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Research

Changing Use Patterns, Changing Feedback Links: Implications for Reorganization of Coastal Fisheries Management in the Stockholm Archipelago, Sweden

Maria Åqvist Almlöv and Monica Hammer

ABSTRACT. Property rights are important institutions for regulating the use of valuable natural resources from coastal ecosystems. In this case study, we identify and analyze property rights and user patterns related to small-scale coastal fisheries in the Stockholm Archipelago, Sweden. User patterns and user groups have changed significantly over the last century, as commercial fishing has been increasingly replaced by recreational activities. Interviews with local resource users and owners of water properties in two different areas, Möja and Ornö parishes within the Stockholm Archipelago, revealed a very diverse pattern of property and user rights, with a large number of water and fishing rights owners. Recreational fisheries, including both sport and household fishing, seem to predominate in both areas, but ownership differs. In Möja, most waters are collectively owned, whereas in Ornö, individual ownership predominates. Very few examples of local influence on fisheries management were found in either area, although the social structure for joint management does exist in Möja. Instead, larger-scale institutions at the regional, national, or international level regulate fisheries, often not addressing local conditions and fish populations. The ongoing shift in resource use has created a heterogeneous user group, and the limitations of centralized management authorities in dealing with the diversity in the coastal ecosystem have created mismatches within the social–ecological system. Combined with a large-scale decline in coastal fish stocks, these mismatches challenge the existing local property rights arrangements as well as the more centralized regulatory management structure. A key issue for fisheries management is how to develop and stimulate appropriate distribution of management functions at different geographical scales and organizational levels. The complexity and diversity in archipelago fisheries call for multilevel arrangements and cross-scale coordination, and initiatives have been taken by both central governmental authorities and local user groups to collaborate concerning habitat restoration and protection of important spawning grounds.

Key Words: *coastal fisheries; management institutions; property rights; social-ecological systems; Stockholm archipelago*

INTRODUCTION

Archipelagoes are important ecosystems providing humans with a variety of ecosystem goods and services (Costanza 1997, Daily et al. 1997). Human activities are often concentrated in coastal regions, resulting in multiple uses of natural resources for human needs, with fisheries as a significant part. In many countries, recreational fishing is increasing as one of the most popular leisure activities (U.S. Fish & Wildlife Service 2002, Sutinen and Johnston 2003, Coleman et al. 2004) and in Europe more than 20 million people are active sport fishers (Jonson 2002). In Sweden, recreational fishing has increased since the second half of the 20th century. At present, 25% of the adult population is engaged in recreational fishing (Bengtsson et al. 2000). As the transition from small-scale commercial fishing to recreational fishing continues, the coastal ecosystem faces new challenges that may affect the delivery of ecosystem services. The intensification in recreational activities changes use patterns, which in turn change feedback links and management practices (Hammer et al. 2003). In this paper, we examine in what ways the changing use patterns of coastal resources, in particular of fish, challenge existing management institutions. We focus on the Stockholm Archipelago on the east

coast of Sweden (Fig. 1), an area of increasing value to the public for outdoor activity, including fishing, swimming, and boating.

For institutions to be able to adapt to changes, feedback mechanisms are needed to link the social and ecological components of the resource use system. Feedback signals can provide information for transforming or sustaining current management to fit the dynamics of ecosystems and social systems across scale (Berkes and Folke 1998, Folke et al. 1998, Levin 1999). Because change is an inherent property of many systems, including linked social–ecological systems, the capacity to respond and adapt to these changes is important for protecting the life-supporting ecosystems and improving sustainable management within coastal areas (Berkes et al. 2003). Central Swedish governmental authorities have played a major role in managing coastal fisheries, but are now recognizing the need for new ways to address resource use problems related to changing use patterns and declining fish populations (Government of Sweden 2003, Statens offentliga utredning (SOU) 2003).

Property rights arrangements, as part of society's institutions (North 1990), constitute an important structuring factor that shapes human use of natural resources and ecosystems (Bromley 1991, Hanna et al. 1996). These arrangements define rights and obligations in relation to resource use and also include the rules under which those rights and duties are exercised. A problem with many property rights systems is the unclear specifications as to who can claim rights, and how rights may be used and protected (Hanna 1996). Also, current property rights regimes are often not ecologically consistent with the resource they are supposed to manage, creating a mismatch between the social and ecological system (Ostrom 1990, Wilson et al. 1997, Folke et al. 1998, Costanza 1999). How institutions and property rights regimes work thus depends on their ecological and social context and also on the way they are implemented (Jentoft and McCay 1995). For example, they might not take into account the dynamics and variability within ecosystems (such as migrating species), and instead aim at removing disturbance to create more predictable systems, resulting in command-and-control management (Holling and Meffe 1996). Ecosystem management is increasingly recognized as an alternative in policy and decision making (UNEP 2000, Millennium Ecosystem Assessment 2005); it focuses on the structures and processes of ecosystems at functional units on the scale appropriate for the problem or issue being addressed.

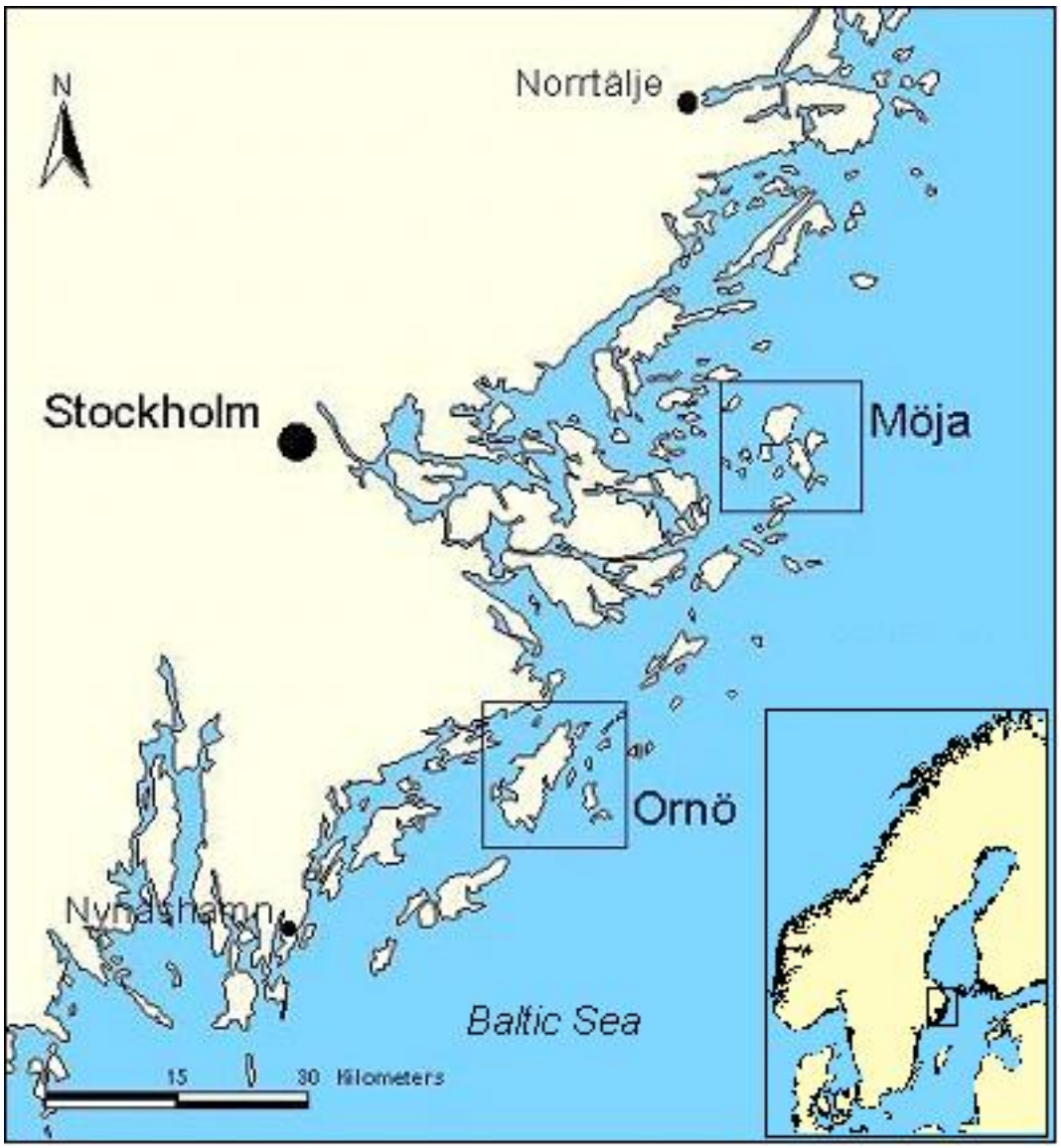
In this paper, we map and analyze existing property and use rights in coastal fisheries, including the rules defining access and withdrawal rights. The ongoing shift from commercial to recreational fishing is examined by studying changes in number of fishers, different types of fishing categories, and the target species. We start by describing the features of the linked social–ecological system related to fisheries in the Stockholm Archipelago and then turn to the present ownership and use patterns in two separate parishes with different traditions in ownership and management of fishing grounds. Finally, we discuss some of the challenges and implications of the changing use patterns on coastal fisheries management.

FISHERIES IN THE STOCKHOLM ARCHIPELAGO

The Stockholm Archipelago covers an area of 3500 km^2, extending along the Swedish east coast. It stretches about 200 km from the town Norrtälje in the north to Nynäshamn in the south. It is widest (about 100 km) at the latitude of Stockholm (Fig. 1). With it's over 30 000 islands, islets, and skerries, it is part of one of the world's largest archipelago areas, stretching across the Baltic Sea to the Finnish coast. The archipelago contains a number of open water basins, shallow bays, and sheltered inlets harboring a productive coastal ecosystem. Habitat-forming macroalgae such as the bladder wrack, *Fucus vesiculosus*, and filamentous green, brown, and red algae are important producer species that offer protection and feeding areas for many fish populations. A mixture of marine and freshwater, migrating and stationary species occurs fairly frequently in the archipelago. About 50 fish species depend on the archipelago during at least part of their life cycle, 11 of which are of interest to coastal fisheries (Olburs 2000).

