# North atlantic fisheries in change: From Organic Associations to Cybernetic Organizations

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*Abstract* During the 1990s radical changes took place in marine ecosystems, fisheries and fishing communities around the North Atlantic. Social-ecological restructuring involving interactive changes in marine ecosystems, harvest technologies, fisheries science, management practices and goals, fishing households and communities and markets radically transformed fisheries associations. This article draws on insights from multiple sources, including a series of career history and other semi-structured interviews with fishers from Newfoundland and Labrador and Norway. These insights are presented in the form of career histories of two fishers, one from North Norway and one from Labrador on Canada's east coast. These career histories are contextualized within the larger literature on the post-World War II history of these two regions and the resulting descriptions are used to inform the design of three ideal types of fishery associations (organic, mechanical and cybernetic) that capture three main phases of interactive social-ecological restructuring during this period. Our argument is that today's North Atlantic harvesters are increasingly embedded in cybernetic fisheries organizations that are radically different from the forms of association that dominated in the past. In our analysis and conclusion we highlight the sustainability challenges and opportunities this process of cyborgization poses for these fishers and for North Atlantic fisheries in the future.

## Introduction

Interactive social-ecological restructuring (Ommer *et al.* 2007) has radically transformed fisheries science and management practices, as well as marine ecosystems, harvest technologies, fishing households and communities, and markets within North Atlantic fisheries in the post World War II period. Establishment of Exclusive Economic Zones (EEZs) in the late 1970s in accordance with the Law of

the Sea provided the legal framework for coastal states to establish and implement national laws and regulations to control fisheries and some other activities within a 200 nautical mile limit (Caddy and Cochrane 2001). In the 1980s the EEZ framework, coupled with persistent social, economic and conservation concerns, contributed to the development of a complex array of management mechanisms for limiting access, conducting stock assessments, and setting and allocating harvest shares in many fisheries. By the 1990s a series of events helped move concerns about sustainability to the foreground of fisheries discussions at national and international levels, including The Report of the World Commission on Environment and Development in 1987 (World Commission on Environment and Development 1987), the collapse of major, managed fish stocks (such as the groundfish stocks in Eastern Canada), and mounting evidence that humans are fishing down marine food chains around the world (Pauly and Maclean 2003).

Today, all of the major fisheries in the North Atlantic feature some combination of State management with efforts to get harvesters to assume greater responsibilities for management in return for their rights to fish (Caddy and Cochrane 2001; Holm 2001; Holm and Nielsen 2007). Accordingly, recent social-ecological thinking has emphasized the complexity of fisheries governance, distinguishing between the 'system to be governed' and the 'governance system' and/or questioning the effectiveness of centralized state management systems (Kooiman *et al.* 2005). In this article we seek to further this thinking by building on earlier research in North Norway and in Newfoundland and Labrador (NL) in Eastern Canada (Johnsen 2005; Murray *et al.* 2006) in which we treat fishers as part of relational networks.

In this article we use the term 'fishing association' to describe the changing *networks of relations* between people, the environment, management, technology, the economy, and other material, cultural and symbolic objects that make it possible for humans to fish or do other fisheries-related operations in different times and places (Johnsen 2005; Murray *et al.* 2006; Latour 2005). Inspired by Burns and Stalker (1964) we also distinguish between *associations* and *organizations* suggesting that while associations are organic and incrementally developed assemblages of relations forming certain patterns, organizations are particular forms of associations with formal bureaucratic structures, instrumental purposes and more defined objectives. An organization is founded on rationalistic ideas, scientific concepts and can be seen as 'a rational instrument engineered to do a job' (Selznick 1957:5).

To explore changes over time in the properties and attributes of 'fishing associations' we use information derived from career history interviews with older, smaller vessel fish harvesters in Newfoundland and Labrador and North Norway. To communicate the character and complexity of the changes in these fisheries from the point of view of the harvesters involved, we elaborate two comparative and exploratory case studies of the relational changes in fishing associations, drawing on interviews with two cod fishers, *Richard* from Lofoten in Norway and *Ben* from Labrador on Canada's north-east coast.[1]

We use these case studies to develop a conceptual framework that describes shifts across three ideal types, from 'organic associations' to 'mechanical associations' and towards 'cybernetic organizations'. In our analysis and conclusion we

raise questions about future directions in fisheries and the challenges and opportunities associated with integrating sustainability, effective monitoring, regulation and management for the public good into cybernetic fishing organizations. The relational changes in the organisation of fishing enterprises – processes we call *cyborgization* – have implications for the future, not least because the technical and organizational ability to catch fish of cybernetic organizations is much higher than the catching ability of the organic associations they have begun to replace (Hersoug 2005:242-243; Johnsen 2005; 2008; Murray *et al*. 2006).

## Approach and Methods

The article draws upon material from multiple research projects. The interview with Ben is one of ten semi-structured interviews with 'expert' fishermen in NL undertaken in 2003 by Murray and Johnsen. These interviews are part of a series of fifty-six similar career history interviews carried out in different areas of Newfoundland and Labrador between 2001 and 2003. The Norwegian material consists of twenty-four semi-structured interviews with fishers carried out in 1997, a group interview carried out in 2001, and participant observation by Johnsen on a fishing boat in 2007. In addition to the results of these formal interviews, we also draw on interviews with other fish harvesters from the area, informal discussions with fishers in community meetings, on boats and in harbours, and with fisheries managers and people from harvester organizations. In contextualizing these interviews we also draw on document analysis, archival sources, research articles, and systematic observations of technological and organizational changes in Norwegian and NL fisheries.

From this material we have chosen to organize our analysis around the careers of 'Ben' and 'Richard', two informants who actively adapted to environmental and managerial changes over their careers in ways that illustrate larger associational changes in the smaller boat sectors of Newfoundland and Labrador and Norway over the past forty years. We interweave stories of the changes these individuals described with a description of changes (derived from both our own research and an analysis of the relevant literature) within the larger social-ecological systems within which these individuals are embedded.

## Fisheries associations in Norway and Newfoundland and Labrador after World War II

Prior to (roughly) the 1960s in both Norway and NL, fishing was basically a household and community-based activity in which all or most family members participated, often in cooperation with other households (see also Jentoft 1993; Holm 1995; Kennedy 1996; Ommer 2002). Indeed, the boundaries between fishing operations, households, and community were fuzzy, often entailing collective, lifelong and multi-generational membership in each, and fishers were socialized into collectives that shared many practices, values and beliefs (Anderson and Wadel

1972; Wadel and Jentoft 1984). In the Labrador small boat cod trap fishery, for example, which operated until the 1990s, the berths for these large, fixed net boxes with leaders were inherited through family relations in some areas while in other areas access was determined through annual community-level lotteries or 'draws' (Kennedy 1996; Jentoft 2004). These associations differed from place to place and over time (for example the particular vessels/crews involved in hauling the traps or the particular individuals on the 'stage' processing fish could vary).[2]

During this phase in both Norway and NL, children began this process of socialization early, beginning work at the age of ten or even younger (Jentoft 1984; Kennedy 1996). As our informants from Northern Norway and NL told us, they were 'born into' the fisheries, with little chance or opportunity to do other things. For example, cod-tongue cutting was an important activity for many young boys and girls in Northern Norway (and still is in some cases) and, at least until the early 1980s many youngsters baited longlines after school hours. In NL they sometimes also cut cod tongues for sale and were expected to work without a wage in order to contribute to the collective welfare.[3] Commercial and subsistence fisheries were largely the same in this respect (and to varying degrees these overlapped). Ben's story helps to illustrate the nature of these fishing associations.

