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Sustainable by Design: How to Build Better Institutions for Fisheries Management in British Columbia

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A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the School of Public Administration

We accept this dissertation as conforming to the required standard

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ABSTRACT

The contemporary crisis in the world's fisheries has been both predictable and predicted for several decades, and has assumed a consistent pattern: as stocks are fished to commercial extinction, fishing effort is displaced to new, previously unvalued or undervalued stocks. Canada's Atlantic and, increasingly its Pacific, fisheries reflect this global trend.

This study explores whether, and how, the development, implementation and enforcement of appropriate property regimes can slow or arrest the destruction of fisheries and the apparently relentless progression from one depleted fishery to another. To answer this question, empirical evidence is provided through the medium of three case studies of commercial fisheries in British Columbia: 1) the Area C Commercial Clam Fishery on British Columbia's Sunshine Coast; 2) the Heiltsuk Tribal Council Commercial Clam Fishery on B.C.'s Central Coast; and 3) the coast-wide fishery for geoduck clams (*Panopea abrupta)*. The former two projects represent management experiments in the general intertidal clam fishery, of which the main commercial species is the manila clam (*Tapes philippinarum).* The last is an example of a recently established, closely held fishery which has experienced dramatic increases in the value of landings.

Institutional analysis of these three cases confirms many of the explanations and predictions that have been generated by the rapidly expanding body of empirical and theoretical literature concerning the succesful application of collective property rights systems in the management of common pool resources. Research findings confirm the importance of rules defining resource boundaries and authorized users; the need to appropriately match resource benefits and costs, the significance of group size and heterogeneity for the magnitude and

distribution of transaction costs incurred by and in the property regime; and, more generally, the critical need for property regimes to be *context specific* if they are to link human and natural systems in ways that achieve acceptable levels of ecological sustainability, economic efficiency, and social equity.

Analysis of the case studies in the context of broader trends in fishery management reveals, as well, a pressing need for what might be termed "preventive" or "pre-emptive" institutional design. Rather than waiting (as is usual) for conservation concerns, financial crises, and acute distributional conflicts to compel institutional reform, it is recommended that governments and communities act to ensure that harvesting rights and corresponding responsibilities, including mechanisms for allocation and transfer, are established and understood in the early stages of fisheries development, thereby forestalling serious ecological, economic and social costs.

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DEDICATION

This dissertation is dedicated to the memory of my parents, Eric and Bonnie Mitchell.

Chapter 1: Introduction

> "The horror of that moment," the King went on. "I shall never, *never* forget!" "You will, though" the Queen said, "if you don't make a memorandum of it."
>
> Lewis Carroll. *Through the Looking Glass*

1.1. The Fisheries Problem

In the late 1800's, celebrated British biologist Thomas Huxley proclaimed that stocks of marine fish were limitless (Harris, 1995:132). About a hundred years later, prominent fisheries scientist Philip Larkin pronounced the state of fisheries management in most parts of the world to be an "unmitigated disaster" (Larkin, 1991 quoted in Pearse, 1994:77). Assuming that Huxley and Larkin fairly represent the perceptions and realities of their times, what happened during the intervening century?

What happened was an expansion of both coastal and distant-water fisheries at an unprecedented and accelerating rate. Between 1800 and 1950, world landings grew from about 6 million to some 19 million tonnes. By the late 1980's, landings had increased by a further five-fold, reaching 100 million tonnes in 1987 (FAO, 1987).

Since the mid-1960's, increases in global landings have come largely from stocks of previously unfished species and so-called "industrial fish" (Keen, 1988), and have reflected a process described by Pearse (1994:78) as

> ...a progression from depleted stocks to new stocks, as the range of fishing fleets, the technology of finding, catching and storing fish, and the techniques of processing and marketing them all improved.

The consequences of this process - deployment of fishing fleets far greater than required to take the available catch, depletion and destruction of fish stocks, and declines in fishing

employment and income - are all well known. The most notorious recent Canadian example is, of course, the collapse of the northern cod fishery in the early 1990's. In many parts of the world, overfishing has been accompanied by extensive damage to key fish habitat.

Fisheries in British Columbia have not been exempt from these global trends. No fishery in B.C. is immune from more or less serious threats to the health and productivity of fish stocks, whether from overfishing, habitat loss, habitat degradation or all three factors. Excessive fishing and processing capacity have resulted in the dissipation of potential resource rents, while current fisheries management has been widely criticized as both expensive and ineffectual. Added to concerns about biological conservation and economic efficiency are intense and rancorous debates about the appropriate and equitable distribution of access to fishery resources.

Problems are more acute and the debate more acrimonious in some fisheries than in others. Indeed, the content of media reports and conference programs - and the preoccupation of most researchers concerned with British Columbia fisheries - strongly suggest that the only species of interest or concern in the province are Pacific salmon and, occasionally, herring.

Rather than entering the hectic (and sufficiently populated) debate about appropriate public policy responses to the problems of the salmon fishery, I have chosen to approach issues common to the management of fisheries and other renewable resources through the medium of two fisheries that have attracted much less popular and academic attention. This study is concerned, not with the glinting and glamorous salmon, but with

two species of marine invertebrates: the manila clam (as the principal organism in the intertidal clam fishery) and the geoduck (a large, primarily subtidal, burrowing clam).

I have chosen these fisheries as the focus of my research for two reasons. First, there has been considerable innovation in the arrangements by which invertebrate fisheries are managed in British Columbia. The variety of arrangements provides a group of "natural experiments" (Feeny, 1992) which can serve to both generate and test hypotheses about success and failure in the management of marine resources.

The second reason for my concentration on clam fisheries is that the harvest of marine invertebrates in total represents the fastest growing component of British Columbia's commercial fishery. The landed value of invertebrates (that is, the price paid to fishers) jumped from $40 million to more than $120 million between 1990 and 1995, and from about 10% to more than 30% of the value of all commercial fisheries (Department of Fisheries and Oceans, 1996). The geoduck harvest alone accounted for over $42 million in landed value in 1995. Pressure on existing - and as yet unexploited - fisheries can be expected to increase as fishing capacity is reduced in other fisheries, primarily the commercial salmon harvest.

Given the growing importance of these fisheries, and the possibility that the recent process of rapid expansion represents the early stages of the depressingly familiar cycle of "boom and bust", it is important to gain a better understanding of how invertebrate fisheries have developed, how they are managed, and where they may be headed.

1.2. Tragedies and Other Tales

Even before Hardin popularized the term in 1968, marine fisheries were considered

the textbook example of what has come to be known as the "tragedy of the commons" (Gordon, 1954, Scott, 1955). In the ensuing years, the "tragedy" has become the dominant metaphor for misuse, overuse and destruction of marine, as well as other, natural resources.

The "tragedy of the commons" is explained by the dynamics of unlimited access to limited resources. When access is not controlled, any individual can take as much as he or she likes from the common resource pool. As long as the resource system can continue to meet the demands placed upon it without being damaged or degraded, this situation is not problematic. Beyond this point, however, every gain to an individual imposes some cost upon the individual **and** upon everyone else who uses the resource; but the individual, while gaining all of the benefit, bears only part of the cost. Since individuals do not have to bear the total costs , but receive all of the benefits, the natural incentive is for individuals to overexploit the resource, perhaps to the point of irreparable damage.

There are three main approaches to resolving the problem of the commons. The first approach defines resources as the property of the State, that is, as the collective property of the citizens of a particular political unit who assign rule-making authority to a public agency (the government) (Hanna et al, 1995). The role of government regulation is to establish rules for the use of the commons, and to detect and punish those who break the rules. At a very broad societal level, this approach tries to ensure that those who obtain individual benefits from public resources do not impose unreasonable costs on others, and quite frequently, also requires that individual beneficiaries "share" their gains with the larger collectivity (through taxation, royalties, permit fees, and so forth). Rather

than changing the underlying incentives, this approach seeks to resolve the problem in a punitive way by imposing penalties upon those who use resources so as to further individual, but not societal, objectives. In such circumstances, the natural tendency of individuals is to try to avoid externally imposed negative incentives, that is, either to find "loopholes" in the regulation or to "cheat" in some way, by poaching, exceeding quotas, evading taxes, etc.

The second approach is to carve up the commons into separate parcels, in a way that attempts to prevent individuals (who may be either natural persons or legal persons, i.e. corporations) from claiming private benefits at the expense of collective costs. The intent is to package all the relevant costs and benefits in separate "bundles". The reasoning behind this approach is that individual owners will then have incentives to invest in and maintain their portion of the commons because they will be able to claim the benefits of such actions into the future. Further, if they misuse their "piece" of the commons, only they will bear the consequences. One major problem with this approach is that it is frequently difficult or impossible to restrict the costs and benefits of resource exploitation within hermetically sealed parcels.

Until the mid-1980's, these two approaches, i.e. regulation **or** privatization, dominated public policy debate about how to resolve the problem of the commons. Since that time, a rapidly expanding body of empirical and analytical research has focussed attention on a third approach. This approach explicitly recognizes that there are many environmental goods and services that cannot be conveniently carved up into individual parcels in such a way as to isolate the costs and benefits of exploiting one parcel from the

costs and benefits of exploiting another. Even if such a process were physically possible, the costs (financial, political or otherwise) of establishing and maintaining such a property regime may exceed the benefits of doing so. In such cases, both individuals and society as a whole may benefit from a system in which an identified **group** of resource users share collective benefits **and** bear collective costs of resource use. This approach, which creates a property regime that lies on a continuum between "sole ownership" and "state ownership", can be described as a system of "collective", "communal" or "joint" property rights. Establishing such a system does not, of course, overcome the problem of the commons **within the group**. Incentives for individuals to underinvest and overexploit in commonly held resources can exist in the smallest groups. However, such incentives may be more readily brought into alignment with at least some aspects of the "common good" through the implementation of communal or small-scale collective rights.

As is discussed further in Chapter 3, this study employs a broad definition of the term "property rights". In this definition, "property rights" consists of the socially established set of rights and responsibilities that define the relationship between those who hold certain types of claims and those who have a duty to respect those claims (Schmid, 1978; Bromley, 1991). Anything that is capable of being subject to property rights may be subject to many different types of claims held by many different claimants, each of them with a legitimate right to make decisions about, receive benefits from (and bear costs resulting from) use of some aspect of the object (or resource, or service) in question. This broad definition of property rights allows us to see rules and regulations made by national or provincial governments as an expression of the property rights of citizens in the subject

of those regulations (for example, fish, petroleum, trees). Collective decisions made at a smaller scale (such as those made by a local government) are, similarly, the expression of collective property rights held at this level. And these decisions do not differ, in kind, from the decisions made by an individual property holder exercising his or her socially confirmed rights and responsibilities. By conceiving of property rights in this way, we can look upon the identification of appropriate property regimes as an exercise in defining an integrated, nested array of claims, rights and responsibilities that reflect socially defined values and interests, not as a forced choice between "regulation" and "property rights", or between "private" and "public" property.

1.3. Old Ideas in New Situations

The idea of collective or communal property is hardly a new one. Many non-Western traditional societies managed (and some continue to manage) resources in this way, and many European societies managed agricultural and other resources under a system of common property for many hundreds of years. But the intense and growing interest in joint property rights and collective forms of management among people other than historians and anthropologists is a much more recent phenomenon, and one that coincides with fundamental changes in the nature of our relationships with each other and with the non-human world. Most of these changes have occurred within the past two hundred years.

Simmons (1989:379) refers to the nineteenth century as the "great discontinuity of the past". Before this watershed in history, human beings exerted a relatively modest impact on the biophysical environment - at least on a global scale. (Localized devastation

of natural environments, such as desertification and deforestation in the Mediterranean region was, of course, fairly common.) Beginning in the 1800's, however, the combination of rapid technological progress and rapid population growth has dramatically altered our relationship with virtually the entire non-human environment. During this time, per capita energy and material consumption have increased even more rapidly than the growth of world human population, which rose from about one billion in 1800 to 2.5 billion in 1950 and more than doubled again during the next four decades (Simmons, 1989; Wackernagel and Rees, 1996).

Growing human demand for finite global resources exerts pressures both for and against specification of property rights. From one perspective, the dynamics of the tragedy of the commons suggest that property rights ought to be fully specified, in order to "match" the costs and benefits of resource use and thus avoid "distorted incentives ...(that)... lead to socially undesirable decisions" (Pearse, 1994:86). However, as my earlier discussion of common pool resources suggests, it is not always possible to perfectly "match" costs and benefits, **even if we were perfectly sure of what all of the costs and benefits are.** As it happens, we are not at all sure about the full range of costs and benefits. In fact, many researchers believe that we will never be sure, and contend that we will always face an irreducible level of uncertainty about the behaviour of natural systems, and about the effects of human behaviour on these systems (Lee, 1993; Mitchell, B., 1995). Such uncertainty suggests that we should be cautious about specifying property rights, lest we inadvertently create incentives for some types of behaviour that are individually and socially undesirable. For instance, fully specified property rights in a

particular fishery may create incentives to maximize the value of that property (and thus may promote conservation of a particular species of fish), but may do so at the cost of non-target species taken as bycatch. This problem is particularly acute in the case of environmental goods and services that are currently "unpriced".

A further pressure against the extension of more exclusive property rights in natural resources lies in the fact that controlling access to the resource requires (by definition) that some current and potential beneficiaries be excluded. Unless they are compensated, those who are excluded can be expected to resist, even if their exclusion means that greater benefits (in total) can be derived from the resource. Insult is added to injury if those who retain access to the resource grow wealthy on the rents.

The emerging academic, political and popular interest in collective or communal property regimes can be seen as resulting from the interplay of these various forces: 1) pressure to specify property rights (to avoid some kinds of perverse incentives); 2) pressure to resist specifying property rights (to avoid creating other kinds of perverse incentives); and 3) resistance to enclosure on the grounds of equity or fairness. From this perspective, community or other small-scale collective property rights regimes may seen as a way of expanding the range of costs and benefits that are incorporated into the incentive structure of property rights holders, while avoiding some of the problems associated with enclosure and exclusion.

