or "bad"? Explain!	•**Good**: 20 = 64.5 % *Comments:* •The earning capacity has increased, we can survive also in bad years – i.e., the number of licenses is on a suitable level now: 12 •The technological effectiveness has increased in trawl fishing: 5 •**Bad**: 0 •**Both good and bad**: 11= 35.5 % *Comments:* •Worry about the recruitment of new commercial fishermen in Norrbotten: 9 •If the trawl group becomes too small, it will be a problem to satisfy the demand for bleak-roe – i.e., a risk that a substitute will take over: 3
16. Should the number of trawl licenses increase when the supply of vendace increases? Why? Why not?	•**Yes**: 8 = 25.8 % *Comments:* •To secure recruitment of young commercial fishermen in the coastal areas in Norrbotten: 8 •**No**: 23 = 74.2 % *Comments:* •To be economically sound also in "bad times", it should be on the same level, i.e., due to the fluctuating nature of the resource: 13 •In some way, the problem with recruiting young commercial fishermen must be solved: 7 •Not before the right to trawl has been expanded for us who already hold a licence: 4
17. How do you look at the fact that commercial fishermen, living outside the County of Norrbotten can apply and receive a trawl license for vendace?	•**Not so good – should be a local resource**: 15 = 48.4 % *Comments:* •It is important to preserve a thriving archipelago community with local fishermen: 7 •Increased risk for over-exploitation: 6 •**It is okay**: 16 = 51.6 % *Comments:* •Emphasised "fairness" – many fishermen from Norrbotten have been fishing in the Baltic Sea (e.g., cod): 10. •Principally, it is okay, but in some way, young people living in coastal communities in Norrbotten should have priority: 8

When discussing the future for trawl-fishing of vendace in Norrbotten and, hence, the future for commercial fishermen in the coastal areas, it often ends up in discussions about the problem of recruiting a new generation of commercial fishermen in these areas. As shown, a majority of the fishermen (approximately 74 percent), are of the opinion that the number of trawl licenses should not increase, even when there is a large increase in the resource system. At the same time, they are worried about the prospects for recruiting a new generation of fishermen. Some of them suggest that,

when a fisherman retires on a pension or when someone quits, young people should have priority when new licenses are issued.

The substantial reduction in trawl licenses that occurred in the late 1990s is considered as good among a majority of the fishermen, because it increased the flexibility in the system. The main arguments are that trawlers have been much more effective and that worse times will come when they must survive. Fishermen have learned 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” (Fisherman no. 14). Furthermore, it is better that the number of licenses is stable, instead of adjusting the number according to the fluctuating nature of the resource. “It is impossible to adjust the number of licenses to the stock and, if this is the case, fishing will be too close to the margins of the stock during the bad years and risking the long-term survival of vendace” (Fisherman, no. 31). Hence, according to another fisherman, the issue can be viewed in the following way:

> Vendace is not an ore deposit with a fixed withdrawal rate. Vendace fluctuates from year to year, and we can take 1,000 tons one year and 3,000 tons another year. We should not make the same mistake again and adapt the number of licenses to the highest point of catch levels, because, when the resource is going down again, the possibility for over-fishing is much higher. We want a reasonable withdrawal, so we can continue to live on the resource in the long-run (Fisherman, no. 19).

All the fishermen who are positive to an increase in licenses (approximately 26 percent) also bring up the issue of securing the recruitment of commercial fishermen in the coastal communities in Norrbotten. Hence, a problem that fishermen appear to be concerned about is that, along with the long-term reduction of licenses, recruiting new and young fishermen has been even more difficult than before.

> All the regulations that have been in force during the last 20 years have totally prevented new business starts, because, no one knows what the conditions will be next year, no one dares to take over after their parents and we are losing an entire generation of fishermen (Fisherman, no. 15).

In recruiting a new generation of trawl fishermen, the economic aspect is also important. According to the president of The Coastal Fishermen's Association in Norrbotten (*Norrbottens Kustfiskareförbund* in Swedish), the costs of establishing a totally new business will be approximately 3 – 4 million SEK in form of a vessel, equipment, storehouse, etc. To succeed in establishing a new business, it is necessary to have the ability to take over from someone who withdraws from fishing. Another alternative would be to inherit the business from relatives. It has been stated that without these abilities, it is almost impossible to set up a new business (Johansson, 2004:7). This circumstance is seen as a threat against the coastal culture of commercial fishermen, and also as a threat against a "thriving archipelago community with local fishermen".

A closely associated problem is the anxiety about the size of the trawl fleet. The fact is that if the trawl group became too small, there will be a problem to satisfy the demand for bleak-roe. If the fishermen cannot satisfy the market demand, there is an obvious risk that already existing substitutes will take over. During the latest resource crisis in the 1990s, fishermen saw this tendency, with imports of, for example, Canadian bleak-roe.

One obvious solution would be to let other actors operate on the action arena. However, the trawl-group is divided on whether it should be possible for fishermen from other counties to receive a trawl-license for vendace. Those who are positive, emphasise "fairness" in their answers, and refer to the fact that a majority of the fishermen have participated in fisheries down in the Baltic, e.g., in cod fisheries. Those who think the recruitment of new fishermen should be internal, express a worry that the resource would become over-exploited if too many fishermen, living outside the county, would participate in bleak-roe fishing. As has been shown in Chapter 9, there are no quotas in bleak-roe fishing. Moreover, there is a "natural" catch limitation in handling vendace catches. To get high quality roe from the fish, every vendace caught must be "squeezed" within 24 hours. Thus, extracting the roe from the fish takes time and, currently, every trawl-fisherman takes care of his own catches – with help from relatives and temporary employed persons.

The argument from the "negative" fishermen is that, as long as bleak-roe fishing is performed by local, small-scale coastal vessels, this puts restrictions on catches. Thus, catches are adapted to the capacity in squeezing.

> In bad times, you spend more hours at sea, and in good times, less hours. 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 (Fisherman, no. 11).

If too many fishermen from other parts of the country participate, there is a risk that another type of fishery will be developed, i.e., an industrial fishery without the same concern for the resource.

> Without the local knowledge and facilities, there is an obvious risk that these [non local] fishermen just try to take as much as possible, and then stow the catch in the cargo space and transport it down south for squeezing under industrial forms (Fisherman, no. 18).

There is a risk that if too many trawlers are acting on the arena, the resource peaks will be "cut off" faster instead of saving for the future (Fisherman, no. 26).

When asked about the biggest threats against future commercial bleak-roe fishing, approximately 52 percent of the respondents mentioned "authorities" in their answers; 45 percent referred to the "environment", while 32 percent mentioned "seals" (Table 14).

Table 14. *Threats against commercial bleak-roe fishery in the future* (see Appendix).

28. What are the biggest threats against commercial bleak-roe fishing in the future?	*Threats mentioned in the answers:* •**Authorities**: 16 = 51.6 % •**Environmental problems**: 13 = 41.9 % •**The boost in seal population**: 11 = 35.5 % •**Difficulties in recruitment of a new generation fishermen**: 8 = 25.8 % •**Other threats**: 4 = 12.9 %

Around 20 percent name other threats and, in that group, difficulties in recruitment of a new generation fishermen is the most frequent answer. As has been frequently emphasised in this chapter, the fact that there is a great uncertainty regarding

management in the future is something that generally worries the fishermen. This view can be summarised by the following quotation:

> Give us the management for some years to come, so we can, in peace and quiet, work onwards to create appropriate forms for a well functioning management system. The authorities must realise that we are the last people on earth who want to kill off the vendace resource; because it is so important economically. We must have the ability to manage the fishery without constantly worrying about that the Board will cancel self-management. It is a resource that requires quick decisions, for example, if there are too many non-matures in a bay, it is important to immediately steer trawling to other bays, and we are the only ones who can do that. Today, we are afraid to open up voluntarily closed areas and, who knows, next year, these bays can be the most suitable for trawling. If we go through the Board, there will always be at least one year's delay in decisions. They [the Board] must have confidence in our ability to make the right decisions (Fisherman, no. 3).

Among the fishermen, there is a worry that if the rules of the game are not fixed for some years in advance they will not dare to make the "right decisions" (Fisherman, no. 16). If they are not fixed, there is a risk that the legitimacy for self management will decrease. Thus, that the fishermen will start to look upon the system as they did on the earlier top-down system and that rule compliance will be the same – more and more infringements of the voluntarily adopted regulations. In the same spirit is the opinion that the fishermen have done their part, and now it is up to the authorities to show if they take local management seriously, or if it is just a "paper tiger" (Fisherman, no. 30). "If we will just have the ability to increase regulations and nothing more, why on earth should we take part and be engaged in management" (Fisherman, no. 4).

According to one respondent (who is a member of the management group), the Board has, due to the high efficiency, been "recommending" a reduction in fishing hours the last few years; something that is believed to be a pure "paper tiger", aimed at satisfying the Board's head office in Gothenburg. The proposed reduction, from 06.00–17.00 to 06.00–15.00, is not believed to affect the fishing at all, but, certainly, it creates irritation among the fishermen. They are aware of the fact that, in essence, the proposal is a "Board decision" (Fisherman, no. 11).

To sum up: the local management system has been working well with responsible users, who have followed their "own" regulations, and who have been

much more engaged in management and in the long-term survival of vendace than before. However, the co-management experiment has taken place in a “positive environment” with a booming resource, and the management system has never been fully “tested” by falling catches, and falling incomes. The fishermen are very aware of the fact that worse times will come again. When this happens, it will not be as a surprise for them, and they will, probably, see the “signs” in nature some years before the anticipated decline and, thus, be prepared. However, when this happens, there will most likely be pressure to open up closed areas again and to release some of the time restrictions; at that time, the system will be fully tested. How will the Board and the collective of fishermen react in such a situation?

The local management system is evaluated and the future for vendace governance is discussed in the next chapter.

