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LEARNING BY FISHING:
PRACTICAL SCIENCE AND SCIENTIFIC PRACTICE

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Abstract

Professional resource managers often assume that the ecological knowledge obtained by fishing skippers during years of practical experience is of relatively little use At the same time, recent research indicates that knowledge gained on the spot, in the course of production, is of fundamental importance. This article explores, with particular reference to the Icelandic context, how fishermen's knowledge differs from that of professional biologists and to what extent the former could be brought more systematically into the process of resource management for the purpose of ensuring resilience and sustainability An important recent attempt at bridging the gap between Icelandic fishermen and marine scientists is the so-called "trawling rally"--a procedure whereby a group of skippers regularly follow the same trawling paths identified by biologists for the purpose of supplying detailed ecological information I argue that while the trawling rally is a useful and interesting experiment, it is important to look for alternative ways of engaging fishermen, of using practical knowledge of fishing for the purpose of sustainable resource-use and responsible management

1. INTRODUCTION

In many fisheries, resource management is largely informed by professional scientists and public officials Such management often assumes that the extensive knowledge that fishing skippers have achieved in the course of their work is relatively irrelevant and ineffectual as far as fisheries management is concerned. Indeed, in many cases there is little attempt to draw upon such knowledge in the process of ecological research and decision-making. The current denigration of practical knowledge has been reinforced by a powerful "modernist" paradigm in bio-economics and resource management which assumes that ecosystems are characterized by linear relationships and that only a market approach, emphasizing private ownership of resources (usually privileging capital rather than labour), will ensure stewardship and responsible resource-use. The estimate of total allowable catch (TAC) and the allocation of transferable resource quotas (ITQs), it is often argued, are the only feasible and efficient management strategies.

Increasing empirical evidence and a growing body of theoretical scholarship suggest, however, that there are good grounds for questioning the assumptions of modernist management. Recent research indicates that, given the significance of the learning context and situated enskilment, the current restrictive emphasis on disembedded knowledge needs to be revised (Lave 1988, Gergen and Semin 1990, Fischer *et al* 1993). Moreover, research emphasizing the uncertain nature of many marine ecosystems suggests that managers modify their hierarchical notion of linearity and expertise. Multi-species ecosystems, it is argued, are highly unpredictable, with constant fluctuations in interactions among species and between species and their habitat (Gomes 1993) Several scholars have suggested that fisheries are chaotic systems with too many uncertainties for any kind of modernist, "scientific" control (Smith 1991, Wilson *et al.* 1994: 296) This does not mean that governance is impossible; it suggests, however, increasing reliance on a finer spatial and temporal scale, a scale that only the skilful practitioner is able to apply. It is essential, therefore, to pay attention to practical knowledge, allowing for contingency and extreme

fluctuations in the ecosystem. Some form of self-governance may be a practical necessity, strange as it may sound to those accustomed to the theory of the "tragedy of the commons" which assumes that overfishing is inevitable as long as access is "free" for everyone.[1]

Focusing on Icelandic fishing, in particular the Vestman Islands, this article discusses the similarities and differences between the knowledge of fishermen and that of professional biologists and the extent to which the former could be brought more systematically into the process of public resource management. With the persistent threat of overexploitation, Icelandic fishing has been subject to increasingly stringent public regulations and scientific control Generally, both marine scientists and resource economists have presented the coastal ecosystem as a predictable, domesticated domain. At the same time there has been a a tendency to assume that the practical knowledge of those who are engaged in fishing on a daily basis is of little or no value for resource management. Thus, there is little attempt to utilize the knowledge that skippers have achieved. Skippers frequently complain that marine biologists tend to treat them "as idiots," reducing practical knowledge and local discourse to mere "loose talk." Despite the occasional lip service in the reference to "collaboration" (*samráð*), there is little real dialogue between fishermen and marine biologists. Those who have come to know the fishing grounds around Iceland, during a lifelong career in fishing, fishermen complain, must remain silent when the "wise men" (*spekingar*) announce their precise measurements of the stocks. Recently, attempts have been made at bridging the gap between fishermen and scientists An important example is the "trawling rally" (*togararall*)--a procedure whereby a group of skippers regularly follow the same trawling paths identified by biologists in order to supply detailed ecological information. While the trawling rally represents an interesting endeavour, it has its shortcomings. It is important, I argue, to look for alternative ways of engaging fishermen, of using knowledge obtained in the course of production for the purpose of responsible resource-use and sustainable management.

