

Apprenticeship and Conservation Incentives

Presented at International Institute of Fisheries Economics and Trade IIFET 2000
Oregon State University, Corvallis, OR
July 12, 2000

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Abstract. Apprentice programs offer a method to encourage responsible individual behavior by laying the foundation for successful collective property rights. Apprenticeship has three purposes: to restrict the rate of entry, to affect the quality of the participant, and to create the conditions for collective action for sustainability. Apprenticeship could be an important fishery management tool, particularly in decentralized, adaptive management regimes that require ongoing, multi-party negotiation for success. It is not vocational training; instead it serves a public purpose: to create the conditions for stewardship and participation in management. This perception of collective property right mimics customary practice in some successful traditional fisheries such as the Maine lobster fishery where customary practice has been demonstrated both to have conservation benefits and to lower enforcement costs. Case information from Maine's new, statutory lobster apprentice program is discussed. Apprenticeship creates conditions for responsible behavior by creating a stable population that can develop long term assurances about expected behavior and can develop credible internal monitoring and sanctions. In addition to requiring a personal investment of time, it provides information about fishing ethics and non-fishing information about basic biology, ecology, and participation in the management system. This, because it changes the frame of reference, should affect individual behavior both fishing and as participants in management. Apprenticeship focuses on the individual fishing as the principal actor in conservation. The apprenticeship approach bolsters both co-management and, for that matter, conventional limited entry programs as well.

Keywords: Apprenticeship, entry controls, lobster, co-management, conservation, property rights

1. INTRODUCTION

No longer is it possible to assert that merely controlling fishing mortality or the number of participants will sustain the world's fisheries. Thus fishery management cannot avoid rules that are integrally tied to the specifics of the fishery in question: how, when, and where fish are caught and how this fits with the ecosystem. Faced with this added complexity, apprenticeship can make a major contribution to establishing the context for effective group consensus to solve the problem of mutual restraint in a world difficult to control from shore.

The National Research Council's *Sustaining Marine Fisheries* (National Research Council 1998) concludes that a broader approach to fishery management is necessary: something broader than controlling fishing mortality rate through single species management. It calls for management that is ecosystem-based. It also called for developing and encouraging socioeconomic and other management incentives that discourage overcapacity and that reward conservative and efficient use of marine resources and their ecosystems. (p. 7)

The same year, in its Report to Congress, the Ecosystems Principles Advisory Panel (National Marine Fisheries Service 1998) recommends that fishery management councils create Fishery Ecosystem Plans. The panel

included consideration of such factors as the limited ability to predict ecosystem behavior, the importance of diversity, the fact that factors occurring on multiple scales are important, and consideration of flows of materials and information in complex patterns. One of the panel's five management policies, designed to facilitate the more complex management that ecosystem-based management represents, is to make local incentives compatible with global goals.

Decentralization of management and development of systems that are accountable and able to adapt is a response to this greater complexity. It is in this context that apprenticeship should be considered as a management measure.

Apprenticeship has three purposes: to restrict the rate of entry, to affect the quality of the participant, and to create the conditions for collective action for sustainability.

2. DEFINITION OF APPRENTICESHIP

The concept of apprenticeship can be broadly defined to include any training or fishery enhancement work required as a specific condition of participation in a fishery. Apprenticeship is a concept that is widely used in Europe outside the fisheries context and is used to a lesser degree in trades and professions in the US. With the

exception of Iceland (Palsson 1994), some countries that require some form of safety or seamanship training, and some traditional societies (Ruddle 1994), apprenticeship is not widely documented as a form of entry restriction in fisheries. The safety and seamanship training is required for a public purpose (safety) that is separate from the conservation and economic efficiency purposes of most fishery management so the safety training programs have not been given serious scrutiny in the fishery management context.

Apprenticeship is not vocational training; it is training to fulfill a public purpose. The stated reason that hairdressers, plumbers, and medical doctors are required to meet licensing standards is to ensure public safety as well as to control entry and bolster wages. For fishing, the public purpose of apprenticeship, in addition to regulation of the rate of entry, is to facilitate sustainable use of the fishery by creating a common knowledge base and quality of participants, a compelling rationale when compared to some of the other trades.

