COMMERCIAL FISHERIES

CHAPTER 17 Putting fishers' knowledge to work

Reconstructing the Gulf of Maine cod spawning grounds on the basis of local ecological knowledge

Ted Ames

ABSTRACT

In today's fisheries and centralized management strategies, fishers' knowledge often gets dismissed as subjective, anecdotal and of little value. Yet, fishers have spent much of their lives accumulating intimate, fine-scale ecological information that is not otherwise available to the scientific community. Accessing this wealth of fisher-based knowledge, however, is not without its pitfalls. This chapter reviews problems encountered while accessing information during the mapping of historical cod and haddock spawning grounds in the Gulf of Maine, and discusses the strategies developed to overcome them. Current and future roles for fishers' knowledge in managing coastal fisheries are examined. Various ways to integrate the local place-based information of fishers into current management strategies and the potential for introducing a new local management paradigm are explored.

INTRODUCTION

In New England, fishers' local ecological knowledge (LEK) has often been dismissed as subjective, anecdotal, and dealing only with local situations. In addition, it often relates to stocks that were fished out decades ago, leading some to suggest that since these fish no longer exist, the fishers' accounts should only be used as historical footnotes.

I tend to disagree. I have used LEK often in my life, not only in order to catch fish, but also as an important source of ecological information about a fishery. From this perspective, the accuracy and breadth of knowledge shared by fishers is very impressive. Fishers and their descriptions have a pivotal role to play in the development and functioning of sustainable fisheries.

Whether LEK gets integrated into mainstream science so that it can influence management will ultimately depend on the ways it is used. Fishers and their vessels are currently being used to develop 'real time' catch data for faster, ongoing stock

assessments. Though useful in bolstering the status quo, this approach tends to employ fishing vessels rather than fishers' knowledge, which deals with local populations and their seasonal habitats.

Fisheries science, involved as it is with the study of large population units, has not focused on local-level phenomena such as the changes in behaviour and distribution of local populations associated with the collapse of a stock that are so often described by fishers. The preoccupation of fisheries science with system-wide characteristics has left it without the historical parameters needed to interpret fine-scale changes in stock distribution, behaviour, or migration patterns over time. Consequently, management has lacked the ability to detect or interpret these changes in abundance.

A NEW ROLE FOR FISHERS' ECOLOGICAL KNOWLEDGE

THIS lack of historical perspective may have aggravated attempts to manage New England's commercial fisheries. We have all been so preoccupied by the depressed state of our fisheries that we may have missed some of the root causes of their depletion. If we are to develop sustainable fisheries, we must at the very least understand how and why the stocks collapsed in the first place. While fishers and scientists acknowledge that many stocks have declined because of high catch rates, the problem is far more complex than the simplistic rationale of 'too many fishers chasing too few fish' (National Research Council, 1999). Declines in abundance have consistently been accompanied by local changes in distribution, migration patterns and species assemblages. Clues abound about the disruption of local interrelationships and changes associated with this. But fine-scale changes cannot be detected by today's system-wide fisheries assessments.

It is here that fishers' knowledge can play an important and perhaps critical role. Fishers are, in fact, the only available source of local, historical, place-based fisheries information. Just to survive, let alone succeed, each fisher has to become proficient at figuring out how local changes in a fish stock affect distribution and abundance. This creates a pool of people who have unique experiences of local marine ecology.

Not only do fishers have special knowledge about what is presently there, but each generation has developed its own particular fishing patterns that are attuned to the stock migrations and behaviour present during that period. With a little effort, information can be retrieved about such factors as distribution, behaviour and species assemblages that are unique to those periods.

Information collected from different generations of fishers can be used to create a series of historical windows into a fishery's local ecology that can be used to identify long-term processes in the fishery. Compiling a historical database forms a timeline that allows those processes to be studied. If a relatively short time-span is used to capture changes occurring before, during and after the depletion of a fishery, the

FISHERS' KNOWLEDGE IN FISHERIES SCIENCE AND MANAGEMENT - ISBN 978-92-3-104029-0 - © UNESCO 2006

sequential effects of its depletion on the marine ecosystem can be analysed. Linking the intimate, place-based knowledge of fishers with that of scientists would help in understanding how highly productive coastal ecosystems functioned when they were more robust. This would also provide historical perspective into the fine-scale details so lacking in the analysis of commercial stocks.