2. PRACTICAL AND THEORETICAL KNOWLEDGE

For several centuries, since the Renaissance and the Enlightenment, Western discourse has tended to radically separate scientific understanding and everyday accounts Scientists, it has often been assumed, are objective explorers of reality, proceeding by rational methods and detached observations, while the lay person is locked up in a particular natural or cultural world, driven by genetic makeup, ecological context, superstitious believes, or local concerns Thus, orthodox functional theory of learning suggests a one-way hierarchical ordering of knowledge.

> In this theory, duality of the person translates into a division of (intellectual) labor between academics and "the rest" that puts primitive, lower class, (school) children's, female, and everyday thought in a single structural position *vis-à-vis* rational scientific thought (Lave 1988: 8).

One of the consequences of such a Cartesian scheme is the tendency to reduce local environmental knowledge to mere trivia and to assume that what people have to say about ecological matters and human-environmental interactions is pure ideology, of relevance only as cultural data. Accordingly, sustainable resource-use and sensible management become the privileged business of outsiders formally trained in public institutions.

In recent years, however, the dualistic theory of knowledge has been challenged on a number of fronts Not only is the notion of absolute objectivity, the idea of some scientific Archimedean standpoint outside history and culture, frequently subject to critical discussion, it is increasingly apparent that the local view makes much more sense than supposedly objective "observers" have often assumed. The community of modellers has been both expanded and redefined, empowering the local voice and relaxing modernist assumptions of privilege and hierarchy (Gudeman and Rivera 1992) This is evident from current interest in practical knowledge in development agencies on the international scene

as well as in academic studies of learning and expertise (Williams and Baines 1993, Lave and Wenger 1991) It is not quite clear, on the other hand, what the empowering of the "local voice" entails.

One of the important issues involved concerns the concepts of "indigenous" and "traditional" knowledge. While it is true that an extensive body of local knowledge has often been set aside, if not eliminated, in the course of Western expansion and domination and there are good grounds for attempting to recapture and preserve what remains of such knowledge (Chapin 1994), the reference to the "indigenous" and "traditional" in such contexts tends to reproduce and reinforce the boundaries of the colonial world, much like earlier notions of the "native" and the "primitive." Such terms are not only loaded with hidden transcripts, the value terms of colonial discourse, they are fraught with ambiguity. How old does a particular skill or body of knowledge have to be to count as "traditional"? Where does it have to be located to be classified as "indigenous"? We may try to relativize our answers to such questions, emphasizing that everything is indigenous and traditional from some point of view, but in the long run "natives" have a tendency to congregate in particular times and locations.

Another contested issue relates to the meaning of knowledge and learning Orthodox theories tend to present the learning process in highly functional terms, presupposing a natural novice who gradually becomes a member of society by assimilating its cultural heritage. Knowledge becomes analogous to grammar or dictionaries, invested with the structural properties and the stability often attributed to language. Given such a perspective, indigenous knowledge is sometimes presented as a marketable commodity--a thing-like "cultural capital"--and at times with "missionary fervor" (DeWalt 1994. 123). It may be useful and quite legitimate in some contexts to think of practical knowledge as a bounded, tradable object, for instance when encoding "indigenous" knowledge for the protection of "intellectual property rights" (Brush 1993) and defending legal claims about patents and royalties.[2] Much of the practitioner's knowledge, however, is tacit--dispositions inscribed in the body in the process of direct engagement with everyday tasks.

In reifying practical knowledge we fall into the trap of Cartesian dualism that we may be trying to avoid, separating body and mind.

The distinction between practical and scientific knowledge resolves such conceptual ambiguities and difficulties. It does not necessarily suggest a cultural or temporal boundary, the radical separation of producers and scientists, participants and observers, traditionalists and modernists. Rather, it draws attention to different ways of knowing, irrespective of time and space. Practical knowledge is not restricted to any particular group of people, for none of us (including practising scientists) would manage to live without it; scientific knowledge, of course, involves some degree of practical knowledge obtained in the course of engagement and experimentation. Likewise, on some occasions most of us seek to formulate our tacit knowledge in general terms, by verbal or textual means.

3. "HAVING A PEE IN THE SALTY SEA"

The theory of practice (see, for instance, Lave 1988) offers a view of learning and craftsmanship which is very different from that of orthodox learning theory. Informed by the notions of situated action and mutual enskilment, it emphasizes democratic collaboration and direct engagement with everyday tasks. Such a perspective not only provides a useful antidote to the project of modernist management, it resonates with some aspects of the discourse of Icelandic fishermen (Pálsson 1994) For them, "real" schooling is supposed to take place in actual fishing, not in formal institutions As one skipper put it: "Naturally, most of the knowledge one uses on a daily basis is obtained by experience. One learns primarily from the results of personal encounters, that is what stays with you." The emphasis on "outdoor" learning is emhasized in frequent derogatory remarks about the "academic" learning of people who have never "peed in salty sea" (*migið í saltan sjó*). Even a novice fisherman, skippers say, with minimal experience of fishing, is likely to know more about the practicalities of fishing than the teachers of the Marine Academy. Therefore, there is little connection between school performance and fishing success