12 Evaluating co-management in bleak-roe fishing

As has been described in Chapter 2, in the bleak-roe case, two coupled frames of resilience – which span from individual fish to the human societal-level – can be measured: (1) At the vendace stock level (i.e., ecological level), *resilience* is defined as the ability of the stock to recover from variations in stock size, spawning biomass and reproduction rates – due to the fact that a fish resource is a fluctuating resource, some level of variation is normal as long as central functions are maintained. (2) At the social/institutional level, resilience is evaluated according to the social system's capacity to change, reduce vulnerabilities and support adaptation to meet new ecological, social, and economic circumstances. Thus, social resilience is understood and measured as a matter of *adaptability* and having *transformability* capacity.

Generally, if a governing system "learns" from new knowledge, the adaptability capacity is regarded as good. If the system can reorganise, using this knowledge when new circumstances (social, political and environmental changes) make this necessary, the transformability capacity is also regarded as good. One could expect that, due to the fluctuating nature of fish resources, social-ecological resilience, by necessity, entails ongoing processes of learning-by-doing. In this context, social resilience can be seen as a measurement of governance structures' abilities to adapt and innovate when new conditions make this necessary.

This thesis also concentrate on effectiveness, which is evaluated through economic importance with the presumption that bleak-roe fishing should continue to produce economic value for the trawl fishermen and, thus, contribute to preserving the culture of a coastal fishing fleet in Norrbotten. In this section of the thesis, the question whether the current co-management system is more effective and sustainable *compared to the previous one* is a matter of concern. What improvements have been accomplished, if any, since local management was implemented?

12.1 Social resilience

Certainly, recreational and subsistence bleak-roe fishing possess some fundamental qualities of social resilience. For example, fishermen can easily vary the intensity of

use. In times of decreasing catches, and if a recreational fisherman is not rewarded for his effort, he can always withdraw from fishing. This is exactly what happened in bleak-roe fishing during the 1990s. Thus, the system is, to some extent, quite self-regulated, because, fishermen go ashore when times are bad, and when the resource returns, they enter the arena again. However, after the crises in the 1990s, when catches started to increase, recreational fishermen 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 the new fishing law (1993) which restricted the number of nets for recreational fishing.

Because of the economic importance of bleak-roe for commercial trawl fishermen, the situation is different than for recreational fishermen (Table 15).

Table 15. *The fishermen's pattern of behaviour in times of resource scarcity* (see Appendix).

3. Do you change your fishing (location and effort) in times of scarcity, or do you continue as "usual"?	•**Change, yes**: 26 = 83.9 % •**No change:** 4 = 12.9 % •**Sometimes**: 1 = 3.2 % *Comments:* •Increased effort and change of location during times of resource scarcity, and *vice versa* – i.e., travelling around the coastal areas searching for vendace in bad times: 26 •Changing location (bays) if the share of non-mature vendace is too high: 14 •Decreased effort in good years, because fishermen cannot handle more than a certain amount of vendace – i.e., catch limitation in extracting the roe from the fish: 8

It should be noted, however, that there are some structural characteristics of the governance system that, still, work against social resilience and, hence, ecological resilience. One example is shown in Table 15. Trawl fishermen report that in times of scarcity, they increase their efforts. Over 80 percent say they are flexible and travel around the coastal areas searching for vendace in bad times. When there are plenty of fish to catch, they stay near their "home ports". One respondent expressed this characteristic of bleak-roe fishing as follows:

> After fishing, there is so much work with vendace and, therefore, you try to stay as close to your home port as possible. It is also expensive to be away from your home-port, because, you must transport the catch to your storehouse every day (Fisherman, no. 7).

Another example is the fact that in bad times, fishermen not only increase their effort, but also their time in fishing.

However, the, so-called, “catch limitation” in the handling of catches – a fisherman only catches as much as there is capacity to squeeze – during good years, can be seen as a positive condition in promoting ecological resilience (i.e., increasing buffering capacity) during these years. To reach the catch capacity during bad years, fishermen spend more and more hours on the trawlers to “chase” enough vendace to fill up their handling capacity. With this strategy, fishermen try to catch as much as possible, also when the stock is decreasing, having the effect that the system becomes more and more over-connected and the buffering capacity decreases (cf. Chapter 1). As mentioned earlier, the requirements for obtaining a commercial fishing license (e.g., the rule that fishing must be the main income) contribute to and strengthen this problem by reducing the transformability capacity in the social system. Fishermen who have other incomes and business opportunities, approximately 45 percent (see Appendix, question 4), are “forced” to fish even during bad years if they want to keep their licenses. This fact is still affecting social resilience negatively.

In the present-day situation, all trawl fishermen participate in other types of fisheries, e.g., salmon and whitefish, which means that if bleak-roe fishing is not working well, they can put more effort in other fisheries. “It is lucky that I had decent incomes from the salmon fishery during the bad bleak-roe years. Otherwise, I had not survived” (Fisherman, 12). Notwithstanding the fact that bleak-roe fishing is the most economically important fishery, the fishermen in Norrbotten can still (supported by the rule about “main income”) alternate and put more or less emphasis in different fisheries (and species), depending on the supply. If this had not been the case, there would certainly have been an even higher pressure on the resource during the bad years. However, this was a problem also before local management was implemented. The issue of concern in this chapter, is to analyse whether there has been any improvements in comparison with the former management system, which was a system that did not involve any fishermen in the decision-making process.

As emphasised, one can note an increased engagement and concern (collective rationality) for the resource among the fishermen. This has been accomplished in association with quick decision-making on the local level; something that is proof of a better adaptiveness in the social system. The trawl-group's self-imposed regulations, together with the law, govern the day-to-day decisions in the fishery. These regulations are more compatible with the special circumstances and local conditions of the vendace resource, compared to the previous type of governance. One positive result of these self-imposed regulations is that fishermen change bays if they get to many non-mature vendace. Obviously, fishermen have the capacity of making such adjustments. "We, who spend so much time out at sea, can see where you should trawl or not, and with self-management, we can call off a bay one day and, as a result, no one is trawling in that bay the next day" (Fisherman, no. 15).

The new management system has been able to make significant quick decisions when this has been necessary, for example, regarding adjustments of trawling areas when the shares of non-matures were found to be too high.

Based on the interviews among fishermen and with representatives from the authorities, one can conclude that, currently, there is an ongoing process of discussions to improve the fishery. This process involves a dialogue among the fishermen, and between the fishermen and representatives of the Board's office in Luleå, as well as with biologists at the Board of Fisheries Research Institute. The possibility for fishermen to test and impose restrictions, in accordance with their local knowledge, instead of obeying general regulations from central authorities, also contributes to the resource system's ability to quickly handle disruptions and new ecological conditions.

When it comes to social resilience, one should also note that the current management process also involves repeated tests to get better selection panels on the trawls and, accordingly, saving non-matures in the fishery. All this can be seen as an *increased learning-by-doing capacity* (i.e., adaptive capacity) which is essential in promoting social resilience. Consequently, on the level of operational rules (cf. Chapter 7), the adaptive capacity has been improved. To some extent, the governing

authorities actually re-organised in connection with the crisis in the 1990s and made necessary institutional changes (i.e., transformability capacity). They changed the rules of the game and reduced the number of trawl-teams and implemented a co-management scheme. The reduction in trawl-teams seems to have been an almost necessary condition to succeed with local management – i.e., according to the trawl fishermen, the present number of trawl-teams is in harmony with the technological improvements and the fluctuating nature of the resource (see Table 13, in Chapter 11). Thus, since the year 2000, the abilities to adapt and innovate, also on the constitutional-choice (fishermen are accepted as a legitimate part of the system) and collective-choice (fishermen participate in the decision-making process) levels (cf. Chapter 7) have been improved. To sum up, it can be concluded that *social resilience has increased since the new co-management system was implemented*.

12.2 Ecological resilience and effectiveness

Through which mechanisms has the new management system affected ecological resilience and effectiveness? That is the topic of this section of the thesis. As has been noted, the negative trend in the total stock of vendace has come to a standstill and, the resource stock has slowly begun to increase. There has been a boost in catches the last few years, which indicates that spawning has been successful, but, even if it has been slightly improved, catches still consist of too many juveniles, while the mean age of the stock is too low. All experts agree, that without an adequate age structure, the stock is more vulnerable to disturbances, shocks and ecological changes – i.e., "connectedness" and "potential" are low (cf. Figure 2 in Chapter 1). However, compared to the situation in the late 1990s, the recent development goes in the right direction. The work with selection panels continues and some progress has been made. If the development of selection panels on the trawls continues and is successful, resilience will probably increase even more as an effect of the policy of "saving" non-matures in the sea. The high share of non-matures and the relatively low mean age, might also be seen as an indication of a well-functioning ecological system, measured as one with successful spawning. The

increased concern – from both the authorities and the fishermen – about how surrounding factors are believed to affect the resource is also notable. As has been described in Chapter 1, although human catch levels affect fish populations, many other factors do so as well, e.g., shifts in water temperature and salinity levels, as well as contaminations (cf. the notion of "panarchy" in Chapter 1).

The number of trawl-teams has been reduced. The consequence of this change is that, during the "good years", when there are plenty of fish to be caught, there are fewer teams that just catch the amount of fish they can handle (i.e., squeezing capacity), thus, leaving more vendace in the sea. During the "bad years", the number of teams that are "chasing" around in the archipelago to reach their catch capacity has been reduced. The reduction of trawl areas that was implemented by local management has resulted in an extension of "untouched" areas, where vendace can spawn and grow up. This will improve the age structure in the vendace stock. It is noteworthy that these areas are almost the same as the ones that the Board wanted to impose restrictions on in 2000. As has been described earlier (Chapter 11), when these restrictions were implemented by the fishermen, instead of by the authorities, the inclination to follow them was much higher. Even though ecological resilience is the matter of concern, it must be stressed that higher rule-obedience definitely will affect the resource stock in a positive direction. As has been demonstrated in previous chapters, in a fishery involving state property, like the vendace fishery, there is always a risk that the resource will be treated as an open access system with negative consequences for the resource stock.[38] Therefore, to avoid this risk, better legitimacy for rules is particularly important.

Together, all these factors indicate that the buffer capacity has increased in the system, and, compared to the situation in the late 1990s, not only social resilience, but also *ecological resilience has been improved*.