1.4. Joint Rights and the Problems of B.C. Fisheries

Unlike most natural resources, fisheries in Canada fall under the jurisdiction of the federal, rather than the provincial level of government; historically, marine fisheries

management in B.C. has been a highly centralized affair. However, during the past decade or so, there have been a number of forays into, and flirtations with, different forms of communal or joint management and with the specification of limited property rights in what has been, traditionally, a state owned and state regulated resource. More recently, these rather tentative advances have found formal expression in the content of anticipated changes to federal fisheries legislation. Under the proposed new *Fisheries Act*, the federal Minister would be empowered to enter into **formal, legally binding** agreements with groups in the fishery for various aspects of fisheries management; these agreements would confer not only management duties, but more fully specified rights of access, upon the users of fisheries resources. In the case of aboriginal fisheries in British Columbia, co-management agreements (under the Aboriginal Fisheries Strategy or otherwise), Interim Measures Agreements, and the negotiation of communal fishing rights as elements of modern treaty settlements already involve the explicit recognition and implementation of communal or joint rights to fisheries resources.

The presumption of this study is, then, that fisheries management in British Columbia is well launched in directions that lead away from centralized state regulation. At the same time, it is unlikely that most fisheries will (or can) be parcelled out in the form of fully individuated private property. I anticipate that the emerging world of fisheries management in this province will involve much greater specification of property rights in fisheries resources, while retaining a significant degree of state regulation. But specification of property rights will consist of an array of joint or collective property arrangements, with (in some limited cases) the allocation of rights and duties that

approach those of individual or sole ownership.

This transformation will happen neither quickly nor easily and it may not happen soon enough to avert tragic outcomes in at least some of British Columbia's embattled fisheries. It is more than possible that the special interests of those who gain from current distributions of access, influence and income may swamp the aggregate achievement of more efficient, sustainable and equitable fisheries. If this occurs, it is not a problem that can be resolved by institutional design.

However, if our concern is to ensure that societal goals and objectives, as expressed in public policy, can be implemented without creating "built in obstacles" (Atkinson, 1993:20) and perverse incentives, then the question "How can we build better institutions (in this case, property regimes)?" becomes both relevant and pressing. On the assumption that good institutional design is important in achieving better fisheries management, this study seeks to answer five questions:

1. Can "common property regimes" contribute to the resolution of the "tragedy of the commons" as part of a continuum or system of individual and collective property rights in natural resources?
2. What are the characteristics of successful common property regimes, in general?

These two questions are addressed through a synthesis of the rapidly expanding literature concerning common pool resources and common property regimes.

3. When we examine institutional arrangements that have been implemented in the intertidal clam and geoduck fisheries, do the characteristics identified

in the literature help us to understand why some of these fisheries are more successful than others?

4. Based on the answers to the first three questions, what conclusions can we reach about the type (or combination of types) of property regimes that would be best suited to the fisheries under examination?

5. Do these conclusions have application to the broader field of fisheries management in British Columbia and, perhaps, beyond?

1.5. Organization of the Study

Following this introductory chapter, I set out in Chapter 2 the research approach and methodology adopted for this study, and offer the usual disclaimers about the limitations of the methodology and the application of the results.

In Chapter 3, I explore a range of theoretical and analytical research in the search for principles, hypotheses and "clues" about when, where, why and how joint property regimes are effective in promoting sustainable, efficient and equitable resource use. In this chapter, I also discuss some theoretical and imparl concerns about the relevance of what is generally known as the "common property" literature to resource management problems in complex industrialized and post-industrialized societies.

On the basis of the findings discussed in Chapter 3, I construct in Chapter 4 a "diagnostic checklist" that allows us to analyze and compare various management regimes across an array of physical, social, economic, political, and institutional variables that are considered to be of importance in predicting institutional success. This checklist (which is oriented toward fisheries management arrangements) will form the basis for analyzing the

case studies presented in Chapters 5 and 6.

In the next two chapters, I present, in narrative form, two case studies in the management of the intertidal clam resource in British Columbia (Chapter 5), and a case study of the organization of the geoduck fishery (Chapter 6).

In Chapter 7, I apply to these cases the diagnostic checklist presented in Chapter 4.

In Chapter 8, I discuss the degree to which the supposed principles for organizational success help us understand the relative success of these management arrangements and suggest ways in which outstanding problems could be resolved

Finally, in Chapter 9, I consider some implications of this research for the design of property rights regimes in the management of British Columbia fisheries and suggest an agenda for further research and policy development.

1.6. Contributions of the Research

As a project which is both interdisciplinary in nature and applied in focus, this study does not purport to significantly advance **theory** in any of the individual fields upon which the research has drawn. It does, however, demonstrate the importance of, and suggest a useful model for, integrating the perspectives of natural and social science in addressing significant and pressing public policy issues. By adopting an interdisciplinary approach, this study brings within its scope many issues and concerns that "single discipline" studies (and associated policy recommendations) consider to be beyond their disciplinary wall. For example, biological research may not address the economic incentives of resource users or economic theory may focus on aggregate optimization without concern for distributional effects. If **successful implementation**, as opposed to

theoretical **purity**, is the ultimate objective of public policy, however, we must be concerned with the **full range** of factors that structure individual and collective decisions and behavioral outcomes. It is these factors, taken together, which ultimately determine whether policy decisions are accepted and whether individual choices are brought more closely in line with collective choices and values as reflected in public policy decisions.

By choosing to focus on modern (and in two cases very recent) fisheries in British Columbia, this study responds as well to the challenge described by Margaret McKean, past President of the International Association for the Study of Common Property, to move beyond the "insides" of common property arrangements to examine questions of the origins of such arrangements, and to their relationships with government, with the market economy, and with their ecological setting (McKean, 1997).

The broad purpose of this study is to contribute to the development of a coherent and disciplined methodology for applying an interdisciplinary framework of analysis to practical resource management issues that arise in complex social, political, economic, ecological and institutional systems. The study's specific contributions are as follows:

1 The study offers a diagnostic framework or checklist for analyzing and comparing resource management situations and for assessing the context in which new institutional arrangements are to be introduced. The framework may be used for research purposes (developing or analyzing case studies) or as a framework for considering relevant factors in designing new management institutions.

2. The study provides detailed description and assessment of the biophysical,

technological, economic, social and institutional characteristics of three British Columbia fisheries. There has been no previous research conducted on two of these fisheries, and little policy-oriented research on the other. While many novel approaches to fisheries management are being introduced or proposed in British Columbia, we are still in the early stages of systematic research about how such approaches work "on the ground" in B.C. , especially in the so-called minor fisheries. It is very important to record clear accounts of institutional development if we are to learn as much and as quickly as possible about building better management systems in fisheries and other resource sectors.

3. Based on the theoretical framework of institutional analysis and our growing appreciation of how common pool resource dilemmas can be resolved in simple, small-scale systems, the study suggests some ways in which our empirical and theoretical understanding may be extended to resolving resource management problems in larger and more complex systems.

Chapter 2: Approach and Methodology: From Theory to Practice and Back Again

A wandering minstrel I - a thing of shreds and patches.

W.S. Gilbert. *The Mikado*

Case study research is not sampling research.

R.E. Stake. *The Art of Case Study Research.*

2.1. Introduction

This study grew out of my curiosity about the apparent unwillingness or inability of individuals and groups affected by serious, and apparently worsening, problems in many British Columbia fisheries to agree on solutions, **even when most or all of the affected parties recognize that, if action is not taken, they will all suffer.** Although I am not trained as an economist, I have adopted the fundamental assumptions underlying what Heyne (1987) calls the "economic way of thinking" because such assumptions - principally the proposition that individuals take those actions they think will yield them the largest net advantage - seem to me to be useful in understanding and explaining such apparently paradoxical situations. Knight (1992:14) offers a more complete explanation for his reliance upon the theory of rational choice for addressing problems of collective action:

> The theoretical justification rests on the claim that most social outcomes (at least those social and political outcomes about which we are most concerned in social sciences) are the product of conflict among actors with competing interests. The rational choice theory of action is better able (than theories of norm-driven action) to capture the strategic aspects of that social conflict. The practical justification is that the conception of institutional effects derived from the theory of social norms is less successful in explaining these outcomes.

I concur: by focussing on marginal decisions, rather than "average behaviour", rational choice theory more directly addresses individual strategic behaviour and issues of institutional change. Hence, I have adopted in this study the "rational choice" version of the so-called "new institutionalism" (Atkinson, 1993).

This study consists of five elements:

1. A theoretical framework based on the relevant literature,
2. A diagnostic checklist that identifies the characteristics and attributes of common pool resource situations that the theoretical framework suggests are essential (or at least relevant) to understanding outcomes in these situations;
3. Three case studies presented both in narrative form, and in accordance with the "checklist";
4. A discussion of the case studies which explores the way in which the framework of institutional analysis helps us understand success and failure in each case; and
5. Suggestions for ways in which the findings of the case studies could help structure public policy experiments in what might be called "preventive" or perhaps more accurately, "pre-emptive", institutions, i.e, institutional arrangements that seek to avert poor resource outcomes rather than try to "fix" them once they have occurred.

In this Chapter, I discuss a) the choice of methodologies for studying common pool resource problems; b) methodological issues in the use of case studies;

c) the manner in which I have designed and carried out the case study research so as to address methodological concerns, and d) the limitations of the research approach and methodology.

2.2. Studying Common Pool Resource Problems: A Choice of Methodologies

When Garret Hardin published his brief polemic in 1968, he cast down a gauntlet that lay virtually uncontested for almost two decades, but has more recently been pounced on by a small army of academic challengers. Having pronounced that the tragedy of the commons can be resolved only by the assignment of individual property rights or by state regulation, Hardin left open a wide field of what might be called "intermediate" solutions. Since the early 1980's, researchers have been foraging in this varied and productive field. The result has been an interplay of empirical research and theoretical development that has produced a reasonably good understanding of how common pool resource (CPR) dilemmas are resolved in at least some circumstances, namely,

> ...simple, small and isolated natural resource systems characterized by:
>
> . a small and stable set of users able to communicate on a face to face basis,
>
> . predictable and easy to measure flows of benefits and costs, and
>
> . symmetry of information, asset structures, capabilities, and preferences (Ostrom, 1994:17).

(This body of theoretical and empirical literature, and its limitations, is described at some length in the next chapter of this study.)

Case study research has been central to both the formulation and testing of

hypotheses about the genesis, performance and survival of institutional arrangements for the management of common pool resources. Laboratory experiments, and less commonly, field experiments have also been employed.

2.2.2. Case Study Approaches

Feeny (1992:268-269) observes that the established reliance on case study approaches in CPR research is likely to continue:

> Studies of common-property (sic) resource management by social scientists, historians, biologists, and human ecologists have largely relied upon natural experiments to generate observations about the behaviour of natural and human systems, and the interactions among and within them. Given the logistical, ethical and conceptual problems associated with experiments involving human beings, natural experiments will quite appropriately continue to be the stock-in-trade for scholars interested in the issues surrounding common-property resources.

Feeny categorizes case study approaches as those involving either retrospective (after the fact) or prospective data collection. The latter approach allows for the establishment of baseline measurement and ongoing monitoring. These elements of research design are generally missing from historical studies, even when the projects or programs that form the subject of these studies were established as "test" or "pilot" initiatives that were supposed to be evaluated at some point. However, the use of retrospective accounts opens up a huge body of literature to the analyst, including case studies in anthropology, history, sociology, economics, ecology, geography, political science, and environmental studies. The utility of this literature in formulating and testing hypotheses depends (as is discussed below in Section 2.3) on the application of a structured framework for extracting, coding and comparing the relevant information in the case studies.

2.2.3. Laboratory and Field Experiments

In his discussion of potential approaches to the study of common pool resource management, Feeny also assesses the possible contributions and limitations of both laboratory and field experiments. Laboratory experiments (which have been most prominent in exploring the contribution of game theory and public-goods theory to CPR analysis [for example, see Ostrom, Gardner and Walker, 1994]) may be particularly useful for initial practical tests of institutional design (Feeny, 1992:276). For example, if empirical research in field settings suggests that a particular institutional design (or aspect of an institutional design) might be broadly useful in improving resource management outcomes, an experiment could be initiated under "ideal" conditions. If the arrangement works under controlled conditions, it may be worth attempting in conditions outside the laboratory; if it fails under ideal conditions, then it is unlikely to work in the field. The limitations of laboratory experiments are, of course, the converse of their advantages: a highly controlled experimental environment cannot capture all of the complex variables and interactions among variables that characterize natural systems, human systems, and the interactions between them.

Controlled field experiments offer advantages over both retrospective and prospective natural experiments. In the case of intentional institutional change, it is practically a truism that pilot projects (or the projects governments wish researchers to study) are those that have been chosen to succeed. Such "biases in favour of success" (Feeny, 1992:277) may not be explicit or conscious, but it is highly unlikely that particular settings for institutional innovation are chosen at random. Biases in favour of success are

also relevant to the study of less formal institutional change; when we study surviving indigenous or traditional resource management institutions, we are, necessarily, mainly studying success. There have presumably been many other institutional experiments that, having failed, are long since forgotten.

Controlled field experiments in the social sciences are difficult and generally expensive to design and conduct. For example, experiments in resource management that can be conducted within a practicable time frame may be of little value when factors such as the nature of the biological resource, natural variability, or other characteristics of the common pool resource context demand study over a much longer period of time (Feeny, 1992). Ethical considerations are also central to any experiment involving human beings. By definition, such experiments involve some group of individuals either being denied a potential benefit or suffering a potential ill. However, unless governments, communities, families and individuals stop undertaking any action whose effects are not **proven** to be beneficial, or at least harmless, we must agree with Feeny (1992:279) - and Lee (1993) - that "human experimentation is already part of the scene" This being so, should we not design experiments so that we can obtain better information in more efficient ways, and thereby accelerate the process of learning from both our failures and our successes? The concluding sections of this study recommend that public policy makers adopt such an "adaptive management" approach - that is, an approach of deliberate experimentation and monitoring (Lee, 1993) - to the development and implementation of new fisheries policy

2.3. Methodological Issues in the Use of Case Studies

Yin (1990:4) defines a case study as an empirical inquiry that

1. investigates a contemporary phenomenon with its real-life context;

2. when the boundaries between phenomenon and context are not clearly evident; and

3. in which multiple sources of evidence are used. Case studies can be descriptive, critical/interpretive, problem solving or theory building. They can range from purely practitioner oriented to esoteric scholarly studies. For public administration the ideal case study will have value for both academics and practitioners.