Questioned about the role of formal schooling, skippers often say that what takes place in the classroom (during lessons in astronomy, for instance) is more or less futile as far as fishing skills and differential success are concerned, although they readily admit that schooling has some good points, preventing accidents and promoting proper responses in critical circumstances involving the safety of boat and crew Commenting on the competence of young men who nowadays graduate from the Marine Academy, one skipper said: "they know absolutely nothing!"

Skipper education recognizes the importance of situated learning. Earlier participation in fishing, as a deck-hand (*háseti*), is a condition for formal training, built into the teaching programme, this is to ensure minimum knowledge about the practice of fishing. Once the student in the Marine Academy has finished his formal studies and received his certificate, he must work temporarily as an apprentice--a mate (*stýrimaður*)--guided by a practising skipper, if he is to receive the full licence of skipperhood. The attitude to the mate varies from one skipper to another; as one skipper remarked, "some skippers regard themselves as teachers trying to advice those who work with them, but others don't." While skippers differ from one another and there is no formal economic recognition of the their role in this respect, in terms of a teaching-salary, according to many skippers the period of apprenticeship is a critical one. Reflecting on his mentor, with whom he had spent several years at sea, one skipper explained: "I acquired my knowledge by working with this skipper, learning his way of fishing I grew up with this man." It is precisely here, in the role of an apprentice at sea, that the mate learns to attend to the environment *as a skipper*. Working as a mate under the guidance of an experienced skipper gives the novice the opportunity to develop attentiveness and self-confidence, and to establish skills at fishing and directing boat and crew. The role of the mate, in fact, institutionalizes what Lave and Wenger (1991) term "legitimate peripheral participation," a form of apprenticeship that allows for protection, experimentation, and varying degrees of skill and responsibility. This is not a one-way transfer of knowledge as the skipper frequently learns from the co-operation of his mate; mate and skipper--in fact, the whole

crew--educate each other. In the beginning, the mate is just like an ordinary deck-hand; in the end he is knowledgeable enough to have a boat of his own. At first he is of little help to his tutor, later on he can be trusted with just about anything; occasionally, the skipper may even take a break and stay ashore, leaving the boat and the crew to his mate.

The folk account of fishing also emphasizes a particular pragmatic view of technology For the skilled skipper, fishing technology--the boat, electronic equipment, and fishing gear--is not to be regarded as an "external" mediator between the person and the environment but rather as a bodily extension in quite a literal sense. Experienced skippers often speak of knowing the details and the patterns of the "landscape" of the sea bottom "as well as their fingers." Thanks to technological extensions the experienced skipper is able to "see" the fish and "probe" the landscape of the sea bed. For many landlubbers, no doubt, the sea is primarily fishing *space*. For skippers, in contrast, it is a three-dimensional world, with variable bottom-features, migrating fish, and stratified masses of water.

The skipper's knowledge is complex; a skipper must choose times and places to fish on the basis of a series of detailed environmental information. It is not surprising, therefore, that fishermen often refer to the importance of "attentiveness" (*eftirtekt*, *athygli*) and "perceptiveness" (*gloggskyggni*); the ability to recognize and apply an array of minute but relevant details Attentiveness is a complex ability and includes, for example, being able to "read" the sky and predict the weather, to participate in discussions within the local fleet, to understand the "sparks" of electronic instruments, and to be able to co-ordinate crew activities In order, however, to have success in catching fish, the skipper must dwell in his crew. Moreover, the crew, of course, is part of a larger context Fishermen often speak of the personnel (*mannskapur*) of a boat in an extended sense--including several people ashore, those who ensure efficient repairs of equipment between fishing trips and those who bait lines and take care of nets, repairing old ones or supplying new ones. Indeed, folk accounts of fishing success often emphasize the importance of good fishing gear and the diligence of the people ashore responsible for its maintenance. "Having a

good crew," therefore, means not only being able to rely on a good *fishing* crew, but also being provided with good "services" (*þjónusta*) on land

The fleet is ever-present as well. While one may speak of the vessels temporarily associated with a particular landing port and nearby fishing grounds as a "local" fleet, such a fleet knows no clear boundaries (cf. Acheson 1988). The fleet is a changing constellation of boats that are registered in different towns and municipalities, and many of the skippers, crew, and boat-owners involved are permanent residents of other localities. Moreover, the fleets of different ports are hard to separate, during fishing they merge on the boundless sea. Nevertheless, the communion at sea is a very important one. Inevitably the skipper's decisions while fishing are constrained by the decisions of other skippers and by the movements of the fleet. While deciding where to fish is largely guided by the readings of electronic equipment and by the skipper's experience of earlier fishing seasons, of no less importance is knowing what *other* skippers are doing, where they are likely to be, and how much they will catch.