Also the *economic effectiveness* has been considerably improved since 1999, and, nowadays, the catches are almost "all-time high" in bleak-roe fishing (see

[38] Compare the discussion in Chapter 5 about "CPR dilemmas" and property rights.

Chapter 11). Still, the bleak-roe fishery is definitely of vital importance for the economic survival of commercial fishermen in Norrbotten. Thus, it can be concluded that the system is *effective* in the sense that it continues to generate stable incomes for the commercial fishermen in Norrbotten.

Figure 16 contains a summary of the analysis of changes in the social-ecological system since co-management was implemented.

Table 16. *The development in the social-ecological system for the vendace resource since the late 1990s.*

The development in the social-ecological system for the vendace resource since the late 1990s	
Sustainability ↗	
Ecological resilience	The resource stock has started to increase and there has been a slight improvement in age structure. Spawning has been successful. A decrease in trawl-areas and in trawl-teams. Ecological resilience – i.e., buffering capacity in the ecological system - has increased.
Social resilience	Increased engagement and concern (collective rationality). Quick decisions on the operational level and according to local conditions. Increased co-operation between the authorities and fishermen. Ongoing learning-by-doing process. Thus, a positive development in the adaptive capacity. Closed trawl-areas and a reduction in trawl-teams – i.e., an increase in transformability capacity.
Effectiveness ↗	
The economic importance	Catches are almost “all-time high”.

The next step in this analysis is to deliberate on the question why resilience and effectiveness have been improved, and to analyse the mechanisms through which institutional changes have affected resilience and effectiveness. With reference to the IAD framework (see Chapter 7), it will be analysed how, and through what means the *action arena* of bleak-roe fishery has been affected. This final part of the chapter is aimed at establishing a last foundation for the concluding discussion in the subsequent, final chapter of this thesis.

12.3 The action arena of vendace fishery; an analysis of the causes of improvements in resilience and effectiveness?

At this junction of the thesis, it is clear that the increase in sustainability and effectiveness since the 1990s is a result of: *(1) successful spawning for several years; (2) the local management system that has promoted collective action within the group of trawl fishermen; and, (3) the reduction in trawl teams and in trawl areas*.

Through which means has this development been accomplished? The increase in collective action has resulted in more engagement and more adherences to rules and regulations among the fishermen. Thus, they look further than just on today's catches. If the Board alone had imposed the restrictions in trawl areas without the current co-management system, it is debatable whether the restrictions would have had any effect. Without the legitimacy of regulations that local management gave rise to, and with regard to the reactions among the fishermen when these restrictions were once presented, the legitimacy would have been very low and the costs for monitoring (transaction costs) would have been very high (cf. Chapters 5 and 7).

A natural resource, like vendace, can be seen as a "moving target" that is constantly changing. This, in turn, puts pressure on the governance system to be adaptive and flexible, on one hand, and, stable enough to be able to enjoy legitimacy among the stakeholders involved, on the other hand. Thus, besides being adaptable to ecological conditions, a governance system for a natural resource, like vendace, must support learning-by-doing, create trust, and enable collective action and economic gain for the users. Consequently, any positive development is the result of coping with the fluctuating nature of the vendace resource and the qualities of the governance system. When it comes to vendace, this is not only a result of local management, but also a result of the Board's authority, especially its decision to reduce the number of trawl licenses, which made the pre-conditions for succeeding with co-management advantageous.

However, the only formal change that has been made is that the trawl group has received the "right to impose further sanctions". How can one explain that such "small formal changes" in governance can affect the performance to such an extent?

12.3.1 Homogeneity among the group of resource users

As should have been obvious, the *attributes of community* have changed considerably since the 1990s. After the extensive reduction in recreational/subsistence fishing, and the reduction in trawl licenses, the user group is smaller and rather homogenous. The reduction of trawl licenses by the Board in the 1990s, has affected the institutional performance in a positive way. With a smaller and more homogenous group of appropriators, it was a good start for local management. If the group would have been too large, it had, probably, been very difficult for the local management system to reduce the number of licenses among its own members.

An overwhelming majority of the fishermen are of the opinion that subsistence/recreational bleak-roe fishing does not affect the trawl fishery at all, which means, that no other group is competing with the trawl fishermen on the arena. A conclusion that can be drawn from the interviews is that, nowadays, the trawl group seems to have a rather united view of bleak-roe fishing, both regarding the earlier and the present system, as well as its view of a future governance system. To most questions, the fishermen's answers are almost identical, and no major diversity can be seen in answers from respondents in different geographical areas. It has been argued that opinions would differ quite a lot between, for example, the fishermen in the Luleå/Piteå area and fishermen in the Kalix/Haparanda area in their views on management and on the resource. For instance, it has been argued, that fishermen in the Luleå/Piteå area, historically, have been more favourably disposed towards the Board and towards central regulations than the fishermen farther north (Sandström et al., 2002). This difference is not verified by the interviews; fishermen have quite a similar opinion in almost all questions. The only really contested question is the right to impose sanctions but, regarding this issue, fishermen are equally divided in all municipalities. There are, for example, no differences in the answers between fishermen in Luleå and Haparanda – they are equally positive, or negative.

12.3.2 Increased social capital and learning-by-doing capacities

Compared to the situation in the 1990s, there are currently more contacts, face-to-face communication and co-operation between the users. Thus, there has been an increase in social capital. Generally, high levels of social capital lower the transaction costs of working together, "people have the confidence to invest in collective activities, knowing that others will do so too" (Pretty, 2003:1912). This has definitely been the case in bleak-roe fishing. As has been demonstrated, fishermen's own rules are regarded as "holy" and breaking them raises an "outcry" – i.e., trust and rule compliance within the system have increased. There is also a higher awareness and engagement for resource conservation, and for sustaining non-matures for future fishing. This development is remarkable, due to the long history of centralised top-down management by the state. Earlier, the governance system generated few incentives for fishermen to engage in management, or in resource conservation. The bleak-roe case shows that, if operational rules are implemented with bottom-up, instead of top-down processes, it is possible to build a functioning co-management structure also in a society without any recent historical experience of local management.

The willingness to impose and follow regulations is much higher with bottom-up approaches. In trawling for vendace, new regulations have always been implemented with top-down approaches. Before the co-management project was initiated, the trawl fishermen reacted very strongly to the proposal from the Board to impose further restrictions in 2000. As has been emphasised before, when the fishermen had their own management, they implemented more or less the same restrictions as the ones so loudly criticised before. The difference was that the trawl fishermen accepted these restrictions as they had been allowed to participate in the development and implementation of them.

When it comes to the issue of learning-by-doing, it should also be emphasised that the user-group consists of trawl fishermen from the whole county, which is a vast area. Together, they make up a group, the members of which, previously, had not been closely associated, such as through social events and co-operation.

Traditionally, there has been a stronger unity between fishermen within each municipality than on a county basis. Commercial trawl fishermen have only been associated more closely because of their strong dependence on vendace for the economic survival as fishermen. As such, they make up a, so-called, "functional group" – i.e., gear-based group – that shares a technology, as opposed to "territorial groups" which share a history and "future of a local community" (Jentoft et al., 1998:430).[39]

All this implies that, contrary to the "tragedy scenario", if the group of resource users is homogenous, small, and with fairly clearly defined boundaries, and, if the ecological resource is mostly non-migratory, the "game of fishing" can be viewed as a repeated game with uncertainty (cf. Chapter 4). Thus, bleak-roe fishing is a game where the players might learn how to act to achieve collective goals. The ecological knowledge about the vendace resource among biologists and researchers is not complete; nor is this knowledge inherent in the local group of fishermen. But, as the vendace case demonstrates, both might have a constructive and important role to play. It has been verified that relations with the Board's Office in Luleå and with the responsible biologist at the Board's Coastal Research Institute have improved. This might be an excellent start to create a fruitful long-term co-operation between the fishermen and the authorities. Through increased engagement and co-operation, also between authorities and fishermen, important knowledge has, to some extent, been practised, for example, demonstrated by the trawl-group's testing of different selection panels and their change of bays when new ecological conditions so require. All this can be seen as important parts of a learning-by-doing process, which serve as building blocks for further adaptive management of the vendace resource (cf. Chapter 1).

The bleak-roe case demonstrates, that once a group of users gets the appropriate incentives from the authorities – in this case, permission to participate in

[39]A functional group differs from the "classical" successful common-property regimes, in pre-industrial and developing societies, where the resource users often live in the same village and are not as much "nested" in the surrounding institutional environment, as a user group in a modern and complex society like Sweden (see Chapters 1 and 6).

bottom-up processes for implementing operational rules – this might promote collective action, also in a system with a tradition of top-down government. In the initial stage of the new "bleak-roe game", it has obviously been enough to have "the right to impose further sanctions" to encourage co-operation and engagement within the group. This should be compared with the former "classic top-down government environment", where the game was more of a "one-shot", "tragedy scenario" type (cf. Chapter 9).

12.3.3 Rules-in-use and monitoring

Bleak-roe fishing is formally regulated by the government, with its authority delegated to the Board in Gothenburg, and the collective-choice rules, as well as the constitutional-choice rules, are within the authorities' responsibility (cf. Chapter 7). Formally, also the operational rules are within the responsibilities of the Board. However, in practice, and as long as they work within the law, the fishermen design their own operational rules. The trawl fishermen are allowed to impose further restrictions (i.e., in "time" and in trawl-areas), but can not modify the regulations that are stipulated in the fishing law. Together with this law, the self-imposed regulations govern the day-to-day decisions in the fishery and, according to the fishermen; these regulations are currently more compatible with the special circumstances and local conditions of the vendace resource than previous regulations were. As a result, they respect and follow their "own" rules to a much higher extent than rules imposed by the authorities.

The *rules-in-use*, which currently govern the bleak-roe fishery, accordingly, are these self-imposed operational rules *together* with the rules of law. The fact that their own rules have high legitimacy among the fishermen was clearly demonstrated in the "incident" during the fishery of 2003, but, the ultimately test of the current co-management system will be the day they try to open up closed areas for trawling, or the next time there will be a resource crisis and the group must impose extensive regulations and perhaps take further and more radical steps. It is much easier to govern a fishery when the resource has an upward tendency.