Bailey (1992:47) notes that the quality of public administration research identified as "practitioner-oriented" - principally the case study - has been criticized on the grounds that it does not live up to scientific standards of rigor, including generalizability, transferability and replicability. Underlying this critique, she argues, is a

> "fundamental bias, an unarticulated value, favouring the acceptability of empirical or quantitative research methods over qualitative. Empirical or 'hard' methods are considered *a priori* to provide more scientific, and thus better, findings than 'soft' methods" (Bailey, 1992:47).

Bailey argues (as do Shrader-Frechette and McCoy, 1993 and Stake, 1995) that insistence upon quantitative analysis to the standards of scientific rigor expected in sciences such as physics risks the production of results that, while reliable, are probably trivial. This is not to say that a rigorous methodology is not required for case study research. Indeed, Bailey argues that many case studies are correctly vilified for their lack of procedural rigor and critical analysis.

Good case studies can meet standards of generalizability, transferability, and replicability. Yin (1990:21) argues that case studies are generalizable to "theoretical

propositions". A case study does not represent a "sample of one" but provides opportunities to "expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)". Results are transferable to the extent that approaches to solutions or problems can be applied in other, similar, conditions. Replicability is enhanced by the use of case study protocols and by the adoption of standard validation techniques in qualitative research, including triangulation. Further replicability "...can be built into case studies through the use of multiple cases, where each case is selected to provide similar results, or (to provide) contrary results, but for predictable reasons" (Bailey, 1992:51).

The case study method is particularly appropriate to the study of complex situations which cannot be disaggregated into a series of independently testable hypotheses. Yin (1990:20) argues that case studies are the **preferred** strategy "when a 'how' or 'why' question is being asked about a contemporary set of events over which the investigator has little or no control".

The strength of the case study is its ability to deal with a wide range of information in a systematic and organized way (Shrader-Frechette and McCoy, 1993:132). As public policy is implemented in complex settings, not "variable by variable", the case study approach may be best suited to providing clues as to what might work in settings that (analytically if not statistically) share similar characteristics.

2.4. The Study Methodology

In general, this study moves "from theory to practice and back again". But, as is perhaps usual, the research itself did not follow such a linear path. The field research,

which consists of three case studies, took place over a period of more than two years. My theoretical understanding of common pool resource problems continued to evolve during that same time. In the process, I was driven back to the theoretical literature for answers to questions that emerged during the field work, and back to the field to answer questions that emerged in my reading of the literature. This process did not conclude until the study was completed. It is not really finished now, but eventually one has to call a halt somewhere.

2.4.1. The Selection of Cases

Because my interest is in the relative success of different institutional arrangements in fisheries management, my search for appropriate cases focussed on situations in which there had been a significant change of management regime and where such a change could be compared with either the previous situation in the same fishery or with fisheries that were substantially similar, but had not undergone the same institutional transformation. It was not my intention to attempt rigorous comparisons among these cases. But I felt that focussing on situations in which institutional innovation had occurred would both heighten the institutional dimensions of the fishery and be of most interest to individuals, groups and agencies who are currently evaluating or promoting non-traditional approaches to fisheries management.

These criteria led me to invertebrate fisheries where, since the late 1980's, substantial management changes have occurred. My choice of particular cases was largely opportunistic. In order to carry out any reasonably substantial research, I had to find willing partners. In this regard, I discovered that two pilot projects in the intertidal clam

fishery were scheduled for management reviews and arranged with the Department of Fisheries and Oceans (DFO) that I would conduct these reviews "for free" on condition that no restrictions would be placed on my use of the resulting data. Under this arrangement, the Department agreed to compensate me for my direct, out-of-pocket expenses for travel and accommodation. Written agreement of the Heiltsuk Tribal Council was also required for the Heiltsuk Commercial Clam Fishery study. The third case study was undertaken with the permission of the Underwater Harvesters Association following a presentation to their annual meeting in 1995. Neither government nor the industry group provided funding for this study.

2.4.2. The Research Process

I began research for the Area C case in December of 1994 and submitted the final version of the report to the Area C Management Board in June of 1995. A revised version of the report was subsequently published in *Western Geography (5/6, 1995-96)* and reprinted in the *Philippines Journal of Public Administration (XXXIX:4, 1995)*. Research for the geoduck fishery case began in the late fall of 1995 and continued until early 1997. The Heiltsuk Commercial Clam fishery review began in January of 1996; fieldwork was completed in the fall, and a final draft of the review submitted to the Heiltsuk Tribal Council and to DFO in the spring of 1997.

In each case, I first reviewed the available literature on the fishery and the specific project. Except for the geoduck fishery, almost all documentation consisted of unpublished reports, minutes of meetings, correspondence and other primary sources, together with publications of the Department of Fisheries and Oceans concerning fishery

biology and conservation. There are relatively few secondary sources of information about the institutional (or social or economic) aspects of the management of invertebrate fisheries in British Columbia. A total of more than eighty semistructured interviews were conducted, ranging from 45 minutes to more than three hours in length. Forty interviews were conducted for the Area C case and about twenty each for the other two cases. Fewer interviews were necessary in the later cases, as a considerable amount of information relevant to both intertidal clam studies was gleaned in the process of researching Area C and, in the case of the geoduck fishery, there was both more documentation available and a smaller pool of potential respondents. (Interview questions are provided in Appendix A.) Interviews were conducted with clam harvesters; geoduck license holders; geoduck divers; shellfish processors and buyers; all members of the Area C Clam Management Board; representatives of the Sliammon, Sechelt and Klahoose First Nations; officials of the Department of Fisheries and Oceans, the B.C. Ministry of Agriculture, Fisheries and Food, and Environment Canada; elected officials and staff of the Heiltsuk Tribal Council; sports fishing representatives; a representative of the Savary Island Residents Association; and representatives of Archipelago Marine Research, an agency which carries out much of the monitoring and validation activity in B.C. individual vessel quota fisheries. Frequent follow-up calls were made to key informants over the course of the study to add to or verify information.

Efforts were made to ensure the validity of research findings by:

1. using multiple sources of information, including confirming facts or impressions gained from one interview with other respondents (preferably

from other respondent groups);

2. submitting draft copies of the studies to representatives of different respondent groups for verification of the facts and comments upon interpretation. In the case of the Area C study, two drafts of the report were submitted to the full Board and to all three First Nations involved, before the study was finalized. The Heiltsuk case was reviewed twice by Heiltsuk and DFO officials, while the geoduck study was reviewed by representatives of DFO, the Underwater Harvesters Association, and Archipelago Marine Research.

During the course of the research, I attended several meetings of the Area C Clam Management Board; spent several days in the offices of the Heiltsuk Fishery Program, (talking to anyone who walked in and watching the interaction among staff and harvesters), and joined a crew of Heiltsuk Fisheries Guardians on a (very cold) night patrol of a commercial clam opening. I also participated in a clam stock assessment survey on Savary Island. I did not, to my regret, see the geoduck fishery in action.

Each case study sought information on four key aspects of the fishery or project under review: 1) the nature of the resource system; 2) market and technological attributes; 3) characteristics (e.g. preferences, capabilities, institutional history) of individuals and communities; and 4) decision-making arrangements. But because the studies were conducted at different times and, in the case of the two clam studies, were intended to meet the needs of project participants as well as the researcher, the three cases are not identical in structure or approach. For the purpose of this study, the two intertidal clam

cases have been edited to remove some of the original recommendations and conclusions, but the flavour of the original reports remains. The diagnostic checklist presented in Chapter 4 (which was not fully developed until rather late in the research process) proved very helpful in normalizing these three different reports. Answering the questions posed by the checklist required me to revisit my field notes and, in some cases, to undertake additional research. Many of the questions focussed my attention on aspects of the cases that I had not previously considered or had not pursued because the information was too difficult to find. My initial experience with the checklist suggests that such a framework will be useful in structuring case research or policy experiments in resource management.

2.4.3. Limitations of the Approach and Methodology

Context and phenomenon: the problem of fuzzy boundaries

As Yin (1990) observes, case studies generally involve situations in which the distinction between the phenomenon under study and its context is not clearly defined. The assumptions of institutional analysis make the distinction between exogenous and endogenous variables, and between variables and parameters, particularly difficult. Snidal (1995:54) notes that:

> Institutional change and especially institutional design require us to consider the (partial) endogeneity of institutions. The very notion of institutional design is one of reshaping boundaries between what is endogenous and what is exogenous. Formal institutions create rules to govern the behaviour of actors and therefore limit or expand the scope of their endogenous choices. The emergence of informal institutions, such as norms, affects individual behaviour by altering the collective belief system that constitutes an important part of each individual's fixed external choice environment. In either case, some institutional factor changes, becomes parametric, and then constrains or channels future individual behaviour.

Snidal's suggestion for addressing the endogeneity of institutions is to think of them as "endogenous parameters, where the former term indicates that they are susceptible to change and the latter term that they provide a relatively fixed setting for other endogenous choices or variables" (1995:54).

Because this study does not purport to develop or test hypotheses about strict causal relationships, I will not pursue this problem further. However, as we develop and test more detailed knowledge of the processes underlying institutional development and change, greater clarity in the distinctions among variables and parameters will become more important. For the purposes of this research, I do suggest a set of contextual factors at the macro-level which can be considered outside the boundaries of any of the cases studied in this work. These are listed in Chapter 3.

Subjectivity and Bias

All qualitative research is subject to accusations of subjectivity - to the choice of a particular model that biases the selection of information and to the interpretation of information in ways that permit the researcher to reach desired conclusions. I am sure that such comments can be justified in this study. It is not possible to interpret the world without the use of some model, however, nor is it possible to give equal weight to all the bits of information that emerge in the course of an investigation. As noted above, I have tried to present a fairly straightforward description of each case (with attempts at validation as noted) and to separate these accounts from my interpretation of them in light of the theoretical framework presented in Chapter 3. The question to be answered then, is not, "is the analysis 'true'?", but, "is it useful?". Does it contribute to a better

understanding of why some fisheries management regimes appear to be more successful than others? Does it provide any guidance to policy makers and others who wish to improve the management of living aquatic resources?

Getting the Facts

The emphasis in institutional analysis on understanding **outcomes** as opposed to simply describing processes highlights the difficulty of obtaining satisfactory information about the status of ecological, economic and social well-being in British Columbia fisheries. Our understanding of the biological status of invertebrate stocks is incomplete (and worse in some fisheries than in others). There is no comprehensive analysis of the net benefits of invertebrate fisheries in British Columbia; we do not even know how much DFO expends each year for fisheries enforcement and other activities. Operational data are incomplete and difficult to interpret. For example, if the number of infractions under the *Fisheries Act* goes up, does this mean there is more illegal activity? Or does it mean that DFO has hired additional staff? Or that more people are phoning in tips to the DFO enforcement hotline? What will happen if large numbers of clam diggers are displaced by licence limitation on a coastwide basis? We know too little about the current population of clam harvesters to be able to predict the effects of such policy decisions.

The absence of this type of information is inconvenient for the academic researcher. For those implementing new fisheries policy (and, more importantly, for those who will be affected by institutional change), the costs of ignorance and uncertainty may be of more than academic concern.

Chapter 3: Achieving Success on the Commons: The Theoretical Background

The fault is great in man or woman
Who steals a goose from off a common.
But who can plead that man's excuse
Who steals a common from a goose?

The Tatler. 1821

And must the choice be private ground
Where no communal goose is found?
When common rules - with skill and luck
Could save the goose - and add a duck.

D. Mitchell, 1997

3.1 Modelling the Problem of the Commons

As noted in Chapter 1, the dominant formulation of the problem of common pool resources (or the "common property" problem) remains that described by Hardin as the "tragedy of the commons". Hardin's preoccupation in his 1968 article was the collective disaster consequent on the unregulated individual freedom to reproduce; the example he chose to illustrate the dynamics of this outcome was the incentive of individual farmers to overgraze a common field because each farmer receives the full benefit of each additional animal turned out to graze, while sharing with all the other farmers the collective costs of overgrazing. This same dynamic was earlier described by Gordon (1954) to explain the overexploitation of profitable fisheries:

> There appears...to be some truth in the conservative dictum that everybody's property is nobody's property. Wealth that is free for all is valued by no one because he who is foolhardy enough to wait for its proper time of use will only find that it has been taken by another....The fish in the sea are valueless to the fisherman, because there is no assurance that they will be there for him tomorrow if they are left behind today (Gordon, 1954:124).

Hardin's metaphor is often formulated as a Multi-Person Prisoners' Dilemma problem (Ostrom, 1990; Runge, 1992), in which rational decisions by individuals lead them to a "non-cooperative" joint outcome that is less desirable than the collective outcome that would follow from cooperative action. As described by Hardin, and formalized in the Prisoners' Dilemma:

- Each individual will choose to defect, leading to a situation in which all are worse off;
- The choices of each individual are unaffected by the choices of the other, therefore defecting is a dominant strategy, regardless of what any other individual chooses to do;
- Even if participants are able to agree to "stint" their use of the commons, any such agreement is unstable because each prefers that others stint while he or she defects and uses the commons exploitively (Sen, 1967, cited in Runge, 1992).

These circumstances, according to Keen (1988:20-24), result in three "imperatives" for any individual participant in a common pool situation:

1. The imperative to harvest the resource before someone else does.
2. The imperative to forego investment that would improve productivity of the resource.
3. The imperative to take the best first.