The value of fishers' historical insights into fisheries ecology goes beyond its benefit to research. Fishers' knowledge may be most effective when applied to fisheries management because it offers management a new paradigm. For the first time, long-term trends, seasonal, site-specific habitats, and species interactions will be available to management. With this knowledge, alternative approaches such as area-based management using local knowledge and local participation could be used to protect reproduction and juveniles as part of the local fishery. This would enhance the possibility of consistent local reproduction while, at the same time, surveys and assessments of larger population units would be continued.

THE GULF OF MAINE COD SPAWNING GROUNDS PROJECT

A good example of the use of traditional fishers' information surfaced during efforts in New England to revitalize the collapsed inshore cod (*Gadus morhua*) fishery. Two fishing associations, the Maine Gillnetters Association and Maine Fisherman's Co-op, successfully petitioned the Maine State Legislature to form a groundfish hatchery commission to study the feasibility of establishing one or more groundfish hatcheries. The hatcheries were funded by raising the groundfish licence fee for commercial fishers. The commission found large areas of groundfish habitat along the coast that used to be highly productive, but were now abandoned. They concluded that, if hatchery production could be used to increase the number of active spawning sites along the coast by reintroducing groundfish into these areas, the resulting spawning success would drastically reduce the time depleted stocks would need to recover. The commission recommended that young cod and haddock (*Melanogrammus aeglefinus*) be released near once-productive spawning grounds and nursery areas in an attempt to jump-start the process. Releasing juveniles in the right habitats would be a critical step.

Unfortunately, most of the inshore grounds that were suitable for such a project had been fished out decades before and had long been abandoned and forgotten by today's fishers. With cod and haddock stocks collapsed, scientists were unable to locate spawning areas by conventional methods. Despite the fact that the Gulf of Maine had maintained a directed cod fishery for more than three centuries, few spawning grounds were known to science. Most of the spawning areas suitable for such a project were abandoned and forgotten, having been 'fished out' decades earlier. Few current fishers were even aware of their existence.

A study was funded to locate and interview the few remaining fishers who had fished those areas and could identify coastal spawning and nursery areas of cod and haddock. It became my privilege and great pleasure to interview these older fishers and to draw the spawning ground maps on the basis of their knowledge.

Prior to the fisher-based spawning ground study, very few coastal spawning locations for cod and haddock were known, causing researchers to raise important questions about whether either species had actually been year-round coastal residents. As the interviews proceeded, the number of confirmed spawning sites mounted. It soon became clear that both cod and haddock once had spawning areas along the entire length of the Gulf of Maine's coast. By the time the study was over, more than 2,800 km^2 of spawning grounds for cod and haddock had been identified, and numerous questions had been raised about what actually precipitated the collapse of those coastal fisheries. The contributions of these fishers have provided new insights into the causes of the collapse of Atlantic cod in the study area. (Ames *et al.*, 2000)

An accompanying study using side-scan sonar confirmed the substrates and depths of the spawning locations given by fishers, indicating that their descriptions were exceptionally accurate (Barnhardt *et al.*, 1996). This reinforced general acceptance of the locations identified by fishers as coastal New England's historical spawning grounds for Atlantic cod.

PITFALLS TO AVOID WHEN INTERVIEWING FISHERS

COLLECTING fisheries information about commercial stocks does not come without its own set of hurdles. Simply interviewing some fishers and then cleaning up the data to make it presentable to the scientific community is only a small part of what has to be done to interview fishers effectively. The process of figuring out who can best provide the information you seek can be formidable. Just any old fishers will not do.