Even though individual fishermen and officials might have had doubts about the idea of local management before it was implemented, the boost in catches has made this easier to accept, and to develop legitimacy for the new management system. Hence, the system is, partly, legitimated by its success (Van Kersbergen and Van Waarden, 2004). However, the developments in collective action, engagement and concern, have increased the likelihood that the system will function properly – also in bad times.

While *monitoring* still is a responsibility of the authorities (i.e., the Swedish Coast Guard), no one has the formal responsibility for monitoring the restrictions that have been imposed by the local management. In practice, these restrictions are monitored by the fishermen themselves. The trawl fishermen seem to be a group that "checks" each other very well and, they all know each other, as well as what is happening within the group. Obviously, this internal monitoring system functioned very well in the "incident" 2003. Hence, one can say that the local management system has passed the "first test", by handling the infringement in the fishery 2003 in accordance with Ostrom's fifth principle – *graduated sanctions* (see Chapter 6). Thus, the users who infringed on operational rules are likely to get graduated sanctions from other users. At the start, the level of sanctions used is often very low, but the level increases when this becomes necessary. Obviously, a "heated" discussion was sufficient to stop further violations in bleak-roe fishing in 2003. Fishermen also give witness to the existence of "social pressure", which has the effect that anyone of the trawl fishermen who violates their "own" rules must take into account the social cost of this behaviour. Cheating on your colleagues has a price in terms of distrust and the risk of being regarded as "an outsider" in the collective of fishermen. To the extent that this "informal system" is functioning, the trawl fishermen in the vendace system constitute a group which easily can prevent free-riding by monitoring and "checking" each other, also in relation to other issues. The fishermen also emphasise, that to solve problems that constantly pop up, they currently discuss more with each other than before.

In the previous discussion, it has been indicated that the experiment with local management can be labelled as a form of co-management system. However, such systems, characterised by power-sharing between a group of users (e.g., trawl fishermen) and the State (e.g., the National Board of Fisheries), make up a wide spectrum. Co-management includes instances of nearly full community control (i.e., minimal state involvement) to nearly full government control (Berkes et al., 2001). The bleak-roe case, obviously, is a system with nearly full government control. The next step in the analysis is to discuss how this co-management system might be improved further.

12.4 How to improve the governance system for vendace?

The role of the overarching governance structures is central in the functioning of CPRs and fishery management – e.g., the kind of incentives that are generated by the governance structures. Co-management can be a useful strategy to shape and implement policy, but it is not an end in itself, and should be judged after its institutional performance; whether particular arrangements lower transaction costs and raise resilience and effectiveness in the resource system (Imperial and Hennessey, 2000). However, co-management as a type of governance structure is also in accordance with the EU's principle of subsidarity, which stipulates that the authority should be delegated to the lowest competent level of governance (Gray and Hatchard, 2003).

As has been emphasised in Chapter 1, there is not one governance structure that is best for all resources. This study shows that the likelihood of "succeeding" in promoting collective action is much higher if rules are implemented with bottom-up processes. Decentralised empowerment and "street-level" participation, accordingly, are very important in policy making and in the implementation of rules in governance of CPRs. Lipsky (1980) argues that lower levels of bureaucracy – "street-level bureaucracy" – are central to effective functioning in organisations. However, Lipsky's view reflects a view that sees effective functioning in the perspective of implementing policy and regulations "from above", i.e., top-down government. The

bleak-roe case challenges this attitude. Local officials do play an important role in bleak-roe management, but, only emphasising street-level bureaucracy is not enough. The determining factor in this case has been the participation of fishermen, thus, the "street-level participation" (i.e., bottom-up governance). Thus, local officials and fishermen do not distort or reinterpret central rules or regulations; they improve them, in the sense that they form a new system that fits and meets ecological, as well as other "local" circumstances. It has already been demonstrated that collective action, resilience, adaptiveness and transformability are promoted, when the fishermen take an active and constructive role. In the words of Stiglitz, "to a large extent, they need to be in the driver's seat" (Stiglitz, 1999:9).

In building new management systems, the most fundamental question, perhaps, is: which components of the old system "are worth saving" (Peters, 1996:13). It would be easy to argue that if the trawl fishermen want more power – "let them run the fishery entirely by themselves". Unfortunately, the question is more complicated than that. In a fishery with a tradition of extensive state management, there are, according to Jentoft (2004b:4), a number of reasons, why there should be some form of continuation of state involvement. Applied to the vendace case, these could be described as follows:

- Firstly, in a country like Sweden, fish stocks are, to a great extent, owned by the public. With a long tradition of subsistence and recreational fishing, and with a tradition of relatively free access to fish resources, there is a public interest in fisheries management and stock conservation in Sweden. The public might wish to have "a say" in management of vendace, and is up to the State to uphold this interest. It is reasonable to assume that, for example, trawl fishermen in Norrbotten only look out for their own interests and concerns, while the public might have broader interests. Thus, the collective good for the group of trawl fishermen might collide with those of the public.
- Secondly, in a complex modern society, institutions are nested in each other. To function effectively with its surroundings, the State can offer legislative powers, financial resources (e.g., subsidies) and research expertise (e.g., the

analysis of samples in bleak-roe fishing). Management is, to various degrees, dependent upon these factors, and, in the long run, management cannot function effectively without this support.

- Thirdly, while "fisheries management intervenes in social relationships and processes of some complexity" (ibid), a democratic state has a mission to help uphold an equitable and just democratic process in the management system. If a user group would be independent of the State, "there is no guarantee that user groups would be able to live up to such noble principles. There is evidence that local fisheries management in some instances are repressive, unjust and ineffective in conflict resolution, and that traditional authority can sometimes be illegitimate and undemocratic. A democratic state can help to avoid fisheries management becoming victim of such tendencies" (Jentoft, 2004b:4). It is important to bear in mind that there is never any guarantee that a "democratic state" will uphold these "noble" principles. For instance, the authority must be subject to public control of the system. Generally, officials should also be cautious in imposing norms and values for internal processes.

As shown above, it would be difficult, or even impossible, for the trawl fishermen to manage the resource without the State. As indicated in Ostrom's last three design principles, the support and co-operation of the authorities are required.

While fishermen might benefit from the State, the vendace case shows that, also with "favourable" conditions for top-down government, the State cannot successfully manage the vendace resource without the participation of the fishermen. A partnership between authorities and the fishermen – co-management – is needed and has indeed already, to some extent, been implemented in bleak-roe fishing.

> Co-management […] allows local groups to take advantage of specific local management opportunities and address specific local concerns. Co-management reduces conflicts between government and fishermen and among fishermen's groups by involving fishermen in enforcement and the development of overall policies which benefits them as well as the resource (Pinkerton, 1989:30).

Local management of vendace is constructed in such a way that the State is the *de facto* holder of all legal rights. There is a regular exchange of information between

the Board (data gathering: statistical and biological information/analysis regarding the status of the stock, the share of non-matures, etc.) and the fishermen (data gathering and information regarding regulations and performance, etc.). This can be labelled as "capacity building", defined as "the sum of efforts needed to nurture, enhance, and utilize the skills and capabilities of people and institutions at all levels" (Berkes, 2002:299).

Capacity building seeks to develop the capacity within fisheries to resolve their own problems, and to increase the effectiveness of management performance, as well as to improve the quality of resource management. In bleak-roe fishing, representatives from the authorities participate in meetings with the management group and give information on biological data and on other relevant news. Both fishermen and the authorities are involved in the development work with selection panels. Hence, a form of "joint group" is formed, where trawl fishermen in co-operation with researchers (at the Board's Coastal Research Office) and officials manage bleak-roe fishing at the operational level.

This co-operation can be seen as a network that has the qualities of an "epistemic community". This means that it is a network of "professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area" (Haas, 1992:3). An epistemic community can lay the groundwork for a broader acceptance of the ideas and beliefs about a proper functioning of the vendace system. This has also been the case in bleak-roe fishing. Currently, many fishermen are more concerned and engaged than before, and they also express a long-term view of the resource. In times of scarcity, there might be an opportunity for this "joint group" to present new alternatives that can be adopted and accepted both by the fishermen and the authorities.

It is known that when fishermen's knowledge is given more attention, this can also improve the data sets and research. Still, however, scientists, officials and fishermen have different opinions regarding many questions, for example, regarding the cause of the resource crisis in late 1990s, how trawling affects spawning areas and

the resource, how biological data should be interpreted, etc. The ongoing *process* of co-operation in management might, however, result in a more well-defined and well-functioning system in the future. As time passes, fishermen and officials might find and re-define their positions and obligations. A result of this process can be a larger amount of shared norms or, at least, a better mutual understanding in the future. The face-to-face contacts between authorities and fishermen help to define such relationships between state and society (Peters, 1996).

In this thesis, co-management is, thus, understood as a "continuous problem-solving *process,* rather than a fixed state…" (Carlsson and Berkes, 2003). As the vendace case has demonstrated, management and, particularly co-management, of a CPR, is a more complex and complicated process than might be concluded from just analysing the formal aspects and the sharing of power between official authorities and fishermen. One should agree with Carlsson and Berkes that "power-sharing is the *result*, and not the starting point, of the process" (Carlsson and Berkes, 2003). Understanding a co-management system as an ongoing, adaptive learning-by-doing process, instead of focusing on formal structures, strengthens the argument that ecosystem management requires a multi-level approach to match social and ecological structures and processes operating at different scales (Olsson, 2003:21).

This view of co-management, as a learning-by-doing process, where power-sharing is the result, and not the starting point, is definitely applicable to bleak-roe management. The development in bleak-roe management can be seen as a process where the authorities themselves were provided an alternative way to manage the resource that "fitted" into the already existing government structure. A critical view of the process could be that implementing the discussed co-management scheme was just a desperate, but suitable way, to cope with a resource crisis by passing responsibility to the fishermen, while relieving the Board of full responsibility. If the downward trend had continued, there would certainly have been extensive criticism directed at governmental authorities and officials from the fishermen, the public, and from local politicians. Thus, not only fishermen benefit from the success in management. The Board has "solved" a serious resource crisis problem and has been

innovative in implementing a new management system. This system is adapted to an already existing institutional arrangement. Hence, the existing governance structure will continue to dominate. Only minor adjustments were required to satisfy the fishermen at the start, while the authorities have secured their "turf". However, to secure the future, the process must go on: "government must not only foster conditions for fisher participation but sustain it" (Pomeroy, 2003:248). In the absence of an appropriate legal basis, the system can be "undermined".