Apprenticeship is a form of entry restriction (Townsend 1990). While most entry restriction regimes focus on achieving the correct number of participants, apprenticeship does not directly restrict the number of participants. Instead, it controls both the rate of entry into a fishery and the quality of the participants. It can be applied as an additional barrier to entry in fisheries where there is limited entry with transferable or non-transferable licenses or where entry is determined by a lottery or waiting list. It can also be used as a substitute for other forms of entry restriction.

True apprenticeship is a form of entry restriction that applies only to commercial users. Nonetheless, it is not inconceivable, (though highly unlikely in the politicized world of recreational saltwater fishing licensing) that the idea of training requirements could be extended to certain recreational fisheries. Hunter safety courses are a standard requirement in many states for obtaining a recreational hunting license.

An apprenticeship can simply require on-the-boat training, which fulfills vocational training and the entry restriction functions. However, to fully serve a public purpose of promoting stewardship, an apprenticeship should also include non-fishing content that a fisherman needs to be a responsible resource user and participant in co-management. This information includes biology and ecology, rules and ethics, information about the regulatory arena and how to participate in that arena effectively. Apprenticeship can also include donation of "conservation time," some kind of work requirement for stock enhancement or stewardship as is frequently done in intertidal clam fisheries.

Apprenticeship differs from many forms of entry restriction because it is focused on the individual, and more specifically, on the individual who is fishing. Once again, the concept is a broad one and could be administered within a licensing system that gives permits to vessels or owners rather than on-board fishermen. In the latter case, the practical questions will be whether to require training and time invested of the owner or of the actual employee fisherman. The benefits of apprenticeship will be the most direct in true owner/operator situations where the actual fisherman is the person both licensed and accountable on the water.

3. MAINE LOBSTER FISHERY

Maine's lobster industry is a trap-only fishery comprised of vessels about 25-40 feet in length. All boat captains are owner-operators and most employ one crew member, called a sternman.

In 1995, groundbreaking lobster legislation passed the Maine Legislature. The new law required that any new lobster fisherman be required to put in two years practical experience prior to obtaining a commercial lobster and crab fishing license. The law also enabled but did not require the Maine Department of Marine Resources to require educational courses. The law was passed as an alternative to an actual limited entry program that controlled the total number of participants in the fishery.

The legislation also established seven Lobster Management Zones and a democratically-elected governance structure that involved Lobster Management Policy Councils (called lobster zone councils) and referendum decision-making by lobstermen on three topics: the trap limit below the state cap (now 800), the time fished, and the numbers of traps fished on a trawl.

It is too early for a meaningful evaluation of the program and to date, none has been attempted. During the five years since implementation, a predictable array of practical and political events has occurred so that to date, there is no clear track record for the apprenticeship as a form of entry restriction. During the first year, the Maine Department of Marine Resources undertook the massive effort of qualifying the existing 7000 lobstermen. As a result of the political outcry from people who were excluded from the fishery as a result of that process, the Legislature eased up on restrictions the next year, allowing additional entry from people with only minor history in the fishery. At the same time, the trap limit and the predictable human reaction of wanting to fish up to the new limit, caused an escalation of traps by those who had previously fished only lightly. These two factors caused established lobstermen to perceive a huge influx of entry. This resulted in the successful campaign to get a

two-year moratorium on entry passed in 1998. At the same time, an owner/operator provision was passed, codifying what is the standard practice in the fishery.

The two-year practical experience requirement has been defined by regulation as a minimum of 200 days over a minimum of two years. An apprentice must have a daily log signed by his/her captain and countersigned every 50 days by the local Maine Marine Patrol officer. Some lobstermen are willing to let any sternman be an apprentice under them. Others are extremely choosy and might, for example, only allow a nephew or son the privilege. Some members of the industry have suggested that a letter should go out to all apprentice sponsors, laying out the responsibility that sponsoring someone entails.