*Ben (Newfoundland and Labrador)*

Ben is from a fishing community in south-eastern Labrador. Labrador fisheries are predominantly conducted in the spring, summer and fall (due in large part to winter ice) and cod, salmon and seals were the main species historically harvested. In the past, Ben's family – like many others – moved between coastal summer communities and inland winter communities. Prior to the start of the cod trap fishery, many fished for Atlantic salmon with salmon gill nets and participated in the seal fishery, often travelling to do so. Indeed, for many coastal fishermen like Ben, salmon landings were more important economically than cod landings.

In the cod fishery, the family had its own berths, near those from other members of the same community, and the fishery was organized as a family operation. As a child Ben fished with his father and uncles without his own wage. The younger children and the women processed the fish at the 'stage' and men hauled the cod traps (and helped in the processing in between hauling the traps). They also used jiggers and hand-lines for cod in the early and later parts of the season in the area around their fishing station. Ben's first duty as a young boy (about ten years old) entering the fishery was to move the fish from the floor up onto the gutting and splitting table located on the stage. Until he was fourteen or fifteen years old he did most of his work on the stage though afterwards he went out in the boat to help with the cod trap. The cod trap was usually hauled during the ebb tide in the morning or the afternoon and, depending on the size, from three to seven men were required to haul it. When the trap was empty it was let back into the water, ready to continue fishing. All the hauling of the trap was done by hand as many of the trap skiffs didn't have hauling equipment. After hauling the traps the crew returned home for meals taken with the rest of the family.

This coastal cod fishery by local Labrador fishermen had long co-existed with a migratory fishery from the Island of Newfoundland and elsewhere that was

prosecuted using similar gears from shore-based stations and from schooners. The migratory cod fishery largely disappeared in the 1950s but was soon replaced in the adjacent offshore areas by a fairly intensive offshore international dragger fishery. Cod landings from the coastal fishery appear to have drawn largely on shoreward feeding migrations from offshore banks with some possible supplementation of landings from bay stocks of 'golden' or 'brown' cod such as those recently identified in Gilbert Bay, Labrador (Wroblewski *et al.* 2005).

As we turn to Richard's story from Norway we can see some basic similarities with the Labrador fishery.

*Richard (Norway)*

Richard was born on Lofoten Island in Northern Norway and started baiting lines when he was around eight years old. After that he began to train as a 'landman' which, in Richard's case, denotes an apprentice position where young boys worked for a partial share together with the adult landman to learn about the gear (in Norway 'landman' refers both to a shore-based role associated with certain tasks and to a particular pay status. A fully-fledged landman is a crewmember who takes care of and organises all the work with the gear on shore and receives a full share in the coastal longline fishery for cod and haddock). As an apprentice landman Richard learned by doing all the skills (baiting, knots, splices. *etcetera*) needed for rigging, maintaining, and preparing the gear. He had to perform well on land before he was permitted to go out fishing, beginning on shorter trips substituting for fishers who were sick or who wanted a short break. Richard also began whaling in the summer around twelve years of age. During the winter he would both attend school and apprentice as a landman until he was finally able to sign on full time at the age of eighteen or nineteen.

Our informants fit into a well-described pattern around the North Atlantic where, during this period, fishers were embedded in their local communities, engaged in a seasonal multi-species fishery and intensive subsistence activities. Fishing crews were household and family-based and constituted by the affective relations (largely kinship based) that existed in the local institutional framework. Heterogeneous fisheries associations were constituted inside the boundaries of households and local communities, through organic and incremental development processes (with the exception of connections to international markets and marketing firms) in intimate relationships with local marine and terrestrial ecosystems. Knowledge was experiential and associated with local ecosystems (or what we call Local Ecological Knowledge or LEK) with fishing success mediated to a substantial degree by intimate and closely guarded knowledge of fishing grounds, fish behaviour, and local fishing practices. Fishing was almost exclusively a male domain with women extensively involved in processing the fish, childcare, subsistence and book-keeping and preparation for fishing (Skaptadottir and Proppe 2005; Kennedy 1996; Jentoft 2004; Neis 1999, Gerrard 1983, 2008). This was the general pattern (with important local variations) in the cod and groundfish fisheries in Norway, the NL cod trap fishery (Johnsen 2005; Murray *et al.* 2006), and in other cod fisheries around the North Atlantic.

During this time, behaviour and relations were mediated by very few explicit, formal controls and regulatory mechanisms (Jentoft 2004; Jentoft *et al*. 2005; Johnson *et al*. 2005). Governance was primarily based on production and circulation of LEK and other forms of practical knowledge infused with implicit and internalised community-based control mechanisms, and based on social interventions and sanctions realized through the affective relations between and within fishing associations. Formal or explicit mechanisms for information collection, processing, and control, as well as for interventions and sanctions were very limited and were often oral versus written (Pascual-Fernández *et al*. 2005). The rules and codes for conduct were implicit, tacit and a part of the actors' perceived 'objective reality' (Berger and Luckman 1991 [1967]). In this context, when the internalised codes of conduct were broken, sanctions would often be implemented and enforced by the collective.

Locally, boats could become known as 'bad' or 'good' boats and skippers could acquire the status of 'crooks' or 'heroes'. Many adaptations were possible inside these associations and governance was a cooperative effort mediated by gender, leadership, age and other primarily local factors. As a result, the organizational patterns, structures, technologies and knowledge associated with fisheries and marine ecosystems varied substantially within and between Norway and NL (Anderson and Wadel 1972; Wadel and Jentoft 1984). While local and individual adaptations were often rather fixed and specialised, in the fisheries as a whole there was a lot of flexibility and associated capacity to respond to change (Barth 1972). The Norwegian *fisher–peasant household*, for example, combined fishing and farming in many different ways that contributed to the development of rather resilient communities (Brox 1966; Brox *et al*. 2006).