Typical coastal species are perch (*Perca fluviatilis*), pike (*Esox lucius*), and pikeperch (*Sander lucioperca*). They are stationary freshwater species that avoid the open sea. Pikeperch, however, can show both migrating and stationary patterns of behavior. Sea-migrating species, such as herring (*Clupea harengus*), reproduce in the archipelago and move between the coastal zone and the open

Fig. 1. Stockholm Archipelago, Sweden, showing the coastline and the two casestudy areas, Möja parish and Ornö parish.



sea. Species such as cod (*Gadus morhua*) and flatfish (*Platichthys flesus*) reproduce in the open sea and appear in the archipelago as juveniles. Other species dependent on the archipelago are river-spawning sea trout (*Salmo trutta*) and salmon (*Salmo salar*), which often migrate long distances between spawning and feeding grounds. Salmon lives pelagically whereas sea trout can be more coastal and migrate shorter distances. The European eel (*Anguilla anguilla*) has a unique life cycle with long-distance spawning migrations to the Sargasso Sea.

Both recreational and commercial coastal fisheries depend on these species. Pike, perch, and pikeperch dominate in recreational fishing, and catches largely exceed commercial fisheries. Local data on catches in the archipelago fishery are not accessible, but a

national survey of recreational fishing estimated catches of pike, perch, and pikeperch, fished exclusively on the east coast, to exceed 7000 tonnes in 2000, whereas commercial catches of these species have varied between 200–300 tonnes annually during the second half of the 1990s (Bengtsson et al. 2000, National Board of Fisheries 2001).

During recent decades, several populations have declined or experienced reproduction disturbances caused by eutrophication, damage to spawning areas, and overfishing (Hansson and Rudstam 1990, Nilsson et al. 2004). Of the 11 species important for coastal fisheries, seven are fully exploited or show decreasing catches in commercial fisheries (Ask and Westerberg 2005). For example, commercial catches and net sampling data show a substantial decrease in pikeperch populations in the second half of 1990s. Throughout the same period, a large-scale decline of perch and pike communities along the Swedish coast and archipelago areas was also documented, caused by recruitment disturbance in the early life stages (Almesjö and Hansson 2001, Nilsson et al. 2004). The decline appears to be local, and the outer parts of the archipelago are the most seriously affected (Ljunggren et al. 2005). Other spring-spawning freshwater species (without commercial or recreational interests) show the same pattern. Eel, the economically most important species in Swedish coastal fisheries, is seriously threatened as a result of decreased recruitment. There is uncertainty about the causes, but overfishing and habitat destruction could be part of the explanation (Feunteun 2002).

User Groups

Fishers are usually divided into groups that use similar methods or gear, and catch the same species. The main user groups are recreational and commercial fishers. The largest group, comprising about 75% of all recreational fishers in Sweden, consists of sport fishers or anglers who use mainly hand-held gear. This group includes a range of different recreational fishers, from unorganized to well-organized fishers, and unspecialized to specialized fishers targeting specific species or using specific gear. This group consists of both water owners and tourist fishers without a local water property. The largest sport fishing organization in the archipelago is the Stockholm Angler Association, with 5528 members in 2005 (B. Åström, personal communication, 2006). The second group, called household fishers, use gill-nets, hoop or fyke-nets, and most have private fishing rights (Bengtsson et al. 2000). Since 1993, commercial fishing is defined as fishing pursued by support of a license permit issued by the Swedish Board of Fisheries. On the basis of methods and gear used within commercial fisheries, two groups can be distinguished: coastal and offshore. Coastal fishing is not a uniform concept, but often refers to short fishing trips with small boats (less than 12 m). In the archipelago, mainly coastal, small-scale, often part-time, commercial fishers operate. This group also uses a more diverse set of gear and catches a multitude of species compared with offshore fishers (Gårdmark et al. 2004).

Changing Fishing Patterns

The general trend in coastal fisheries is toward recreational activities. Since 1963, the number of people engaged in recreational fishing in Sweden has increased from about 1 million to 2.3 million in 2000 (SOU 1968, Bengtsson et al. 2000). In Stockholm County, there may be as many as 400 000 recreational fishers (Nilsson 1990), whereas the number of licensed commercial fishers declined from almost 3000 to only 36 over a 40-year period (H. C. Andersson, personal communication, 2005). The shift in use patterns relates to a number of socio–economic factors, such as increased leisure time and transportation modes (Hammer et al. 2003). Factors affecting commercial fisheries relate to the general decline in profitability of traditional means of livelihood, making part-time fishery in the archipelago less attractive. Economic incentives and subsidy systems in fisheries have also favored large-scale operations, and the compulsory licenses for commercial fishing introduced in 1993 resulted in a further decline in small-scale commercial fishers. Today, another form of recreational fishing is expanding, the rapidly growing fishing tourism with professional guides arranging fishing trips. Twenty-two fishing-guide entrepreneurs operate in the Stockholm Archipelago (Jonson 2002).

Institutional Arrangements

Historically, Swedish fishing rights included both local rules and formal regulations. The first Fisheries Law came in 1766, stating free fishing for all citizens in common waters (Agricultural

Ministry 1992). In near-shore waters, fishing rights were tied to land ownership and fishers had to lease fishing rights from the landowning farmers (Hammer 1995, Bruckmeier et al. 2003). Fishing was regularly combined with agriculture, forestry, and hunting, following seasonal variations. This yearly cycle combining fishing and farming was possible thanks to the large variation in harvesting and fishing methods. With the development of the industrial fisheries in the 20th century, the integration between fisheries and agriculture was reduced. During the second half of the 20th century, three important changes in fishing rights have influenced the opportunities for recreational fishing to expand in the archipelago. First, the establishment of borders between public and private waters in a national law (the Swedish Code of Conduct) in 1951 (Svensk författningssamling (SFS) 1950) clarified the access right. In general, private water extends 300 m from the coastline, which makes most of the archipelago waters private. In private waters, fishing rights belonged to the owner of the land property; in public waters, fishing was free for all Swedish citizens. Second, in 1960, the Swedish government gave water owners the opportunity to form local fishing associations and sell temporary fishing rights—fishing permits within these areas (SFS 1981)—which increased access to fishing waters for the public. Twenty-seven such fisheries management associations (FMAs) were formed in Stockholm County between 1960 and 1985, most of them in the northern part of the archipelago. The main function of these associations, aside from selling permits, was to establish rules for the local fishery. Third, access to fisheries was expanded into private waters in 1985 by allowing free fishing with hand-held gear in all coastal waters. This redistribution of fishing rights significantly increased the access to fishing waters for recreational purposes. The decision was based on the argument that coastal fish resources were exploited well below their potential and that it would not interfere with the private water owners' rights and opportunities to fish (National Board of Fisheries 1984). However, the owners lost the income from fishing permits, and local regulations and control of catches were made more difficult. Only in a few cases were water owners compensated economically, and as a result, they strongly opposed the law (Hultkrantz 1995, Bruckmeier et al. 2003).

The public fishing right also affected commercial fishers by reducing their exclusive fishing right in private or leased waters. The increased public access right was followed by a centralized decision to establish more detailed gear limitations in both private and public waters. Limitations in the public fishing right restrict the type and number of gear that can be used. In private waters, rods and lines with a maximum of ten hooks are allowed, and herring gill-nets can also be used in waters that are deeper than 6 m. Size limitations for many coastal species apply to both public and private fishing rights, but aside from that water owners have free access to fisheries in their own waters. These use rights are regulated by the Swedish Code of Statutes: the Fishery Act (SFS 1993) and the Fishing Decree (SFS 1994). The main purposes of the regulations are to protect fish resources by safeguarding reproduction, to protect the commercial fisheries by preventing over-large catches, and to minimize competition (L. Ask, personal communication, 1999). An important regulation concerning coastal fisheries is the trawling ban for all fishers in areas within 6.5 km from the coast. National regulations also include criteria for forming FMAs (SFS 1981), monitoring (Fiskeriverkets författningssamling (FIFS) 2004), and subsidies for fish conservation activities (SFS 1998).

In 1978, the Baltic Sea was essentially fully divided among the coastal states, which agreed to consider the Baltic Sea fish stocks as common property to be managed jointly (Hammer 1995). Since Sweden joined the EU in 1995, fisheries are regulated by international agreements within the framework of the EU's Common Fisheries Policy (CFP). The CFP does not concern coastal waters inside the baseline for Swedish waters in general, but agreements on quotas, surveillance rules, and subsidies affect primarily commercial fishers operating in coastal waters too.

On the national level, the Swedish Board of Fisheries has the overall management responsibility, and is accountable for monitoring fish stocks in coastal waters. Statistics of commercial landings are combined with yearly net sampling to estimate fish stock conditions (Ask and Westerberg 2004). However, catch statistics from private waters are largely lacking. For example, comparing eel catches reported in 1996 (150 tonnes) from commercial fisheries with landings on the east coast of Sweden during the 1990s (500–700 tonnes/year) indicates the difficulty in using catch statistics for estimating fisheries (Andersson 1998). Recreational catches (sport and household fishing) are estimated every 5th year in a national survey, giving a very rough picture of resource outtake.

Administration and design of Swedish fisheries management are not only a result of national and international laws and regulations; local and regional authorities and organizations are also involved (Table 1). On the regional level, the Stockholm County Administration Board (SCAB) is responsible for promoting sustainable resource use, protect the resource base and at the same time increase possibilities for both public and commercial fisheries within the archipelago. One way of providing for public interests is the regional fishing permit or TDA permit that increases the public fishing right in some parts of the archipelago where exist. By purchasing a regional fishing permit, fishers get access to water areas where methods including trolling, dragging behind a boat and ice fishing with standing lines (TDA fishing) are allowed. These methods make it possible to catch larger amounts of certain species than with gears normally allowed for sports fishers. For example, pike and pike-perch can be caught in wintertime by angling and trolling makes the salmon and sea trout fishing more effective during autumn and late spring. The income from these permits is used for conservation measures.

Seven archipelago municipalities share the responsibility for fisheries management with the SCAB and take an intermediate position between the regional and local level. They influence fisheries primarily by the physical planning of coastal areas. On the local level, a substantial number of interest groups and other organizations also operate, including more than 40 recreational fishing associations and three commercial fishing organizations.