An important issue in current discussions of practical knowledge is the extent to which technical and economic changes influence levels of practical skill, leading to deskilling or upskilling (Gallie 1994). Somewhat paradoxically, with the crisis in the world's fisheries, fishing technology has been revolutionized. While in some fisheries, for instance in Brazil (see Kottak 1992), technological changes seem to have resulted in rapid deskilling, there is little reason to believe that this has generally been the case. Some skills are inevitably lost, in Iceland, old and retired skippers sometimes point out that fishing has been radically transformed by electronic technology (including the computer) and artificial intelligence, emphasising that "natural signs" are increasingly redundant. Attentiveness continues, however, to be one of the central assets of the good skipper and, just as before, it demands lengthy training. The skipper's universe is very different from that of his colleagues of earlier decades, but what shows on the screens of the radar, the computer, and the fish-finder is no less a "natural sign," directly sensed, than birds in the air or natural landmarks.

4 SCIENTIFIC MANAGEMENT

Nowadays, decisions on the scope of fishing operations are usually informed by marine sciences, setting the limit of the total allowable catch for a fishing season on the basis of measurements and estimates of stock sizes and fish recruitment. The science of resource economics, however, has played an even more important role in fisheries management than marine biology, providing the theoretical framework and the political rationale for a quota system, and, by extension, private property In many ways, resource economics has *replaced* marine biology as the hegemonic discourse on Icelandic fishing. While the original, formal demand for the quota system came from within the fishing industry, it would hardly have been instituted if it had not been advocated by influential Icelandic economists. Not only did they play a leading role within the major political parties as well as on a series of important committees that designed and modified the management regime, their writings, in newspapers, specialized magazines, and scholarly journals, paved the way for the "scientific" discourse on efficiency and the "rational" management which the quota system represents. Some of the economists argued, with reference to the "tragedy of the commons," that the only realistic alternative--euphemistically defined as "rights based" fishing, as if rights were something new--was a system of individual transferable quotas. Assuming a sense of responsibility among the new "owners" of the resource (the quota holders) and a free transfer of quotas from less to more efficient producers, economists argued, a quota system would both encourage ecological stewardship and ensure maximum economic efficiency

It seems difficult to separate such bio-economic theorizing from politics, culture, and rhetorics (see, for instance, McCloskey 1985, Gudeman 1992, Ferber and Nelson 1993). One example of the rhetorical content of theorizing on enclosure and privatization is the persistent inclination of advocates of systems of individual transferable quotas to privilege capital over labour Icelandic fishing is a case in point. Here, a quota system was introduced in the cod fishery in 1983 to prevent the "collapse" of the major stocks and

make fishing more economical (Pálsson 1991: Ch. 6) This system divided access to the resource among those who happened to be boat owners when the system was introduced, largely on the basis of their fishing record during the three years preceding the system. Each fishing vessel over 10 tons was allotted a fixed proportion (*aflahlutdeild*) of future total allowable catches of cod and five other demersal fish species. Catch-quotas (*aflamark*) for each species, measured in tons, were allotted annually on the basis of this permanent quota-share And the fortunate quota-holders were the owners of vessels, not crews This arrangement did not go uncontested, for there have been heated debates about what to allocate and to whom. The issues involved illustrate the discursive contest between different groups of "producers " Boat-owners argued for "*catch*-quotas," to be allocated to *their* boats Some fishermen, on the other hand, advocated an "*effort*-quota," to be allocated to skippers or crews

In the modern world, individual transferrable quotas and similar market approaches are increasingly adopted in response to environmental problems. Their wider social and economic implications are hotly debated, however, as they raise central questions of ethics, politics, and social theory (Dewees 1989, McCay and Creed 1990, Pálsson and Helgason 1995). For many of the critics, market approaches to resource management are incompatible with egalitarian sensibilities and communitarian notions of responsibility. Social scientists--including anthropologists and economists--should attempt to examine what the rather loose reference to the "market" entails (Dilley 1992). How the narrative of privatization and economic efficiency is used in specific ethnographic contexts is an important topic for research.