## 'Modernization' and Systems in Change

After World War II, these fishing associations came to be seen as economically marginal, irrational and one of the causes for low economic productivity in both Norway and NL. In NL, a focus on lack of growth, poor product quality, sector stagnation and inefficiency was one starting point for a process of restructuring on the coast (Sinclair 1987). Both the Canadian federal government (which acquired jurisdiction over fish harvesting in NL in 1949) and the Norwegian government applied an industrial development model to fisheries in order to promote stability as well as technological and economic modernisation (Hersoug 2005; Wright 2001). These initiatives also included efforts to 'modernize' the fish processing industry in order to provide the basis for stable incomes, work and settlement in rural areas where fisheries had been primarily seasonal with huge fluctuations in landings, labour needs, income and market prices. In both contexts, modernization was partly financed by the state and was associated with efforts to promote technological change in harvesting and processing. This technological change included the introduction of such things as wet-fish trawlers and the construction of filleting and freezing plants where the organization of work was driven by mechanized processing, scientific management principles and a gendered division of labour

(Cullum 2003; Hersoug 2005; Neis 1991; Wright 2001). In NL modernization was informed by 'growth centre' thinking and associated programs to resettle fishers and their families into larger centres. The modernization program involved substantial subsidies in the form of loans and grants to a few integrated frozen fish firms that came to dominate NL fisheries (Sinclair 1987; Wright 2001). In most of NL except Labrador, the household production of salt cod largely disappeared and was replaced by the sale of fresh cod to processing plants. The effects of industrial modernization on local fisheries were augmented by the introduction of welfare state programs such as free education, pension plans, family allowance and unemployment insurance for fishermen and fish processing workers employed in the new fish plants, increasing access to cash for investment in new technologies, and youth out-migration from fishing communities and fisheries in the 1960s and 1970s (Neis 1993; McCay 1976 ).

In Norway the number of persons and vessels involved in the fisheries declined between 1960-1978, but the productivity measured in tons captured per fisher increased from about sixty to one hundred (Director of Fisheries).[4] From 1978 to 1990 the total catch and the productivity per fisher decreased, but stronger national control was exercised due to the establishment of the 200 mile EEZ. In NL the fishing fleet was also modernizing and becoming more capital intensive during this period, and landings increased up to the late 1960s when, probably due to intense foreign fishing, they started to decline – though the modernisation of the fleet continued (Murray *et al*, 2008). Indeed, throughout the 1970s and 1980s engine sizes, the level of technology, and investments increased in the Norwegian and Newfoundland fishing fleets (Jentoft 2004; Murray *et al*. 2006, 2008).

The stories of both Richard and Ben illustrate how these prodigious efforts to modernize fisheries in NL and Norway, while not always achieving the goals of their proponents, resulted in major changes to fisheries.

*Richard: Modernisation in Norway*

In 1978 Richard decided to become a fulltime fisher again (after working some years in the merchant fleet) and he bought the thirty-eight foot vessel that he is still using. This vessel is a traditional Norwegian coastal design with the wheelhouse at the stern and the working area on the foredeck. He fished for cod almost year-round, specializing in longlines – the fishery he learned in Lofoten and an important fishery in the Finnmark community where he eventually settled. Although he was an experienced fisher, Richard had to learn the local fishing grounds and conditions in his new community and he struggled to make a living in the first few years. However, help from local, experienced people and investment in a DECCA navigator helped him learn the local grounds. When a divorce left him a single parent with primary responsibility for his children, the closeness of these grounds allowed Richard to maintain 'almost normal' working hours while spending more time with his children.

The cod fishery in Finnmark is largely a mobile winter and spring fishery. In the long lining fishery, fishers fished between fifteen and eighteen tubs of gear per vessel with approximately 300 baited hooks in each tub. The gear was hauled and reset every day the weather allowed and the lines were usually deployed in

two fleets, usually with seven to nine tubs in each fleet. In the cod fishery season, Richard usually fished with one shareman onboard and one landman who led a group hired to bait lines on shore. To make the baiting more effective, Richard organized his baiting station after guidelines from a fisheries technology research institute. Baiters were paid per hook baited and not with a share of the catch like the landman. Richard preferred to employ people from the Lofoten Islands as landmen and sharemen. When Richard and his shareman came to the grounds they would haul a fleet from the previous day, set a new one and let it soak for a while, haul that one in and set a last fleet before they returned to land with the catch and the unbaited lines. At that time, many coastal vessels did not leave the gear behind for the next day, fishing instead with only two fleets. Richard's 'three fleet' approach was more effective. On the other hand, it required more gear because he always had baited gear in the water. In the relatively open access long line fishery that existed up to 1988, Richard fished cod like this from October to February. During the rest of the season he jigged (with automatic jigging machines) until the haddock long line fishery started in the summer.

Technological modernization and organizational changes made it possible for Richard to adapt to a new environment. Richard's story also points to a professionalization process in that he hired crew from outside the area, used hired baiters on shore, and organized his fishery in a formal way, including following 'scientific' procedures for baiting. In short, Richard was running a small-scale fishing organization that was different in many ways from the associations of the past. In Richard's case, part of his rationale was to be able to combine his work at sea with his obligations as a single parent – but these changes were not unique to Richard's networks and practices. In this period of transition, the whole Norwegian fishing fleet went through a process of technological and social modernisation (Johnsen 2004, 2005). Ben's story illustrates how parallel changes were occurring on the other side of the Atlantic:

*Ben: Modernisation in* NL

Ben built a fifty-two foot 'longliner' in 1969 (in NL, 'longliner' refers to a decked fishing vessel up to sixty-five feet, used for various types of fishing). One of the reasons Ben started to build a new boat was that the cod trap fishery had started to decline (due in part to offshore trawler activity) and, like others from both Labrador and the island of Newfoundland, he wanted to fish more gillnets and steam farther away in order to access still-abundant grounds. Ben also travelled while doing surveying work with the boat and sailed along the coast to collect salmon for processors. Ben became the first in his area for whom the longliner/gillnet approach became the main cod fishery. The technological jump from trap skiff and cod trap to longliner and gillnets also involved the purchase of a sounder, a gurdy (a mechanical hauling aid) and a radio, allowing them to stay out for several days. Although Ben's longliner crew was still family-based, the link to the local community was weaker because he was travelling further away to fish, and spending significantly more time away from home. Ben and his crew (there were four men onboard for gill netting and three when collecting salmon) had transitioned from stationary harvesters using fixed gear on traditional grounds (cod-trapping) to mi-

grating fish hunters and a more active fishing approach. Ben continued fishing for cod until a moratorium on fishing the northern cod stocks off the northeast coast of Newfoundland and Labrador was declared in 1992.

During this era, the local and larger scale associations within which each fisherman was embedded began to change as well. Ben's new activities like surveying and collecting salmon along the coast changed his planning and the way he organized his fishing. He also increased his mobility and added new technology. Richard started to hire people from outside and, like other harvesters, started to use new technology, enhancing the efficiency of his operation.