STUDY AREA AND METHODS

Ornö and Möja Parishes

The case study focuses on two areas in the Stockholm Archipelago with somewhat different development: Möja parish, covering 157 km^2 situated in the northern part of the Stockholm Archipelago, and Ornö parish, covering 193 km^2 in the southern part (Fig. 1). Parishes are a historical administrative unit that includes the village structure of larger islands in the archipelago. The reason for selecting Ornö and Möja parishes is that they cover a range of typical archipelago environments, from more sheltered bays in the inner and central parts, to the wind- and wave-exposed areas with bare islands and skerries in the eastern part. Both areas have permanent settlements and summer residents, and are popular for recreation, with areas classified as of national interest including nature reserves. They also have long traditions of commercial and household fisheries. The larger islands have good connections to the mainland and the city of Stockholm by regular, year-round boat traffic. One important difference between the areas is that, in Ornö parish, a former entailed estate owns a large area of land and water, whereas in Möja parish, there is a tradition of village councils regulating commonly owned and managed fishing grounds. This is a general pattern in the archipelago, with more individually owned waters in the south and common or collective ownership in the north.

Identification of Property and Use Rights

To identify and analyze property rights and regulation of fish resources in view of the changing fishing patterns in Stockholm Archipelago, we identified and classified as much as possible, current water ownership conditions, types of fishing, management practices, and rules framing resource use in Ornö and Möja parishes. Information on real property ownership was collected from economic maps showing property delimitations linked to the real property record kept by the National Land Survey (Lantmäteriet) in Stockholm. The information on local fishery management practices and regulations came from interviews with stakeholders and real property owners in the study areas. The interviews were carried out during September–November 1998 (Ornö) and February–March 2000 (Möja). In the initial stage, real property owners were contacted by telephone, which resulted in 22 interviews with representatives of different types of water owners, undertaking various fishing activities in Möja and Ornö. Respondants included landowners with different interests in fishing, such as fishing association members, commercial fishers, managers of reserves, and fisheries inspectors. Only one of these representatives did not have any private water tied to the land property. In addition, to include other relevant stakeholders, two representatives of the Stockholm Angler Association, one fisheries inspector from the municipality of Stockholm, two fisheries consultants from the SCAB, and a representative from the Stockholm Federation of Fishing Rights were interviewed. Semi-structured interviews were carried out with these individuals, five in person and 23 over the telephone, using

Table 1. Authorities and organizations involved in regulating and managing fishing waters in Stockholm Archipelago, divided into five organizational levels.

Level	Authority / Organization	Example of influence on fishery
International	EU's Common Fisheries Policy (CFP)	Total allowable catch (TAC)
	ICES	Scientific advice
National	National Board of Fisheries	Overall responsibility for fish resources and fisheries, issuing regulations, monitoring, and research
	Swedish Coast Guard	Enforcement
	National Environmental Protection Board	Environmental monitoring
Regional	Stockholm County Administrative Board	Fish stocking, administrating fishery management areas, inspector education and issuing fisheries license, regulating fisheries, monitoring
	The Archipelago Foundation	Monitoring and enforcement by inspectors
	Stockholm County fishers	Stimulation of commercial fishing interests
	Angler Association	Fish stocking, habitat restoration
	Federation of Fishing Rights Owners	Stimulation of strengthened property rights, advisory function
District	Archipelago municipalities (Haninge, Norrtälje, Nynäshamn, Stockholm, Södertälje, Vaxholm, Värmdö, Österåker)	Administration of TDA-fisheries, enforcement by local inspectors
Local	Fishery management associations	Internal management and regulation by gear and seasonal limitations, access rights and preservation actions
	Private fishing rights owners	Management and regulation on individually owned private waters

qualitative interview techniques with open-ended questions (Kvale 1997) covering the subject areas: fishing patterns, management practices in use, the influence of local users and owners on regulation of fisheries, and the perception of the status of the resource base. Supplementary information and material come from the literature, scientific publications, and official documents provided by authorities, such as the SCAB and the Swedish Board of Fisheries. This information was used primarily to identify the formal institutional framework for coastal fisheries.

Classification of Ownership and Fisheries

Three broad forms of property rights regimes are private, common, or state property (Berkes 1989, Bromley 1991, Ostrom 1990), but these often overlap or are combined, creating a wide diversity of regime types with different ownership and use rights. In our study, we divide private waters into three ownership categories: individual, common, and state. Individual property is ownership within a family or sometimes a company; common property corresponds to some form of collective ownership, e.g., a group of people organized in an association; and state property represents ownership by authorities, such as the municipality or the government. Included in this category is the Archipelago Foundation, a collaboration between the SCAB, the municipality of Stockholm, and the archipelago municipalities. The foundation currently owns and manages 15% of the land and water area in the Stockholm Archipelago. Use patterns are also divided into three groups: commercial, sport, and household fishing (defined above). Furthermore, there is a category of unknown ownership and fishery, where we were unable to identify individual owners because of complicated estate distributions, unclear beneficiaries of estates, or lack of information in the real property record. The spatial distribution of the classified property rights and use patterns is presented as maps in a GIS database, using ArcView® 3.2 software.

OWNERSHIP AND USE PATTERNS IN ORNÖ AND MÖJA

The interviews with various owners of private waters in Ornö and Möja parishes show that there are diverse ownership and user groups with different use patterns (Tables 2 and 3). Both Ornö and Möja parishes are characterized by a large number of water and fishing rights owners. The distribution of different categories of owners is roughly of the same magnitude as estimates made for the whole Stockholm Archipelago (Stroh 2003), with individual properties dominating in the southern parts (Ornö) and FMAs in the northern parts (Möja). In Figs. 2 and 3, the spatial distribution of the different types of ownership and fishing categories is shown. Commercial fishing is mixed with household and sports fishing. As sport fishing is free and pursued fairly frequently in all waters, it is not specified in the figures.

Scattered Ownership

In Ornö parish, individual ownership constitutes the largest category, with many small water properties covering just over half the water area (80 km^2 distributed between 54 properties, Table 2). This is largely due to the existence of the former entailed estate, which sold land lots with adjacent waters to summer residents during the second half of the 19th century. In addition, the entailed estate is still a large owner of water areas, covering about half of the individually owned waters. In six areas, the water is common property with collective ownership. One example is northern Fåglarö island in the northwestern part of the parish, where a summer house owner association manages the fisheries. The association includes about 100 households and was formed in the 1960s when land lots were sold for summer house settlements. Two large areas are classified as state property, the islands of Fjärdlång and Huvudskär. Fjärdlång came into state ownership in 1940 and Huvudskär was acquired by the Archipelago Foundation in 1972. Huvudskär has a long tradition of fishing with historical statutes dating back to 1450. Both areas are nature reserves today. Two smaller areas are also state property, where the municipalities of Haninge and Stockholm own the water. In two areas, the ownership is unclear due to complicated inheritance or partitioning, and therefore, the borders between the properties have not been set (R. Råva, personal communication, 1998).

In Möja, more than half of the water area is managed by five local FMAs (Fig. 2 and Table 2). The size of these areas ranges from just a few square kilometers to more than 20 km^2. These FMAs were formed between 1962 and 1984 within already existing collective arrangements, i.e., village

Table 2. Distribution of water ownership and fishery categories in Möja and Ornö parishes, the number of properties within each category, the size and proportion of the total water area.

	Möja			Ornö		
Ownership	No of properties	Area (km^2)	%	No of properties	Area (km^2)	%
Individual	22	31	26	54	80	53
Common	6	16	14	6	14	9
FMA†	5	67	58	-	-	-
State	-	-	-	5	31	21
Unknown	1	2	2	2	26	17
Fishery						
Commercial	1	20	17	5	37	24
Household	9	82	70	4	15	10
TDA‡	-	-	-	2	4	3
Unknown	24	15	13	56	95	63
Total	34	117	100	67	151	100

† Fishery management area

‡ Trolling, dragging, ice fishing

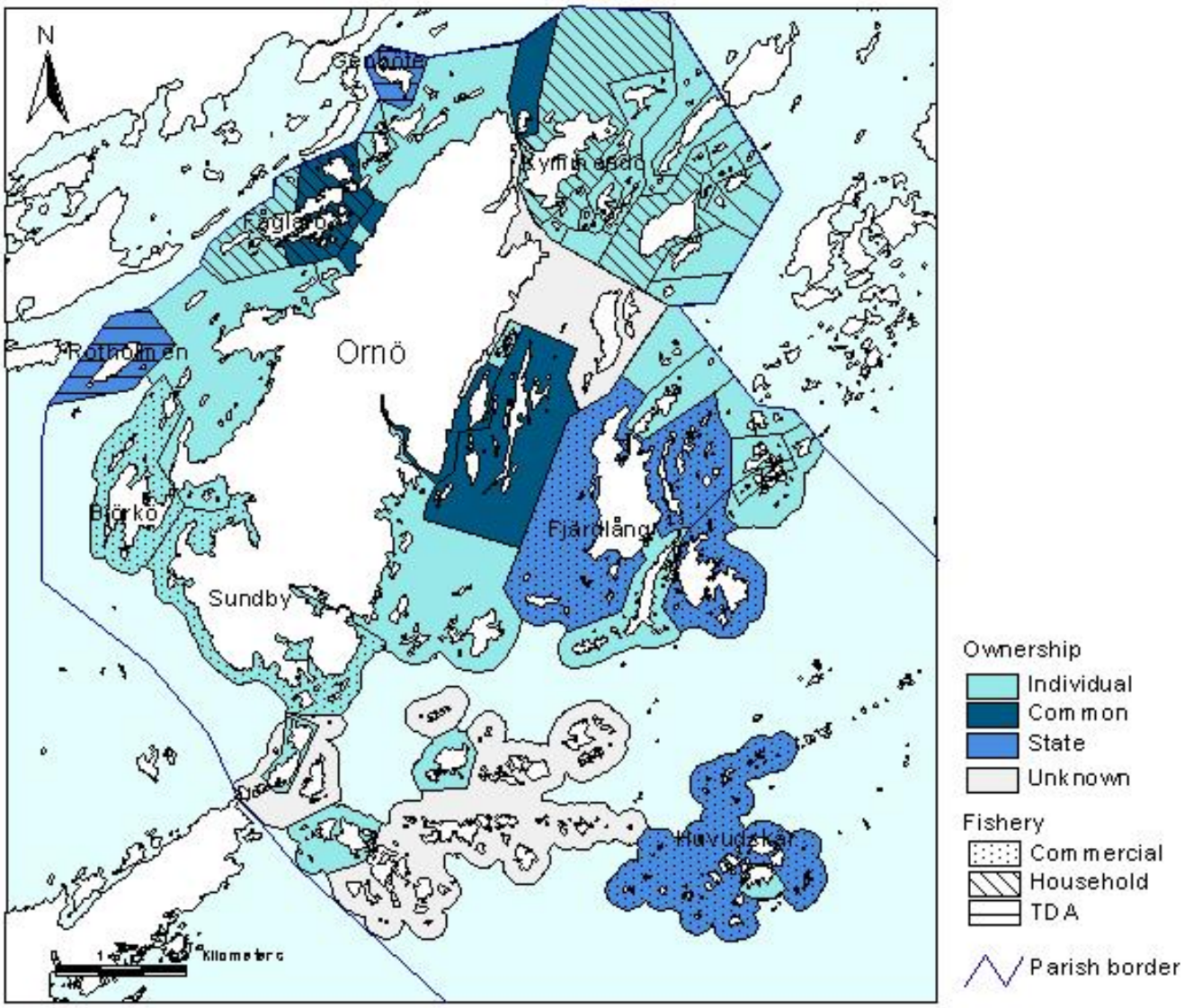
Table 3. User groups with different fishing rights identified in Ornö and Möja. Two main groups are fishers with private fishing rights (leaseholder or owner of individual or common waters) and fishers with public fishing rights. These can be further differentiated into permanent residents, summer residents, or visitors using commercial, household, or sport fishing methods (cf Sandström et al. 2002).