With reference to the discussion about the short-comings of the current co-management system, it can be assumed that the system needs more far-reaching rule changes to function effectively in the future: "The successful exercise of rights on one level depends on the exercise of rights at higher and lower levels" (Pinkerton, 2003:75). It is also important to create a more stable and long-term governance system for the local management group to function in. To support co-management – laws, policies and administrative routines have to change:

> If co-management initiatives are to be successful, basic issues of government legislation and policy to establish supportive legal rights and authority frameworks must be addressed (Pomeroy and Berkes, 1997:465).

With these changes, the system would have the prerequisites of becoming more flexible and adaptive – hence, resilience would increase and legitimacy continues to be high. This is important, because we know for sure that there will be good and bad years also in the future and when the bad years come, the system must be prepared. Without high legitimacy, trust in regulations, flexibility and adaptiveness, the capability to deal with future problems will be uncertain. This is a general problem for many types of policy areas. If regulations are almost impossible to abolish, or if they stay unchanged for a very long period of time, this might indicate that the governance system might be too inflexible and inappropriate to regulate the dynamic environment of a fluctuating non-linear resource like vendace. If this is the case for vendace, the answer is perhaps, that the current government system entails local management (i.e., the governance system), resists fundamental change and will

uphold the “old structure” for own gains and purposes, such as to secure professional and scientific competence.

As described in this section, co-management is a process and, in the next section, it is discussed what has to be done in the next step of the processes.

12.5 Problems that need to be solved

The previous discussion can be summarised in the following way: *Firstly*, a major problem that has to be solved is the question of right to impose sanctions. To function effectively in the long-run, the local management system should have some form of conflict-resolution mechanism for discussing and resolving what constitutes an infraction, and what type of sanction different sorts of rule-breaking behaviour would bring about (cf. Ostrom’s design principle “conflict resolution mechanisms”). If more infractions were to happen, and the local management has no formal right to impose sanctions, there is a possibility and a risk that the legitimacy of the trawl-group’s own rules could be eroded rather quickly. Thus, that the fishermen would fall back to their “old behaviour”: an individual catch-maximising strategy and without looking at the collective rational behaviour in the long-run.

In the future, *a second key issue*, in the same context, *will be how to regulate access to the vendace resource;* by selling and buying memberships, or by majority decisions? These rules must be fixed; if not, the question of membership might be a major threat against the unity and co-operation within the group. If access would be regulated by, for example, majority decisions or by “selling and buying”, this might provide a solution to the striking fact that the Swedish law actually puts pressure on the commercial fishermen to overexploit fish resources in times of scarcity. Even though the role of adaptiveness and transformability capacities has been emphasised in this thesis, to function over time, it is also important that the institutional setting provides stable working and behavioural conditions for the fishermen. Thus, *“the rules of the game” must be settled*. An appropriate governance structure could resolve the paradox of flexibility and adaptiveness and, the same time promote stability in institutions (cf. Chapter 3). Thus, if the local management system would have

influence over access rights and licenses, fishermen do not have to face pressure to harvest also in "bad years". In addition, if fishermen would also be given the responsibility of monitoring the resource, while enjoying support from the authorities in imposing sanctions, this would promote flexibility and stability. With an institutional setting that is perceived as legitimate, stable and fair, the transaction costs will be lower (cf. Chapter 5 and 7).

Thirdly, if the fishermen want more power, they must also be prepared for, and willing to take, more responsibility. It is important to bear in mind that fishermen in Sweden, for a very long period of time, have worked within a system where the State has been taking the full responsibility for implementation and supervision of rules. As has been shown, this has created an "atmosphere" among many of the fishermen, where it is "okay" with rule-breaking behaviour, as long as one is cheating the State. In some interviews, the answers from the fishermen are incoherent in the sense that they argue that the resource crisis in the 1990s was not because of trawling, while the increase was an effect of local management (e.g., that the "boom" was partly due to the quick decisions to change bays). This "strategic thinking", indicates that these fishermen easily learn when a certain attitude fits their own interests. This behaviour must be overcome for co-management with more "fisherman power" to function satisfactorily. However, the experience with successful collective action can, hopefully, function as a provider of important social capital that might be used to overcome this form of strategic behaviour. Thus, the conclusion is, that with other incentives and with increased legitimacy and trust for governance, this behaviour will decrease.

Fourthly, without an overarching view of the governance system, the system will be incomplete and not function properly. This is a problem for those involved in the bleak-roe fishing. *So far, the experiment with a local management system is performed on an operational level only, without appropriate changes of rules on other levels* (cf. Ostrom's design principle "collective-choice arrangements"). The only changes that have been made are that the fishermen have got the right to impose more restrictions on an operational level, but, there are no legal frameworks that

support them in their work. The authorities have kept an eye on almost all decisions, and the fishermen report that they feel a pressure to "make the right choices". In many of the interviews, one can read between the lines that, at the moment, there is something of a "moment of truth" for the management system. If more power and responsibility will not be delegated to the fishermen, the legitimacy of the management system will be reduced; with an obvious risk that the inclination to follow rules also will decline. The increasing dissatisfaction over the lack of independence and power-sharing in the vendace system indicates that the fishermen also have to be represented in policy making on a longer-term level, not only on the day-to-day operational level. Experience worldwide has shown that "real" participation increases awareness and appreciation of important issues and contributes to improved management (Lane and Stephenson, 2000:390).

Fundamental policy changes might have political costs that the authorities are unwilling to incur, such as a debate whether a group of commercial fishermen should have the right to govern a valuable natural resource by themselves. This could easily result in discussions, e.g., "should the profit-maximising trawl-fishermen who almost killed off the resource in the 1990s, manage the resource by themselves". In itself, such a conflict would raise transaction costs. Also transactions costs having to do with "turf guarding" (cf. Chapter 7) may affect the authorities' willingness to give up policy-making on the operational level.

Fifthly, another overarching governance problem is that *the vendace resource is still mainly managed with a single-species approach* (cf. Chapter 1). However, all the trawl fishermen also participate in other local fisheries. Therefore, one can assume that they are in a fairly good position to get an appropriate overview of the whole ecological system. This knowledge will be needed if the co-management system should also incorporate management of other resources in the future. Not only fish species are important in this context; the increasing seal population affects the social-ecological system and, could be a matter of concern for co-management. However, the "technical solutions" and "policy problems" in creating such a management system is not a matter of concern for this thesis.

To sum up, and with reference to the title of this thesis, the pyramid (i.e., the top-down government system) has not been “flipped”, it has just been “shaken”.

13 Conclusions

In the second chapter, the aims of this thesis were specified, namely, to contribute to the development of a better understanding of governance in a relatively small and clearly defined, but complex, common-pool resource system. It was also stated that the thesis aims at providing insights about how different governance strategies affect individual user's incentives, and the adaptive capacity of different management systems. These aims were specified into five research questions:

1. How could a resource crisis occur for a resource like vendace, despite heavy state regulation, formal central control, access to scientific knowledge, and in an industrialised society without corruption?
2. What are the consequences of the changes in governance implemented in the year 2000?
3. Has this new governance strategy for vendace been successful in the sense that it has promoted collective action among the fishermen and produced a more sustainable and effective fishery?
4. In terms of governance of a common-pool resource in a complex, diverse and modern society; what kind of governance system is suitable for a resource like vendace?
5. What are the general implications of this case for management of coastal fisheries?

The answers to these questions can be summarised as follows:

1. Shortcomings in governance system, i.e., the system generated catch-maximising incentives among the fishermen and were too static and inflexible (lack of adaptive and transformability capacities) to cope with the fluctuating nature of the vendace resource. This explains the severeness of the resource crisis that happened in the 1990s.
2. In the year 2000, a refined co-management system was implemented. Althougt it represents a minor change in governance structure, it has, however, caused

major changes in strategies and, accordingly, the performance in the vendace system.

3. The current co-management system has promoted collective action among the fishermen, and a more sustainable and effective fishery. The boost in the resource system can be explained by: successful spawning for several years; the local management system that promoted collective action and adaptiveness, and; the reduction in trawl-teams (made by the previous management system), and in trawl-areas.
4. To promote an effective and sustainable fishery in the long run, the co-management process should continue. Still, some important questions in the governance system have to be resolved: the "rules of the game" must be settled; the fishermen must be prepared for and willing to take more responsibility, and; to support the co-management project, appropriate rules should be created on other levels than on the operational level only.

The fifth research question, about the general implications of this case, is discussed in the subsequent parts of this chapter.

13.1 The general implications from the bleak-roe case

In this thesis, it has been argued that co-management is, and should be seen, as a process. With this view, the development that has occurred in governance of the vendece system, and the effects of these changes, are likely to be valid also for other CPR systems. This assumption (hypothesis) is illustrated in Figure 21. The dotted line should be understood as the "governance line", which indicates the change in governance, thus, the shift in policy-making procedures, from top-down to bottom-up processes.