While modernization ideas had begun to influence policy before the establishment of the EEZs in the late 1970s, the legal framework associated with the EEZs and other emerging requirements to manage stocks for optimum or 'maximum sustainable' yield supported rapid change in the institutional arrangements and policies governing fisheries (Hardin 1968; Hannesson 1978, 2005; Holm 2001; Johnsen 2005; Charles 1997; Caddy and Cochrane 2001). In Canada, the establishment of the 200-mile EEZ led to enclosure of the fisheries by the federal state. Management based on Total Allowable Catches (TAC) was introduced in the 1970s, and reflected a growing emphasis on limiting entry into fisheries (Mansfield 2004; Kirby 1982) through increased use of limited access licenses and, in eastern Canada, the introduction of Enterprise Allocations (EAs) and Individual Quota (IQ) programs in some fisheries. Limited entry was instituted for the under sixtyfive otter trawl groundfish fleet beginning in 1977, for example, and EAs were established in the offshore groundfish sector in NL in 1982 (Gough 2006). Most of the newer Atlantic fisheries such as shrimp and crab were organized around limited entry licensing. In the case of cod and other groundfish stocks, quotas were set too high in the 1980s and not strictly enforced, contributing to stock collapse in the early 1990s (Finlayson 1994). This resulted in the Moratorium on the fishing of 'Northern' cod, which included the cod stocks off Labrador and northeast Newfoundland, in 1992.

In Norway the first step towards limited access occurred in the herring fisheries, where a licence system was established in 1973 (Johnsen 2004). Until around 1990 this fishery was an exception to the open access principle that had persisted in the rest of the Norwegian fisheries. After 1990, when scientists reported the collapse of the Northern cod stocks, the coastal cod fishery was closed and new measures to limit access and manage the fisheries were introduced (Gerrard 2008).

When groundfish stocks collapsed in the North Atlantic in the late 1980s and early 1990s, many explanations were put forward (for a NL overview see Hutchings, 1996), but the explanation that was most forcefully embraced by policy-makers and industry leaders was that the collapse was the result of 'too many fishers chasing too few fish'. Despite some differences in management instruments and practices, the theoretical and ideological bases for the Canadian and Norwegian management regimes during and since the modernization period continue to have a lot in common and the industry and stock recovery strategies that have been embraced most forcefully focus on increased individualization and privatization of resource access, and professionalization. These initiatives are underpinned by a 'bio-economic' modelling framework (Finlayson 1994; Wright 2001; Apostle

*et al*. 2002; Johnsen 2004). Bio-economic modelling combines Beverton and Holt's (1957) population dynamic model from biology with micro-economic models for human behaviour where assumptions about nature and fisher behaviour under different conditions are integrated (Holm 2001). The models were designed to deal with the problems caused by fisheries that are assumed to be open access in the absence of state intervention (Matthews 1993). Where differences exist between NL and Norway in terms of instruments and mechanisms, they reflect different histories and different stages in the process of abandoning the traditions and structures associated with community-based fisheries (where access was to substantially mediated by knowledge, kinship, limits on wealth, technologies and constraints on use rights) and transitioning to more technocratic, professionalized, 'rational', individualized and more privatised fisheries with less attachment to communities.

The interactive social-ecological restructuring that contributed to the collapse of groundfish stocks in NL and North Norway in the late 1980s and early 1990s and the changes that have taken place since then, particularly in fisheries management, have substantially changed the lives and practices of Ben, Richard and other small boat fishers and fishery communities in both regions.

*Ben – Surviving the Northern Cod Moratorium*

With the Moratorium on fishing for northern cod in 1992, Ben and his sons took up salmon fishing from a speedboat (a much smaller vessel than their longliner) and also fished whelk, lumpfish, and scallop. These were bad times and by 1995 the commercial salmon fishery had also been closed. Ben obtained a snow crab license around 1992, but he did not use it initially because their speedboat was too small and not rigged for crab. However, with the salmon fishery gone and access to other species very limited (particularly in Southern Labrador) they soon decided that they had to try snow crab fishing.[5]

In Labrador, the snow crab fishery starts in mid-June and continues until the boats have caught their quotas. Each boat has a license that allows them to fish in a particular large NAFO area (2J in this case). Furthermore, they are supposed to keep log books that must be updated on a regular basis and they also occasionally are required to bring observers on board when they go fishing. The observers monitor their catches which are also monitored more routinely at the dock. Fishers are obliged to sort out the smaller female crabs and undersized males, and return them to the water (males of legal size are kept alive in the hold). Snowcrab is fished with pots and Ben and his sons invested in a new boat and gear in order to participate. Navigation skills are very important as vessels cover large distances, and fishing occurs very far out (sometimes more than 100 miles offshore). In the beginning, there was a lot of crab and they had good catches. The boat was only forty feet long though, like most NL boats, she was very heavy and robust. After two years they lengthened the boat to fifty feet, made her wider and deeper, and installed a bigger engine. Ben and his sons started with 300 pots (pots are divided into strings with fifty pots on each) but ultimately roughly tripled the number of pots they were fishing. Today, this vessel is fully equipped for offshore crab fishing, with sophisticated communications and fish-finding electronics, and power-

ful hauling equipment. Ben fished until he retired a few years ago and handed the business over to his oldest son, who at the time of the interview had been the skipper for several years.

Ben's fishery and way of life have changed a lot since he started. Like other fishing families from this Southern Labrador community, twenty-five years ago his fishing family stopped moving back and forth between summer and winter communities and gave up using their summer fishing station when the cod and salmon fisheries were closed. Over his career, Ben changed from being an inshore cod and salmon fisher in a trap skiff, returning back home for meals and to sleep, and became, instead, an offshore crab fisher in a limited access fishery, sleeping onboard his boat during longer fishing trips, and surrounded by technology and enmeshed in regulations that governed when and where he could fish, the species he could target, the timing and length of fishing seasons, the type, design and amount of gear he could use, his vessel size and design, and the training he and his sons and grandsons needed to have in order to retain their right to fish.

Like Ben, Richard also had to cope with a number of radical changes to his 'network of relations'.

*Richard: Entangled in New Relations*

As a consequence of a 1988/89 cod stock collapse, the Norwegian fishery was abruptly closed and a more complex regulatory system was developed for the coastal fishery. The cod collapse and the introduction of individual vessel quotas in 1990 occurred at the worst possible time for Richard as he had recently invested in a new engine and renovations to his boathouse and baiting station. To adapt, the first thing he did was to reduce the size of his crew and to involve himself more in baiting. After a difficult first year (1990) Richard decided to try something new. With his efficient fishing practices and the small individual quota of cod available to him his season would have been over in a very short time if he directly targeted cod as he had in the past. Furthermore, under the new regulations the by-catch of cod in other fisheries was deducted from his quota, meaning that if he fished all his cod directly he could not fish for other species if there was a cod by-catch. Richard therefore decided not to fish directly for cod, and started in January to fish for haddock, which was not a quota-based fishery. While haddock and cod are often abundant on the same grounds, fishing practices and gear design can be used to minimize cod by-catch. By rigging the lines in different ways, and with his knowledge about fish behaviour and abundance, he was able to fish haddock and slowly catch his limited cod quota at the same time. In this way Richard could continue to fish over a longer period and get good catches of haddock with fulfilment of his cod quota as a bonus. Thus, while the rest of the local fleet took their cod quotas early in the season and adapted to the regulations by stopping fishing, Richard was able to continue fishing all winter by changing his practice.