Fishing right	User groups
Private	Licensed commercial fishers
	Unlicensed commercial fishers
	Permanent inhabitants fishing for household needs or sport fishing
	Summer residents fishing for household needs or sport fishing
	Permanent or summer residents not interested in fishing
Public	Permanent inhabitants sport fishing
	Summer residents sport fishing
	Visitors / tourists sport fishing

councils. The number of shareholders in these associations often exceeds 100 people and is increasing as land property is further divided and sold. The large nature reserve east of Möja (Storö-Bockö-Lökaö-nature reserve) is classified as state property. Although it is formally owned by the Archipelago Foundation, fishing rights are transferred to three of the local FMAs.

As in Ornö, the number of individual properties is large. Twenty of these are small properties and one is large (Fig. 3). Together these individual properties make up 26% of the total water area (Table 2). The large individually owned water area in Southern Stavsudda was divided among village members at the end of the 19th century, but the local agreement was never reported in the real property record. Even though local residents claim that waters are individually owned, the authorities regard them as collective. Hence, no borders between the properties are shown in Fig. 3. The common waters owned by different types of associations (boat club, recreational association) are typically very small, covering less than 1 km^2 each. One exception is Northern Stavsudda, which covers 14 km^2 of water, and where an association of approximately 250 households actively take into consideration archipelago interests related to communication and information. Shareowners within the village have also made a local agreement to distribute fishing rights between each other, but in contrast to Southern Stavsudda, local property owners still regard the water as collectively owned. Only one area has unclear ownership with lack of information in the real property record.

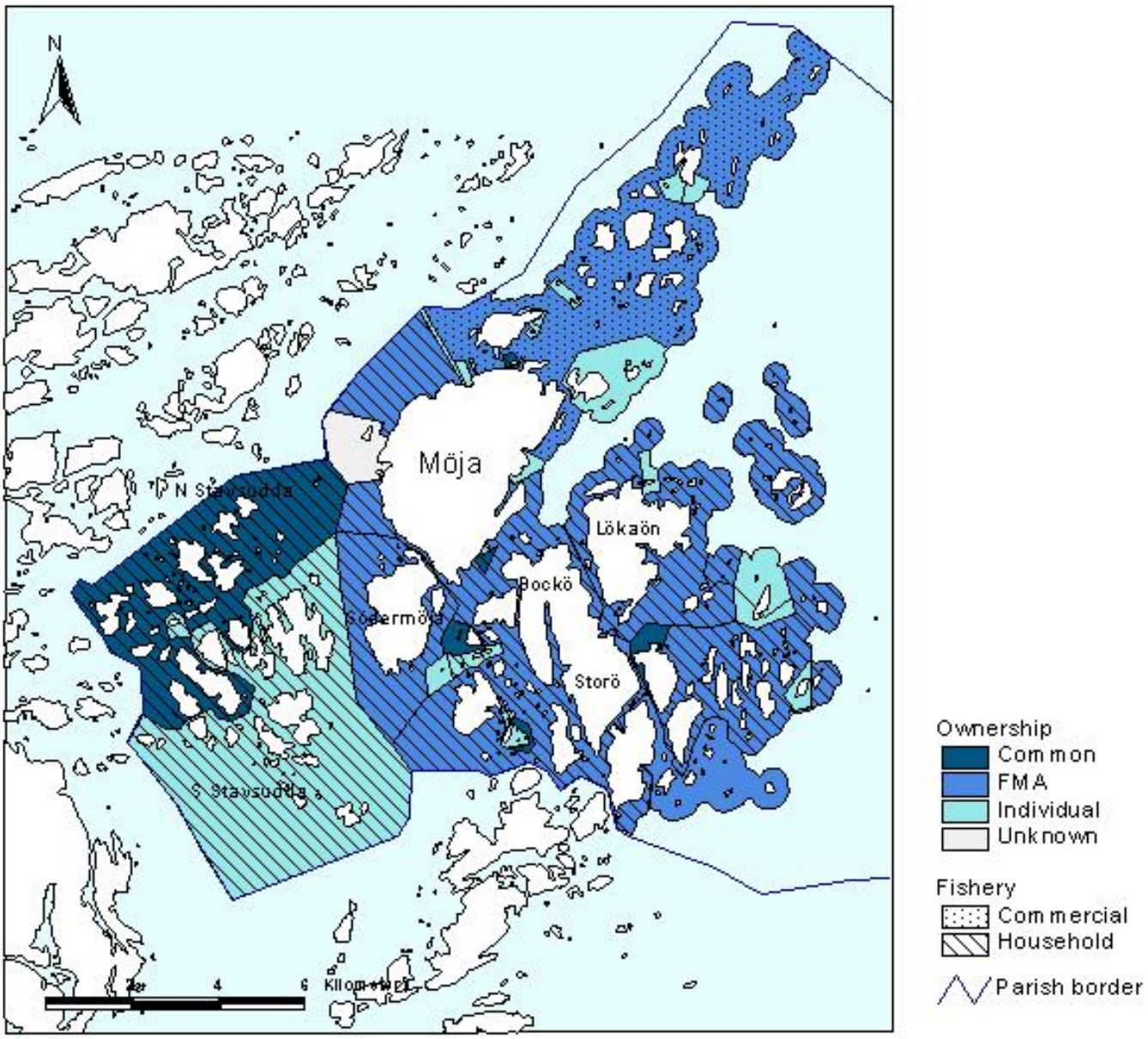
Fig. 2. Spatial distributions of ownership and fishery categories in Ornö parish.



Intensive Sport Fishing

A survey of recreational fisheries in Ornö Archipelago indicates that the total amount of fish caught (in weight) by sport fishers is about four times greater than that of household fishing (Svedäng et al.1998). Sport and household fishing also greatly exceed the catches reported by commercial fishing in Ornö parish (Fig. 4). This agrees with the view among interviewed local residents and water owners, in both Möja and Ornö parishes, that sport fishing is widespread and has increased since the expansion of public fishing rights in 1985. In addition, an increasing number of permanent inhabitants and seasonal residents without private fishing rights take advantage of the right to fish with hand-held gear. At least two groups of sport fishers can be distinguished, local residents with or without private fishing rights fishing in their "home" waters and the fishing tourists or visitors. According to the local land and water owners, the intensity is greatest during the summer months

Fig. 3. Distribution of ownership and fishery categories in Möja parish.



when sport fishers catch pike, perch, and sea trout with rod and line, and herring with a jig. Sports fishers are often seen as well informed as to when and where good fishing exists, and are often concentrated in the inner parts of the archipelago (Svedäng et al. 1998). In some parts of the archipelago, including St. Rotholmen and Genböte in Ornö parish (Fig. 2), trolling is allowed after purchasing the regional TDA permit. These areas are owned by the municipalities of Haninge and Stockholm, and the income from these permits goes to conservation measures that the municipality of Stockholm administers. Trolling is popular among many sport fishers, and the TDA permit generated 50 000 Swedish kroner to management in 2004 (Roxberger and Lovén 2004). On the other hand,

local land and water owners stated in the interviews that sport fishers using trolling methods often fish outside these areas, trespassing on private waters.