In addition, the majority of interviewers confirm that fishers can be difficult to interview, their information is difficult to verify and, once verified, is very difficult to integrate into conventional fisheries information. A well-defined strategy for surmounting these hurdles is essential for good results. It is especially important to obtain ethical clearance for LEK interviews, for it may involve proprietary information and cultural issues. A brief, concise form disclosing who will have access to their information and how it will be used can dispel the concerns of many fishers, while simultaneously avoiding any misunderstanding.

Also be aware that different gear types may give quite different types of information. What is observed by one fishing technique alone can be very misleading. For example, an overview of coastal New England shows that hook fishers caught cod in their feeding areas. Since fish feed less when they are spawning, hook fishing

FISHERS' KNOWLEDGE IN FISHERIES SCIENCE AND MANAGEMENT - ISBN 978-92-3-104029-0 - © UNESCO 2006

may not provide good information about spawning locations. Otter trawlers and gillnetters caught fish whether or not they were feeding and so became a prime source for spawning ground information.

A brief description of problems that emerged during the spawning ground project and the strategies used to resolve them is provided below. It is hoped that this summary will be of use to others.

1. When we started, we did not know the names or addresses of the fishers who were part of the collapsed coastal fishery for cod and haddock. Most of them were retired and had not fished for decades. We asked Maine's two coastal groundfish organizations to help us identify older fishers to interview. Their members prepared a list of older fishers for us who were well known locally and respected for their skill at catching cod and haddock in coastal waters.

   The fishers interviewed during the project were selected from a potential list of several hundred groundfishers. They were retired captains who averaged about 65 years of age and had been very effective in Maine's inshore cod and haddock fisheries. All had been lifelong fishers with at least thirty years experience on small and medium-sized boats engaged in otter trawling or tub trawling/longlining. Many had started out as handliners or lobster (*Homarus gammarus*) fishers and shifted to various technologies as opportunities appeared.
2. Fishers generally mistrusted fisheries researchers and managers. Countering this was the credible fishing history of my family and myself. In addition, a local fisher accompanied me, introduced me, and participated in most sessions. This effectively put everyone at ease. The fishers who accompanied us during the interviews were younger, active fishers whom I knew personally or by their reputation and who were members of the two fishing associations supporting the project. They were unpaid, untrained, and became involved because of a collective desire to rebuild the fishery for their communities.
3. In general, fishers are not inclined to hand over hard-won knowledge that could threaten the livelihood of friends, family, and self by inviting competition or closures. However, this difficulty was not often encountered because the fishers being interviewed were older and had little motivation to safeguard or falsify information. In addition, the interviews focused on coastal spawning areas that had been fished out years ago, rendering their location relatively worthless. Notably, information about current fishing areas was not forthcoming.
4. Fishers are often reluctant to answer questions if they perceive the interviewer to be collecting information simply for the sake of collecting it, or worse yet, for management purposes they do not support. The survey addressed this concern by explaining that its purpose was to rebuild the fishery for the benefit of fishers. The few remaining fishers who had taken part in the fishery were the only ones left who knew where the spawning grounds were located.

I stated that if we could find where the grounds were, funding would be available to support an effort to rebuild the stocks. In the end, fishers themselves were to be the beneficiaries. All recognized that restoration efforts were a long shot at best, but felt that it was worth talking with us anyway. And, if all went well, fishers in their area would regain a fishery.

5. Fishers feel especially threatened when asked to share information that may become public, and often refuse to talk. Interviewers should recognize the economic consequences fishers may face when fishing secrets are revealed. These are not trivial issues. Once published, facts affecting the fishers' landings that were casually shared with the interviewer become available to competitors and anti-fishing interests. An important step includes thoughtful decisions about what to ask and how to handle such information. Only then does a strategy to persuade fishers to share their knowledge become realistic. In the spawning ground study, questions were deliberately limited to depleted coastal grounds no longer used by local fishers.