After the winter cod season was over, despite the stock collapse, there was so much cod on the fishing grounds around Richard's home that the fleet could not fish haddock without getting too much cod.[6] The result was that almost the whole fleet that depended heavily on cod and haddock was forced to abandon the summer haddock fishery. Richard, however, fished for wolffish in the summer,

but rigged his lines so he could get cod as a by-catch. To avoid the problem of getting too much cod on any one day and too little on others, he *negotiated* with the local fisheries authorities for a weekly rather than a daily by-catch allowance. Because the situation was new for both fishers and managers, the interpretation and enforcement of rules and regulations were not yet clearly defined giving him the latitude to negotiate this accommodation. Overall, Richard's strategies allowed him to expand his options by adapting to the situation and learning to navigate the new world of logbooks, quotas and by-catch reporting and control systems.

Richard's access to knowledge and technology and his organizational changes helped him adapt to the cod closure, regulatory change and the new quota system. Skills he had learned as a young fisher in Lofoten, the use of new technology like the DECCA which translated the natural environment into a symbolic world, and his ability to negotiate the new set of formal rules governing the fishery were all important. Even though he was more creative than many others, Richard was not unique. Almost all of our Norwegian and Newfoundland informants told similar stories about how they acquired new knowledge, changed their social relations, used new technology, and applied the organizing principles that these technologies required to adapt to new situations (Johnsen 2002, 2004; Murray *et al*. 2006).

**From Organic Fishery Associations to Cybernetic Organizations**

As noted in the introduction, our focus is on the relational attributes of fishing actors. In this conceptualization, the acts and processes of fishing are not just the activities of individual human beings, but are instead the result of a complex set of interactions within the associations in which individual human beings are embedded. To understand the acts and processes of fishing (a critical pre-condition for effective management) one must therefore better understand the nature and dynamics of these associations. Our focus on two individuals allows us to consider the dynamism and evolution of the associations in which they have been embedded over their lengthy careers, as well as to highlight the similarities and differences in the trajectories of the two fishers and the two areas – thereby illustrating the variety of processes by which change occurs.

We have constructed three ideal types of fishing associations; *organic, mechanistic and cybernetic,* based on our case studies of fisher career histories from Norway and NL, as well as related descriptions in Johnsen (2005) and Murray *et al*. (2006). These three ideal types characterize and help us conceptualize the relational changes in these North Atlantic fisheries over the past fifty years. Clearly, the processes we described above have been uneven, are incomplete and ongoing, and do not entail a linear or categorical transition from one fixed state (or one ideal type) to another. However, while these and other fishing associations do not fall neatly into one of these ideal types, the elaboration of these types can bring into the foreground some of the fundamental elements in these fisheries and help us see more clearly the dynamics and consequences of interactive social-ecological change as well as their relevance for future options.

The case study descriptions we present above are consonant with a significant body of literature from both Norway and NL that characterizes what is thought of as the traditional organisation of fishing communities associated with the pre- and early post World War II period (Anderson and Wadel 1972; Barth 1972, Brox 1996; Brox *et al*. 2006). Here we conceptualize this traditional organization as consisting of *organic associations*. Organic associations are the collective outcome of the *ad hoc* organization of everyday life in response to and in interaction with primarily local and immediate social-ecological environments. Organic associations are not organised on the basis of explicit formulated laws, abstract formal plans, explicit strategies, explicit, generalised knowledge, or on principles or ideologies that operate at macro spatial, temporal or organizational scales. Rather, they develop incrementally and pragmatically and can vary substantially from place to place and over time – that is, they are diverse and patchy. Organic associations are largely based on perceived reality, tacit or vernacular knowledge, apprenticeship versus formal education, and are thus guided by local history and practice.

Within organic associations, practices and activities are continuously adjusted in response to daily experiences in order to accommodate environmental, economic and social constraints and fluctuations. These associations are largely situated within a local structural, symbolic and normative setting, though they have long been (as in the case of the Newfoundland and Labrador and Norwegian fisheries) vulnerable to 'exogenous' shifts and changes in larger physical, biological, economic, religious and socio-political environments. Thus, the principles of organization within organic associations can be characterized as *ad hoc* and situational. Moreover, the structures of communication and decision-making in organic associations are not formally organised or bureaucratic, but rather are heavily shaped and patterned by local environments, relationships, hierarchies, norms and values.

The social relations in organic associations are largely *affective*, by which we mean they are close and personal without necessarily being equitable. In a fisheries setting, the owners and the crew are often members of the same community, family or household and are fishing together on a common resource, as well as often working together in other spheres (for example, subsistence agriculture, hunting, home construction). The crew are often hired on an informal and personal basis and work responsibilities and catch shares are based on trust, respect or dependence, traditions, family or community obligations, different types of reciprocity, and other informal arrangements, rather than on formalized agreements, cash exchanges, rules and regulations and professional qualifications.

While the mechanics of capture within organic fishing associations require a kind of structured organisation of technologies, work sequences and roles, each of these can be expected to vary to some degree across seasons, fisheries, and within and between households and communities. Technologies are loosely coupled to the association and necessary adaptations are made in practical situations. Therefore, the who, how and what of the performance of practical fishing activities often differs across seasons, over life cycles, and between fishing vessels, due to differences in the options, resources, challenges and experiences of crew and skippers, applied local knowledge and practical situations.

In organic associations, communication, socialization, and decision-making take place primarily through face-to-face relations and interactions between close acquaintances, as with children and parents, master and apprentice, skipper and crew, fisher and merchant or fish buyer and among community members (Berger and Luckman 1991 [1967]). They also take place in close interaction with complex, dynamic and variable experienced physical and biological environments over which harvesters exercise little control. Knowledge is primarily local, the product of intergenerational and intra-community communication and accumulated experience. The main basis for future action and decision-making is accumulated localised and situated experiences and observations from the past based on direct experience and intergenerational transfer of knowledge, and operational decisions are based on the actual conditions encountered.

In organic associations, control tends to be implicit and internalised; generalized reciprocity and local power dynamics may be integral to their operation (Burns and Stalker 1994 [1961]; Scott 1988; Ouchi 1980). In this sense they are largely self-governing (Kooiman *et al*. 2005). Organic associations can produce a sense of community and may be characterised by cooperative action, but can also be characterized by short or even extended periods of conflict and informal sanctions. Hence, power relations and decision-making processes in the association are mediated by a whole range of internal and external factors which can vary considerably within and across communities. These processes can be both horizontal and vertical and are frequently mediated by gender, class, generation, kinship, religion and local tradition as much or more than by law and regulation. Horizontally, decisions can be based to varying degrees on tradition, beliefs and ongoing negotiation among community members about crucial strategic issues for the fishing association including fishing seasons, access to grounds and berths, and when and where it is safe to fish. Vertically, the local merchant or buyer and the skipper will often make tactical decisions for the fishing operation including those related to cash expenditures, what species to target, the choice of gear and bait, hours of work, divisions of labour and final products. Furthermore, decision-making and risk handling are often *ad hoc* and situational rather than planned, formalized and programmed.