Icelandic fishermen continue to challenge the privileging of capital over labor This is sometimes expressed in a critique of the notion of "fishing history" which defined the original quota allocations on the basis of previous catches. In the words of one fisherman:

> It's a shame that quotas were only allocated to boat owners. Originally, allocations were based on "fishing history," but that history has nothing

to do with companies and boat ownership It's the men on board the boats who have created the right to fish.

The present debate on fisheries management is not so much concerned with the technical details of quota allocation as with the larger social and political consequences of the system. The most serious criticism of the current system is that it transfers immense resources into the hands of a relatively small group of people, comprised of the owners and managers of the biggest fishing companies. Many people have questioned the privileged access of the large quota-holders, the "feudal lords" or the "princes of the sea" (*sægreifar*), as the latter are frequently called. In a popular phrase from recent political campaigns, the quota system represents "the biggest theft in Icelandic history "

Not only has the quota system given permanent rights of access to an exclusive group, but this right has been turned into a marketable commodity. With some companies holding more than they are capable or willing to fish and others with less than they actually need, some companies temporarily rent a part of their annual quota. In public discourse this is frequently referred to by a loaded and somewhat fuzzy term, "quota-profiteering" (*kvótabrask*) The public is increasingly concerned with growing inequality due to the concentration of quotas One skipper who had a bigger quota at his disposal than most of his colleagues claimed that the apparently increased concentration of quotas in only a few hands was "totally unacceptable"· "It scares me to think of the possibility that four or five companies might gain control of the entire national quota." Results obtained through interviews and ethnographic fieldwork were strengthened by statistical conclusions regarding the distribution of quotas. Statistical results show that there have been radical changes in the total number of quota holders, a reduction from 535 to 391 (27%), from 1984 to 1994 Another measure is provided by examining the relative holdings belonging to different groups of quota holders, heuristically defined as "giants," "large" owners, "small" owners, and "dwarves" (see Pálsson and Helgason 1995). If quotas are changing hands, with full transferability, and the total number of quota owners is decreasing, where

are the quotas going? To cut a long story short, the proportion of the quota-holdings of the "giants" has rapidly increased in only one decade, from 27.9% to 49.7%. During the same period, the proportion of the quota belonging to the "dwarves" has decreased from 12.5% to 8 7%. Thus, quotas are increasingly concentrated at the top.

After more than a decade of stringent quota management and redistribution of assets, the major Icelandic fishery (the cod fishery) is still in a critical phase and, even worse, there are no signs of ecological recovery. Stock sizes and recruitment rates continue to be far too low, given earlier estimates of maximum sustainable yield. The relative failure of the quota system and scientific management of recent years to deliver the goods they promised, and the severe social and ethical problems of inequality they have raised, suggest that it may be wise to look for alternative management schemes emphasizing the practical knowledge of the fishing industry, in particular the people who are directly engaged with the ecosystem.

Wilson and associates suggest that the "numerical" approach of current resource economics and marine biology, emphasizing linear relationships and states of equilibrium, fails to account for the chaotic aspects of many fisheries. Their empirical work shows that while fisheries are deterministic systems, because of their extreme sensitivity to initial conditions even simple fish communities have no equilibrium tendency. As a result, management faces forbidding problems when trying to explain the noise in ecological relationships, for example the relationship between recruitment and stock size, often a key issue for managers: "the degree of accuracy and the completeness of knowledge required for prediction are far beyond any capabilities we might expect to achieve in a fisheries environment" (Wilson *et al* 1994 296). Therefore, it becomes difficult, if not impossible, to know the outcomes of management actions such as quotas

5. BRIDGING THE GAP· THE "TRAWLING RALLY"

If marine ecosystems are chaotic and fluctuating regimes, those who are directly involved in resource use are likely to have the most reliable information as to what goes on

in the system at any particular point in time. Often, however, scientists are reluctant to collaborate with fishermen. One of the reasons for the lack of collaboration is the fundamental difference between the two groups in terms of the knowledge they seek; the knowledge of scientists is largely normative and textual, preoccupied with statistical methods and theoretical ways of knowing, while that of fishermen, often tacit, is tuned to practical realities in the ever-changing sea.