PITFALLS TO AVOID WHEN PROCESSING FISHERS' INFORMATION

Traditionally, many fisheries scientists have brushed fishers' information aside because it is so difficult to integrate into the world of high-tech, statistics-based research. Even when fishers' subjective observations can be confirmed, they lack the reproducibility and precision of carefully controlled experiments. Given these concerns, controlling data quality becomes critical. Researchers who find ways to accommodate these limitations by developing ways to validate fishers' knowledge, however, may find a great deal of site-specific information about fisheries ecology.

The strategies developed in the spawning ground study for validating data included requiring that each spawning ground and its location be independently verified by two or more fishers, and that the depth and substrate present at the site should agree with known spawning ground preferences. In addition, the exact location of the site described by fishers required validation. Two or more independent identifications by fishers were needed when spawning grounds were identified directly on nautical charts. Most, however, preferred to simply name a fishing ground in an area, or gave marks and bearings leading to the bottom they had once fished. The location of specific grounds had to be corroborated by interviews with additional fishers or historical references, while spawning areas identified by sets of landmarks had to be plotted and their location independently confirmed by other fishers. Once identified, the site then had to agree with the bottom types reported on nautical charts and, where possible, confirmed by side-scan sonar.

Of all parameters encountered in the study, timelines were perhaps the most difficult to establish and verify. Fishing information collected during the spawning

FISHERS' KNOWLEDGE IN FISHERIES SCIENCE AND MANAGEMENT - ISBN 978-92-3-104029-0 - © UNESCO 2006

ground study was, by necessity, decades old. Even though fishers were quite sure of the season or month they had caught ripe fish, they often could not recall the exact year when it happened. In such cases, supporting information occurring during the same period was used to identify and then determine the approximate year when the fish were caught.

For example, when a participant was unsure of when he had found ripe cod on a particular ground, questions such as 'Was it before or after the war?, Were you married then?', 'What grade in school was your oldest boy then?' were used to bracket the period and eventually allowed the date to be identified.

EPILOGUE TO THE SPAWNING GROUND PROJECT

A unique aspect of the spawning ground study was that all the participants involved were attempting to rebuild the fishery, even though retired fishers had no interest in returning to the sea and younger fishers knew their efforts might be for naught. This idealism was undoubtedly the key to the project's success. All wanted local fishers from coastal fishing communities to continue harvesting cod in a limited, hook fishery once the fishery recovered. As events unfolded, however, this was not to be. The depleted groundfish stocks precipitated management regulations that eliminated most of the active fishers involved in the study, even though they were instrumental in efforts to improve the fishery through spawning season closures.

It seems ironic that nearly all the fishers involved in the project have now lost access to the fishery, an outcome that was once inconceivable to Maine fishers. Six years after the study, the eastern two-thirds of Maine's long coastline has but three active groundfish permits left among the 10,000-odd fishers who live there, and those three will disappear with Amendment 13, leaving many embittered and frustrated fishers with few business alternatives, and Maine's coastal fishing communities disenfranchised.

Perhaps the most grievous insult came as the aquaculture industry consumed $2 million of Federal groundfish assistance in a three-year period to grow and release 450 fingerling cod. Much of the funding disappeared in their efforts to commercially grow pen-raised haddock, rather than cod.

New applications for fishers' knowledge

The mapping project of cod and haddock spawning grounds displays only a fraction of the potential value found in fishers' knowledge. It has since been use to build a prototype LEK database for Atlantic cod to analyse stock structure in the Gulf of Maine during the 1920s, a period when the population was more robust (Ames, 2004). The historical spawning grounds were used as points of origin for tracking

the cod's seasonal movements within a spatial plot of fishing grounds and were instrumental in determining movement patterns.

By mapping the distribution of cod for each season of the year on a geographic information system (GIS), and then displaying the seasons sequentially, fine-scale details of movements could be tracked. From this, the location of sub-populations and their spawning components and/or local populations were tentatively identified. Recent discoveries show cod returned to specific spawning grounds for reproduction (Wroblewski, 1998; Green and Wroblewski, 2000). Concentrations of cod were tracked from spawning areas to bordering fishing grounds and then back to the same spawning ground through each season of the year. When viewed in their entirety, the collective movements of Atlantic cod among fishing grounds in the Gulf of Maine followed seasonal migration corridors associated with three sub-populations, and local spawning components made local, circular movement patterns between feeding areas and their spawning ground.