Fisheries as organic associations are the ontological point of departure for the contextualist tradition in fisheries management within which fishing actors are seen as relational actors embedded in communities and social networks and where attention is paid to the potential for community-based management within fisheries (Apostle *et al*. 2002; Jentoft 1993; Jentoft 2000; Jentoft and Kristoffersen 1989). Perhaps most importantly, organic associations are also sometimes regarded as adaptive and resilient for societies dealing with unstable environments (Burns and Stalker 1994 [1961]:121-125; Scott 1988; Ouchi 1980) although they were also often associated with poverty and resource degradation (Cadigan 2003).

In post World War II fisheries in Norway and NL, interactive restructuring began to change organic associated fisheries into more *mechanistic associations* (Hersoug 2006; Wright 2001). As we have seen, to varying degrees and at varying times, western North Atlantic fisheries transitioned towards the mechanistic associative form in the last quarter of the twentieth century. The extension of the

200 mile EEZs supported this transformation but it was never complete or evenly established and was deeper and more obvious on the large, corporate-owned trawlers and in processing plants. *Mechanistic associations* are characterised by the differentiation of functional tasks and are organised on the basis of more abstract and generalised principles than are found in organic associations. In mechanistic associations more formal, often external and bureaucratic structures and mechanisms for management, regulation and communication are introduced into fisheries that are defined as public resources in order to limit access or exploitation of fisheries resources. Corporate ownership of harvesting and processing technology increases and science, economics, engineering and scientific management are applied in an effort to make fisheries more efficient, 'rational' and predictable. The functionality of mechanistic associations rests upon the development of a formal governing system and (based on an implicit principle of differentiation of tasks) a division between the *system-to-be-governed* and the *governing system*, which takes on a somewhat formalized, rule-based and hierarchical organizational form (Burns and Stalker 1992 [1961]:120).

In mechanistic fishing associations, production is more capital intensive and work relationships, roles and responsibilities are more integrated and standardized than in organic associations. Whereas people are born and socialised or informally apprenticed into organic associated fisheries, they tend to be hired into mechanistic associated fisheries. Relationships in mechanistic associations are more contractual, formalised and less likely to be based on affective relationships. Tasks and responsibilities are more defined, structured and organized around functional divisions of labour. While flexibility in work organization is still needed skippers increasingly require formal schooling and crew members start to occupy specific positions (for example bosun or mate) within a more hierarchical structure.

Within mechanistic fishing associations, communication and training are largely accomplished through specialized and formal structures guided by increasingly formalized curriculum and certification procedures. This is what Berger and Luckman (1991 [1967]) call *secondary socialisation*. In this context, knowledge becomes more explicit, abstract and general and is inscribed in objects like manuals, books and technologies that can be transported in time and space. Over time, the texts, tools, procedures and technologies in mechanistic associated fisheries become agents for change, and because they can be evaluated, reproduced and systematically transferred, they gradually undermine support for organic associated processes and practices that can not be easily evaluated by formal standards and transferred through formal procedures.

Power relations in mechanistic associations are more vertical and linked to formal and functional hierarchies of control and procedures. Decision-making, as in the case of decisions regarding whether or not to sail and when to stop fishing, are more likely to be guided by formal procedures rather than experience and tradition. Decisions are regarded as 'rational' when they are guided by formal, scientific or managerial knowledge that defines the relationship between causes and effects and means and ends. Mechanistic fishing associations rely on a centralized system for management, control and intervention informed by classical fisher-

ies bio-economics and related mechanisms designed to motivate (through formal incentives and/or sanctions) actors, conceptualized as economically rational individuals, to behave in a predictable and prescribed way (Gordon 1954; Schrank *et al*. 2003).

By the late 1980s and early 1990s stock collapses and the associated erosion of science-based state management's perceived legitimacy (Arnason *et al*. 2003; Finlayson 1994), the sheer size and cost of the management bureaucracy and control mechanisms,[7] and broader shifts in power relationships, technologies, and state policies had helped fuel a shift towards a new fisheries form that we call *cybernetic organizations*. *Cybernetic fishery organizations* are *techno-scientific systems* (Haraway 1997) and, metaphorically, the word implies a relatively seamless joining of the human and the non-human; a tighter, more refined and more extreme integration/fusion of the fisher*man* with a larger network of human and non-human elements than is found in mechanistic and organic fishery associations.[8] In cybernetic organizations structures and relations become more highly formalised and contractual including relations with both human and non-human elements (that is, the fish) (Mirowski 2002). Cybernetic fishery associations interact with the fish and the biophysical environment through relationships organized by more formal ownership versus usufruct property relations, science, rhetoric, control and monitoring, and mechanisms for risk assessment, modeling and handling. They are full of symbolic and material mechanisms like rules, prescriptions, procedures, advanced information and calculation systems and computers that shape, control, govern and structure action and relations. They are also associated with efforts to formalize and solidify relations among people and between people and fish through the introduction of individual quotas (IQS) and, in the ideal form, transferability of those quotas (ITQS). Creating a formal, contractual property relationship between harvesters and fish and then making that property transferable integrates the fish and the fisher more tightly into larger corporate and financial networks. Fish become an 'asset' of the enterprise to be bought, sold and speculated on in new ways.

Power in cybernetic organizations is partly vertical, in the sense that the associations respond to top-down decisions, but power is also 'delegated' as it is built into the work procedures onboard and into contractual and property relations. When the skipper and the crew fish for quotas or carry out quality control by following a certain (and eventually taken for granted) procedure they are exercising delegated power. Hence, control becomes implicit in the work operation. In this operation, skippers are transformed into 'professionals' with qualifications, skills, roles, functions and responsibilities and expected to self-regulate in the context of oversight by their professional association and by occasional external intervention.

In cybernetic organizations external regulation and monitoring tend to be replaced by indicators and formalised feedback mechanisms that are often technologically-mediated and trigger responses and interventions when requirements are not met. Holm (1996) and Holm and Nielsen (2007) describe modern North Sea fisheries management as a cybernetic system for regulating fishing activities based on the development and deployment of an abstract, symbolic and formal

system of knowledge. It is a system for handling uncertainties by way of mechanisms for counting, calculation and prediction, and technologies for feedback and intervention – what they call the Total Allowable Catch (TAC)*-Machine*.[9] The theory of the Tragedy of the Commons and its economically rational actor logic, and the Gordon-Schaefer bio-economic model are examples of the representations and concepts used in the TAC-Machine. The TAC-machine integrates a system of scientific representation with 'technologies of intervention' like the TAC (with its individual fishing quotas) in order to achieve, from the resource managers' point of view, more rational control over fishers and fisheries (Holm and Nielsen 2007). Ideally, according to Holm and Nielsen, the TAC-machine integrates the governing system and the system-to-be-governed.