In addition to the "tragedy of the commons" and the Prisoners' Dilemma, the problem of the commons has been variously formulated as the problem of "problematic

social situations" (Raub and Voss, 1990), the logic of collective action (Olson, 1965), and the problem of contracting for rights to non-exclusive resources (Cheung, 1970). Each of these formulations describes and attempts to explain the apparent paradox that individually rational outcomes lead to collectively irrational results. Such a conclusion challenges the view that, if members of a group share a common interest, and they would be better off if that interest were realized, rational and self-interested members of the group would act together to that end. Some formulations suggest that it is impossible for rational creatures to cooperate at all (Campbell, 1985:3, cited in Ostrom, 1990).

This model of the problem of the commons leads Hardin and others to conclude that either a) resources must be removed from the commons by the creation of private property rights, or b) because individuals lack incentives to make and keep agreements about their use of the commons, enforceable rules must be imposed from outside. From this perspective, avoiding the tragedy of the commons requires either privatization or the application of the coercive powers of the state (Demsetz, 1967; Welch, 1983; Ophuls, 1973, Hardin, 1978, all cited in Ostrom, 1990).

Ranged against these conclusions is a substantial body of evidence that individuals do sometimes voluntarily cooperate to achieve collective benefits from common pool resources (CPR's) without (or in spite of) external coercion in the form of government regulation. The next section of this chapter outlines the response of institutional analysts - exemplified by Elinor Ostrom and colleagues at the Workshop in Political Theory and Policy Analysis at Indiana University - to the alleged "inevitability" of tragic outcomes, a conclusion which, it is proposed, relies on a mistaken equivalence between "common pool

resources" and "common property rights".

Note: While most of the literature reviewed in this chapter applies to the broad range of common pool resources, specific reference is periodically made to the narrower question of fishery resources. This focus has been chosen because a) management of fisheries (particularly marine fisheries) is often considered among the most challenging of resource management problems and is the "case" frequently chosen to illustrate theoretical principles, and b) fisheries management issues are those most germane to the field research carried out for this study.

3.2 A Brief Foray into the Definition of Terms

Most of the specialized terminology used in this study is defined as it appears in the text. It may be useful however to define some key terms at the outset.

3.2.1. Resources and Resource Systems

In this study, *resource systems* are distinguished from *eco-systems*. The term "eco-system" is used to mean "the community of organisms living in a specified locale, along with the non-biological factors in the environment - air, water, rock, and so on - that support them, as well as the ensemble of interactions among all these components (Ophuls, 1977:20). Not all organisms and non-biological elements in the environment are resources. For example, a small lake represents an eco-system with a very large number of biological and non-biological elements. Only some of these elements are defined by human beings as *resources* (although this definition can and does change from time to time). A *resource* is defined as an organic or inorganic element within the physical environment for which there is a) human demand for the materials or services produced by

the element and b) existing knowledge and technical skills to allow its extraction and utilization. "*Resource*" is a human construct, based on human ability and need (Rees, 1990).

A *resource stock* represents the total quantity of a resource present in an ecosystem at any point in time while a *resource unit* consists of one "piece" of a resource stock. Finally, a *resource system* can be defined as those aspects (biological or non-biological) of an ecosystem defined as *resources* together with the factors in the environment that support them and the dynamics that govern their evolution over time. For instance, the fish in the lake which are of interest to humans would represent a stock of individual resource units, i.e. of individual fish that live in and are supported by a resource system, which includes water, vegetation, small animal life, and so forth.

3.2.2. Institutions and Property Rights

Broadly defined, the term *institution* is used in this study to mean " the set of rules actually used by a set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others" (Ostrom, 1992:19). Institutions or *rules* may be **about** anything which is the subject of human interaction - marriage and kinship, education, socialization, religious belief, friendship, and so on. The institutions of primary interest to this study are institutions related to property. The term *property* is defined as "a claim to a benefit or income stream" (Bromley, 1991:22). A *property right* is, in turn, a claim to a benefit stream that some higher body (usually the state) will agree to protect through the assignment of duty to others who may covet, or somehow interfere with, the benefit stream (Bromley). Property rights can represent

varying "bundles" of claims and duties to respect claims. These different "bundles" are created by the sets of rules that, in this study, are described as *property regimes.* With respect to natural resources, property regimes are those institutional arrangements (sets of rules) that create, enforce and change the property rights relative to a particular resource stock or resource system.

3.3. The Nature of Common Pool Resources

Until recently, the literature on policy analysis and economics rarely distinguished between "common pool resources" and "common property resources" (Ostrom, 1990; McKean, 1992). This failure to distinguish between a "common pool" as a type of resource or *good* and "common property" as a type of *property regime* is critical to the argument of CPR theorists that the tragedy of the commons is not inevitable when resources are used collectively.

As a type of good, common pool resources share with *public goods* the characteristic of *non-excludability.* For example, in the case of both common pool resources (such as aquifers and ocean fisheries) and public goods (such as lighthouses and weather forecasts), it is difficult to limit their use once the good has been provided. Common pool resources differ from pure public goods, however, in that their use by one beneficiary reduces their availability to other potential beneficiaries. While a ship using the services of a lighthouse does not make the lighthouse any less useful to any other ship, once a gallon of water is pumped or a fish is caught, the same water and fish are not available to anyone else. In this respect, common pool resources are like *private goods* in that their benefits are *subtractable* or *rivalrous in use* (Weimer and Vining, 1992).

Subtractability

Excludability	Low	High
Difficult	PURE PUBLIC GOODS	COMMON POOL RESOURCES
Easy	TOLL GOODS	PRIVATE GOODS

Table 3.1. A Typology of Goods (Ostrom, Gardner and Walker, 1994:7)

While the above typology depicts ideal types of goods, most goods lie in fact upon some continuum of "excludability" and "subtractability". As public goods become more and more congested in use, for example, they move across the continuum toward common pool resources. Indeed, as characterized by Weimer and Vining (1994), common pool resources are simply a congested form of public goods (a class which is rapidly losing its "pure" members as congestion increases and fewer and fewer collective goods remain unaffected by either pollution or appropriation.) Similarly, as excluding other users becomes more difficult or costly, "private goods" increasingly come to resemble common pool resources.

The hybrid nature of common pool resources results in two main classes of problems for appropriators and others concerned with their use. The first group of problems arise in determining and allocating the appropriate level of *flow* of resource units - the fish to be caught, the trees to be cut, the cattle to be grazed, the deer to be hunted. This first group is termed *appropriation problems* (or harvesting problems). The second group of problems are those "...related to creating a resource, maintaining or improving the production capabilities of the resource or avoiding the destruction of the resource

(Ostrom, Gardner and Walker, 1994:9). This second group is called *provision problems* (or investment problems).

3.3.1. Appropriation Problems

Appropriation problems arise because individual resource units are subtractable. Ostrom, Gardner and Walker (1994) identify three classes of appropriation problems: 1) appropriation externalities; 2) assignment problems: and 3) technological externalities.

The classic example of an appropriation externality is that described by Gordon in 1954 concerning fishers in an open access fishery:

> As a single user appropriates from the (fishery) resource, that user reduces the average return to all appropriators, thereby creating externalities. However, individually rational appropriators who consider only their own returns ignore the impact of their own increased appropriation on overall returns from appropriation. By ignoring the negative impact of an individual's appropriation on **other's** returns, the appropriator creates a negative externality. The presence of the externality leads to overinvestment of resources into the appropriation process. Net yield to appropriators from the resource is driven below optimal levels (Ostrom, Gardner, and Walker, 1994:10-11. Emphasis added).

Assignment problems arise because of heterogeneous spatial (and temporal) distribution of resource units. Some patches of grazing are more productive than others, although this relative productivity may change from season to season. Some fishing spots are better than others and the order in which fishers set their nets may significantly determine their respective catches. Both inefficiency and conflict follow from such problems unless rules are devised to deal with them.

The third group of appropriation problems - technological externalities - occurs when one technology interferes with (or possibly enhances) the productivity of another. In extreme cases, technologies may interfere with each other physically, as might occur if

trawlers dragging over a particular bay destroyed crab or shrimp traps. When large numbers of boats converge on a particular fishing ground (as in the case of the roe herring fishery in British Columbia) the potential for conflict resulting in damage to gear and personal injury can be very high. However, positive externalities are also possible, as might occur when a hatchery or aquaculture operation produces stock which is available for capture by individuals other than investors.

3.3.2. Provision Problems

Provision problems arise because of the difficulty of excluding potential beneficiaries, and are thus equivalent to the "free rider" problem associated with public goods. Unlike public goods, however, common pool resources display appropriation problems that, if not resolved, may result in the destruction of the resource stock or facility itself. Thus, appropriators are faced with both "demand side" provision problems and the need to create incentives to avoid resource destruction through overuse, and "supply side" provision problems and the need to create incentives to invest in the construction, maintenance, and protection of the resource system. The two classes of problems are further linked because, if appropriators anticipate that the resource stock or system will itself be destroyed, they have few incentives to "stint" their appropriation (Pearse, 1994; Ostrom, Gardner, and Walker, 1994). If fishers expect that fish habitat will be destroyed because of urban development or logging practices, for example, why should they not take all the fish available while there are still some to be taken? In such circumstances, the potential is clear for a vicious circle of free-riding and over-exploitation, in which failure to address one type of problem increases the severity of the

other.

3.4. Property Rights in the Commons

The nature of common pool resources as a type of resource or *good* does not dictate a particular type of property rights regime. A common pool resource is not by definition "unowned", as was the assumption of Hardin, Gordon and others who equated "common pool" with "common property" . The distinction which ought to be made, rather, is between "open access" (no property rights) versus some form of property right held in relation to common pool resource systems.

As Schmid (1978), Pearse (1988) and Bromley (1991) observe, *property* is not a tangible object, but a social relation. Rights in property exist because they are recognized as such, and because property owners can call upon legitimate authority (generally the state) to enforce those rights. Further, property rights consist of a variable "bundle" of legitimate claims by the property owner and corresponding duties by all others to respect those claims. Pearse (1994: 86-87) defines a "perfect" property right as one which is "exclusive, perpetual, divisible, transferable and (which) conveys all the economic rights to its holder". There is a considerable range between "perfect" property rights and "no property rights".

Noting that "rights" and "rules" are frequently used interchangeably to define how natural resources can be used, Schlager and Ostrom (1993:14-16) emphasize that there is a clear analytical distinction between "rights" and "rules". "Rights" are the product of "rules", and determine a set of authorized actions. Rules prescribe both the rights to be exercised by the holder of a right, and the duty of others to observe this right. Further,

rights and rules are generally arranged or "nested" at different levels of authority. At the highest level of analysis, *constitutional level* rules assign rights to create *collective choice* rules. Those authorized to create collective choice rules define, in turn, rights and duties at an *operational* level. For example, the state may assign to a group of fishers the exclusive right to determine who will be granted fishing licenses (a constitutional level rule establishing who will have the right to participate in making collective choices rules). The group of fishers now has the collective-choice right to make rules about how, when and where individual fishers may use the resource - that is, to determine the operational-level rights held by the individual fishers.

Theoretically, property rights may extend across a very wide range of possibilities and may assume a great number of potential configurations. In the context of fisheries, however, Schlager and Ostrom proposed that the following group of property rights are those most relevant to the management of common pool fishery resources.

Operational Level Rights

1. *Access*: the right to enter a defined resource system.
2. *Withdrawal* : the right to obtain the "products" of a resource system (e.g. catch fish, cut firewood).

These *operational level rights* are in turn determined by the holders of

Collective Level Rights of:

3. *Management*: the right to regulate internal use patterns (i.e. the right of withdrawal) and to transform the resource system by making improvements;
4. *Exclusion*: the right to determine who will have an access right, and how

that right may be transferred.

5. *Alienation*: the right to sell or lease either or both of the above rights.

The composition of any particular bundle of these property rights is not fixed. As Schlager and Ostrom (1993:16) observe,

> ... it is possible to have entry rights without withdrawal rights, to have withdrawal rights without management rights, to have management rights without exclusion rights, and to have exclusion rights without the rights of alienation.... on the other hand, to hold some of these rights implies the possession of others. The exercise of withdrawal rights is not meaningful without the right of access; alienation rights depend upon having rights to be transferred.

With respect to fisheries, however, Schlager and Ostrom propose that rights are frequently held in regularly observed combinations which can be used to define four classes of property right holders: *owners, proprietors, claimants* and *authorized users*.

	Owner	**Proprietor**	**Claimant**	**Authorized User**
Access/ Withdrawal	X	X	X	X
Management	X	X	X	
Exclusion	X	X		
Alienation	X			

Table 3.2. Bundles of Rights Associated with Right Holder Positions
(Schlager and Ostrom, 1993:16)

In the above typology, an *owner* has what are normally considered full and complete property rights. At the other extreme, if **no-one** were excluded from access or

withdrawal, then no property rights exist: this is the circumstance often described as "open access" or the "unowned commons". Between these two extremes lies a range of possible bundles of rights with varying consequences for the management of those resources to which they apply.

Just as the nature of goods does not dictate the nature of property rights in relation to them, there is no **necessary** relationship between a type of property right and a type or class of holder. Organizing the five types of property rights identified by Schlager and Ostrom across the array of possible rights holders reveals, however, a typology of property regimes that includes most if not all of the arrangements that might be expected to exist in the context of marine fisheries. This framework (which is presented below) adopts the Schlager/Ostrom classification of property rights, except that the right of "transferability" of rights of the operational level rights of access and withdrawal is distinguished from the right of "alienation" of the collective-choice rights of management and exclusion. Thus, the category of "authorized user" may include both those who are prohibited from transferring a fishing license or quota, and those who are permitted to do so by sale or lease.

1.	**UNOWNED**
	There are no rights holders

2. STATE OWNED OPEN ACCESS

State retains rights of : Management, Exclusion, Alienation

State Assigns rights of Access and Withdrawal to: Everyone (although some qualification (e.g. citizenship) will generally be required)

3. AUTHORIZED USERS

State retains rights of: Management, Exclusion and Alienation

State Assigns rights of Access and Withdrawal (which may not be transferable among Authorized Users) to:

3.1. Authorized Individual Users

3.2. Authorized Communal Users

3.2. Authorized Corporate Users

4. CLAIMANTS

State retains rights of Exclusion and Alienation

State assigns rights of Management, Access and Withdrawal to:

4.1. Individual Claimants

4.2. Communal Claimants

4.3. Corporate Claimants

5. PROPRIETORS State retains right of Alienation; Assigns rights of Management, Exclusion, Access and Withdrawal to: **5.1. Individual Proprietors** **5.2. Communal Proprietors** **5.3. Corporate Proprietors**
6. OWNERS State assigns all rights to **6.1. Individual Owners** **6.2. Communal Owners** **6.3. Corporate Owners**

Table 3.3. A Typology of Property Regimes

This framework of property regimes is useful for discussions of common pool resource management because it clearly identifies "communal ownership" or "common property" as a type of *joint property right* as opposed to an absence of property rights.