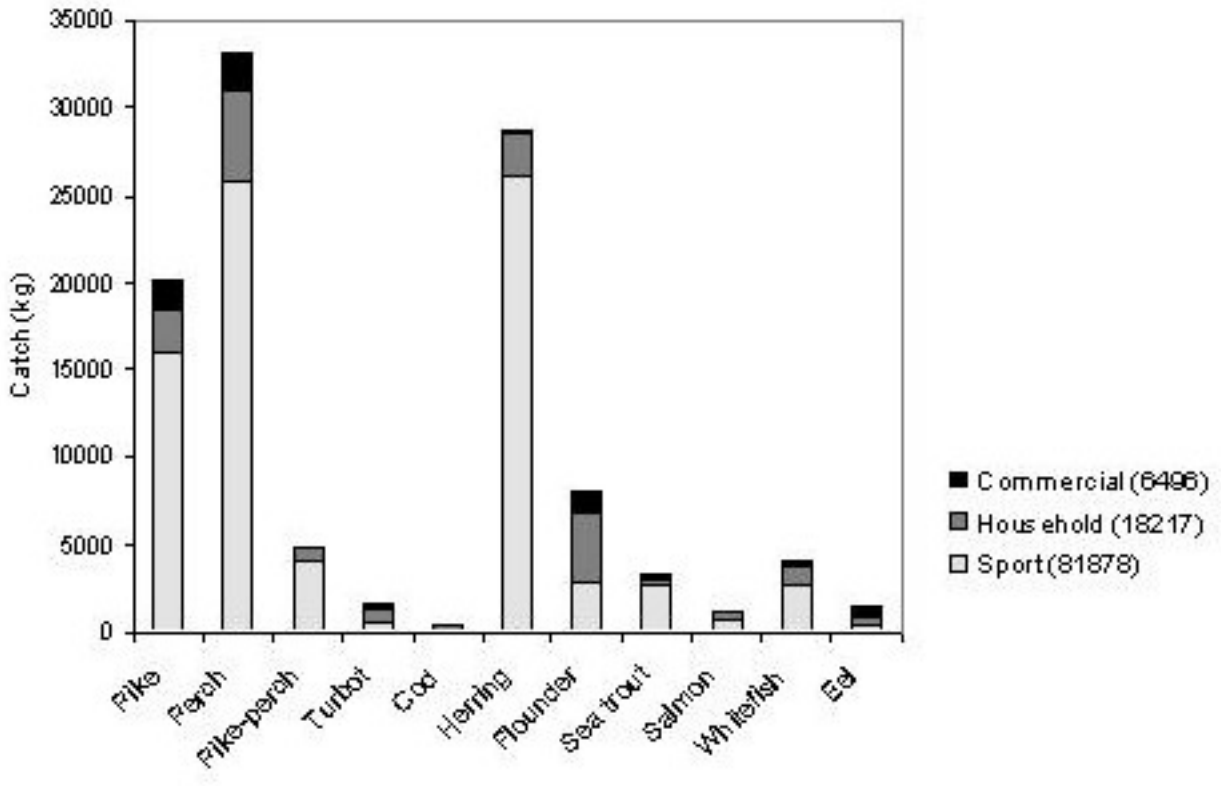
Both commercial fishers and recreational fishers with private fishing rights stated in the interviews that they felt that public fishing rights have changed the incentives for local fisheries management. The commercial fishers said they wanted to have the sole right to the fish resources in the water areas they lease or own, so that they can control how fish resources are used. This was the case before public fishing rights were introduced, and many creeks and inlets were then protected during breeding season according to local fishers in both Möja and Ornö. In some cases, it was even prohibited to row through the most sensitive areas. The water owners argued that those who are interested in local management would be able to sell fishing permits to sports fishers, regulate when and where to fish, and use the income for conservation measures if owners had more exclusive rights to their waters. Today, it is not regarded as profitable for owners to carry out conservation measures on the fishing grounds because this effort is not necessarily profitable for them. One fisher argued that if a fishing rights owner decides not to fish in a spawning area to safeguard the pike stock, recreational fishers are still allowed to fish and thus negate the initiative to protect a certain fish stock.

Household Fishing Previously under Local Management

Household fishing is most spatially widespread in Möja parish, and is the dominant fishing type in the FMAs and in northern and southern Stavsudda (Fig. 3 and Table 2). Private water owners can use household fishing methods. Fish species regularly harvested in the household fishery are herring, pike, perch, whitefish (*Coregonus lavaretus*), flounder (*Platichthys flesus*), and pikeperch caught with gillnets and winter fishing on ice with trap or net. Permanent residents tend to fish year round, whereas summer residents only fish on holidays and weekends during the summer months. One FMA, formed in 1974 and covering 21 km^2 of water, regulates fishing for 200 members by allocating access to fishing waters and making recommendations to avoid fishing during certain periods, e.g., to protect spawning. Members are divided into groups with access to fishing grounds depending on their shares in the village. A group can have access to more than one area and the fishing is free within these areas. In this way, fishing is distributed throughout the whole area. The association also restricts selling of shares, and must be consulted before non-members may be allowed to use fishing rights. This is a response to the increasing number of shareowners, such as seasonal residents, pursuing real property within the village. In three areas, selling of shares in commonly managed fishing waters is not restricted and thus, keeping track of all shareowners becomes difficult, especially when fishing rights are transferred as oral traditions and not reported in the real property record kept by regional authorities, as is the case in Stavsudda.

Within one FMA, waters were rotated on a yearly basis until 1954 when rotation stopped as a result of an increase in the number of shareowners when land properties were divided into smaller lots. This change made the association inactive and today, waters could in practice be regarded as individually owned. Further reasons for the continuous development stated by representatives from the local fisheries associations and commercial fishers are again public fishing rights in private waters reducing incentives to manage fishing waters collectively, but also a decreased dependence on fish resources for subsistence. Another change related to public fishing rights is the decreased sale of temporary fishing permits experienced by the local FMAs in particular. Earlier, the income from the local fishing associations' permits was used to fund joint measures, such as restoration of spawning grounds or stocking of pikeperch. According to the chairman of one of the fishing associations in Möja, they formed a FMA in 1984 at the request of a former county fisheries counselor. The purpose was to increase the sale of permits to the public. Members of the village council spent time and money organizing it. When public fishing rights were introduced 1 year later, the fishers in the FMA felt that their incentives for collective action were reduced. The chairman stated that the possibility to regulate fisheries directly by controlling the number of fishers, and thus indirectly the catches, was lost. Even though they and the other FMAs occasionally sell permits for household fisheries, total catches in the area are not known. Fishing water owners also observe a misuse of the free fishing, when methods such as trolling are used where it is not allowed. In 2004, more than 100 violations of fishing regulations were recorded by regional authorities (Roxberger and Lovén 2004).

Fig. 4. Fish catches in Ornö parish in 1995, divided into commercial, household, and sport fishing. (Source: Svedäng et al. 1998, commercial fisheries statistics from the National Board of Fisheries.)



In our study, household fishing was not found to be as spatially widespread in Ornö as in Möja. One reason could be that, in a large number of primarily individually owned areas, the extent of fishing activities is unknown. If household fishing occurs in these areas, it could account for more than 70% of the area instead of one tenth. No FMA exists in Ornö, but a summer house association on Fåglarö Island manages fisheries by restricting types of gear, and to some extent, when and where fishing is permitted. This association covers only 4 km^2 or 2% of the total water area and is the only case found within Ornö parish that actively manages local fisheries. For example, eel fishing is managed by allowing only one trap to be placed on a selected spot at a specific time for each household in the association. Additional gear restrictions include the use of no more than 3–4 nets with a maximum length of 150 m. According to the local fishery inspector at Fåglarö, the purpose of the restrictions is to prevent members of the association from taking larger catches than necessary for household needs, thus trying to maintain the fish resource through constraints placed on use. The management practices and regulations within the associations seem to have changed over time, depending on the interests of active members. At present, one member of the association committee has initiated ongoing discussions to increase regulations to further protect and improve spawning areas by restoration activities, exemplifying the role of leaders in developing local institutions (F. Westley, personal communication, 2005).

Declining Commercial Fishing

The general decrease in number of commercial fishers experienced across the whole archipelago also pertains to Ornö and Möja. Until the end of 1980s, 35 commercial fishers operated in Möja parish (Andersson 1998). Today, only one licensed fisher is involved in commercial fishing there. Water is leased around the main island and the fisher has shares in the Möja-Långvik FMA (Fig. 3). One unlicensed fisher, catching eel primarily, was also found to operate in Möja and there could be several more according to water owners in the area. In Ornö, commercial fishers have declined from ten to three over the last 20 years. Local commercial fishers also argue that decreased herring stocks in the archipelago aggravated the situation. Commercial fishing in Ornö and Möja is concentrated in the near shore areas. Coastal species, such as herring, pike, perch, flounder, and eel are caught and the main gears used are traps and nets. In Ornö, commercial fishing takes place mainly in the southern part of the parish, around Fjärdlång and Huvudskär (Fig. 2). Two local commercial fishers lease fishing rights in individual and state properties and one fisher leases fishing waters from the former entailed estate, but also uses public waters. According to the fishers, the main factors restricting fishing is access to fishing waters, time limitations, and a weak market demand for fish. One commercial fisher takes active part in a management project initiated by the SCAB. He monitors species in the area where he usually fishes. Otherwise, commercial fishers in Ornö and Möja do not perform any local management activities in areas they own or lease, but state that they would if they had exclusive fishing rights. The same fishers refer to previous local management activities where important fishing grounds such as inlets and creeks were protected during spawning periods and where rowing through somebody else's waters during this period was regarded as a severe violation of local rules and customs.

Fishing is complemented in various ways. One fisher manages a small salmon farm and processes fish (e.g., by smoking), and sells it directly to summer guests. Another fisher runs a store on the mainland where a large part of the catch is sold, whereas eel catches are distributed through a wholesaler. This flexibility in individual initiatives is part of the traditional strategy of archipelago residents to combine occupations to cope with the dynamic archipelago environment (Storå 1985, Hammer et al. 1993, Andersson and Eklund 1999). Responding to changes in fish abundance by switching to other species is also part of this adaptive strategy. One example is the substitution of cod and whitefish for herring in the 1980s when herring catches declined according to one commercial fisher. Another fisher reports that a decrease in pike stocks at the end of 1990s made fishers switch to perch, which was more abundant in the area according to the fishers' own observations.

The Role of Regional and National Authorities

Local resource use is primarily linked vertically in a management system of regional and national authorities. These different organizational levels interact to manage fisheries. For example, restoration of streams and stocking of sea trout, salmon, and pikeperch have been carried out by the SCAB in cooperation with municipalities and local fishing associations since 1970 (Holmlund and Hammer 2004). For example, 2000 and 3000 1-year-old sea trout smolt were stocked in Ornö and in Möja, respectively, in June 2004 (Roxberger and Lovén 2004). Another collaborative project is the protection of spawning areas in the archipelago in response to local reports about declining pike and perch stocks. Local fishers and water owners and representatives from management authorities met at a conference to discuss fisheries management in 2003, and the consensus was to deal with the resource issue (H. C. Andersson, personal communication). Hence, their shared concern sparked the formation of a multi-stakeholder group comprising regional and local level associations: Stockholm County Fishers Federation, Federation of Fishing Rights Owners, Stockholm Anglers Association, the Archipelago Foundation, and the SCAB. This collaboration resulted in 17 protected bays where fishing is banned for all users between 1 April and 15 June. Local users participated in the process of selecting the protected areas. Two of these areas are situated in Ornö parish (Sundbymaren and Varänsfjärden) and another (Ängsö) is proposed (H. C. Andersson, personal communication, 2005). Furthermore, the SCAB and the archipelago municipalities cooperate to monitor and control the use of fish resources in the archipelago. Sampling with Nordic gill nets is performed during August in one area north of Möja and another covering Ornö, extending from shallow grounds through bays to the farthest outports of the archipelago (Andersson 2003). Two inspectors work part time to supervise the fishery. In addition,

about 50 local inspectors are authorized to perform fisheries supervision on a non-profit basis. They are appointed by local fishery organizations, e.g., FMAs, but also by the Archipelago Foundation, and the inspectors can confiscate equipment and report violators to the police when rules are broken.