In addition to ever more effective catch technology, cybernetic fishing organizations utilize modern navigation, communication and information technology, like Global Positioning Systems (GPS), internet, satellite and mobile phone connections that both increase the amount of information and the speed of information collection and exchange. These technologies can also be used to enact intervention mechanisms such as TAC/individual quotas and other regulatory controls such as the use of 'black box' real-time GPS location monitoring devices.

Scientific models such as the Gordon-Schaefer model also increasingly influence procedures onboard the fishing vessel, a process that is reinforced as fishers become professional actors expected to actively contribute to the production of scientific knowledge and economic information that feed into the management process. In Newfoundland and Labrador and in Norway some fishers are trained to do sampling for scientific stock assessment and are sometimes paid to help with those stock assessments (Murray *et al*. 2005).[10]

Within contemporary resource management in Norway and NL, access to fish has become a limited right and becoming a licence holder (a 'new' component) means not only a right, but also an obligation to fish. Once fishers have this right, they risk losing it if they don't fish the full quota, or if they derive too much of their income from other sources. Moreover, the right to fish comes with obligations related to fishing, training, management and conservation that shapes, sometimes inequitably, who has access to those rights (MacDonald *et al*., in press). The fishing quota is technically a 'privilege' provided by the Minister of Fisheries but is generally and increasingly treated as property by the parties involved so long as the requirements are followed. Fishing rights and quota systems have integrated the fish into the fishing organization in new ways in the sense that fish can now sometimes be bought in the form of vessel or individual quotas which are sometimes formally transferable and often informally controlled through leases or other mechanisms when formal transfer is not supposed to take place.

The fishers who survived and/or succeeded have been those who *have* been in a position to adapt to and integrate resource management into their practice, diversify into other species, move to new, unfamiliar areas, and who have bought bigger boats at great cost with gear and technology they have had to learn about quickly and often at great personal risk (Dolan *et al*. 2005). The flip side of survival is accepting some substantial integration into and development towards new and more *cybernetic fishing organizations*.[11] These organizations are the *fishing actors* of today.

Table 1 summarizes the attributes of the organic and mechanistic associations and cybernetic organizations.

*Table 1. Types of fishing organizations*

| **Attributes** | **Organic associations** | **Mechanistic Associations** | **Cybernetic Organizations** |
|---|---|---|---|
| Relations to fish | Common resource with access mediated by kinship, local knowledge, technology, practice | State resource with state regulated access | Towards privatization or propitiation of resources |
| Social structure and relations | Affective social relations | Contractual social relations | Highly formalised, professionalized |
| Participants | Members of community and visitors | Open access and after EEZ state mediated access linked to citizenship (Neis 1991) | Professional specialists |
| Technology | Loosely coupled to the association | Integrated in the organization | Integrated in the organization |
| Principles for organisation and management | *Ad Hoc* organic and situational, mediated by kinship, gender, age | Scientific management, planned, structured and bureaucratic | Feedback and response based with mechanisms for evaluation and modelling |
| Power | Horizontal and vertical but dispersed and fluid | Vertical and formally structured | Vertical and delegated, formally structured |
| Decision making and risk handling | Informal situational and local | Planned and bureaucratic decision making | Feedback, evaluation, 'principled' model and market-based decisions |
| Work performance and roles | Flexible procedures, self regulation, few specialised roles | Procedures for performance, explicit control and enforcement of procedures, increased specialization of roles | Procedures for performance evaluation, internal control systems, highly specialised roles |
| Local embeddedness | Embedded in community | Partly embedded in community. | Embedded in professional networks |
| Crew relations | Informal and personal | Increased formalisation | Contractual |
| Knowledge | Experiential, implicit, partly tacit, personal and embodied | Increased use of formal, explicit, transferable and scientific knowledge | Formal, explicit, and scientific, with systems for knowledge accumulation in the organization |
| Rationality | Local, reciprocal, 'way of life', survival | Economic and local | Economic and scientific, entrepreneurial |
| Feed back | *Ad Hoc* and experiential | Experiential and procedural | Formalised and procedural |
| Control | Implicit and internalised mechanisms | Explicit, external mechanisms | Explicit mechanisms, but internalised in the organization |
| Governance and management | Self-governing | Explicit governing system | Governing system and system to be governed become integrated. |

To varying degrees in different fisheries, quotas, reporting systems, log books, and 'black boxes' (GPS-based vessel-monitoring systems) and other new devices for fishing, control, and feedback have all come to shape fish, fishers, organizational forms and fishery performance in new ways in recent decades. Ben and Richard have not only adapted to regulations, they have both to some degree internalised them into their practices. The stories of both Ben and Richard provide examples of the increasing integration of fishing activities and relationships into more structured and formalised systems. Richard negotiated an interpretation and enforcement mechanism that fit his practice, and he took increasing responsibility for fitting his activity into new frameworks. In Ben and other crab fishers' cases, their licence is issued for a certain area and they have to keep logbooks and deal with observers and dockside monitoring. Logbooks and licences for certain areas are devices that insert regulation into daily activities and that can be used for system and performance evaluation in addition to monitoring practices at sea on a daily basis. In this sense they are components in cybernetic feedback systems and are thus part of a process by which the governance system and the system-to-be-governed (Kooiman *et al*. 2005) become more closely integrated.

This phenomenon of integration also extends to markets where, in Norway, the skippers in certain fisheries through online communication with the sales organization can get fisheries reports, send catch reports and sell fish.[12] These communication opportunities increase their ability to handle information and to respond on the basis of that information. Norwegian pelagic fisheries provide an extreme example of a situation where vessel, management, and market are closely integrated (see Johnsen *et al*. this issue). Similarly, many Norwegian and NL fishers no longer make their own gear as most is now bought rigged and ready from gear factories. In Norway, these gear factories also store it between seasons. Thus more and more of these and other services are taken care of by specialised suppliers who have become a part of the fishing organisation (Johnsen 2005).

## Conclusion

Radical changes have occurred in North Atlantic fisheries over the past few decades. Ben and Richard's stories are about changes in two fishing associations that 'survived', but many didn't. Richard was able to link his practices to an expanded and increasingly cybernetic network and continue fishing for groundfish because the cod stocks were healthier in Norway than off Labrador (and the moratorium was soon lifted) and because he was embedded in relations within the Lofoten fishery. When Richard moved to Finnmark, he became the link between two different systems of practices and knowledge. He utilized his knowledge from the organic fishing associations of the 1960s to find the specialists needed to run a more cybernetic fishery in the 1990s. Like those of his colleagues who succeeded, Richard adapted to the introduction of formal management regimes in Norway's coastal fishery and he started to try to get as much as possible out of his 'property', the fish that now had become a part of his capital and his 'enterprise'.