The typology also distinguishes between joint rights held by corporate antedates and those held by communal or cooperative antedates. As Townsend (1995) observes, most discussions of common or joint property rights in fisheries management regimes explicitly or implicitly assume some form of democratic, self-organizing structure of governance. Townsend contends, however, that *corporate governance* should be considered as an alternate form of self-governing property arrangement, and one that may

be more consistent with the institutions of developed countries than the more usually proposed institutional models (Townsend, 1995:41). Indeed, as discussed in the conclusion of this study, the complexity of resource management problems in modern industrial and post-industrial systems likely requires a whole range of joint property arrangements that create rights in a various aspects of a resource system, or even a single resource stock.

The framework offered above also provides a basis for determining the nature and extent to which management is exercised by different entities in any particular property regime, thus helping to clarify the character of "co-management" regimes. For the purposes of this study, "co-management" is considered to exist only when the state has assigned all or some aspects of at least one of the two collective-choice rights of management and exclusion to individuals or groups. This definition provides a more positive delineation of "co-management" than do such frequently used descriptions as "cooperation" or "shared management".

Finally, the proposed framework provides a skeletal model within which it is possible to identify the points at which the nature and distribution of rights allocated under a particular regime may be expected to influence the structure of individual incentives respecting appropriation and provision of the resource in question. To use an automotive metaphor, these are the points at which the clutch is engaged, and the force of institutions is exerted upon the incentives of individual decision-makers. For example, the incentive structure of "owners" is expected to be different from that of "authorized users", similarly, the incentive structure of "shareholders" in e.g. a fish packing plant which controls a

corporate quota of fish, may well differ from that of co-owners of a communal fishery.

3.5. Rights, Rules and Individual Incentives: or Why Institutions Matter

The tragedy of the commons poses a dilemma for a group of participants because individually rational decisions lead them to outcomes that make all of them worse off. On the one hand, participants know that they would be better off by cooperating; on the other hand, they know that if cooperation is not universal (or close to universal) each individual will suffer even more from cooperating than from continuing on his or her (tragic) individual way.

Institutional analysts of the rational choice school do not assume that failures of collective action occur because individuals are unaware of problems or choices, or do not wish to solve problems. They assume rather that individuals faced with problems of collective action are "broadly rational" (Ostrom, 1990:33) and that an individual's choice of action in any particular situation depends on how he or she weighs the benefits and costs of various alternatives and their likely outcomes (Tang, 1992:15). However, individuals are not assumed to have complete information, or to be able to process complete information if it were available to them. Thus, they are considered to be, in Herbert Simon's terms, "intendedly rational but only limitedly so" (Simon, 1961:xxiv). This "information processing" limitation on individual rationality is compounded by the uncertainty present in almost every decision-making context; thus, rationality is "bounded" not only by human cognitive limitations but also by the unknowable nature of the world itself. Opportunism - "self interest with guile" (Tang,1992:15) - is also assumed to

figure in individual choice. These three factors taken together

> ...create difficulties in both negotiating and enforcing cooperative agreements. Individuals may hinder the process of negotiation by trying to hide their true preferences from one another in order to secure a better deal. After they have entered into some form of mutually agreed contract, disputes may arise as to its proper interpretation when novel situations appear or new individuals become involved. Such disputes are especially likely because it is impossible to devise rules that take into account all future contingencies (Tang, 1992:16).

From an **institutional perspective**, the key to resolving this dilemma is the creation of rules that inhibit opportunistic behaviour sufficiently to allow participants to achieve the benefits available from collective action. In the case of common pool resources, "the problem, then, is to devise rules or codes of conduct that restrict the behaviour of individual appropriators in such a way as to avoid overuse or exhaustion of the relevant resources" (Young, 1995:35). (Depending on the nature of the resource and demands upon it, the challenge may also include, of course, the development of rules to overcome "supply side" provision problems.)

Why institutions matter, thus, to the management of natural resources, is because of their impact on the structure of individual incentives. From an **institutional perspective**, the tragedy of the commons occurs because there are no rules to effectively alter the incentives that lead individuals to maximize private benefits at the expense of collective costs, and potential long-term individual costs.

Institutions are said to affect the structure of incentives through their influence on the magnitude and distribution of potential gains from collective action (Knight, 1992) and on the magnitude and distribution of *transaction costs* - the costs of devising, monitoring

and enforcing rules (Williamson, 1981; Knight, 1992). By reducing costs for those involved in a joint activity, institutions create incentives for rational collective action and discourage opportunistic behaviour in the form of free-riding, rent-seeking and corruption.

Property regimes are not the only source of incentives that structure choices around the use of common pool resources. Ostrom (1992:24-26) describes such other sources as a) the "internal values" that individuals assign to different outcomes; b) physical and technological variables; and c) general cultural values shared by individuals in a community. Other researchers invoke as "contextual" variables a broad range of biophysical, technical, economic, social, political and other attributes and characteristics (e.g. Nielson et al, 1996). Each of these factors may influence incentives through their effects on transaction costs and on the structure of "payoffs" from joint or individual behaviour (Keohane and Ostrom, 1995). Moreover, these groups of factors are themselves interconnected, as indicated in the model sketched below.

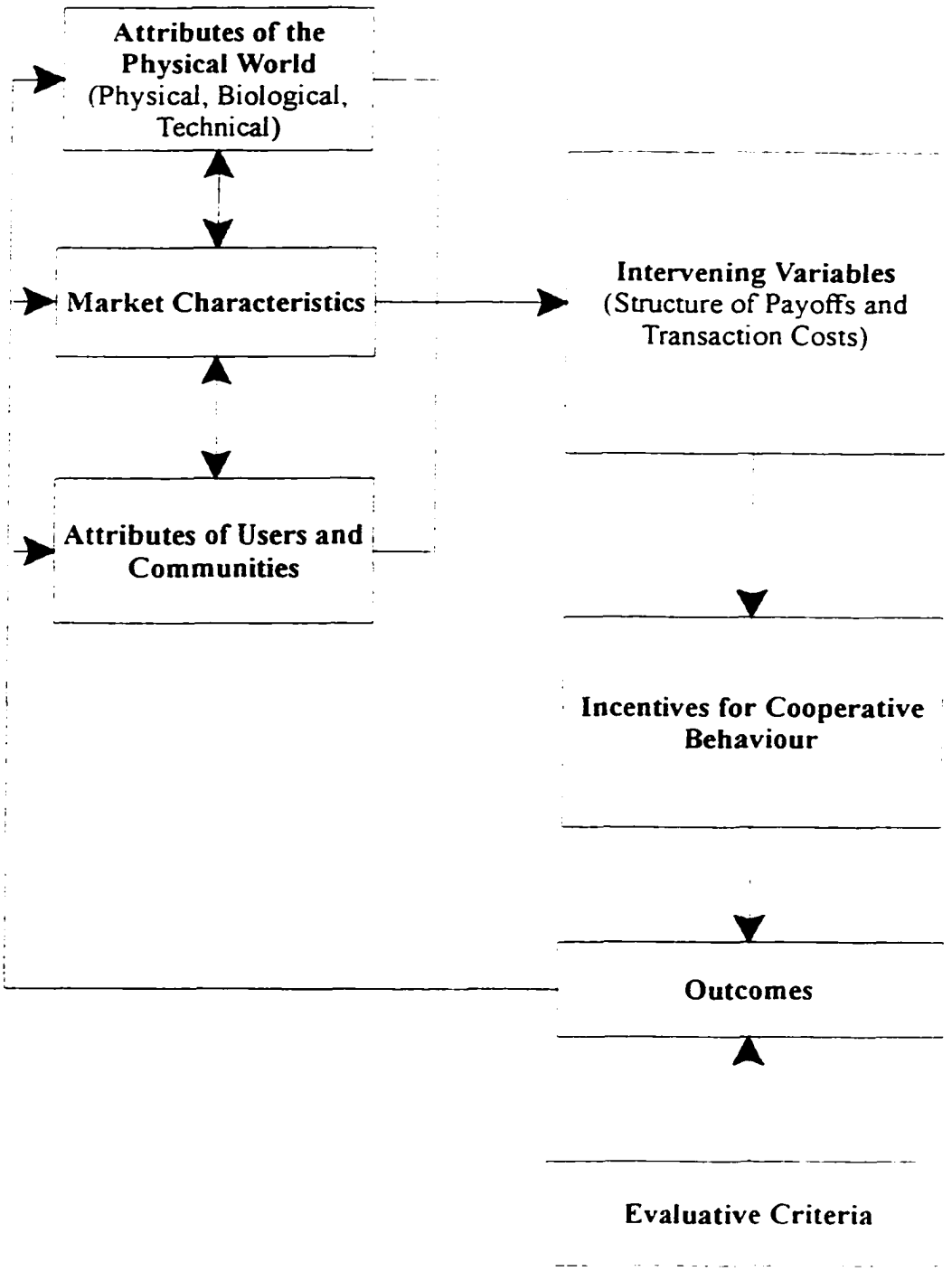

Figure 3 1 A model for Analyzing CPR Situations
(Adapted from Oakerson, 1989, Keohane and Ostrom, 1995, and Nielson et al, 1996)

3.6. The Choice of Property Regime for CPR Management

As noted earlier in this paper, the two conventional solutions to the "tragedy of the commons" are privatization and centralized government regulation. "Common property" regimes are the emerging (one might say the "once and future") third contender. This section of the study first outlines criteria for distinguishing among more or less successful management regimes and then goes on to describe the factors influencing the choice of CPR management regime (in general) with particular attention to the choice of regime for managing marine fisheries.

3.6.1. The Meaning of "Success" on the Commons

The meaning of "success on the commons" is far from self-evident. Minimally, "success" would seem to entail the avoidance of irreversible loss of a resource as a result of human activity. A stronger version of this aspect of success would be, however, the maintenance of the capacity of a resource to produce an undiminished flow of resource units over the long term, which might be labelled a "sustainability" criterion.

A second criterion of success is that of economic efficiency, that is the degree to which a management regime achieves *Pareto optimality (* the condition in which no reallocation of resources will improve the welfare of some person or group without making someone else worse off [Ostrom, Schroeder and Wynne, 1994:113]). Using the example of fisheries, an efficient management regime would maximize the net benefits of resource utilization by avoiding the dissipation of economic rents which results (as demonstrated by Gordon in 1954) from unrestricted access to profitable fishery resources. A **minimal** level of efficiency requires that the benefits of operating a fishery under a

particular management regime are at least as great as its direct and indirect costs; one management regime would be considered comparatively more efficient than another based on the relative size of net benefits in each case (Ostrom, 1992).

The third major criterion of "success" is that of equity or fairness. Almost certainly the most difficult criterion to define and measure, "equity" may be judged in a number of different ways, some of which may be in direct conflict with others. Determining whether a management regime is "equitable" or not is complicated by the fact that, while ecological sustainability entails the concept of intergenerational equity, neither "sustainability" nor "efficiency" entail any particular distribution of property rights among potential rights holders today or tomorrow. As will be discussed later in this study, the distributional impacts of institutional arrangements are almost always a major - and sometimes the overwhelming - factor in whether institutional change will take place, and whether it will be more or less ecologically sustainable, efficient, or both.

When determining whether a particular management regime is "fair", one may consider the fairness of the **process** (by which it was created) or the fairness of the **outcomes** (the ultimate distribution of wealth) or both.

Fair Processes

The fairness of the process has been a central focus in the development of participatory, multi-stakeholder, "consensus based" "shared decision-making" in land and resource planning (a development in which British Columbia has been at the forefront). While such processes are rarely if ever described as new institutional arrangements for the allocation of property rights, this is, in fact, their role. *Property rights* are a recognized

claim to a stream of benefits; these benefits need not be financial in nature. Decisions that allocate land and resources to some uses (and some users) rather than others create property rights, although such rights may be very general or attenuated in many cases, such as the public right to use a provincial park. Duffy et al (1996:8) citing Susskind and Cruikshank (1987) assert that

> Evaluating the fairness of a decision can be conducted by judging the fairness of the process by which it was reached. Susskind and Cruikshank (1987) suggest that a number of questions be posed in determining the fairness of a decision-making process: Was the process open to public scrutiny? Were all the groups who wanted to participate given an adequate chance to do so? Were all parties given access to the technical information they needed? Was everyone given an opportunity to express his or her views? Were the people involved accountable to the constituencies they represented? Was there a means whereby a due process complaint could be heard at the conclusion of the negotiations?

This emphasis on the fairness of the decision-making procedures places a heavy burden on the organizers of such processes (typically governments [Hoberg, 1993]) to ensure that participants are appropriately selected. Such participation is neither fully self-selecting nor neutral in it effects upon the eventual decisions reached. As Reich (1985:1626-1627) observes, the organizer of such processes (Reich refers to him/her as the "administrator")

> ... alter(s) public perceptions and preferences in at least three ways. First, by choosing to listen to certain spokesmen, or subtly encouraging certain groups to come forward, the administrator has shaped perceptions of what is at stake. These spokesmen have identified the key issues and arguments, defined the relative constituencies, and structured how the emerging debate will proceed....Second, the implicit selection of certain groups or leaders to participate has subtly altered the configuration of influence and political authority in the community. These groups, and those who have spoken on their behalf, are now seen as having access to power, and this perception feeds on itself.....Finally, the act of participation has turned private concerns into appropriate subjects of public debate, and - by implication - of public action. Their very expression has legitimized them.