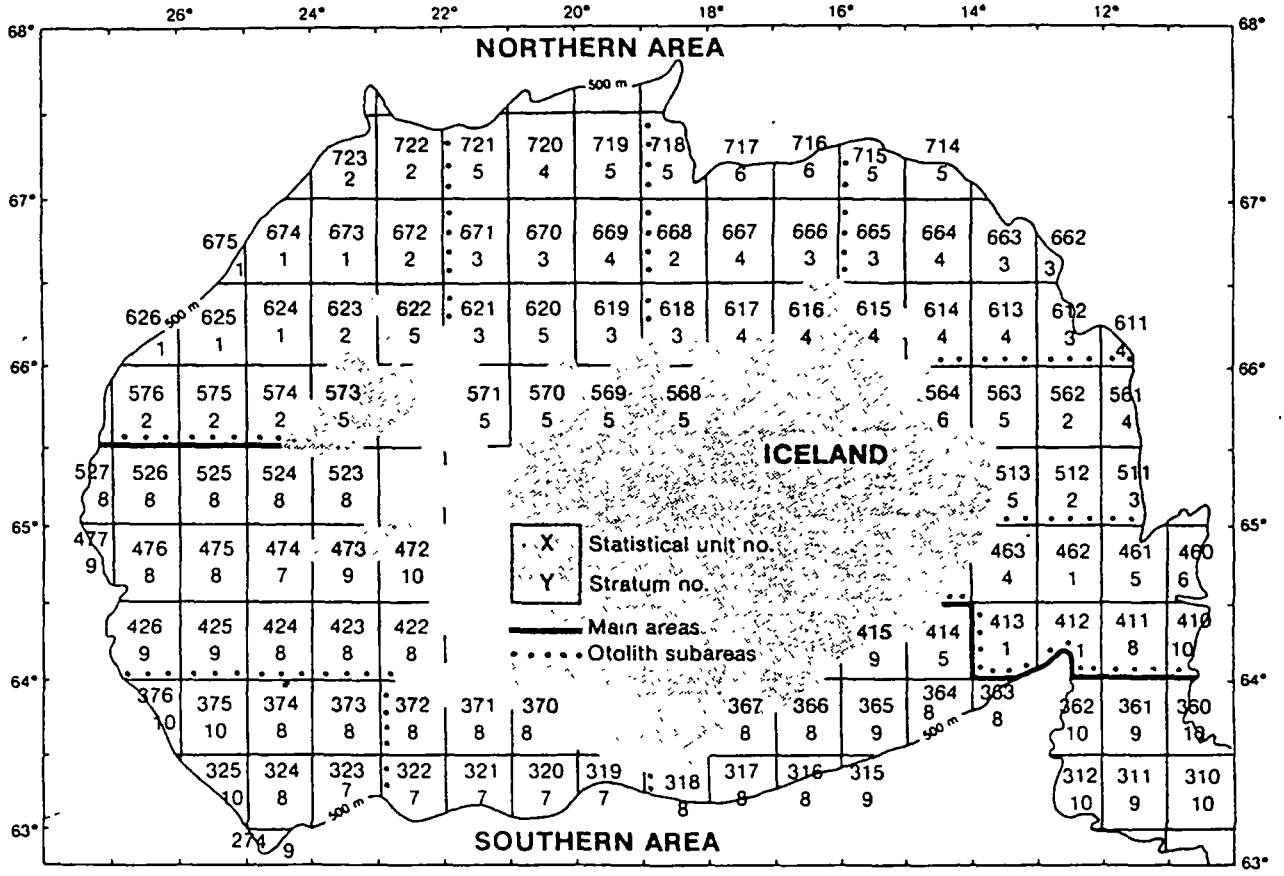
In an attempt to encourage cooperation between scientists and fishermen and to involve the latter in the collection of detailed ecological data on the state of the seas and the fishing stocks, the Marine Research Institute hires a group of skippers to regularly fish along the same pre-given trawling paths on their commercial vessels (see Pálsson *et al.* 1989); this is the so-called "groundfish project"--in everyday language, the "trawling rally"--initiated in 1985:

> The cooperation with fishermen is based on the main objective of the project; to increase precision and reliability of stock size estimates of relevant fish stocks, especially cod, through the integration of fishermen's knowledge of fish behavior and migrations, as well as the topography of the fishing grounds (Pálsson *et al*, 1989: 54).

Because mature cod sometimes migrate from Greenland to Icelandic fishing grounds, thereby making traditional stock assessment on the basis of fishing statistics relatively unreliable, a systematic fishery-independent survey was seen to be essential. Such a large-scale project was beyond the capabilities of Icelandic research vessles and, therefore, commercial vessels were hired for the task. For two weeks in March every year, five vessels survey the same research stations (595 in the beginning, later on 600), originally selected through a semi-randomly stratified process in co-operation with fishermen (see Figure 1). The vessels (stern-trawlers) are identical in overall equipment and design, in terms of size, fishing gear, engine power, etc. This is seen to be important

to ensure comparable data-sets, allowing for reliable estimates of changes in the ecosystem from one year to another.