Many of the historical cod spawning grounds could be verified by recent cod egg distribution surveys (Berrien and Sibunka, 1999), confirming that not only had fishers identified the right spawning areas, but that historical spawning components still used the same grounds (Figure 17.1). Many abandoned spawning areas were also found. The absence of recent spawning activity and cod landings near those sites identified them as spawning areas used by extinct spawning components or local stocks.

A new paradigm for management?

Today's fisheries managers and fishers are trapped in a management system dependent on system-wide stock assessments that are not designed to detect local depletions (Frank *et al.*, 1994; Sinclair *et al.*, 1997; Smedbol and Stevenson, 2001). All have been helpless in avoiding the depletion of valuable fisheries that are now diminished to a fraction of their historical productivity.

The linking of fishers' ecological knowledge (LEK) with current fisheries reports, however, offers fishers, managers and environmentalists a new paradigm that can be used to identify and evaluate temporal changes in fine-scale population structure. Ames (2004) used LEK to create an overarching framework of historical stock structure and behaviour patterns as part of an analysis of Gulf of Maine Atlantic cod. The distribution of historical spawning components within the Gulf of Maine grouping was described and their interactions were summarized, on the basis of seasonal movements to and from specific spawning grounds. The results were then compared to recent fisheries surveys and studies, first to validate the methodology used, and then to evaluate changes that have occurred in the disposition of today's spawning components. Such insights are pivotal if the reproductive capacity of non-panmictic populations such as cod and herring are to be maintained and if