DISCUSSION

Reorganizing Coastal Fisheries Management

The Stockholm Archipelago has developed into a multi-use system characterized by a scattered ownership structure where rights and duties are distributed among a heterogeneous group of actors (Tables 2 and 3). The mixture of individual ownership, collective arrangements, public access, and governmental influence creates a diversity of stakeholders and authorities with different influence on fisheries regulations (Table 1). The rules determining where and how to use fish resources, the operational rules (Ostrom 1990, Ostrom et al. 1994) have multiple sources ranging from local to international levels (Table 4). Overlapping regulations, stemming from the coexistence of several management authorities and associations, create institutional complexity. Hence, institutional and organizational levels cover local property rights (predominantly collective in Möja and individual in Ornö), and regional, national, and to some extent, international management arrangements. This social and institutional complexity, combined with the changing use patterns and declining resource base, has opened up discussion about the future design of Swedish coastal fisheries management. The Swedish government is beginning to recognize the need for institutional reform emphasizing development of local coastal fisheries, with increased influence of local user groups as a way of complementing centralized fisheries management (Government of Sweden 2003, Bruckmeier and Neuman 2005). Below, we discuss some of the challenges facing a reorganization of coastal fisheries to meet both the ecological and user group characteristics.

Coping with User Heterogeneity

The resource users in archipelago fisheries have developed into a functionally and spatially heterogeneous group. A small number of commercial fishers in Ornö and Möja share resources with a large group of recreational fishers (the interviews indicating several hundred in both areas) and an unknown number of "visiting" sport fishers, a pattern also manifested in the whole of Stockholm County. Many sport fishers often live outside the archipelago and move between fishing grounds scattered across the whole area (Svedäng et al. 1998) whereas water owners with private fishing rights in Ornö and Möja seem to have a more stationary fishing pattern. There is also diversity in the interests and engagement in management activities of different user groups. Some owners with private fishing rights are actively involved in fisheries associations, carrying out management and conservation measures, and have fishing as their main leisure activity. Others are not engaged in fishing at all. This difference can also be found among non local or "visiting" sport fishers. Sport fishers from one organized group spend a lot of time fishing and are often interested in fisheries management (Holmlund and Hammer 2004), but others spend just a few days fishing (Bengtsson et al. 2000) These differences in interests have consequences for management, and in some cases, create a mismatch between users and owners. It is argued that governments often take more responsibility for management and decision making when user groups are heterogeneous (Sen and Nielsen 1996). A fundamental issue for the centralized authorities then is how to balance different user groups and public, local, and other specific interests. In Sweden, the centralized fisheries management has tended to favor recreational fishing along with the offshore fisheries (Hammer 1994, Hultkrantz et al. 1997). Recreational fishing has been stimulated by the governmental decisions that gradually increased public access to fishing waters during the second half of the 20th century. This expansion of recreational fishing rights has also been manifested in increased recreational fishing, creating a large group of fishers with different interests (Bengtsson et al. 2000). By introducing public fishing rights in 1985, a double admittance to fisheries in private waters was created. This decision sparked intense dissatisfaction among water owners in the archipelago and is still a source of conflict after 20 years of public fishing rights. A common opinion among water owners is that public fishing rights restrict the rights of owners to the extent that incentives for managing fisheries locally are eliminated. This is reflected in the formation of the FMAs. Only one management area has been formed within the archipelago since 1985 when public

Table 4. Fisheries regulations and management practices at the local (L), regional (R), national (N), and international (I) levels identified in Ornö and Möja parishes.

Regulation/management practice	Example	L	R	N	I
Access	free fishing with handheld gear			•	
	private fishing rights			•	
	license for commercial fishing			•	
	TDA-fishing		•		
	membership in fishery association	•			
	rotation of fishing waters	•			
Seasonal limitations	protection of spawning areas		•		
	eel-fishing	•			
Fish stocking	sea trout, salmon, pikeperch, eel	•	•		
Gear limitations	amount of gear	•	•	•	
	type of gear (net size, number of hooks)	•	•	•	
	trawling ban	•	•	•	
Minimum size of fish	salmon, sea trout, pike, pikeperch, eel, cod, turbot, flounder			•	
Catch quotas	cod, salmon, herring, sprat				•

fishing rights were introduced. Furthermore, some common properties are being transformed into individual properties when collective management practices, such as rotation of fishing grounds, stop as associations or village councils become inactive (e.g., FMAs in Möja).

The examples of local management initiatives and regulations currently in use in Ornö and Möja include both operational rules (e.g., gear and seasonal limitations) and collective-choice arrangements regulating access and alienation, i.e., the right to sell fishing rights (Ostrom and Schlager 1996). These rules were more developed and commonspread in the past according to commercial fishers and members of FMAs. The will to (re-)establish collective-choice arrangements exists among some resource users in the areas examined. Fåglarö Summerhouse and Fishing Association is an example of a relatively new group of resource users that manages fisheries collectively. If exceptions to public fishing rights in private waters could be made, several FMAs state that they would be interested too. But the lack of information about who has fishing rights, as the number of shareholders increases in many of the associations, could complicate this process. The question is whether incentives for local management can be increased by redefining property rights, either by further increasing the rights of sport fishers and

giving active sport fishing associations an opportunity to manage specific areas or by withdrawing public fishing rights in some private waters. Local water owners in both Ornö and Möja, especially those organized in some form of sport fishing association, could benefit from limiting public fishing rights as it would thereby establish incentives for local management. At the same time, recreational fishing based on public fishing rights is widespread and important for public health, and has strong political and public support (Government of Sweden 2003; L.-O. Larsson, personal communication, 2005).

Other difficulties related to the large and heterogeneous group of resource users (e.g., the dispersed group of sport fishers) include monitoring and enforcement of user behavior. When abuse goes undetected and regulations are not enforced, users face incentives to violate the rules (Ostrom 1990), as is reported by local water owners and fishery inspectors (e.g., trolling in private waters). Users engaged in fishing associations often with private fishing rights can exert peer pressure within the local resource group (Eggert and Ellegård 2003), and in some cases, have dealt with the monitoring problem by appointing local inspectors to survey fishing, e. g., FMAs in Möja and the Fåglarö Summerhouse and Fishing Association in Ornö. Unorganized recreational fishers without the social networks and local connection to specific areas might not have the same opportunities to develop informal institutions that could emerge from interdependence within the group.

Addressing Resource Characteristics

The characteristics of the archipelago resource system, with patchy environments and migrating fish, cause the ecological conditions for management to vary within the area. Under the present management arrangements, a mismatch arises between the dominant large-scale management and the sometimes much smaller scale of ecological processes. When discrete local fish populations are treated as one stock, there is a risk of overexploiting specific populations and reducing diversity. As sport fishing is concentrated in specific bays in the archipelago, local populations, particularly of stationary species, may be exposed to a high fishing pressure. Several water owners expressed worries about the intensive sport fishing for pike in some areas. The documented catch level of pike in Ornö parish supports these observations, and this fishing pattern could lead to overharvesting of some local populations (Svedäng et al. 1998).

One way of addressing the conditions of specific populations and species is to decentralize management to the local level, thus increasing the influence of resource users in a specific area. Even though local management increases the opportunities to manage different populations separately, population-based management can be difficult in practice. The discreteness of local populations may apply only to some life stages, and areas outside the local management unit are critical as well. For example, salmon consists of several populations originating from different rivers, but fishing takes place on the mixed stock at sea. Management of single populations of such river-spawning species is possible if current fishing patterns are changed, e.g., by restricting fishing exclusively to the rivers. However, species such as eel and cod that migrate long distances and consist of few populations cannot be managed locally, and need national or even international agreements. Hence, the diversity in spatial and temporal scales of multiple species and their interactions make it difficult to define a single appropriate management unit. Adding the spatial pattern of water properties within the Stockholm Archipelago further complicates the picture. A large number of individual properties, predominantly in Ornö parish, are too small to function as management units on their own, whereas the size of FMAs in, e.g., Möja corresponds more to the requirements of coastal species such as perch, pike, and pikeperch. Studies on migration patterns of these species indicate that the whole life cycle could take place within these management units (Saulamo and Nauman 2002). Detailed information on local conditions is, however, required to consider the functional aspect of these areas, including feeding and nursery areas for the species in question.

Expanding the Knowledge Base for Management

Variability in both natural (e.g., temperature) and human induced (e.g., eutrophication) conditions have effects on important species and fisheries. The interviews provided examples of how changes in the ecological system have had an impact on use patterns in the archipelago, primarily affecting commercial fisheries. For example, awareness of spatial and seasonal fluctuations in fish species

abundance makes fishers switch target species within and between seasons. This was a typical characteristic of traditional coastal fisheries, where fishing was divided into periods determined by the migration and abundance of species (Löfgren 1977, Hammer 1995). According to commercial fishers, declining herring and cod populations during the 1980s contributed to the extensive decline in the number of fishers in both Ornö and Möja. Although this is an extreme example, it illustrates how variability in the resource base feeds back to local fishers, who then adjust resource use, in this case by changing occupations. This strategy of combining occupations has created a flexibility among archipelago residents that builds capacity to adapt and transform when faced with variability and uncertainty in ecosystems and that may improve their ability to deal with uncertainty and change in the future (Holling 1978, Walters 1986).

Furthermore, local users could gather detailed information about the resource base, which is difficult and costly to obtain for centralized authorities or is not included in larger-scale monitoring programs. Using the experience of local resource users offers the potential to complement scientific knowledge (Johannes 1978, Gadgil et al. 1993, Scoones 1999, Olsson and Folke 2001). For example, local users can provide information on potential large-scale changes, as in the Newfoundland cod fisheries, where local coastal fishers observed changes in population size long before the collapse occurred (Finlayson and McCay 1998). Commercial fishers, local residents, and water owners in Ornö and Möja parishes observe fluctuations in fish stock abundance, habitat destruction and disturbance in reproduction areas. This often site-specific knowledge could be used in management decisions, as was done in the identification process of important spawning grounds in the Stockholm Archipelago that resulted in the protection of 17 bays during spring spawning. As fishing patterns change, experienced-based knowledge may also transform; some of it may be lost over time and new insights may be gained. Still, there is a wide gap between the level of knowledge needed to use a resource and that needed to sustain it. Informal local knowledge acquired through experience is often limited, and sustaining the resource requires understanding of complex dynamics of, e.g., population size and structure, recruitment processes, species interactions, and abiotic factors influencing resources. This information is or could be generated by management authorities with expert knowledge and research.