In this passage, Reich is referring to somewhat informal public consultations, not to the even more explicit designation of "legitimate" interests that occurs in the structuring of most participatory land and resource planning processes.

Assessing the fairness of decisions by the fairness of the process by which they are reached does not, thus, substitute a more neutral and objective set of criteria. It merely makes an explicit process of allocating claims to publicly owned resources more implicit and, probably more obscure. From the point of view of governments (and powerful stakeholders) this may be one of its cardinal virtues (Hoberg, 1993).

Fair Outcomes

Outcomes (and processes as well) may be assessed according to criteria of **vertical** equity or **horizontal** equity.

Vertical Equity

An example of vertical equity would be the adoption of a goal or criterion of *redistribution*, according to which benefits are allocated based on differential ability to pay. Poorer individuals receive relatively greater benefits while wealthier beneficiaries bear relatively greater shares of the cost. A progressive system of income tax to finance public services reflects redistributional notions of fairness.

Horizontal Equity

In general, horizontal equity requires that equals be treated equally. This criterion may be applied on ethical or moral grounds, in, for example, the proposition that every person should be treated equally before the law or that every person should be entitled to comparable levels of public health services - on the basis of common humanity or

common citizenship. The concept of *Fiscal Equivalence* incorporates a somewhat similar criterion on the basis of financial costs and benefits. Achieving fiscal equivalence requires that those who benefit from a service should bear the costs of providing it, and that those who derive greater benefits should bear a greater proportion of the costs. For example, water taxes set at rates directly proportionate to water consumption would reflect the principle of fiscal equivalence (Ostrom, Schroeder, and Wynne,1994:114).

In practice, discussions of fairness in the choice of management regimes invariably include, as well, demands for the protection of current entitlements or compensation for loss of past entitlements. In any existing fishery, beneficiaries and aspiring beneficiaries can be expected to argue for such entitlements, even where these claims are not grounded in "rights" but consist rather of "presumptive rights" or "privileges" (Bromley, 1991).

The **overall** success of a management regime depends on the degree to which property rights effectively link ecological systems (and the sustainability criterion) with human systems (and the criteria of efficiency and equity) (Hanna et al, 1996). As Hanna et al (1996:20) observe, this linkage " ... is specific to context because they (property rights) connect a particular human system, with its unique economic, legal and social structure, to a particular ecological system, with its unique biophysical structure". Achieving property regimes that are "context specific" is particularly challenging when both human and ecological systems are changing rapidly and where such regimes have little opportunity to evolve through traditional "trial and error" patterns.

As is invariably the case with complex systems, it is extremely difficult to measure

ultimate impact or success. In the case of CPR management, theorists have identified a number of operational criteria whose achievement is *assumed* to contribute to (or to reflect) the attainment of goals such as sustainabilty or equity. These include the following.

1. Increases in information about the resource and increased exchange of information among users. (Ostrom, 1992).

2. High levels of rule compliance (Ostrom, 1992).

3. Replicability, or the ability of institutional and organizational arrangements to be disseminated widely and maintained (Pomeroy, 1995).

4. Accountability of officials and leaders to resource users concerning management and governance (Ostrom, Schroeder and Wynne, 1993).

5. Adaptability, or the ability of institutional and organizational arrangements to respond to changing political, social, economic and environmental conditions (Ostrom, Schroeder and Wynne, 1993).

6. Ability of individuals to learn from their mistakes and improve on outcomes over time (Lee, 1993; Ostrom, Gardner and Walker, 1994).

7. Intergenerational transmission, or whether rules can be transmitted from one generation to the next without the introduction of substantial error (Ostrom, Gardner and Walker, 1994).

8. Stability over time (Keohane and Ostrom, 1995).

Taken together, these operational criteria suggest that successful management regimes are characterized by adaptability and flexibility, balanced by a reasonable degree of stability over time, and that the appropriateness or legitimacy of such regimes is recognized by users, officials, **and** "outsiders". While successful regimes do not necessarily produce **optimal** resource allocation solutions (assuming that optimality is possible), they do represent reasonable efficiency (in that long term benefits exceed

costs) within a context of broad social acceptability or equity and within the boundaries of ecological sustainability.

3.6.2. Choosing Leviathan: Fisheries and State Regulation

State regulation includes two of the property regimes described above: "Public Property - Open Access" and "Authorized Users". Comparatively few fisheries that fall under the jurisdiction of the nation state in developed countries offer completely open access. At the least, participants must pay the "price of admission" in the form of licence fees. More commonly, some form of limited entry has been introduced to restrict exploitation of the fishery to a specific number of harvesters.

The argument for government regulation of a fishery is quite straightforward: it is intended to control the degree to which fishers respond to the incentives created by common pool resources in the absence of property rights, i.e. the incentives to over-exploit and under-invest. The structure of fishers' incentives is changed by the introduction of rules which, if transgressed, will result in punishment. Thus, two parallel sets of incentives are created: one related to incentives to fish and one related to incentives to avoid punishment for breaking the law.

Whether government regulation offers the best approach to managing a particular CPR depends on a number of factors (Ostrom (1990):

1. Does the state have adequate information about the carrying capacity of the resource and the optimal level of effort to achieve a sustainable yield?
2. Does the state have valid and reliable information about the actions

of individual users of the resource ? That is, what are the state's monitoring capabilities? Can it reliably detect infringements of the law?

3. Can the state set and enforce appropriate sanctions for wrong-doers?

4. What are the costs of information, monitoring and enforcement?

The extent to which the state is deficient with respect to information and capacity, and the magnitude of information, monitoring and enforcement costs that must be incurred, will determine the extent to which government regulation will be successful in altering the incentives of individual appropriators and hence in promoting greater efficiency than would be expected under a system of completely open access. For example, central regulation in a fishery may be worse than no regulation at all if the cost of regulation exceeds the value of the fishery itself or if, by limiting access to some species, regulation increases the rate of exploitation of others. Further, in almost every case, the majority of the cost of regulation is borne by groups and individuals other than those who are the subject of regulation. Thus, there is no incentive created for resource users to reduce such costs, as they bear only a small part of them.

In the above discussion , it is assumed that the *objective* of government regulation is efficient, sustainable resource use. The relative effectiveness of government regulation is thus, determined by its impact upon the incentives of those who are subject to regulation. If this assumption is relaxed, government regulation becomes yet more problematic. As McKean (1992:251) observes:

> Public property can be as vulnerable as unowned resources to over-use because it is afflicted with severe principal-agent disease. Ownership is vested in an abstract entity ('the public')

> whose representatives (government officials) are only managers who are often removed from the resource itself and thus unable to police its use, and who in any case have no personal stake in the resource and thus no great motivation to exert themselves to protect it. On the contrary, rent-seeking motives may lead them to do the opposite.

Not surprisingly, this line of argument is popular among both those who advocate privatization and those who deplore the neglect by government of the potential for collective self- governing resource systems. Some commentators have gone so far as to characterize the problems of fisheries management as a "tragedy of mismanaged state property" (March, 1987:5). Pinkerton (1987:348), for example, argues that problems in the British Columbia salmon fishery have arisen because ".... many of the incentives (for individual over-investment) were provided directly by the government..." in the form of initiatives such as fishermen's loans programs, vessel-construction subsidies, and license limitation programs that contributed to corporate concentration and "capital stuffing" (Pinkerton, 1987).

In summary, regulatory approaches to addressing the problem of the commons attempt to block the efforts of resource users to respond to the incentives created by the common pool attributes of resource systems such as marine fisheries (Munro, 1997). The central problem with this approach is that the underlying incentives remain in full vigour and many new (equally perverse) incentives may be created in the very process of state regulation.

The above discussion of the implications of state regulation is consistent with North's analysis (1981) of the conflict between the state and owners of economic resources. As Knight (1992:191) observes:

> The standard conclusion drawn from North's analysis is that the introduction of the state's interests increases the inefficiency of social institutions... (However) there are two cases in which the state may prefer a more socially efficient institution (than that desired by economic actors). First, it may prefer it if state actors are directly affected by the consequences of the rule and if they benefit materially from a more socially efficient rule.

(Knight offers the example of legislation that prescribes collective-bargaining procedures that limit the likelihood of strikes and lockouts resulting in interruptions of activities that produce revenues for the government.)

In the second case (which is perhaps more directly relevant to natural resource management [Knight, 1992:191]),

> ...the state may prefer a more socially efficient institution if state actors are indirectly affected by the rule through its effect on their ability to stay in power and they will benefit politically from a more socially beneficial rule....If state actors are concerned primarily about remaining in power, they will look to all potential sources of political support. In the process of creating formal institutions, they can consider the interests of all the members of society and not just those directly affected by the proposed rule. Those people who are not directly affected by a particular rule will have no particular distributional interest in the form that the rule takes. They might therefore prefer a socially efficient rule to one that gives distributional advantage to a particular actor.

To carry Knight's point a little further, the creation of resource management institutions by the state not only allows for the impact of "disinterested" parties, but also for the participation of parties with **different** interests (e.g. conservation, non-consumptive use of the resource system, etc.). I will return to this point in the final chapter of this study.

3.6.3. Choosing Privatization: Ownership and Fisheries

The limitations of creating individual private property rights as a response to the tragedy of the commons are rooted in the nature of common pool resources. CPR

systems (particularly marine resource systems) are interactive and interdependent:

> Marine fishery resources are almost all wild animal species, many of which range over wide areas. The habitat of any one resource species overlaps in part or in full the habitats of several others. Rights to the habitat of any one wild stock or species cannot be assigned without creating a potential for conflict with owners of the habitat of other stocks or species. Similarly, assignment of separate ownership of individual wild stocks or species will create conflict over use of the habitat (Keen, 1988:52).

Not only is each resource stock a commons, but each stock is a "commons within a commons" (Bish, 1994). Thus, even where private ownership of resource units is possible (that is, where rights to particular *units* are "quantified and salable"), the privatization of *resource systems* is far less feasible (Ostrom, 1990:30). As a result, the scope of property regimes to create private incentives for long term stewardship of resources is limited, although it may be considerably greater in some circumstances (such as shellfisheries and aquaculture) than in others (Pearse, 1994). Even these arrangements cannot be said to **remove** resources from the commons, however, as such resources remain vulnerable to competition by other users of the resource system and the resulting impacts of siltation, pollution, and so on. Nor do the impacts of such arrangements on the surrounding eco-system (such as pollution from decomposing feed or threats to native species from exotic escapes) enter fully into the calculation of the shellfish leaseholder or aquaculturist.

As long as rights are less than perfect, individual incentives to maximize short-term private benefits and spread long-term costs across current and future users of the resource will remain (Mace, 1993). In cases where the productivity of a resource is less than the discount rate of the user, even sole ownership of a resource stock will not guarantee its preservation. As Clark demonstrated in 1973, the optimal financial strategy of an owner

in such circumstances is to "mine" the resource and reinvest the capital elsewhere once stocks are depleted or exhausted

It will be argued later in this study that better defined and more complete property rights in fishery resources are critical to resolving problems of biological overfishing and economic inefficiency. As discussed at the beginning of this Chapter, however, these problems are not solely or even primarily failures of **individual** rationality, but failures of collective action, which follow in large part from the difficulty of vesting property rights to common pool resources in individuals in such a way as to contain both the benefits and the costs of resource exploitation (Munro, 1997). To the extent that the problems are irreducibly collective , then, we must look to collective solutions to address such problems (Munro, 1997; Ostrom, 1990). The challenge faced by CPR analysts and fellow travellers is to define the conditions which promote the creation and maintenance of successful collective property right regimes. The challenge from a public policy perspective is to translate this understanding into principles and strategies that will enable and encourage, and if necessary, impose, the implementation of such regimes.

3.6.4. Choosing Common Property Regimes: Overcoming the Dilemmas of Collective Action

The central conundrum in explaining the genesis and maintenance of collective (but non-governmental) property institutions lies in the public goods aspect of common pool resources, and in the public goods characteristics of the very institutions necessary to overcome the free-rider problems presented by the resource itself. This challenge (which Hechter (1990:16) describes as a "three-tier free-rider problem") requires

explanation of 1) how new institutions are supplied, 2) how credible commitments can be made, and 3) why monitoring must be supplied (Ostrom, 1990:41).

In Ostrom's seminal work on the genesis of self-governing, self-enforcing institutions (1990), she distinguishes among explanations of the creation of "the state", "the firm", and self-organizing common property regimes. In the latter case, she argues, the benefits of collective action remain within the collectivity; they are not captured by the "ruler" or the "entrepreneur". Thus, a different explanation is needed for their creation. But, historically and analytically, it does not appear that human beings go about engaged in three separate types of institution building. Rather, political, social and economic institutions develop interdependently; one often grows from the other, or is influenced or regulated by the other. In small, clan-based societies, the distinctions among political, social and economic institutions may be very slight indeed. Thus, it seems that a separate explanation for the genesis and maintenance of voluntary common property institutions is neither desirable nor necessary, and tends, in fact, to obscure the relationships and interdependence among the wide range of institutions which structure, and are structured by, collective action. What is required, rather, is an explanation for both a) the creation of institutions ab initio (where no relevant institution exists) and b) the continuing genesis of institutions by individuals on a voluntary basis without the involvement of external institutions, i.e. the state.

Hechter (1990:16) proposes that the general solution to the problem of

institutional supply is

> ... the entrepreneurial one; it lies in the individuals' incentive to think up designs that -were the designs implemented - would provide them with private benefits greatly exceeding the cost of design-making. For example, ambitious individuals would gamble by formulating plans whose adoption requires either expertise or resources that they alone can claim to have.

Ostrom's approach is somewhat different. She concludes, with Robert Bates (1988, cited in Ostrom, 1990. Also Frank, 1988, Putnam, 1992), that the development of trust and a sense of community is central to solving the problem of supplying institutions. Trust and community are, in turn, established through (in the language of game theory), one player signalling to another an intention to cooperate in hopes of reciprocation. By small increments, repeated interactions and positive results can produce a stock of *social capital* in the form of institutional arrangements that facilitate the development and formulation of future cooperation and new institutions. These two explanations may not be inconsistent, however, as both require that some individual(s) make the first move and that others reciprocate and find the resulting arrangements to their benefit. This explanation is consistent with Axelrod's conclusions concerning the impact of repeated interactions on the evolution of cooperative behaviour (Axelrod, 1984).