Maine does not require any educational courses as part of the two-year lobster apprenticeship. The law is permissive, however, and we have collected information from the industry about their preferences for courses, should they be required. Virtually universally, lobstermen wanted courses to be limited to things that served the public purpose: either conservation or safety. Topics that received support for inclusion in an educational offering included basic lobster biology and ecology, local fishing ethics, rules and regulations and their purpose, the structure of the fishery management agencies, and how to participate in management at various levels. Lobstermen did not support any vocational training beyond what would be taking place in the 200 days on the boat.

3. CONTEXT

Current fishery managers face a highly confusing situation. Assumptions underlying conventional management policy have changed, and many commonly-used management tools have proven to be unreliable in creating stewardship and conservative behavior.

The basic assumptions underlying discussions about the common pool dilemma have changed dramatically in the thirty years since Garrett Hardin's "Tragedy of the Commons." (Hardin 1968) This does not change the challenge of managing a common pool resource, articulated by Hardin as, "mutual coercion, mutually agreed upon." It does, however, change the context in which policy is made.

A distinction has been drawn between open access resources, common property resources, and privatized resources. Hardin's tragedy was one that comes from open access, where no one owns a resource (Ciriacy-Wantrup and Bishop 1975). Common property resources are those where access and terms of use are controlled by

a distinct community, an institutional arrangement that has proven successful in numerous cases. (Wade 1994, Berkes 1985, Hanna 1990, Eggertson 1993, Feeney et al - 1996, McKay and Acheson 1987)

No longer can we assume that users of the resource are unboundedly rational, maximizers of individual utility. Instead, it is more appropriate to assume that users are constrained by norms, imperfect information, sub-optimal equilibria, path dependencies, and contradictory goals, and that they are capable of cooperation under certain conditions (Simon 1954, 1987, North 1990, Sugiden 1990, Taylor 1990, Conlisk 1996, Ostrom 1999).

Our view of fishery resources has changed as more has been learned about the complexity of their biology and oceanography. Fisheries can no longer be considered homogeneous across their range. Ecosystem, rather than single species management is recommended, albeit not yet developed. (National Marine Fisheries Service 1998, National Research Council 1998) Control of fishing mortality while still important, is not enough (Wilson et al 1994).

The role of uncertainty in science, in policymaking, and in the information that harvesters use must now be acknowledged in the development of both theory and policy. (Ludwig 1993, Holling 1978) The theory of complex adaptive systems (Holland 1998) offers more effective guidance to a policy maker than a deterministic view of fisheries.

In an effort to control fishing mortality, fishery policy has focused on limiting access, and/or privatizing resources through measures such as individual transferable quotas (ITQs). Conventional approaches to limited access do not attempt to directly resolve the conflict between the individual and social incentives (Wilson 1994). And, in fact, neither conventional limited entry nor individual transferable quotas (ITQs) have produced reliable conservation outcomes. (Copes 1986, Townsend, 1990) Townsend's (1990) evaluation of many limited entry fisheries demonstrates that limited entry has neither reliably eliminated capital stuffing nor obviated the need for an escalating set of direct input and output controls in order to achieve necessary conservation. The shift from common property to exclusive access rights, in many resource contexts, has, at times, exacerbated the conservation problem (Ciriacy and Wantrup 1975, Blaikie & Brookfield 1987, Schmink & Wood 1987, Van Ginkel 1988, Hanna 1990) Furthermore, in fisheries with ITQs privatizing the rights to the fish stock have not eliminated enforcement problems. (Townsend 1990).

Decentralized management that is community-based, adaptive and capable of learning is emerging as an approach that offers promise in dealing with this

complexity. It is in this context, where fishermen and managers will be obliged to successfully negotiate the terms of fishery management, that apprenticeship can make a major contribution. The role of fishery manager has changed. Formerly, a fishery manager was someone who must arrive, through rational analysis, at the appropriate quota and then impose and enforce it from the top, through bureaucratic authority. Now a manager must try to develop collective institutions within the fishery that can result in conservative behavior by those individuals involved in use of the resource.