Stimulating Multilevel Management Arrangements

The future of coastal fisheries will depend on how fish resources, the ecosystem providing them, and the interests of different stakeholders are dealt with by management authorities at different levels. The interdependence of resource users and the existence of local as well as larger-scale resource management arrangements call for joint approaches where institutions are coordinated and linked across scales in some form of collaborative management arrangement (Pinkerton 1989, Pomeroy 1995, Jentoft et al. 1998). In such arrangements, decision making and management are part of a process where responsibility is shared between different types of stakeholders, authorities, and researchers, often involving decentralization to the lowest appropriate level. Involving local resource users in the management process has been shown to legitimize and generate a better knowledge and understanding of rules concerning resource use (Anderies et al. 2004), but transferring part of the management responsibilities to the resource users does not implicitly mean that resources will be managed sustainably. The user group or the community still has to design and implement a management system securing sustainable use. Conflicts and competition between stakeholders, user groups unwilling to participate, and free riders, and uneven power relations or resource dependencies are problems to overcome (Trisak 2005, Sen and Nielsen 1996, Carlsson and Berkes 2005). By stimulating joint, collaborative measures between multilevel users, as the stakeholder group developed in Stockholm Archipelago, including users with both private and public fishing rights who are interested in managing fisheries, these problems can be addressed. For example, FMAs provide existing structures to build on. The spatial units and social networks of local resource users already exist and function in relation to other common issues like roads and harbors. In these areas, a redefinition of property rights, to be more exclusive, could increase the incentives for managing fisheries locally. Two successful examples of increased user participation in Swedish coastal fisheries are the co-management of vendace (*Coregonus albula*) fisheries in the northern part of the Gulf of Bothnia (Rova 2004) and the shrimp fishery in Koster-Väderö on the west coast of

Sweden (Píriz 2004) developed in recent years. It was possible to develop these initiatives within the existing framework of formal regulations. Stimulating agreements between water owners and sport fishing associations without private fishing rights is another way to increase user participation in fisheries management. However, transferring management authority entirely to the local level may not be possible or even desirable. A centralized management may be required to ensure the public interests of the large group of non-local fishers without private fishing rights, as is done in TDA fishing areas. As stated before, the heterogeneity among resource users and the characteristics of the coastal ecosystem necessitates multiple ways of managing coastal fish resources. A key issue when reorganizing fisheries management is how to develop and stimulate appropriate distributions of management functions on different geographical scales and organizational levels and create links for cross-scale coordination within the interconnected social–ecological system.

CONCLUSIONS

This study show how archipelago fisheries are going through a transition from dominating small-scale commercial fishing to recreational fishing, creating institutional complexity that emphasizes a reorganization of the centralized management arrangements. National authorities have, until recently, treated Swedish fisheries more or less uniformly, mostly focusing on large-scale commercial fishing. By not considering local conditions and not promoting incentives for collective action at the local level, coastal fish resources are often left unmanaged. Furthermore, the varying contexts of property and use rights, heterogeneity among users related to diverse interests and resource use patterns, and the dynamics of the coastal ecosystem supporting fisheries are some of the challenges facing the reorganization of fisheries management to cope with declining fish populations.

First, greater involvement of local users—including both local water owners and recreational fishers without private waters—in decision making could provide specific and detailed information of local conditions that may help in the process of designing new institutions for more sustainable management. Also, these users are more likely to conserve resources if they have incentives and real influence on how they are used. Second, the diversity of property rights regimes with different ownership categories and use rights makes the preconditions for local management in the archipelago variable. The appropriate scale of management depends both on the resource and the traditions of collective arrangements or individual ownership. This diversity and complexity call for multilevel arrangements and cross-scale interactions between user groups, communities, associations and authorities in order to deal with the increasing demands on resources and ecosystems. In some areas and for some species, local management is feasible; for others, it may require action at the regional, national, or even global scale to safeguard the ability of coastal areas to continuously generate valuable fish resources.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol11/iss2/art3/responses/

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LITERATURE CITED

Agricultural Ministry. 1992. *Enklare fiskebestämmelser.* Departements serie (Ds) 1997:7. Jordbruksdepartementet, Stockholm, Sweden.

Almesjö, L., and S. Hansson. 2001. Minskande bestånd och rekryteringsstörningar hos kustbestånd av abborre (*Perca fluviatilis*) och gädda (*Esox lucius*). [online] URL: http://www.naturvardsverket.se/dokument/natur/vaglednv/pdf/abborre.pdf.

Anderies, J. M., M. A. Janssen, and E. Ostrom. 2004. A framework to analyze the robustness of social–ecological systems from an institutional

perspective. *Ecology and Society* **9**:18. [online] URL: http://www.ecologyandsociety.org/vol9/iss1/art18/.

Andersson, H. C. 2003. *Fiskar och fiskare i Stockholms län-äget år 2002.* Report 2003:19. Stockholm County Administration Board, Stockholm, Sweden.

Andersson, J. 1998. Kustfisk och fiske vid svenska Östersjökusten. *Fiskeriverket information* **1**:1998.

Andersson, K., and E. Eklund. 1999. Tradition and innovation in coastal Finland: the transformation of the archipelago sea region. *Sociologia Ruralis* **39**:377–393.

Ask, L., and H. Westerberg. 2004. *Resurs- och miljööversikt 2004.* National Board of Fisheries, Gothenburg, Sweden.

Ask, L., and H. Westerberg. 2005. *Fiskbestånd och miljö i hav och sötvatten. Resurs- och miljööversikt 2005.* National Board of Fisheries, Gothenburg, Sweden.

Bengtsson, B., R. Lundgren, and G. Johansson. 2000. *Fiske 2000: En undersökning om svenskarnas sport- och husbehovsfiske.* National Board of Fisheries, Gothenburg, Sweden.

Berkes, F. 1989. *Common property resources: ecology and community-based sustainable development.* Belhaven Press, London, UK.

Berkes, F., J. Colding, and C. Folke. 2003. *Navigating social–ecological systems: building resilience for complexity and change.* Cambridge University Press, Cambridge, UK.

Berkes, F., and C. Folke. 1998. *Linking social and ecological systems. Management practices and social mechanisms for building resilience.* Cambridge University Press, Cambridge, UK.

Bromley, D. W. 1991. *Environment and economy: property rights and public policy.* Basil Blackwell, Oxford, UK.

Bruckmeier, K., E. Neuman, and P. Salmi. 2003. Local fishery management, private property of coastal waters and common pool resources in Swedish and Finnish coastal fishery. *In* Proceedngs of the conference on *Rights and duties in the coastal zone,* 12–14 June 2003, Stockholm, Sweden.

Bruckmeier, K., and E. Neuman. 2005. Local fisheries management at the Swedish coast: biological and social preconditions. *Ambio* **34**:91–100.

Carlsson, L., and F. Berkes. 2005. Co-management: concepts and methodological implications. *Journal of Environmental Management* **75**:65–76.

Coleman, F. C., W. F. Figueira, J. S. Ueland, and L. B. Crowder. 2004. The impact of United States recreational fisheries on marine fish populations. *Science* **305**:1958–1960.

Costanza, R. 1997. The ecological, economic, and social importance of coastal and marine systems. Pages 237–252 *in With rivers to the sea.* Stockholm Water Symposium, 10–15 August 1997, Stockholm, Sweden.

Costanza, R. 1999. The ecological, economic and social importance of the oceans. *Ecological Economics* **31**:171–187.

Daily, G. C., S. Alexander, P. R. Ehrlich, L. Goulder, J. Lubchenco, P. A. Matson, H. A. Mooney, S. Postel, S. H. Schneider, D. Tilman, and G. M. Woodwell. 1997. Ecosystem services: benefits supplied to human societies by natural ecosystems. *Issues in Ecology* **2**:2–16. [online] URL: http://www.esa.org/science/Issues/FileEnglish/issue2.pdf.

Eggert H., and A. Ellegård. 2003. Fishery control and regulation compliance: a case for co-management in Swedish commercial fisheries. *Marine Policy* **27**:525–533

Feunteun, E. 2002. Management and restoration of European eel population (*Anguilla anguilla*): an impossible bargain. *Ecological Engineering* **18**:575–591. [online] URL: http://www.sciencedirect.com/science?_ob=IssueURL&_tockey=%23TOC%236006%232002%23999819994%2332061 6%23FLA%23&_auth=y&view=c&_acct=C000035218&_version=1&_urlVersion=0&_userid=2195977&md5=e52f2ed42bf4a17eebfd2c1d5a530b02.

Fiskeriverkets författningssamling (FIFS). 2004. *Fiskeriverkets föreskrifter FIFS 2004:25 om resurstillträde och kontroll på fiskets område.*

Swedish Board of Fisheries, Gothenburg, Sweden. [online] URL: http://www.fiskeriverket.se/juridik/fifs/2004-25/KV/2004-25-keu.pdf.

Finlayson, A., and B. McCay. 1998. Crossing the threshold of ecosystem resilience: the commercial extinction of northern cod. Pages 311–337 *in* F. Berkes and C. Folke, editors. *Linking social and ecological systems. Management practices and social mechanisms for building resilience.* Cambridge University Press, Cambridge, UK.

Folke, C., L. Pritchard, Jr., F. Berkes, J. Colding, and U. Svedin. 1998. *The problem of fit between ecosystems and institutions.* IHDP, Bonn, Germany. [online] URL: http://www.ihdp.uni-bonn.de/html/publications/workingpaper/wp02m.htm.

Gadgil, M., F. Berkes, and C. Folke. 1993. Indigenous knowledge for biodiversity conservation. *Ambio* **22**:151–156.