Neither generalized altruism, an "organic society" (Putnam, 1992), nor a societal ethos of cooperation are needed to explain the **demand** for new institutional arrangements. It is only necessary that individuals desire to consume jointly-produced goods that they cannot obtain by following individual strategies. Hechter (1990) suggests that cooperative institutions, including those that provide public goods, probably first arose in the joint provision of private goods. This initial step in institution building would

be facilitated by highly visible production and distribution activities (as in a cooperative hunt followed by a public distribution of meat), by the participation of small groups of individuals, and by the adoption of unanimity rules for decision-making. In such circumstances, the remaining two challenges of institutional supply and maintenance - the problem of making credible commitments and the provision of mutual monitoring and enforcement - would be simplified, in that both the production and distribution of goods would be highly visible to all participants, and the costs to each individual of another's shirking or "cheating" would be very clear. Once a group is organized to provide one sort of joint good, others may follow, as the group now has a stock of social capital, including norms, values, and favours received and exchanged, that it may deploy in the development of new institutional arrangements. In applying these ideas to the rise of trade partnerships, guilds and merchant leagues in medieval Europe, for example, Hechter notes that, in order to take advantage of opportunities for long-distance trade, individual merchants were forced into a variety of joint ventures, such as the organization of caravans or trade flotillas for mutual protection, or the establishment of partnerships to finance long voyages. Merchant leagues, such as the German Hansa, originated in a joint demand for protection, but eventually came to provide typical public goods including lighthouses and other navigational aids. The activities of the Hansa may be seen as a precursor to state provision of such goods, and an example of the relationships among "voluntary" and "state" institutions.

Once provided, collective goods function as a sort of central store or bank of benefits from which individuals can withdraw benefits under particular sets of rules. Free-

riding in such circumstances is analogous to someone withdrawing more than his or her 'share' of the central store, and thereby robbing other participants or possibly destroying the whole investment. In order to preserve his or her share of the central store of investment, then, each individual is motivated to monitor the actions of others and thereby (inadvertently) provides the whole group with a collective good, that is, the security of the entire investment. Finally, in order for rules to be credible and thus observed, non-compliance, once observed, must be punished. It is, therefore, in the interests of each participant to punish infractions of the rules, **even if the individual 'one time' cost is higher in any one instance of sanctioning than the individual 'one time' benefit** (Hechter, 1990).

It is worth emphasizing that the above explanation for collaborative action relies solely on individual calculation of individual self-interest. Without the deux ex machina of some sort of collective ethos of group solidarity, however, is there not an anomaly in the proposition that individuals will act in ways that yield higher costs than benefits?

Rowe (1989) explains this apparent anomaly by contrasting the rationality of *acts* with the rationality of *rules*. Rule compliance is rational, states Rowe (1989:4) if, "by following that rule, an agent maximizes his expected (long term) utility". By following rules, individuals are able to acquire a reputation for following rules (or keeping promises or commitments) that enable them to influence the behaviour of others. Someone with a reputation for being trustworthy - i.e. someone whose behaviour is predictable - is better able to make credible commitments and thus contract readily with others for the provision and distribution of collective benefits (Frank, 1988, also Schelling, 1960 cited in Frank,

1988).

In a small close-knit society, the trustworthiness of particular individuals (personal trust) may be virtually synonymous with "social trust" . In larger, more complex societies, however, more impersonal or indirect forms of trust are required for investments in social capital to be made and maintained. Putnam (1992) argues that "social trust" arises from two sources: norms of generalized reciprocity and networks of civic engagement.

Norms of reciprocity are similar to Rowe's "rule rationality" . Although I may not benefit directly and immediately from every kindness or favour that I extend, a norm of reciprocity allows me to expect that benefits will be conferred in the future. I will, thus. risk a (specific) current investment because of my (general) confidence in future returns.

Trust is also generated through networks of civic engagement. Dense networks of horizontal interaction through clubs, societies, cooperatives, and business organizations have the effect, Putnam argues, of :

1. increasing the potential costs to a defector in any individual transaction, because opportunism puts other transactions at risk, now and in the future;

2. fostering norms of reciprocity, discussed above;

3. facilitating communication and the flow of information about the trustworthiness of individuals, and

4. serving as the embodiment of past successes at collaboration, "which can serve as culturally-defined templates for future collaboration"(Putnam, 1992:174).

Finally, Putnam, Ostrom (1990), Bates (1988) and others argue that the social capital embodied in norms, networks and trust, tends to be self-reinforcing and

cumulative. Like other forms of capital, "them as has, gits".

While the above section sketches a theoretical framework for voluntary collective solutions to the problem of the commons, it does not explain why such solutions are adopted in some instances and not in others. Further, this account of the genesis of and rationale for social institutions does not directly address the question of why institutions may be created and sustained that are socially inequitable, and, in some cases, morally abhorrent. (The question of economic suboptimality is generally addressed from the perspective of transaction costs [Ostrom, 1990; Knight, 1992]).

Knight (1992) argues that distributional factors are not well addressed by the "new institutionalism" in part because of a pervasive emphasis on aggregate benefits from collective action. Some researchers (McKean, 1992; Libecap, 1989 and 1995) address issues of inequality (or heterogeneity of capacity) in terms of their impact upon the stability of property regimes or upon the likelihood that more efficient regimes will be negotiated (see Section 3.7.3.D. of this chapter). Knight (1992:19), however, argues that social institutions should not be conceived of as products of the efforts of individuals to constrain and coordinate their **mutual** behaviour in order to achieve collective benefits, but "as the product of the efforts of some to constrain the actions of **others** with whom they interact". In other words, "... the ongoing development of social institutions is not best explained as a Pareto-superior response to collective goals or benefits but, rather, as a by-product of conflicts over distributional gains" (Knight, 1992:19). The significance of this view of the role of strategic action by individuals in the creation of institutions will be further developed in Section 3.7.3.D. of this chapter.

The purpose of the next section of this chapter is to summarize the major factors which are believed to a) contribute to the likelihood of "success on the commons" through the implementation and maintenance of collective or common property institutions; b) influence the form which such institutions may take, and c) affect the timing and process of institutional change.

3.7. When and Why do Collective Property Regimes Work?

3.7.1. The Nature of the Debate

In recent years, CPR analysts have become increasingly engrossed in determining the question of *why* self-generated, self-enforcing common property regimes are established and maintained in some circumstances and not in others. Ostrom in *Governing the Commons* (1990) offered the initial comprehensive codification of both 'design principles' and conclusions about the circumstances in which such regimes may arise. Subsequent work, much of it by Ostrom in collaboration with other institutional analysts, has been directed to expanding, refining and testing these propositions.

In the CPR literature, numerous variables have been identified as potentially important in explaining the genesis, implementation and maintenance of successful regimes. "Design principles" have been broadly debated. As Keohane and Ostrom (1995:4) note, while there is substantial agreement among researchers on some issues - notably the impact of different structures of preferences and of the impact of transaction costs on the likelihood and extent of cooperation - many questions are much more difficult to address. This difficulty arises in part from the challenge of distinguishing between *analytically determined* regularities in successful CPR regimes, as opposed to *empirically*

determined regularities. In the case of the latter, such regularities may simply be accidents of the particular cases that have been analyzed so far, or they may be analytically important, but there is as yet no sufficiently well-developed theory to explain their significance. Factors predicted by theory are themselves problematic. At one extreme, theoretical predictions based on ideal conditions may be so divorced from real life complexities that their usefulness is swamped by empirical realities. In less extreme cases (as is discussed further in Section 3.8.), theoretical assumptions may be reasonable in some class of actual CPR situations, but these situations may be relatively uncommon or unimportant.

Understanding the reasons for success or failure of CPR regimes is further complicated by the absence of a model that incorporates the interactions among various factors and allows the analyst to predict, for example, the "amounts" and "proportions" of different factors needed for CPR success. As a rough analogy, the current state of institutional theory of CPR situations is not unlike a theory of baking cakes that identifies commonly observed ingredients in successful cakes and predicts that without ingredients such as flour and leavening, the cake will fail. The theory is not, however, able to fully specify amounts and proportions of each required ingredient, or possible substitutes, or ingredients that can be added "to taste".

To carry the analogy a little further, it is not necessary to be a food chemist to bake good cakes. Neither should it be necessary to be trained as an institutional analyst to be able to build good institutions. The ability to make predictions of institutional success or failure based on a relatively simple, robust theoretical framework is essential to

the utility of institutional analysis in solving CPR problems in the field. However, as the preceding sections of this chapter suggest, CPR theory is highly complex and, in its more rigorous and systematic forms, has developed a "metalanguage" (Ostrom, Gardner and Walker, 1994) that, while contributing to analytical precision, raises significant barriers to the uninitiated who wish to use the theory in practical application.

Given the diversity of CPR situations, useful theoretical predictions are more likely to be in the form of "if, then" statements, than in the form of categorical predictions applicable to the whole universe of possible CPR cases; even these predictions will require caution in interpretation and application. While there is considerable analytical and empirical evidence for such relationships, there is as yet no model which fully links the individual variables and predicts their cumulative impact on the resolution of CPR problems, although attempts to link certain variables have been undertaken, and are discussed below. For the purposes of this study, it will be necessary to discuss most variables only from the perspective of their probable independent impact on incentives for successful collective action in CPR situations. At this point in the development and application of CPR theory, we are still faced with the following tasks:

1) Fully specifying the relevant variables. This is addressed in the balance of Section 3.7.

2) Constructing a diagnostic framework or "checklist" to guide analysts and participants in asking relevant questions about CPR situations and assessing prospects for institutional reform. This task is addressed in Chapter 4: Fisheries Management Arrangements: A Diagnostic Checklist.

3.7.2. A Core of Broad Design Principles

Participants in successful CPR regimes have been able to resolve the dilemmas posed by the attributes of CPR problems, i.e., that have enabled participants to overcome the twin problems of under-investing free-riders and over-exploiting opportunists. In so doing, successful regimes have been able to achieve acceptable levels of ecological sustainability, efficiency and equity, at least within the relevant group and resource system.

There is wide agreement on several of the fundamental "design principles" of successful CPR regimes, with these points of consensus being both firmly grounded in theory and widely observed in the field. In so far as categorical predictions may be made, the following design principles appear to be the best candidates.

Boundary Rules: The Essential First Step

Clearly defined boundaries are indispensable to the transformation of an open access common pool resource system to any other form of property regime. Rules are required to delineate the physical limits of the CPR and to specify those who have property rights in the CPR (Ostrom, 1990 and 1992; Pinkerton, 1994; Hanna et al, 1995). Without such boundaries, it is impossible for individuals to exclude "outsiders" and to begin to develop rules that constrain free-riding and overexploitation within the group of "insiders". Hanna et al (1995:19) observe that,

> Defining the various 'interests' - individuals or groups with a stake in the resource is fundamental to property rights design. The specification of the community of interests is a first step in the specification of rights and obligations, and is often a complex process involving both traditional and emerging resource users.

Rules for Appropriation and Provision

While boundary rules specify who and what are "in" and who and what are "out", they say nothing about the rights and obligations of participants in a CPR situation to benefit from and pay for the exploitation of resource stocks and the resource system. Rules are necessary to govern both appropriation (e.g. harvesting plans that determine time, place, technology and/or quantity of resource units that may be extracted by various classes of rights holders) and provision (labour, material and/or money that must be invested in building and maintaining the resource stock or system) (Ostrom, 1990). Appropriation rules are effective when they reduce appropriation externalities by properly "matching" costs and benefits (Ostrom et al, 1994; Hanna et al, 1995; Pinkerton, 1994) and when they limit assignment problems and technological externalities (Ostrom et al, 1994). Provision rules are effective when they supply appropriate incentives for beneficiaries to invest in the CPR by contributing to its maintenance and enhancement.

The appropriate content of such rules, the proper selection of rule makers , and the appropriate designation of rights holders will vary widely depending on the particular CPR situation. Successful appropriation and provision rules must, however, be congruent with each other and with local conditions (Ostrom, 1990; Ostrom and Keohane, 1995; McKean, 1992; Hanna et al, 1995; Pinkerton and Weinstein, 1995).

Monitoring, Enforcement and Conflict Resolution

Mechanisms for rule monitoring, enforcement and conflict resolution are essential to overcoming *assurance* problems, that is, problems of providing incentives for individuals to make mutual, credible commitments. Rule compliance must be monitored

with reasonable accuracy, and rule infringement must be appropriately sanctioned, in order for individuals to feel confident that their commitments not to free ride or overexploit will be matched by the commitments of others (Ostrom, 1990; Pinkerton and Weinstein, 1995; McKean, 1992). The manner in which monitoring and enforcement are conducted must not itself create perverse incentives. These conditions have led many analysts to observe that a) in order to be effective, monitoring and enforcement must be conducted either by participants themselves, or by officials accountable to participants; and b) that sanctions should be "graduated", that is, they should be related to the seriousness and context of the offense (Coleman, 1990; Ostrom, 1990; McKean, 1992; Pinkerton, 1994).

Mechanisms for conflict resolution are required as well, else effectiveness of monitoring and enforcement may founder on disagreements about the content of rules, the way in which they are applied and enforced, and the appropriateness of sanctions (Ostrom, 1990; Pinkerton, 1994; Hanna et al, 1995; Nielson et al, 1996).

Distribution of Decision-Making Authority: Who Gets Rights? Who Makes Rules?

As discussed earlier in this study, the central arguments for collective rights approaches to common pool resource problems rely on the proposition that the nature and distribution of rights and rule-making authority should be determined by the character of the resource situation. To overcome the disincentives created by state regulation, and the externalities that follow from the (necessarily incomplete) privatization of CPR's, appropriators and other affected interests must have some type and degree of joint property rights and be able to exercise the management authority which is vested in those rights. It is perfectly possible for the state to determine geographic boundaries, designate

authorized users, create appropriation and provision rules, and provide mechanisms for monitoring, enforcement and conflict resolution. But such strategies, when employed alone, have been notoriously unsuccessful in altering the incentives of appropriators toward increased sustainability, efficiency and equity. It should be emphasized that when state regulation fails to achieve these goals, it is not because actions of the state are different in **kind** from actions at any other level of collectivity. It appears to be the case rather that individuals believe that a) they cannot affect decisions at this level of aggregation (and through established processes for participation) or b) that state sanctions of an appropriate magnitude will not be reliably enforced, or both.