5. PURPOSE OF APPRENTICESHIP

It is particularly important to look at apprenticeship in light of the trend toward decentralized management. Apprenticeship directly, rather than indirectly, addresses the need to stimulate stewardship in a fishery in order to achieve conservation goals. Apprenticeship operates in three ways: Restricts the rate of entry, establishes an environment where stewardship is part of the culture of a fishery; and provides the tools that make stewardship possible.

Apprenticeship can contribute to creating effective collective property rights and aligning individual actions and interests with the common good. It can contribute to creating the conditions for stewardship and enabling collective action to solve the problem of mutual restraint. Apprenticeship addresses a number of the conditions that both Ostrom (1990, 1999) and Pinkerton and Weinstein (1995) list as characteristic of successful resource management regimes including group boundaries, accountability, effective management/locally appropriate rules, accountable monitoring and effective sanctions, good public discussion, adequate conflict resolution in fishing and in rulemaking, and adaptiveness and ability to learn.

5.1 Restrict rate of entry

Apprenticeship requires a future entrant to invest of his or her own time and attention in the fishery. Depending on the length of time and degree of attention required, apprenticeship can greatly reduce opportunistic entry. Apprenticeship requires that someone desiring to enter a fishery make a deliberate decision to do so and commit time and work to becoming eligible, work that precludes other opportunities in the mean time. This makes it impossible, for example, for someone to quickly invest in gear and/or boat to take advantage of a recently discovered concentration of product in a fishery.

The barrier to entry that apprenticeship represents, while translatable to cost or investment, is substantively

different from the purely financial investment required for the purchase of a transferable license or quota. An investment in a license or quota must be capitalized, which requires an entrant to borrow money and start large to pay the entry fee. This sets up an incentive that directly opposes the conservation intent. In contrast, apprenticeship requires the investment of time and attention on the job, something that a young person from a fishing community can give without having to borrow. It enables a new entrant to start small, build sweat equity, and retain the ability to adapt (by not fishing) to changing resource conditions.

Apprenticeship can provide greater flexibility in controlling the rate of entry, compared to most conventional entry restriction mechanisms that rely on fixed numerical thresholds. It is not legal in most states to use educational requirements solely as entrance barriers to a trade or profession. However, particularly when fishing apprenticeship is in its infancy, it is possible to affect the rate of entry by varying parameters such as the time span of an existing apprenticeship program or the rigor of training and evaluation procedures. This provides the policy maker with a tool that has fewer of the political and legal hurdles that pertain in more direct and absolute changes in license availability or ownership rights.

In Maine, the apprenticeship law provides a formal, institutionalized imitation of a social practice that had existed in the fishery previously. Entry into lobstering in a given area has always been contingent to some degree on acceptance by those fishermen fishing the same area. (Acheson 1988) However, prior to the passage of the lobster apprenticeship law, the fishery experienced a period of unprecedented growth. High lobster abundance and changes in technology made lobstering easier to succeed at and these factors eroded the traditional barriers to entry that functioned through lobster clusters and a complex social structure that regulated who fished, where, and with what standards. (Acheson 1988, 2000, Acheson and Brewer 2000) Many of the new entrants did not have the experience in the mores of lobstering, and contributed to a rapid escalation of effort.

Only two years' data exists for apprentice licenses in Maine (Table 1.) The number of apprentices in 1999 increased 118% over 1998 largely due to a change in the law that required student licensees to participate in the formal apprenticeship program. However, relative to the total number of licenses, the percentage of apprentices remains low: 3.4% in 1998 and 8.1% in 1999. Even in 1999, there are fewer than half as many apprentices as there are fishermen age 61 and older. These numbers are a good indicator of the change that apprenticeship has created in the fishery. Previously, holding a lobster license was a basic matter of identity for members of coastal communities, whether or not they actively fished,

and as lobster abundance and technology changed, this increasingly included wage earners and retired people as well as members of traditional fishing families. This provided a huge pool of potential fishermen who were available to enter opportunistically when conditions either in the fishery or in the rest of the coastal economy warranted. Formalized apprenticeship now appears to have virtually eliminated this type of entrant.