Gårdmark, A., T. Aho, and A.-B. Florin. 2004. *Kustfisk och fiske – tillståndet hos icke kvotbelagda fiskresurser år 2003.* National Board of Fisheries, Gothenburg, Sweden.

Government of Sweden. 2003. *Kust- och insjöfiske samt vattenbruk.* Regeringes proposition 2003/04:51. [online] URL: http://www.regeringen.se/content/1/c6/01/50/40/fbc5a1ec.pdf.

Hammer, M. 1994. *Natural and human-made capital interdependencies in fisheries. Examples from the Baltic Sea.* Dissertation. Stockholm University, Stockholm, Sweden.

Hammer, M. 1995. Integrating ecological and socioeconomic feedbacks for sustainable fisheries. Pages 141–151 *in* S. Hanna and M. Munasinghe, editors. *Property rights in a social and ecological context: case studies and design applications.* World Bank Publications, Washington, D.C., USA.

Hammer, M., C. M. Holmlund, and M. Åqvist Almlöv. 2003. Social–ecological feedback links for ecosystem management: a case study of fisheries in the central Baltic Sea archipelago. *Ocean & Coastal Management* **46**:527–545.

Hammer, M., A. M. Jansson, and B.-O. Jansson. 1993. Diversity change and sustainability: implications for fisheries. *Ambio* **22**:97–105.

Hanna, S. 1996. Property rights, people and the environment. Pages 381–393 *in* R. Coztanza, O. Segura, and J. Martinez-Alier, editors. *Getting down to earth. Political applications of ecological economics.* Island Press, Washington, D.C., USA.

Hanna, S., C. Folke, and K.-G. Mäler, editors. 1996. *Rights to nature. Ecological, economic, cultural and political principles of institutions for the environment.* Island Press, Washington, D.C., USA.

Hansson, S., and L. G. Rudstam. 1990. Eutrophication and Baltic fish communities. *Ambio* **19**:123–125.

Holling, C. S. 1978. *Adaptive environmental assessment and management.* John Wiley & Son, New York, New York, USA.

Holling, C. S., and G. K. Meffe. 1996. Command and control and the pathology of the natural resource management. *Conservation Biology* **10**:328–337.

Holmlund, C. M., and M. Hammer. 2004. Effects of fish stocking on ecosystem services: an overview and case study using the Stockholm Archipelago. *Environmental Management* **33**:799–820.

Hultkrantz, L. 1995. *Hushållning med knappa naturresurser - Exemplet sportfiske.* Ds 1995:47. Fritze, Stockholm, Sweden.

Hultkrantz, L., Y. Hasselberg, and D. Stigberg 1997. *Fisk och Fusk - Mål, medel och makt i fiskeripolitiken.* Regeringskansliet, Finansdepartementet. Ds 1997:81. Stockholm, Sweden.

Jentoft, S., and B. McCay. 1995. User participation in fisheries management: lessons drawn from international experiences. *Marine Policy* **19**:227–246.

Jentoft, S., B. J. McCay, and D. C. Wilson. 1998. Social theory and fisheries co-management. *Marine Policy* **22**:423–436.

Johannes, R. E. 1978. Traditional marine conservation methods in Oceania and their demise. *Annual Review of Ecology and Systematics* **9**:349–364.

Jonson, M. 2002. *Fisketuristiskt företagande i Sverige.* Sveriges FisketurismFöretagare, Forshaga,

Sweden.

Kvale, S. 1997. *Den kvalitativa forskningsintervjun.* Studentlitteratur, Lund, Sweden.

Levin, S. 1999. *Fragile dominion. Complexity and the commons.* Perseus Publishing, Cambridge, Massachusetts, USA.

Ljunggren, L., A. Sandström, G. Johansson, G. Sundblad, and P. Karås. 2005. Recruitment failure in coastal fish populations in the Baltic Sea. *Finfo* **2005:5**. [online] URL: http://www.fiskeriverket.se/publikationer/finfo/pdf/2005/finfo05_5.pdf.

Löfgren, O. 1977. *Maritime hunters in Industrial Society.* Liber Läromedel Lund, Sweden.

Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: synthesis.* Island Press, Washington, D.C., USA.

National Board of Fisheries. 1984. *Fritt handreskapsfiske.* Liber, Stockholm, Sweden.

National Board of Fisheries. 2001. *Småskaligt kustfiske och insjöfiske- en analys.* National Board of Fisheries, Gothenburg, Sweden.

Nilsson, J., J. Andersson, P. Karås, and O. Sandström. 2004. Recruitment failure and decerasing catches of perch (*Perca fluviatlilis* L.) and pike (*Esox licius* L.) in the coastal waters of southeast Sweden. *Boreal Environment Research* **9**:295–306.

Nilsson, M. 1990. *Fritidsfiske -90.* Statistiska Centralbyrån, Fiskeristyrelsen, Örebro, Sweden.

North, D. C. 1990. *Institutions, institutional change and economic performance.* Cambridge University Press, Cambridge, UK.

Olburs, C. 2000. *Om uthålligt fiske och vattenbruk i skärgården.* Stockholm County Administration Board, Stockholm, Sweden.

Olsson, P., and C. Folke. 2001. Local ecological knowledge and institutional dynamics for ecosystem management: a study of Lake Racken watershed, Sweden. *Ecosystems* **4**:85–104.

Ostrom, E. 1990. *Governing the commons. The evolution of institutions for collective action.* Cambridge University Press, New York, New York, USA.

Ostrom, E., R. Gardner, and J. Walker. 1994. *Rules, games and common-pool resources.* University of Michigan Press, Ann Arbor, Michigan, USA.

Ostrom, E., and E. Schlager. 1996. The formation of property rights. Pages 127–156 *in* S. S. Hanna, C. Folke, and K.-G. Mäler, editors. *Rights to nature. Ecological, economic, cultural and political principles of institutions for the environment.* Island Press, Washington, D.C., USA.

Pinkerton, E. 1989. *Co-operative management of local fisheries.* University of British Columbia Press, Vancouver, British Columbia, Canada.

Píriz, L. 2004. *Hauling home the co-management of coastal fisheries. A study on institutional barriers to fishermen's involvement in the management of coastal fisheries on the west coast of Sweden.* Dissertation. Gothenburg University, Gothenburg, Sweden.

Pomeroy, R. S. 1995. Community-based and co-management institutions for sustainable coastal fisheries management in Southeast Asia. *Ocean & Coastal Management* **27**:143–162.

Rova, C. 2004. *Flipping the pyramid. Lessons from converting top-down management of bleak-roe fishing.* Dissertation. Luleå University of Technology, Luleå, Sweden.

Roxberger, Å., and S. Lovén. 2004. *Slutredovisning för statsbidragsfinansierad fiskevård och fisketillsyn 2004.* Idrottsförvaltningen, Stockholm Stad, Stockholm, Sweden.

Sandström, O., B. Holmström, A. Lappalainen, E. Neuman, H. Ojaveer, P. Salmi, C. Storå, R. Varjopuro, and M. Vetemaa. 2002. *Management models for the Baltic archipelago fisheries and aquaculture.* Tema Nord 2002: 521. Nordic Council, Copenhagen, Denmark. **Saulamo, K., and E. Nauman.** 2002. Local management of Baltic fish stocks—significance of migrations. *Finfo* **2002:**9.

Scoones, I. 1999. New ecology and the social sciences: what prospects for fruitful engagement? *Annual Review of Anthropology* **28**:479–507.

Sen, S., and J. R. Nielsen. 1996. Fisheries co-management: a comparative analysis. *Marine Policy* **20**:405–418.

Svensk författningssamling (SFS). 1950. *Lag om gräns mot allmänt vattenområde* Swedish Codes of Statutes 1950:595. Stockholm, Sweden.

SFS. 1981. *Lag om fiskevårdsområden.* Swedish Codes of Statutes 1981:533. Stockholm, Sweden.

SFS. 1993. *Fiskelagen.* (Fishery Act.) Swedish Codes of Statutes 1993:787. Stockholm, Sweden.

SFS. 1994. *Förordning om fisket, vattenbruket och fiskerinäringen* (Fishery decree). Swedish Codes of Statutes 1994:1716. Stockholm, Sweden.

SFS. 1998. *Förordningen om stöd till fiskevården.* Swedish Codes of Statutes 1998:1343. Stockholm, Sweden.

Statens offentliga utredning (SOU). 1968. *Fritidsfisket* SOU 1968:13 Jordbruksdepartementet. Stockholm, Sweden.

SOU. 2003. *The sea—time for a new strategy* SOU 2003:72 Havsmiljökommisionen. Stockholm, Sweden. [online] URL: http://www.regeringen.se/content/1/c4/17/16/88d37695.pdf.

Storå, N. 1985. Adaptive dynamics and island life. *Studia Fennica* **30**:112–144.

Stroh E. 2003. *Analys av fiskerättsförhållandena i Stockholms skärgård i relation till känsliga områden samt fysisk störning.* Seminarieuppsatser nr 98, Lunds Universitet, Lund, Sweden.

Sutinen, J. G., and R. J. Johnston. 2003. Angling management organizations: integrating the recreational sector into fishery management. *Marine Policy* **27**:471–487.

Svedäng, H., G. Thoresson, S. Thorfve, and A. Berglund. 1998. Undersökning av fritidsfiske vid Gålö-Ornö, Stockholms skärgård 1995–96. *Fiskeriverket rapport* **1:1998.** National Board of Fisheries, Gothenburg, Sweden.

Trisak, J. 2005. Applying game theory to analyze the influence of biological characteristics on fishers' cooperation in fisheries co-management. *Fisheries research* **75**:164–174

U.S Fish & Wildlife Service. 2002. *2001 national survey of fishing, hunting, and wildlife-associated recreation: national overview.* Department of the Interior, Fish and Wildlife Service; Washington, D. C., USA.

UNEP. 2000. *Report of the fifth meeting of the conference of the parties to the convention on biological diversity.* [online] URL: http://www.biodiv.org/doc/meetings/cop/cop-05/official/cop-05-23-en.doc.

Walters, C. J. 1986. *Adaptive management of renwable resources.* McGraw Hill, New York, New York, USA.

Wilson, C. J., R. S. Reid, N. L. Stanton, and B. D. Perry. 1997. Effects of land use and tsetse fly control on bird species richness in southwestern Ethiopia. *Conservation Biology* **11**:435–447.