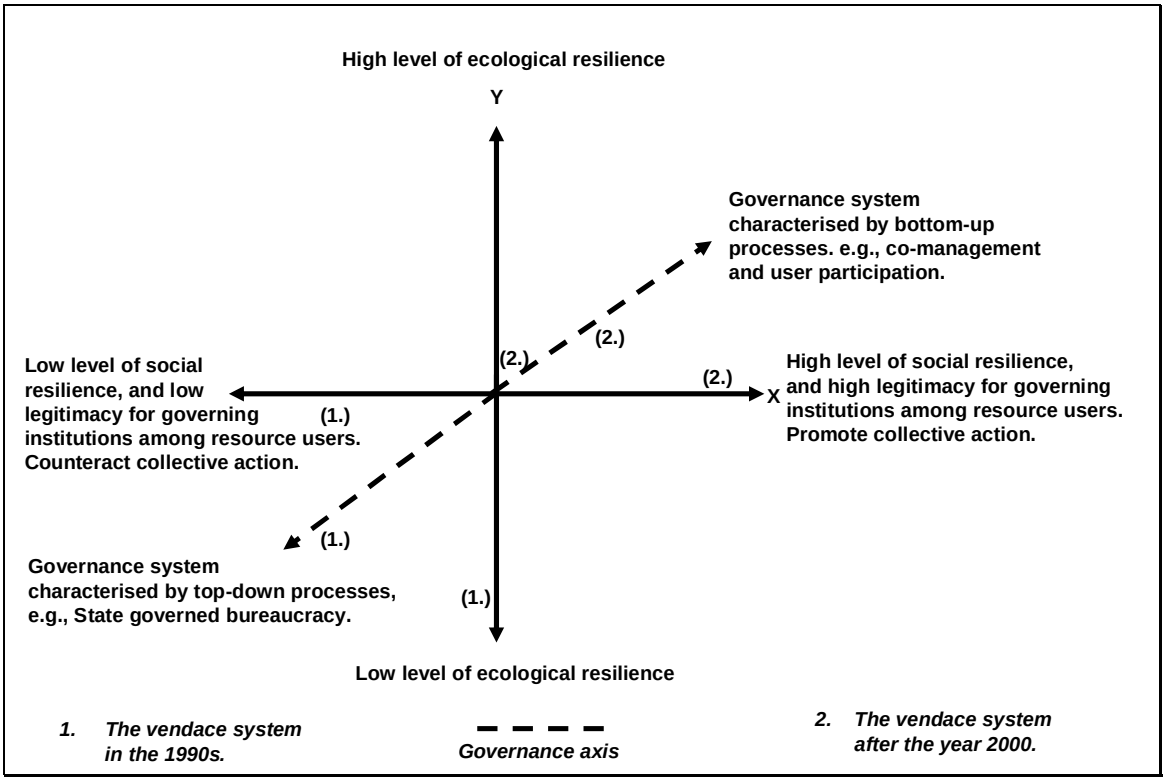

Figure 21. *The relation between governance and social-ecological resilience.*

As has been demonstrated in this study, shifts in governance methods, i.e., movements along the dotted line, affect social and ecological resilience (the X and Y-axes). With an increase in bottom-up processes and user participation, social and ecological resilience increase. Inversely, with more top-down methods and more involvement of state-centred bureaucracy, social and ecological resilience decrease. As has been emphasised through the entire thesis, a fish resource is not a static reserve. Even though the governance structure might be rather fixed, there is a constant movement up and down on the X and Y-axes. For example, since the beginning of the 1970s, although subject to a rather fixed governance structure, the vendace resource has been moving downward on the "ecological resilience axis". This, in turn, has affected the legitimacy of the governing authorities (X-axis) negatively, even without changes in governance. Given that this view of the dynamics between resilience and governance is true, what are the implications for policy-making?

13.1.1 Non-linear processes in governance

If we assume that, in a complex and modern society, where resource use often is just a way to secure incomes, the formal institutional framework generates the incentive structure for resource users. Thus, the shape of, and, the incentives generated by the formal institutional setting, affect the possibility for collective action in the user groups. As this case has shown, the changes along the "governance-line" and, on the X and Y-axes, are not necessarily proportional, but non-linear processes. As has also been demonstrated, fairly small changes in the governance system might affect collective action among resource users in an un-proportional, but positive way. Logically, if the system moves downward in the direction of the dotted arrow, collective action might decrease rather quickly. Without any claims of precision, it can be concluded that changes in governance are likely to affect social resilience more than ecological resilience, i.e., the increase is not believed to be proportional. However, such changes open up possibilities for the Y-axis to "catch up" with the X-axis, i.e., adjustments in social resilience cause changes in ecological resilience.

Another important lesson from the vendace case is the observation that the incentive structure, generated by governance, is never static. Within the framework of the same institutional setting, the incentive structure for participants might change extensively over time. The co-management experiment in bleak-roe governance indicates that if the process does not continue, the gain in social capital that has been created might vanish rather quickly. Without a continuation of the process, the results that have been gained might easily be converted into a hostile attitude towards governance. In such a "frozen" institutional setting, it is reasonable to assume that, over time, the movements on the X-axis will be to the left (i.e., a decreasing social resilience, etc), which, in turn, will affect the Y-axis (ecological resilience) negatively.

A relevant question is, why people should engage and invest time, if they have the feeling that they only "give away", without having the ability to "gain" authority, or expressed by the fishermen in the following way: "we can only impose further restrictions, but nothing more". With regard to the vendace case, the initial happiness

over more responsibility might fade away when fishermen are confronted with the hard reality in their daily work, while managing and trying to unify the group. In the long run, it might be difficult to unify user groups to take part in restrictions when there are few possibilities that anything will be "paid back" to the actors.[40]

The logical argument against this reasoning would be that, for example fishermen, are typically "paid" by increasing catches. However, due to the dynamics of fish resources, worse times will always come, and, experiences world-wide (compare the state of crises in commercial fisheries in general) have shown that, without suitable bottom-up processes, and by just focusing on catch-levels, the possibility to develop social capital and collective action will be small. It is a reasonable assumption that we manage and use our resources according to our perception of the opportunities and our validation of the alternatives at hand. With this assumption, the likelihood to succeed with a co-management system, where some central actors have the feeling that they just have "duties", is not benign in the long-run. For example, in the year 2000, new restrictions in trawl-areas for vendace were put into practice by the fishermen. If these regulations had been implemented with top-down methods, the likelihood of rule compliance had been small. Hence, the importance of bottom-up processes should not be underestimated.

Consequently, not only management, but also the overarching governance structure should be looked upon as an ongoing process with potential learning-by-doing capacities. In the same way that conditions for the ecological system constantly change, the conditions and incentives generated by governance systems do so as well. For example, other compositions of user groups, such as the trawl-group for vendace, might understand the incentives generated by management in another way. For instance, an inflow of fishermen without local knowledge and local connections – presumably with other strategies and incentives – might treat the resource differently. This, in turn, affects the ability to successfully govern the fishery with the existing

[40] Although it has not been the aim of this thesis, the vendace case clearly supports Ostrom's theory, which stipulates that only under particular circumstances are people willing to invest time and effort in trying to create systems for self-governance. Obviously, the vendace case fulfills the criteria (see Ostrom 2001:17 ff. and Stern et al., 2002:456.).

governance system. Thus, the same institutional setting might generate a totally different result, if the composition of user groups (in this case the trawl-group) changes. Other modifications of the "nested institutional" environment that all resource systems are part of, might also give other and unpredictable results. For example, norms and values may change which might challenge existing formal rules and regulations. The inflexibility in governance in changing to new conditions can be seen in many areas in society. The increased acceptance for a "black market in Sweden," for many products (e.g., alcohol, tobacco, craftsman services), as well as the increased acceptance for a "black labour force", are two examples; new values related to the preservation of wildlife, consumption of meat, are others. The possible clashes between new values and existing institutional systems might indicate a governance system that is too static. People's preferences and incentives have changed over time, without an adequate change in governance, which, in turn, affects the legitimacy of regulations negatively. With this development, the "free-rider" problem is obvious, even if an individual, in reality, considers, for example, that hiring a carpenter without paying taxes or illegally catch a protected species of fish, is wrong, the temptation to do so is strong, because, "it wouldn't make any difference if I am the only one acting lawfully".

The complicated issue in governing and for policy makers is, thus, to have a "sensitive ear" for changes in people's preferences and conceptions. As has been argued, and also shown in the bleak-roe case (Figure 21), changes in governance and in preferences are not proportional; they are non-linear processes with uncertain outcomes. In the initial stage, the small formal changes in bleak-roe governance in 2000 meant a large change in collective action, rule compliance and social capital. However, changes in the other direction may be "equally un-proportional". Imagine for example, a shift in bleak-roe governance back to the previous setting; that the National Board of Fisheries would cancel the co-management project. All the trust and co-operation that have been built up between the fishermen and authorities since the year 2000, and perhaps also the trust that existed before the project started, would vanish rather quickly. In such a situation, rule compliance and collective action

would probably fall to a level below the level in the late 1990s. The trust in regulations and authorities would be more or less non-existent. From that point, building up a fruitful co-operation and a sustainable fishery would be almost impossible.

This logic is not only applicable to resource governance, but also to society in general. How much do the taxes on labour, services, alcohol and tobacco have to be lowered before the incentives to "act lawfully" have returned? Presumably, much more than the increases that make the "cup run over" (cf. "thresholds", in Chapter 1) to a non-lawful behaviour. Thus, it is necessary for policymakers to carefully consider what incentives that are generated – in different contexts, for different governing strategies. The same institutional rules can have different effects on performance, depending on which incentives that are generated in regard to the particular user-group in focus. Consequently, general policies and laws for dissimilar resources and user groups will, probably, be insufficient in natural resource management.

13.1.2 "Timing" in implementation

An important aspect of transforming a governance system into a co-management system, that is not commonly discussed in literature, but which has proven to be of significant importance in this case, can be described as "timing". As the vendace case demonstrates, the governing authorities have an important role to play in this process. It is known that co-management processes are often implemented when other forms of management do not work, for example, when conflict among user groups or between user groups and authorities, increases; when regulation effectiveness and rule compliance decrease, and; when transaction costs of management are too high. Such problems often trigger attempts to form new institutional arrangements, for the purpose of recovering overexploited resources. This was also the case in bleak-roe fishing. The new co-management system was implemented in an already existing system without any recent experience of this type of management, loaded with a tradition of extensive state governing, and, with dramatically falling catches.