	Lobster licenses	Apprentices	Licensees >60
1997	6406	NA	NA
1998	6321	217	NA
1999	5989	487	1063

Table 1. Maine lobster licenses

5.2 Affect quality of participant

Whereas most entry restrictions control the number of participants, apprenticeship directly addresses the quality and training of new entrants.

It is important to note that apprenticeship differs from many management tools in that it recognizes the unique status of the individual working fisherman in the conservation equation. Apprenticeship operates at the level of the individual fisherman: the person who is actually onboard, interacting directly with the resource, rather than on owners or vessels. This fact gives apprenticeship tremendous power because conservation actually takes place on the boat, not in the boardroom. Fishing takes place out of sight of the general public and far beyond the effective reach of most enforcement authorities. Detection of rule violations by authorities is very difficult, so that the peer pressure and individual values are important deterrents to illegal activity. This means that the norms of those actually doing the fishing, those being addressed directly by apprenticeship, are far more important to conservation than they would be in a more controllable situation.

Apprenticeship places an explicit focus on the individual responsibility that a fisherman has both in fishing and in participating as someone who holds responsibility in a decentralized management system.

5.3 Create conditions for collective action for sustainability

Apprenticeship can facilitate creation of the conditions necessary for effective collective action for sustainability. It contributes to group definition, creating boundaries

within which trust and negotiation can take place. It provides information to create a common pool of knowledge, expectations, and ethics for participants in a fishery, thereby changing both values and behavior. And it provides orientation to the participatory arena within which all fishermen involved in decentralized management must operate.

Apprenticeship creates a stable population of participants. Because of the time required to fulfill the requirements, the individuals in an apprenticeship fishery are relatively stable and predictable when compared to a system without apprenticeship and with license transferability. This facilitates the creation of group boundaries and the elimination of free riders, allowing discount rates to remain low and institution building to occur. It creates a situation where participants in the fishery can establish long term assurances about the expected behavior of other participants, a necessary condition for mutual restraint (Ostrom, 1990, Wilson 1994). This is not possible in a situation with license transferability without apprenticeship.

Apprenticeship can facilitate development of effective internal monitoring and sanctions, thereby improving voluntary compliance with rules. Effective sanctions are essential for effective management. Because it is unrealistic to expect the force of law to be effective enough on the water to provide adequate external deterrence, voluntary compliance is not only the most cost-effective option, it is essential. (Ostrom 1990, Sutinen et al 1990)

The benefits of group formation and effective sanctions operate both with respect to externally derived rules and in the often invisible internal structure of a fishery. In every fishery there are fishing practices that are commonly accepted. Acceptable practices involve appropriate and inappropriate ways of sharing information, standards for showing respect to or handling conflict with other fishermen fishing in the same area, and insuring against unsafe practices. In a fixed gear fishery such as a demersal or pelagic longline fishery or the Maine lobster fishery acceptable practices include such things as how to set trawls relative to other fishermen's gear or relative to the tide. They also include a number of informal common courtesy practices that vary from area to area. In a mobile gear fishery they include procedures for lining up to share a tow, a specific path where towing is possible on hard bottom. These are externalities that require continuous negotiation and cooperation to operate well. Fishermen who disregard these informal rules reduce the efficiency of responsible fishermen and degrade the fishery. If the violators cannot be controlled, behavior sinks to the lowest common denominator, as responsible fishermen are forced to respond in kind in order to compete. Apprenticeship can establish the

conditions where such negotiation, cooperation, and conflict resolution can function effectively.

The information dissemination that occurs during an apprenticeship also contributes to group formation and effective sanctions. Two types of information are transmitted: ethics and standard practices that obtain in the fishery and non-fishing information about biology, ecology, rules, and process. This occurs in the on-the-boat work requirement and in the coursework.

Traditionally, ethics and standard practices in fisheries have been transmitted through on-the-job training. The results of this are uneven and dependent on the degree of teaching done by the captain and his/her standards.