Figure 1. The survey areas of the "trawling rally" within the 500-m debth contour (from Pálsson *et al.* 1989; reproduced with authors' permission)



The trawling rally is an interesting experiment. While it is partly a diplomatic endeavour on behalf of the Marine Research Institute, in order to reduce the tension that has developed between biologists and fishermen in recent years, as a result of stringent scientific management, and to improve the image of the Institute among the general public, there is obviously more to the story No doubt, the trawling rally yields extensive comparative information that the biologists could not possibly gain otherwise, given their limited funding.

Nevertheless, as an attempt to cultivate effective interactions between fishermen and biologists for management purposes it has significant limitations. To begin with, while

the design of controlled surveying has an obvious comparative rationale, it is also a straitjacket, preventing a more flexible and dynamic sensing of ecological interactions in the sea. Skippers fail to be impressed with the scientific design, criticising the biologists for "isolating themselves temporarily on particular ships, pretending to practice great science," to parahrase one of the skippers. Many skippers pointed out during interviews that, fixed to the same paths year after year, the rally fails to respond to fluctuations in the ecosystem, thus providing unreliable estimates; one of them, a skipper who had participated in the trawling rally, remarked that knowing how the biologists worked he had lost all faith in scientific procedures! "If these guys were skippers," another skipper remarked, "they would have been fired long ago."

Also, the reliance on trawling, skippers say, is likely to produce biased results. Often, those fishing with gill nets on nearby grounds offer a very different picture. From the skippers' point of view, a more intuitive and holistic approach, allowing for different kinds of fishing gear and greater flexibility in time and space, would make more sense. Indeed, skippers discuss their normal fishing strategies in such terms, emphasizing constant experimentation, the role of "perpetual engagement" (*að vera í stanslausu sambandi*), and the importance of "hunches" (*stuð*) and tacit knowledge.

Like their colleagues in other parts of the world, Icelandic biologists have often focused on one species at a time, modelling recruitment, growth rates, and stock sizes, although recently they have paid increasing attention to analyses of interactions in "multi-species" fisheries While scientists may qualify their analyses and predictions with reference to some degree of uncertainty, the "margin of error," they often talk as if that margin is immaterial Fishermen question their basic assumptions, arguing that understanding of fish migrations and stock sizes is still very small. Knowledge of the ecosystem, they claim, is too imperfect for making reliable forecasts. "Erecting an iwory tower around themselves," one skipper argued, "biologists are somewhat removed from the field of action; they are too dependent on the book." While such comments have to be seen in the light of cultural and economic tension between social classes and between

center and periphery, they should not be rejected on that ground alone as they also have some grain of truth. Biological estimates and fisheries policy are often literal and rigid in form, unable to deal with variability and to respond to changes in the ecosystem Skipper knowledge, in contrast, the result of situated learning, of direct engagement with the aquatic environment, is necessarily tuned to the flux and momentum of fishing An important task on the management agenda is to look for ways in which that knowledge can be employed to a greater extent than at present for the purpose of responsible and democratic resource management, bridging the modernist gap between scientists and practitioners.

6. CONCLUSIONS AND POLICY IMPLICATIONS

There is a strange paradox in Western environmental discourse. On the one hand, there is a tendency to project an image of resource management as an a-political enterprise, as the "rational" domination of nature independent of ethics and social discourse. Policy makers in fisheries often remain firmly committed to a modernist stance, curiously innocent of recent developments in social and ecological theory, presenting themselves as detached observers, as pure analysts of the economic and material world, independent of the "partial" viewpoints and the trivial, practical knowledge of the actors. On the other hand, current environmental discourse is characterized by the postmodern condition, emphasizing, much like medieval European discourse, the embedded nature of any kind of scholarship and the interrelatedness of nature and society (Pálsson 1996) The former view, which presents the pursuit of environmental knowledge as a relatively straightforward accumulation of "facts" and radically separates knowledge of nature and the social context in which it is produced, has come increasingly under attack in several fields of scholarship, including anthropology, economics, and environmental history We may well be advised to search for alternative epistemologies and alternative management schemes, democratizing and decentralizing the policy-making process. It may simply be more effective Below, I briefly discuss three related policy implications of the preceding

discussion, emphasizing the issues of property rights, the nature and relevance of practical knowledge, and, finally, the need to develop institutional frameworks which allow for democratic participation