However, with the answer at hand, it was not bad timing, it was actually perfect timing, in the sense that the conditions were very favourable. The National Board of Fisheries' reduction in trawl licenses, and the boost in grey seal population, had contributed to the forming of a small and relatively homogenous user group. Due to successful spawning for several years, catches and the resource stock started to increase the same year that co-management was implemented. This can be labelled as "good luck", or "perfect timing", but the important lesson to be learned is that implementation was done at exactly the right moment. It is easier to work in a homogenous group with few conflict dimensions and with increasing economic gains from the resource. The first three years of co-management has resulted in better profits every year. The group of fishermen have had the chance to develop trust, social capital, and, methods and routines for co-operation under favourable conditions. It is very reasonable to assume that it is easier to build trust, and to develop a collective behaviour and co-operation, when there are plenty of fishes to catch.

If the same governance system had been implemented in the mid-1990s, the result had, probably, been different. The bleak-roe case shows, that in transforming a governance system, it is important for policy makers to have the right "timing" for implementation. The essential question is: when does a decision-maker know that the "timing is right"? The answer is: that the implemention of bottom-up processes should be performed when the resource has an upward tendency. As was done in the bleak-roe case, authorities should also create favourable conditions for the new system. For instance, if there are any difficult decisions that have to be made and that, presumably, would "split" and create mistrust in the group, the authorities should make these decisions before the implementation itself. A good example is the Board's reduction in trawl licenses, before the local management was put into practice, which played an important role for the successful start. As a consequence, the "classical mismatch" in many fisheries between the resource base and the harvesting capacity, was, thus, reduced by the Board in the 1990s. With reference to the earlier discussion about non-linearity in governance, and un-proportional effects in incentives and

legitimacy, if the “timing” is bad and a new management fails, the costs to restore such a failure might be “un-proportionally high”.

13.1.3 Imperfect knowledge

We can assume that the incomplete ecological knowledge about the vendace resource, and the surrounding ecological system, is a general picture of the knowledge about many commercial fish species. This highlights the importance of, so-called, local knowledge, also in well-developed societies with a high level of scientific knowledge. The importance of the information and knowledge about the ecological system that the fishermen get when they spend hour upon hour on the vessel, should not be underestimated. There is a need to learn from these experiences, and to incorporate this knowledge into the governance system. However, neither fishermen nor state authorities have perfect knowledge of the ecological processes steering a fish resource. This is quite an important argument for some form of co-management system between the users and the State. However, to succeed with a co-management process is not an easy task:

> We cannot vote for more fish in the sea, we know this, we have tried. The reality of nature is not a function of the equity of our decision making process, nor is knowledge of nature equitably distributed among stakeholder groups. Meeting the knowledge needs of community-based fisheries co-management is a very complex process as it is so closely linked to these two objectives (Wilson, 2003:265).

The logical consequence for policy-making and the politics of natural resources management would be (to plead for) some kind of deliberative democracy which would include processes such as the ones that have been analysed in this thesis. When it comes to natural resources management in modern industrialised societies, authorities, experts and user groups must find ways to co-operate. Not necessarily by means of formal specifications of different roles, but rather trough the establishment of joint arenas for decision-making; arenas that enable the performance of experiment, evaluation of results, monitoring, deliberate adjustment of rules, etc., i.e., the performance of all the features we associate with the concept of adaptive management. For example, if, like in the bleak-roe case, the co-operation and

understanding between the fishermen and the biological expertise would increase, then learning capacities would do so as well, which means that a mutual understanding and improved knowledge might result. Not only fishermen, but also politicians, policy makers and authorities ought to treat resource use as a "repeated game with incomplete knowledge".

Policy makers and managers of many commercial species (e.g., northern cod) have, over the years, pursued an aggressive strategy (in practise, a linear catch-maximising strategy), similar to a "one-shot game". It is necessary that involved actors realise that they are part of a repeated game, full of uncertainties and imperfect knowledge. With this insight, the incentives for co-operation should increase, not only nationally, but also on wider arena. For example, when it comes to the European Union's negotiations about quotas between countries, politicians and policy makers need to *think again* before they try to maximise the quota levels, far above the initial stage. With such a "quota-maximising-behaviour", the "tragedy scenario" is certain to take place. The strategies in governance of fluctuating natural resources should be in accordance with the principle of subsidarity, which is far from the prevalent strategies in command today. Policy makers need to incorporate scientific uncertainty in their decisions and in governance. In essence, this is a matter of co-management.

13.1.4 Concluding remarks

The bleak-roe case shows that even in an industrialised modern society, where the conditions for top-down governance to succeed seem quite favourable, bottom-up processes and user participation, hence, co-management, functions better also for a fish resource with high commercial value. It also shows that the insights from Ostrom's eight design principles (cf. Chapter 6) are well suited to a modern, complex, and diverse society. If a system is designed according to these principles – not necessarily all of them, but in general – the flexibility and legitimacy that such a system enables will promote social-ecological resilience. However, this is an area that requires further research. More case studies of transforming "classical" top-down

governed resource systems in well-developed and complex societies, into some form of co-management system with bottom-up processes, are needed.

If the conclusions from the bleak-roe case are applicable to society in general, and, if the situation presented in Figure 21 can be applied to other governance areas as well, this would indicate that, in order to restore the legitimacy of and trust in policy making and governing institutions in society, more bottom-up processes with user participation and engaged citizens are needed. Governance which is too static means that the citizens' preferences and incentives might change without adequate changes in the institutional framework. This can cause "unexpected" changes in legitimacy for rules and regulations. Based on the insights from this thesis, it can be concluded that, not only fisheries, but also a well-functioning society, need flexible and adaptive institutions which enhance engagement, trust and collective action among the citizens. How to reach this goal is, however, an issue for policy makers and politicians. What we know for sure is that not only "[f]ish swim across political boundaries and migrate without regard for management plans […]" (McGinn, 1999:140).

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Fisherman, no. 11, 2003-09-17, and telephone interviews 2004-01-27; 2004-05-10.	Fisherman, no. 12, 2003-11-26.
	Fisherman, no. 13, 2003-11-20.
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Fisherman, no. 27, 2004-02-12.	Fisherman, no. 28, 2004-02-12.
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Hasselborg at the National Board of Fisheries Office in Luleå, 2003-08-28.

Elinor Ostrom, 1999-09-29.

Telephone interview with Fisherman 1, 1999-08-16.

Telephone interview with Fisherman 2, 1999-08-25.

Interview with Fisherman 3, 1999-08-28.

Telephone interviews with Hasselborg at the National Board of Fisheries Office in Luleå; 1997-04-16 and 1999-06-22.

Telephone interview with Robin Lundgren at the National Board of Fisheries in Gothenburg, 1999-07-06.

Meetings:

The Vendace Management Group; 2003-09-08 and 2004-01-29.

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E-mail correspondence:

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Appendix

This appendix contains a summary of the results of semi-structured in-depth interviews with 31 bleak-roe fishermen that were carried out during 2003 and 2004. The interviews lasted between 1.5 – 3 hours. As the interviews were semi-structured, some answers ended up in other questions than the one that was in focus. However, at the end of each session, a check was done to see that all questions had been covered. The intention with the questions was to get an understanding of the respondents' view of bleak-roe governance the way it was configured as a result of the experiment with increased co-management that was launched in 2000. Many of the answers were very extensive and filled a number of cassette tapes. In this appendix, the answers are summarised and categorised into a short and, when possible, quantitative manner. The answers are supplemented with key words and sentences. These sentences are not quotations, but, are believed to make up a brief summary of the opinions that the respondents have expressed. Not all opinions are accounted for in this summary, only the ones that occur most frequently.

However, in this thesis, quotations from the interviews are used for the purpose of illustration when they are found to be relevant and suitable. Due to the small number of trawl fishermen and due to the promise that the interviewer made to the respondents (that they could answer honestly without any "risk" that the authorities or other fishermen could "track down" their answers), each respondent is assigned a number instead of name in reference to sources and in the list of references.

Questionnaire: commercial fishermen with trawl licenses for bleak-roe fishing (N = 31)

1. How old are you?

71. 64. 37. 57. 68. 40. 39. 33. 42. 37. 51. 41. 54. 39. 45. 53. 57. 46. 60. 40. 42. 34. 66. 38. 43. 40. 53. 31. 36. 40. 50. **Mean age:** 46.7 (years).

2. How many years have you participated in trawl fishing for vendace?

40. 25. 15. 30. 37. 20. 21. 11. 23.11. 32. 10. 23. 21. 15. 25. 37. 13. 43. 15. 21. 8. 30. 23. 25. 25. 23. 2. 3. 22. 22. **Mean time:** 21.6 (years)

Comments:

- Pointed out that they had participated in bleak-roe fishing with relatives or as a subsistence fisherman before they received their own license: 14.

3. Do you change your fishing (location and effort) in times of scarcity, or do you continue as "usual"?

Change, yes: 26 = 83.9 %
No change: 4 = 12.9 %
Sometimes: 1 = 3.2 %

Comments:

- Increased effort and change of location during times of resource scarcity, and *vice versa* – i.e., travelling around the coastal areas searching for vendace in bad times: 26
- Changing location (bays) if the share of non-mature vendace is too high: 14
- Decreased effort in good years, because fishermen cannot handle more than a certain amount of vendace – i.e., catch limitation in extracting the roe from the fish: 8

4. Do you have other incomes than from fishing?

Yes: 14 = 45.2 %
No: 17 = 54.8 %

5. How important is bleak-roe fishing for your economy (estimated value of annual turnover in fishing)?

- Less than 50 %: 2 = 6.4 %
- 50 – 60 %: 5 = 16.1 %
- 60 – 70 %: 14 = 45.2 %
- 70 -80 %: 5 = 16.1 %
- More than 80 %: 5 = 16.1 %

Mean value: approximately 67 %

6a. Do you know which rules that are governing commercial bleak-roe fishing?

Yes: 31
No: 0

6b. Do you know which rules that are governing recreational bleak-roe fishing?

Yes: 28 = 90.3 %
No, not sure: 3 = 9.7 %

7a. How do prevailing regulations of bleak-roe fishing function?

Well: 24 = 77.4 %
Satisfactorily: 7 = 22.6 %
Not so well: 0
Bad: 0

7b. Are you of the opinion that, in general, the trawl fishermen follow rules and regulations in bleak-roe fishing today?