In the Maine lobster fishery, apprenticeship mimics a traditional practice at a time when those traditions are changing. The state of Maine issues lobstering licenses that ostensibly allow licensees to set their traps anywhere in state waters. In practice, however, entry into the fishery, and the spatial area available to the setting of traps, are controlled by harbor-based groups of fishermen. The membership of each harbor group is comprised of persons residing nearby, many of whom come from fishing families. Relative outsiders who enter the fishery directly, without serving as a sternman in the area, are usually able to gain fishing privileges only after enduring a couple years of hazing. They usually suffer losses of capital and labor in the form of molestation and damage of fishing gear and other property, as well as shunning or direct verbal communications. These practices have diminished somewhat in recent years, however, undermined by unprecedented lobster abundance, technological and socioeconomic changes, and increased state involvement in management and enforcement. (Acheson and Brewer, 2000). Because of these changes, many lobstermen we interviewed supported using apprenticeship to standardize expectations for teaching ethics and standard practices.

Non-fishing information is something not normally provided to or required of fishermen. Basic biological and ecological information about the fishery they pursue and the ecology of the area in which they fish (as opposed to stock assessment models) provide the baseline understanding of the system they use. It is surprising that, while managers and the general public often decry fishermen's irresponsibility and, sometimes, ignorance, fishermen are not required to acquire this basic information. In most fisheries, there is virtually no non-regulatory forum in which managers, scientists, and fishermen can talk about the life cycle of commercially fished species. Simple information such as the fact that most commercial species have a pelagic life stage can be a revelation to a fisherman who has never been exposed to marine science.

A good apprentice program also provides information about rules, management agencies, and processes as well as skills necessary for effective participation in management. These include such skills as conflict resolution and meeting protocols. A byproduct of the skill acquisition should be added confidence and more effective participation.

Decentralized management makes the acquisition of both the scientific and the participatory skills particularly important. Co-management or community based management requires discussion and negotiation among diverse groups: other fishermen, managers, scientists, and the general public. This is what Dietz and Stern (1998) call analytic deliberation. The common knowledge base will strengthen the group formation within the fishery and may facilitate their arriving at consensus. Both the skills and the knowledge will help the multi-party deliberation process to integrate scientific analysis and deliberation and manage conflict.

All of this assumes that acquisition of knowledge and skills can change behavior. In fact, apprenticeship should help align individual rationality with the common good. It does so by changing the "bounds" of fishermen's rationality – the frame of reference of information and values which informs their ecological economic, and negotiation decisions. While altering the bounds of rationality alters subsequent actions, the nature of these changes is not entirely predictable. In this regard apprenticeship is an act of trust/faith. Like co-management, there is little conclusive proof of its effectiveness/benefits. Until such evidence is available, apprenticeship is initiated in the spirit of Horace Mann of Massachusetts (1846), who said, "The property of this Commonwealth is pledged for the education of all its youth, up to such a point as will ... prepare them for the adequate performance of their social and civil duties."

6. RECOMMENDATIONS

It is not in the scope of this paper to provide a discussion of implementation recommendations. Certain comments, however, are appropriate.

Nothing has been said above about costs of apprenticeship. While the costs of developing and maintaining curriculum are appropriate public sector investments, in certain circumstances they could also be shared with industry if the program is developed collaboratively. Cost sharing with apprentices is appropriate to cover administrative and maintenance costs.

The requirements of an apprenticeship should provide both fishing experience and non-fishing information.

Design of an apprentice curriculum should draw on other apprentice programs and should keep in mind the explicit public purposes of the program. Apprenticeship programs should be designed and maintained in a collaborative process with industry and managers. Technology provides a number of options for delivery of the educational portion of a curriculum in innovative ways.

7. CONCLUSIONS

Apprenticeship should be considered as a management tool that restricts rate of entry, affects the quality of the participants, and creates conditions for collective action for sustainability. It is particularly important for decentralized adaptive management systems that require ongoing negotiation or analytic deliberation with many parties.

8. ACKNOWLEDGEMENTS

Henry P. Kendall Foundation, Boston, MA has supported my work in developing an educational curriculum for the Maine lobster apprentice program. Ted Ames and Dr. James A. Wilson have provided valuable perspective and assistance.

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