FISHERS' KNOWLEDGE IN FISHERIES SCIENCE AND MANAGEMENT - ISBN 978-92-3-104029-0 - © UNESCO 2006

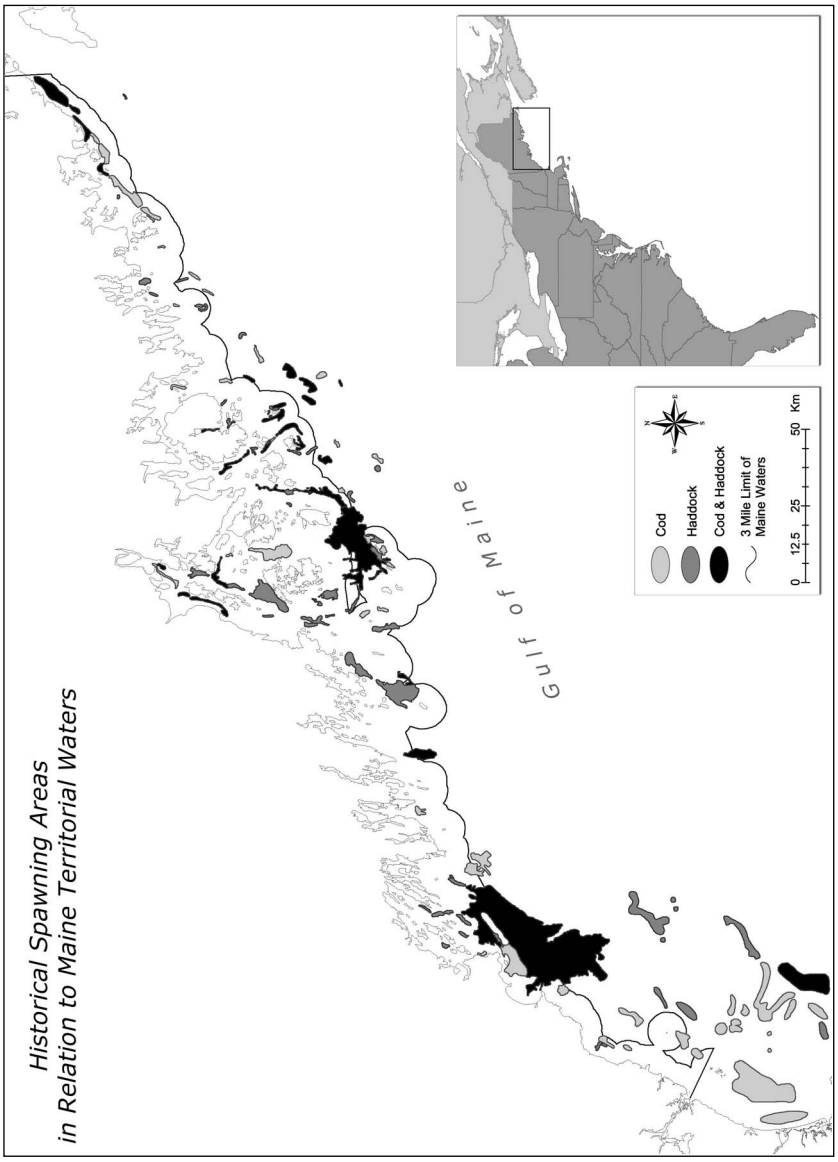

FIGURE 17.1 *Historical cod spawning grounds and recent distribution patterns of cod eggs in the northern Gulf of Maine.*
Source: Ames, 1997.

functional ecological boundaries for fisheries management areas are to be defined. The information derived from fishers' local, fine-scale knowledge can facilitate strategies to improve reproduction and recruitment, and protect critical habitats.

The New England Fisheries Management Council (NEFMC) recently considered the Gulf of Maine Conservation and Stewardship Plan, which would have been used to manage three sub-populations of Atlantic cod spawning components along the US coastal shelf of the Gulf of Maine. The proposed plan would have created three ecologically-discrete subdivisions on the coastal shelf, accessible only to fishers who agreed to fish in one of the areas for five years, making it imperative that they develop a good rebuilding programme to protect spawning aggregations, juveniles, nursery habitats and forage stocks. Harvesting was to be restricted to modest levels that allow development of a sustainable fishery that provides long-term economic benefits to local economies in the area.

The NEFMC was to delegate local management plans for each area to a committee, pending the council's approval. The plan proposed a committee chaired by the NEFMC, with a scientist-advisor, area fisher delegates of each gear type, fishing community delegates and environmentalists. The committee was to be patterned after the State of Maine's Lobster Zone Councils where consensus building and peer-group pressure could be used to support an ecosystem-based recovery plan for area fishers, who would be the principal beneficiaries.

Several reports identify a need to manage cod stocks at finer scales (Frank and Brickman, 2001; Smedbol and Stevenson, 2001). One way to accomplish this would be by adding area management units for rebuilding sub-populations. The spawning ground project succeeded because inshore fishers chose to be stewards of their local fishery in an attempt to improve it. This exemplifies a practical form of stewardship shared by many coastal fishers who could be enlisted in innovative, area-based management plans to rebuild individual coastal spawning components in order to establish sustainable fisheries. Improvements in component abundance should be detected adequately by improvements in the current larger-scale assessment surveys.

The success of such an approach, of course, would depend on creating management units that were predisposed to support rebuilding programmes for depleted coastal stocks. The Gulf of Maine Conservation and Stewardship Plan's strategy proposed to do that by restricting access to fishers who were willing to be dependent on the area's local stocks and by focusing peer-group pressure to improve stewardship efforts through participation in the management process.

REFERENCES

AMES, E.P. 1997. COD AND HADDOCK SPAWNING GROUNDS OF THE GULF OF MAINE FROM GRAND MANAN TO IPSWICH BAY. IN: I. HUNT VON HERBING, I. KORNFIELD,

FISHERS' KNOWLEDGE IN FISHERIES SCIENCE AND MANAGEMENT - ISBN 978-92-3-104029-0 - © UNESCO 2006

M. TUPPER AND J. WILSON (EDS.), *THE IMPLICATIONS OF LOCALIZED FISH STOCKS*. ITHACA, NY, NRAES-118, PP. 55–64.

——. 2004. ATLANTIC COD STRUCTURE IN THE GULF OF MAINE. *JOURNAL OF THE AMERICAN FISHERIES SOCIETY*, VOL. 29, NO. 1, P. 10–27.