6.1 PROPERTY RIGHTS

Many scholars have raised serious doubts and criticisms with respect to the central assumptions of bio-economic theory To begin with, the emphasis on privatization and the tragedy of the commons has been challenged on practical grounds. Some "commons" regimes function rather well (McCay and Acheson 1987, Durrenberger and Pálsson 1987) and, conversely, some privatized regimes are obvious failures In some African pastoralist economies, for example, the argument about the tragedy of the commons has been forcefully used by governments and companies when pressing for privatization of communal grazing areas In the process, earlier mechanisms for regulating access have sometimes been eliminated, with serious ecological consequences. Environmental degredation was not the consequence of the absence of property rights, but rather the result of the imposition of a privatized regime. There is some evidence about a similar erosion of responsibility in fisheries as a result of quota management. Discarding of small and immature fish during fishing operations and the "high-grading" of the catch (the dumping of species of relatively low economic value) seem to be major problems in many fisheries, including the Icelandic one. In addition, privatization sometimes causes severe social inequalities and ethical problems, which escalate the problem of irresponsible resource-use Before instituting programs of privatization and quota allocation, managers should be careful to examine the particularities of history and culture and the likely social and ecological consequences of their schemes

6.2 PRACTICAL KNOWLEDGE

An important conceptual problem with current bio-economic theory relates to the tendency to separate systems and activities, experts and practitioners Management is

often presented and practiced as a hierarchical exercise, the business of privileged professionals (see Marglin 1990). As I have argued, learning by doing entails the development of detailed practical knowledge, the accumulation of personal wisdom potentially of crucial importance for any project of resource management that seeks to ensure resilience and sustainability. Standardized procedures such as the Icelandic trawling rally may prove to be quite useful in this respect. Science and practical knowledge should be seen as complimentary and interactive sources of wisdom, not mutually exclusive.

The fact, however, that skipper often fail to express what they know by verbal means, since much of what they have learnt is tacit and intuitive, presents a formidable "translation" problem. One Icelandic skipper explained his approach in the following terms "It's so strange, when I get there it's as if everything becomes clear I may not be able to tell you exactly the location, but once I'm there it's as if everything opens up." Indeed, a frequent comment in interviews with skippers on their fishing tactics is simply "I cannot quite explain." How can one elicit and reformulate such tacit knowledge in general terms, in order to incorporate it into biological models and decision making? If much of the relevant knowledge that skippers obtain in the course of their work is the result of first-hand experience, embedded in the practical world of fishing, its mediation to landlubbers is obviously a difficult task

Scientists and practitioner, after all, have somewhat different methods and motives One of the problems entailed by their collaboration, to draw upon J Kloppenburg and B R. DeWalt, is to transform practical knowledge which produces "mutable immobiles"--that is, relatively flexible knowledge geared to the details of a given task of a particular locality--into "mutable mobiles" (see DeWalt 1994)--general, holistic knowledge that can be applied to similar phenomena in other contexts. This should not, however, be seen as an insurmountable hindrance One possible avenue in this direction, in the context of fisheries management, is to have biologists observe practising skippers on different kinds of commercial vessels during actual fishing trips, using a variety of fishing gear at different times of the year This would allow them to learn by fishing, much like a novice mate

learns from his skipper in the course of production Biologists would thereby periodically become apprentices, guided by experienced skippers. Knowledge obtained in such practical encounters may later on become important for ecological assessment, for the estimation of stock sizes, recruitment, migrations, and carrying capacity.

6.3 FRAMEWORKS OF COOPERATION

While much of fishermen's knowledge is tacit and non-verbal, one should not forget that they often discuss their observations and theories in fairly clear terms, verbalizing their personal knowledge, their decision making, and their management goals To draw upon this personal resource--indeed, upon local knowledge and concerns in general (including those of fishworkers)--it is important to establish a democratic institutional framework, a framework that avoids the hierarchy of modernist management, allowing for what Habermas has called "the ideal speech situation," a "speech situation that is immune to repression and inequality" (1990: 85). Such an institutional context is particularly important nowadays, given the mutual integration of many fishing societies and the importance of coordinated fisheries policy Several studies of European fishing communities, informed by theorising on the process of "globalization," have drawn attention to the ways in which local concerns are articulated within a larger regional, national and international context, emphasizing that in order to understand recent developments and to act responsibly it is necessary to move beyond the study of either "local" or "external" influences to the wider encompassment of the local community within larger contexts (see, for instance, LiPuma and Meltzoff 1994). Often fishing associations act as mediating institutions in this process, co-ordinating individual concerns, local activities, and the political structures of the larger environment, looking both inside and outward.

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NOTES

1 In some fisheries, including the lobster fishery of Maine in the United States (Acheson 1988), fishermen have an important role to play in fisheries management. The relations of power between local fishermen and professional managers and scientific experts typical for many fisheries in the western world seem to be reversed.

2. When defending indigenous claims, anthropologists have often emphasized the boundedness of cultural units and the intellectual properties belonging to them: "Biological knowledge is among the most important types of information *possessed* by any culture, a fact long recognized and emphasized by anthropologists" (Brush 1993: 657; italics added).

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