Yes: 31
No: 0
Comments:

- Today, when fishermen have implemented their own rules, they follow regulations; earlier, it was "only so-so" with observance of rules: 19

8. Are you of the opinion that routines and regulations for bleak-roe fishing are functioning "better", "worse" or "the same" today than before self-governance was implemented?

Better: 29 = 93.5 %
The same: 2 = 6.4 %
Worse: 0
Comments:

- It would work even better if fishermen had not felt pressure from the authorities to "make the right decisions".
- Quick decisions; the ability to stop fishing in a certain bay and "no one is trawling in that bay": 13

9. Has any trawl-team intentionally infringed on the rules that are implemented by the trawl group?

Yes, one single case (2003): 28 = 90.3 %
Don't know: 3* = 9.7 %
(* These three interviews were done before the fishery 2003.)

10. Have there been any violations of your "own" rules? If so, what actions were taken?

Comments in fishermen's answers:

- The group of trawl fishermen hold a meeting the next day: 24* = 85.7 %
- We talk with them: 20 = 71.4 %
- Worried that the legitimacy of their own rules will decrease if it happens again: 12 = 42.8 %
- Our own rules are "holy": 12 = 42.8 %
- The "guilty" trawl team was "given a lesson" and the discussions were "heated": 10 = 35.7 %

* The three interviews that were done before the fishery 2003 are not accounted for in this question.

11. Has the unity within the group of trawl fishermen "increased", "decreased" or is it "unchanged" since local management was implemented? If it has increased or decreased, why?

I**ncreased***:* 24 = 77.4 %
Comments:

- Increased responsibility and closer contacts - more cooperation and discussions: 23
- Smaller group and more trust: 14

Decreased: 0
Unchanged: 7 = 22.6 %
Comments:

- The unity within the group has always been good: 6

12. Has there been any conflicts between fishermen and authorities in bleak-roe fishing? If it has, can you give any examples?

Yes: 28 = 90.3 %
Comments:

- The authorities do not have the right competence and make wrong decisions: 18
- Authorities do not listen to the fishermen's knowledge: 16
- The authorities are slow and bureaucratic: 8

No: 3 = 9.7 %

13. Has the level of conflict between fishermen and authorities changed since local management was implemented? Please give examples!

Better: 15 = 48.4 %
Comments:

- Increased cooperation with the authorities – i.e., increased influence: 10
- Fewer contacts with the authorities: 3

The same: 16 = 51.6 %

Comments:

- The authorities try to steer the decisions: 11
- There is still too much bureaucracy: 6

Worse: 0

14. Should the experiment with local management "continue the same", "be cancelled", or "be expanded"?

Continue: 9 = 29 %
Cancel: 0
Expand: 22 = 71 %
Comments:

- A few years of good working conditions are needed – i.e., a fixed time-period for the project: 18
- The best knowledge is among local users – i.e., more power to the management group: 17
- Formal right to impose sanctions is needed: 11

15. During the last few years, the number of trawl licenses has been substantially reduced. Is this "good" or "bad"? Explain!

Good: 20 = 64.5 %
Comments:

- The earning capacity has increased, we can survive also in bad years – i.e., the number of licenses is on suitable level now: 12
- The technological effectiveness has increased in trawl fishing: 5

Bad: 0
Both good and bad: 11 = 35.5 %
Comments:

- Worry about the recruitment of new commercial fishermen in Norrbotten: 9
- If the trawl group becomes too small, it will be a problem to satisfy the demand for bleak-roe – i.e., a risk that a substitute will take over: 3

16. Should the number of trawl licenses increase when the supply of vendace increases? Why? Why not?

Yes: 8 = 25.8 %
Comments:

- To secure recruitment of young commercial fishermen in the coastal areas in Norrbotten: 8

No: 23 = 74.2 %
Comments:

- To be economically sound also in "bad times", it should be on the same level, i.e., due to the fluctuating nature of the resource: 13
- In some way, the problem with recruiting young commercial fishermen must be solved: 7
- Not before the right to trawl has been expanded for us who already hold a license: 4

17. How do you look at the fact that commercial fishermen, living outside the County of Norrbotten, can apply and receive a trawl license for vendace?

Not so good – should be a local resource: 15 = 48.4 %
Comments:

- It is important to secure a thriving archipelago community with local fishermen : 7
- Increased risk for overexploitation: 6

It is okay: 16 = 51.6 %
Comments:

- Emphasised "fairness" – many fishermen from Norrbotten have been fishing in the Baltic Sea (e.g., cod): 10
- Principally, it is okay, but in some way, young people living in coastal communities in Norrbotten should have priority: 8

18. Who should have the decision right in trawl licenses matters?

- The National Board of Fisheries and the trawl group as a body, to which a proposed measure is referred for consideration: 13 = 41.9 %
- The County Administrative Board and the trawl group as a body, to which a proposed measure is referred for consideration: 7 = 22.6 %
- The National Board of Fisheries: 3 = 9.7 %
- The Swedish East Coast Fishermen's Association (SOC): 2 = 6.4 %
- The County Administrative Board:1 = 3.2 %
- Do not know: 2 = 6.4 %

19. Are you of the opinion that also recreational bleak-roe fishermen should participate in the experiment with local management? Why. Why not?

Yes: 2 = 6.4 %
Comments:

- Recreational fishermen can participate if they want to, but their fishing does not affect the stock: 2

No: 29 = 93.5 %
Comments:

- Today, recreational fishing does not affect the resource and there are so few recreational fishermen left: 21
- It can create antagonism between commercial and recreational fishermen: 7
- Recreational fishermen do not earn a living through fishing: 5

20. Are you of the opinion that, in general, recreational bleak-roe fishermen follow rules and regulations?

Yes: 16 = 51.6 %
No: 5 = 16.1 %
Comments:

- They use too many gears: 5

Some do, some do not: 10 = 32.3 %
Comments:

- Some of them are using too many gears: 10

21. Is recreational bleak-roe fishing affecting the supply of vendace?

Yes: 3 = 9.7 %
Comments:

- All fishing affects the supply, but the extent of recreational bleak-roe fishing today is harmless: 3

No: 28 = 90.3 %
Comments:

- Earlier, it did affect, but not today: 3
- The boost in grey seal population has made it almost impossible for recreational fishing: 10

22. Is recreational bleak-roe fishing affecting commercial fishing? If it does, how?

Yes: 5 = 16.1 %
Comments:

- If they sell bleak-roe too cheap or if the quality of the roe is bad it can affect the market negatively: 4

No: 26 = 83.9 %

23. Do recreational bleak-roe fishermen change their behaviour in times of resource scarcity? If they do, how; by "reducing their effort", "increasing their effort" or continuing "as usual"?

Increasing their effort: 2 = 6.4 %
Comments

- If they want to earn money by selling the roe they must increase their effort: 2

Reducing their effort: 29 = 93.5 %
Comments:

- "The seal problem": 25
- They quit: 23
- It is only "old" people who are still fishing: 5
- Even now, when the resource has recovered, recreational fishermen have not returned: 5
- The young recreational fishermen have quit: 3
- Some will probably return now due to the good catches last few years: 5

Continuing as usual: 0

24. Do you believe that the decrease in the stock of vendace during the 1990s is a result of a too high fishing pressure? If not, what is the cause of the resource crisis?

Yes: 0
Yes, in combination with unsuccessful spawning: 12 = 38.7 %
No: 19 = 61.3 %
Comments:

- Unsuccessful spawning: 19
- Unsuccessful spawning dependent on natural conditions (e.g., water temperature, salinity levels, autumn storms, etc.): 11
- Unsuccessful spawning dependent on natural conditions and pollution of the environment: 5

25a. Do you believe that it is one or several local populations (stocks) of vendace on the Swedish side of the Bothnian Bay?

One population: 20 = 64.5 %
Several populations: 9 = 29 %
No opinion: 3 = 9.7 %

25b. Are you of the opinion that the spawning areas for vendace are affected by trawling? Why, why not?

Yes: 3 = 9.7 %
No: 24 = 77.4 %
Comments:

- Vendace spawn in shallow waters and near land where trawling is not allowed: 19
- It cannot affect spawning areas, because, bays that were the best 40 years ago are still the best: 7

No opinion: 2 = 6.4 %

26. How does the control system for bleak-roe fishing function – i.e., at sea, logbooks controls, etc? Is it on an appropriate level?

Okay: 16 = 51.6 %
Comments:

- During the last few years it has been on an appropriate level, but earlier the authorities were checking the same papers and gears over and over again: 12

Not functioning: 15 = 48.4 %
Comments:

- The control system has no function – it is constructed for a fishery with quotas: 8
- Trawling for bleak-roe is self-regulated because it is a small group where everyone knows each other and which vessels that are allowed to participate: 5

27. Today, the control system is managed by the Coast Guard and by the National Board of Fisheries; is it possible that the fishermen could run the control system by themselves?

Yes: 13 = 41.9 %
To a certain extent: 7 = 22.6 %
Comments:

- It can be done with support from the authorities – e.g., be able to call the Coast Guard when it is necessary, etc.: 6
- **No**: 11 = 35.5 %

Comments:

- There is a risk of disruption within the group – a fisherman should not act like a policeman: 6

28. What are the biggest threats against commercial bleak-roe fishing in the future?

Threats mentioned in the answers:

- **Authorities**: 16 = 51.6 %
- **Environmental problems**: 13 = 41.9 %
- **The boost in seal population**: 11 = 35.5 %
- **Difficulties in recruitment of a new generation fishermen**: 8 = 25.8 %
- **Other threats**: 4 = 12.9 %

29. Generally, how does the present management system for bleak-roe fishing function? What can be done to improve the system?

Good: 29 = 93.5 %
Not so good: 2 = 6.4 %
Most frequent answers on how to improve management:

- The rules of the game must be fixed for some years in advance: 25
- There is a need to delegate more power from the authorities to the group of trawl fishermen: 14
- A formal right to open up and close all areas by the group of trawl fishermen: 6
- Right to impose sanctions: 12
- Still a bureaucratic system: 2