AMES, E.P.; WATSON, S.; WILSON, J. 2000. RETHINKING OVERFISHING: INSIGHTS FROM ORAL HISTORIES OF RETIRED GROUNDFISHERMEN. IN: B. NEIS AND L. FELT (EDS.), *FINDING OUR SEA LEGS*. ST. JOHNS, ISER PRESS, PP. 153–64.

BERRIEN, P.; SIBUNKA, J. 1999. DISTRIBUTION PATTERNS OF FISH EGGS IN THE U.S. NE CONTINENTAL SHELF ECOSYSTEM 1977–1987, WOODS HOLE, MASSACHUSETTS, *NOAA TECHNICAL REPORT, NMFS*, VOL. 145.

BARNHARDT, W.A.; BELKNAP, D.F.; KELLY, A.R.; KELLY, J.T.; DICKSON, S.M. 1996. SURFICIAL GEOLOGY OF THE INNER CONTINENTAL SHELF OF THE NORTHWESTERN GULF OF MAINE. *MAINE GEOLOGICAL SURVEY*, GEOLOGIC MAPS 96-6, 96-7, 96-8, 96-10, 96-11, AND 96-12.

FRANK, K.T.; BRICKMAN, D. 2001. CONTEMPORARY MANAGEMENT ISSUES CONFRONTING FISHERIES SCIENCE. *JOURNAL OF SEA RESEARCH*, VOL. 45, PP. 173–87.

FRANK, K.T.; DRINKWATER, K.F.; PAGE, F.H. 1994. POSSIBLE CAUSES OF RECENT TRENDS AND FLUCTUATIONS IN SCOTIAN SHELF/GULF OF MAINE COD STOCKS (ICES). *MARINE SYMPOSIA*, VOL. 198, PP. 110–20.

GREEN, J.M.; WROBLEWSKI, J.S. 2000. MOVEMENT PATTERNS OF ATLANTIC COD IN GILBERT BAY, LABRADOR: EVIDENCE FOR BAY RESIDENCY AND SPAWNING SITE FIDELITY. *JOURNAL OF MARINE BIOLOGICAL ASSESSMENT*, UK, VOL. 80, NO. 3675, PP. 1-9.

NATIONAL RESEARCH COUNCIL. 1999. *SHARING THE FISH: TOWARD A NATIONAL POLICY ON INDIVIDUAL FISHING QUOTAS*. WASHINGTON, DC, NATIONAL ACADEMY PRESS, 164 PP.

SINCLAIR, M.; O'BOYLE, R. BURKE, D.L.; PEACOCK, G. 1997. WHY DO SOME FISHERIES SURVIVE AND OTHERS COLLAPSE? DEVELOPING AND SUSTAINING WORLD FISHERIES RESOURCES: THE STATE OF SCIENCE AND MANAGEMENT. *PROCEEDINGS OF THE SECOND WORLD FISHERIES CONGRESS*. MELBOURNE, CSIRO, PP. 23–35.

SMEDBOL, R.K.; STEVENSON, R. 2001. THE IMPORTANCE OF MANAGING WITHIN-SPECIES DIVERSITY IN COD AND HERRING FISHERIES OF THE NORTHWESTERN ATLANTIC. *JOURNAL OF FISH BIOLOGY*, SUPPL. A, PP. 109–28.

WROBLEWSKI, J.S. 1998. SUBSTOCKS OF NORTHERN COD AND LOCALIZED FISHERIES IN TRINITY BAY, EASTERN NEWFOUNDLAND AND IN GILBERT BAY, SOUTHERN LABRADOR. IN: I. HUNT VON HERBING, I. KORNFIELD, M. TUPPER AND J. WILSON (EDS.), *PROCEEDINGS FROM THE IMPLICATIONS OF LOCALIZED FISH STOCKS*. ITHACA, NY, NRAES, PP. 104–16.