On the other side of the North Atlantic, Ben, his family and his crew made similar moves to adapt to changes.[13] Like Richard, Ben changed grounds, technology, and knowledge and acquired a new licence and quota as he adapted to a new ecological, technological, social, and legal framework. His fishing association changed to involve new contents as well as new boundaries. In both cases their fishing enterprises became a part of more complex, evolving webs of relations extending beyond the boundaries of the vessels and local communities to local, regional, national, and international systems, as well as into the sea to new areas within fluctuating and changing marine ecosystems. In Labrador, where cod stocks have not recovered, fishers have had to switch largely to crab to survive, forcing them to acquire new technologies and vessels, develop new practices, and develop a whole complex of new knowledge (Murray *et al*. 2006).

By interpreting the interactive, social-ecological restructuring in these fisheries as a relational and organizational change from organic associations to cybernetic organizations we have sought to foreground some of the main elements of the changes that have taken place in the post World War II fishery. The process of cyborgization we associate with the contemporary era creates fewer, but more powerful actors on the assumption that science, internalized, professionalized practices, and fewer harvesters will protect the fish, improve fisheries incomes and reduce industry volatility for the longer term.

While skippers are still sometimes owners in cybernetic fishing organizations and still make some choices and decisions (Johnsen 2008), the network they are part of structures their choices and decision-making alternatives and thereby constrains their options and relationships with fish, crew, other skippers, fishing communities, future generations, government, buyers and international markets in new and fundamental ways. On the one hand management mechanisms contribute to a downsizing of the fisheries, but on the other hand they cause remaining actors to increase the technological and economic efficiency of their hunt, tend to concentrate the wealth from fisheries in fewer hands, and often discourage recruitment of young fishers into the small boat fishery. Enhanced efficiency drives up the potential threat to limited and frequently degraded resources, augmenting requirements for surveillance and control which, in professionalized fisheries, are expected to be paid for by fishing organizations that are increasingly constituted as business enterprises within which attention to profit and professional codes and hierarchies tend to erode reciprocity within and between enterprises and across generations. Access to fish and fish resources is now largely disconnected from membership in particular communities, and is increasingly professionalized, privatized and commercialized.

As long as management ideology and frameworks for analysis give a prominent position to the 'tragedy of the commons' as the single factor responsible for poverty and resource decline in fisheries, and to 'economic rationality', 'financial mechanisms' and 'privatization' as the solution to these problems (Holm 2001; Hersoug 2006; Johnsen 2005; Murray *et al*. 2006; Mansfield 2004), we can expect a continued drive towards ever more radical cyborgisation in the fisheries both in Norway and NL, and a continued restructuring of fishing practices, communities, household and gender relations as a result (Gerrard 2008). Fishing households

and community activities in fisheries will continue to be replaced by corporations, more effective machines, better gear and better boats. Paradoxically, the continued growth of cybernetic harvest organizations will help to ensure that fewer fishers and fewer boats do not translate into real reductions in capture capacity. Efficiency, power, and the need for fish in these cyborgs are so huge that sustainability could become more remote than ever before. As quotas become regarded as property and framed inside a certain legal and moralistic framework, it is unclear to what extent cybernetic fishing organizations will internalise appropriate rules to protect stocks into their daily practices or respond appropriately and quickly enough to increasing industrial and environmental volatility. Simultaneously, these contemporary cyborgization processes erode the potential and capacity for effective, timely external surveillance and intervention.

Today we see some re-emphasis on local ecological knowledge in stock assessment, reliance on more diverse scientific methods, increased user participation in management, increased monitoring, a reliance on market mechanisms, a call for ecosystem approaches to fisheries management (EAF) and a focus on oceans rather than just fisheries. The question is how these elements will interface with cybernetic organizations in the future. For instance, is the current trajectory with its focus on quota-based fisheries consistent with an EAF approach or does it, instead, run counter to such an approach? Fishing actors are increasingly accustomed to external regulation versus informal local management and to moderating their behaviour to adjust to such regulations in ways that may be positive or negative for the future of fish, fisheries and fishing communities. If EAF opens the door to interventions by new stakeholder groups how will they interact within the existing cybernetic system? Will we end up with parallel fishing and EAF processes rather than an integrated approach? If fisheries become fully privatized and ownership fully transferable; how will this mediate our capacity to regulate the industry and manage the resources for the greater public good? We do not yet have a clear answer to these questions, in part because the processes we have described are still unfolding. Whatever happens there is a clear need to conceptualize the actors in the fisheries as emergent cybernetic organizations rather than autonomous individuals, so we can monitor and model how relations change to become able to identify options and challenges for effective governance.

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## Notes

1 The story about Richard is built on an interview from 1997 and is supplemented with information from an interview in 2002. Parts of this story are presented in Johnsen (2004). The interview with "Ben" was done in October 2003. Both are in their sixties today.
2 "The fishing stage" is the elevated platform on the shore with working tables and sheds where the fish is landed, salted, and dried and where the fishing gear is stored.
3 In Norway youths participating in fishing have commonly received a share.
4 Lecture by the Director of Fisheries 03 September 2004. Sjømat for alle (Seafood for everybody) - Conference. 2.- 4. September, Bergen, Norway.
5 The NL snow crab fishery started in the 1960s with a relatively small number of limited entry licenses. Some supplementary licenses were issued in the 1980s, and in the 1990's, temporary snow crab fishing permits were issued to fishers in vessels under 35 feet in length along with often very small individual quotas for crab. These permits were eventually converted to licenses but individual quotas for the small boat fleet remain very small. In Newfoundland, however, the snow crab fishery started in the 1960s, though at a much smaller scale (See McCay 1999).
6 The Norwegian cod stock assessment from 1988/89 was later revised and it was suggested that the arctic cod stock was in better condition than the scientists thought in 1989.
7 According to Arnason et. al (2003:168) management costs in NL have varied between 11-28% of landed value between 1989-1999. In Norway they have dropped from 13 to 11% in the same period. In Norway the number of fishers has dropped, while the number of bureaucrats has increased. The Norwegian Newspaper, *Fiskeribladet Fiskaren*, (2. May 2008 pp-16-17) has estimated the ratio of bureaucrats/fisher to be 0,5.
8 In technical cybernetics the term *Cyborg* means *cybernetic organism* and signifies an extreme interface between human and machine, we use the term *Cyborg* to refer to *cybernetic organization,* which also allows us to include less extreme interfaces and links.
9 The TAC-Machine is the cybernetic system for setting TAC in the North Sea Fisheries. It is described by Holm and Nielsen (2007).
10 See also (http://www.imr.no/data/page/6761/HI-tema_nr.3.06_Referanseflaaten.pdf;
11 This process also that brings with it new identities and symbols of masculinity (Power 2008).
12 http://www.rafisklaget.no
13 See also Murray *et al*. (2006) where another of our informants; *Jack*, adapts in similar ways.

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