A sample of typical propositions about the importance of collective rights and rule-making authority in successful CPR regimes is listed below, and reflects these twin themes of effective participation and appropriate (and predictable) sanctions:

> a. Most individuals affected by the operational rules can participate in modifying the operational rules, that is, they have rights in collective-choice arenas (Ostrom, 1990).
>
> b. Participants are able to assert management rights on an informal, if not formal basis (Pinkerton, 1994).
>
> c. Management regimes are "incentive compatible". Local involvement is matched to local situations (Keohane and Ostrom, 1995).
>
> d. The more fishermen are involved in decision-making processes, the more legitimate the regulatory process will be perceived (Jentoft, 1989).
>
> e. Property rights are specified to ensure that rights and responsibilities are as congruent as possible. "The task is to minimize the possibility of free-riding... when an individual receives resource benefits and avoids bearing proportional costs" (Hanna et al, 1995:19).

> f. Participants are willing to invest if they have a real voice in decisions (Pinkerton and Weinstein, 1995).
>
> g. Appropriators are not prevented from exercising local initiative by a central government (Ostrom, 1992).
>
> h. The co-owners of the commons have to be a self-conscious and self-governing community with the political independence to manage the commons as it sees fit (McKean, 1992).
>
> i. (In successful CPR regimes) appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and content of the offence) by other appropriators, by officials accountable to these appropriators, or by both (Ostrom, 1990:94).

These statements, and many similar propositions throughout the CPR literature, repeat the themes of a) the need for property rights to be specified in order to match the costs and benefits of CPR management; and b) the greater legitimacy of rules that emerges when those who are affected by rules participate in their creation and enforcement. Ostrom (1990:54) emphasizes the significance of this latter point to the process of solving problems in the design and implementation of good CPR institutions:

> Individuals who have no self-organizing and self-governing authority are stuck in a single-tier world. The structure of their problems is given to them. The best they can do is to adopt strategies within the bounds that they are given.

Most CPR analysts recognize that few, if any, contemporary CPR situations can be (or at least will be) managed independently by a single self-governing and self-organizing entity. While the **nature and extent** of the appropriate mix of state, collective and individual property rights in CPR regimes is widely debated, there does appear to be broad support for the following propositions:

a) Where CPR's are part of larger systems, enterprises must be " nested", that is

appropriation, monitoring, enforcement, conflict resolution and governance activities must be organized in multiple layers that appropriately link constitutional, collective and operational level decision-making arenas (Ostrom, 1990). Such "nested enterprises" may be required to a) mediate demands for different elements of resource systems (e.g. foreshore rights for marinas and for aquaculture), or b) allocate resource stocks among competing interests, or both.

b) Where broader societal interests and potential "spillover" effects are concerned (such as conservation of ecosystems and standards of equity), the state has a continuing role to play even where collective (or individual) rights holders are primarily responsible for management of a resource stock or system (Pinkerton, 1994; Pearse, 1994).

3.7.3. Characteristics that Make a Difference

The above design principles are offered as the most widely recognized features of successful CPR regimes. This next section of the study explores a range of variables that are believed to be important in explaining how and why successful regimes come into being, and how and why some regimes differ from others. This section is organized in 5 subsections. Subsection A discusses the fundamental condition necessary for institutional change - that a CPR *situation* is, from the perspective of the relevant interests, a CPR *dilemma*. Subsections B, C and D address, respectively, biophysical, economic, and social (i.e. user/community attributes). Technological issues are first introduced in Subsection B (biophysical attributes) but are also discussed under the headings of economic and social attributes.

The final subsection discusses some macro-level developments that are believed to influence the likelihood and direction of institutional change.

A. Real Dilemmas: the Potential for Gains from Collective Action

While it may seem self evident that collective action is desirable in the case of collective goods, Ostrom, Gardner and Walker (1994:15) observe that,

> ...many CPR **situations** are not CPR **dilemmas**. In some CPR's, the quantity demanded of the resource is not sufficiently large to induce appropriators to pursue individual strategies that produce sub-optimal outcomes. Such situations are not problematic, even though they might become so if the demand for the resource units were to increase or appropriation costs were to decrease (emphasis added).

Similarly, Pearse (1994:86) notes that,

> ...where resources are abundant relative to demands on them, so that their value is low, the system of users' rights is crude and properly so.

In such cases, there is no significant degree of congestion, no payoffs from collective action that exceed the payoffs from individual strategies, and hence, no "dilemma". The resource is effectively a "free good". There may be harvesting costs, but there are no externalities due to competition for units of a scarce resource.

Even in cases where there **are** aggregate expected gains from cooperation, such gains must be apparent from the perspective of the **appropriators** (and other participants), and there must be institutionally feasible alternatives to achieve such gains (again from the perspective of the individual participants). The size of the aggregate gains of collective action is relevant, but so is the distribution of those gains (and the costs of achieving them). Libecap (1989:21) states that "all things being equal, the greater the size of the anticipated aggregate benefits of institutional change (the greater the losses of the

common pool), the more likely new property rights will be sought and adopted." However, as is discussed below in Subsection D, it is the distribution of current and prospective losses and gains among individuals and groups that largely determines whether a CPR situation which is a dilemma **in aggregate** is **seen** as a dilemma by those who must act in order to resolve it.

B. Characteristics of the Physical World

Factors discussed in this sub-section are those concerning:

. the biological or physical nature of the resource and resource system

. the level and mix of technology used in resource appropriation and provision

Biological and Physical Characteristics

The resource characteristics most commonly discussed in the CPR literature are those of

a) size of the CPR and the congruence of CPR boundaries with ecosystem or other natural boundaries;

b) *stationarity* (or *mobility);*

c) *storage* ("the physical capacity of a resource to collect and hold resource units" [Ostrom, Gardner and Walker: 309]).

Size and Congruence

Ostrom (1992) proposes that CPR regimes should encompass geographic areas that are sufficiently small that (given the transportation and communication technology available) appropriators can develop accurate knowledge of external boundaries and internal micro-environments. Size of the CPR system is also relevant to the costs of

marking and defending boundaries and to internal monitoring and enforcement (Acheson, 1987; Libecap, 1989). Ostrom notes that the boundaries of CPR systems need to be distinct, so that they are easily recognized by appropriators and others (Ostrom, 1992), while Pinkerton (1994) argues for congruence of CPR boundaries with ecosystem boundaries so that user communities can more readily appreciate and understand natural relationships in resource and ecological systems.

"Size" in and of itself may be less critical to CPR management success than is the degree of congruence between the physical scale of the CPR and the scale and other characteristics of the management regime, including technology and other factors which enable participants to reduce the information and other transaction costs associated with physical scale of the CPR (Pinkerton and Weinstein, 1995).

Stationarity and Storage

The *mobility* (or *stationarity*) of resources is often mentioned as a factor in differential characteristics and success of CPR management regimes. Libecap (1989) finds that costs are greater if the resource is migratory or otherwise difficult to observe and that property rights are likely to be more complete for stationary, observable resources, than for migratory, unobservable resources. Pinkerton and Weinstein (1995:102) suggest that relatively immobile resources (such as groundfish and shellfish) "...theoretically should be simple to manage through the creation of formal or informal tenures", while Pearse (1994:87) notes that "... considerable opportunities exist in shellfisheries and aquaculture ...(for)... exclusive rights over defined areas ..(to be)... assigned to particular enterprises".

Ostrom et al (1994) observe that *storage* is closely related to *stationarity*, in that

storage can be used to retain resource units that would otherwise be mobile and which can then be saved for future use.

Drawing on a 1991 discussion by Blomquist, Schlager and Tang, Ostrom, Gardner and Walker (1994) create a typology in which individual CPR's are classified according to whether individual resource units are "stationary" and "nonstationary" and whether storage is available or not.

Stationarity of Resource Units

Storage of Resource Units	**Stationary**	**Nonstationary**
Available	groundwater basins, lakes	irrigation canals with reservoirs
Not Available	shellfish, grazing lands, annual forest products	migratory fish, run-of-the-river irrigation systems

Table 3.4. A typology of CPR's (Ostrom, Gardner and Walker, 1994:309)

Ostrom et al (1994) conjecture that, "all other things being equal" appropriators of CPR's that lack storage and/or yield nonstationary resource units face greater difficulty in devising and enforcing allocation rules that reduce appropriation and provision problems. For example, when resources are mobile or "fugitive", it is more difficult to regulate the quantity of resource units that are harvested. In such circumstances, appropriators are considered to be more likely to try to regulate access to the resource (through restrictions on seasons, gear, or minimum size of organisms harvested) than the actual quantity of units that may be taken. In that such restrictions are only indirectly related to the quantity of units extracted, they are likely to be less effective than direct limitations on harvests or catches. Similar problems occur in addressing technological

externalities and assignment problems; it is generally easier to see and understand the impact of crowding or conflict between technologies when resource units are relatively stationary.

Stationarity also influences incentives to invest in resources. On the one hand, degradation (in the form of pollution or exhausted stocks) passes (sometimes literally) downstream; on the other, the fruits of investments in the resource may similarly move beyond the reach of those who have made such investments.

The availability of storage can help mitigate the effects of resource mobility. Nonstationary resources such as fish and water can be impounded. Banking resources in this way helps reduce future uncertainty (and thereby increase incentives for investment), and may also help to alleviate pressures to overinvest in harvest capacity, as resource units can be shared out among claimants at some future date. However, storage provisions may add to the "free rider" problems of a CPR by creating the need to supply and maintain the storage system itself.

Both stationarity and storage affect transaction costs through their impact on the difficulty and costs of obtaining information about the quality and quantity of a resource, about the rate and impacts of appropriation, and about the effects of investment or disinvestment in the resource system.

Finally, nonstationary resource units (such as salmon or migratory wildfowl) are particularly problematic if they flow through multiple resource systems. Ostrom, Gardner and Walker (1994:311) observe that, in such cases,

i) appropriators in any of the resources sharing a common nonstationary flow

are likely to attribute flow declines to the behaviour of appropriators elsewhere in the system;

ii) appropriators in any one CPR cannot control the flow even if they act collectively;

iii) because no one group can control the flow and capture the benefits of collective action, appropriators of any one resource are less likely to provide benefits for appropriators elsewhere by restraining their own appropriation activities; and

iv) coordinating activities with appropriators from other resources in other locations raises transaction costs.

Other Resource Characteristics

Spatial and temporal heterogeneities of resource distribution within a CPR system were discussed earlier in this paper in connection with the nature and severity of assignment problems.

The problems of creating and enforcing appropriation rules in the face of such heterogeneity are well illustrated by the salmon fishery on Canada's Pacific coast: there is great uncertainty about both the number of salmon that will return to coastal fisheries each year and the routes they will travel. Walters (1995), Dahlman (1980), Ostrom (1990), Berkes (1992) and Runge (1984, 1992) have identified low resource productivity and/or spatial or temporal heterogeneity as significant variables in the choice of property regime for a particular CPR. Netting (1976) for example, argues that communal forms of land tenure are better when a) the value of production per unit of land is low and 2) the frequency or dependability of use or yield is low and c) a large territory is needed for effective use.

Characteristics that are discussed less commonly in what might be called the

"mainstream" CPR literature include the health, integrity and resilience of resources and eco-systems (but see Berkes, 1989; Mitchell, B., 1995; Nielson et al, 1996; Libecap, 1989; and Hanna et al, 1994 for some exceptions). These factors are, of course, widely discussed in other bodies of literature, including those of ecology, conservation biology, ecological economics, geography and environmental studies. The relative lack of attention to such factors unfortunately limits the degree to which it is currently possible to answer a number of potentially significant questions concerning the interaction of ecosystems and institutions. For example, to what degree is the success of CPR regimes related to the resilience of the relevant resource system(s)? In other words, are some CPR's more successful than others because they rely on resource systems that can sustain a lot of errors and abuse? How can institutions best cope with complex systems "...which are permeated by uncertainties and discontinuities, and have several possible equilibrial states?" (Hanna et al, 1994, citing Holling, 1986 and Holling et al, 1994). Berkes and Folke (1995:132) note the complementarity of ecological economics and institutional analysis in capturing the "fundamental interrelation between natural capital, human-made capital and cultural capital" and the linkages between social systems and ecological systems.

CPR's and Technology

Technological externalities and technological heterogeneity are both discussed rather widely in the CPR literature (the latter issue is referred to below in Subsection D), but the impact of technological capacity per se does not appear to figure as a critical variable in the mainstream of analysis of CPR success and failure. This apparent omission

is rather puzzling, in that links between technological capacity and the "sustainability" of traditional resource management regimes are not uncommonly debated (for instance, Suttles, 1968; Hunn, 1982) and attempts to reduce technological capacity have certainly been crucial in the policy and practices of fisheries management and the management of other renewable resources (McConnell and Norton, 1978). Increased investment (especially **over**-investment) in technology is generally discussed as a problem of inefficiency arising from the open access character of "unowned" commons (Gordon, 1954; Clark and Munro, 1982). As an independent consideration, however, different **types** of technology may, even at efficient levels of investment, have adverse effects upon resource systems. One mechanical dredge used in a clam harvest may, for example, be efficient from the perspective of the clam harvester (and of society, in the short run), but may cause widespread damage which is difficult to both quantify and "price".

C. Economic Factors

Resource scarcity relative to demand (competition) is clearly related to the potential for gains to be realized by collective action (Libecap, 1989; Pearse, 1994). On the issue of scarcity, Ostrom (1992) suggests that the amount of resource units extracted from the CPR needs to be sufficiently high that users are aware that their withdrawal patterns are interdependent.

Nielson et al (1996) identify a number of market attributes which they consider relevant to the design of management regimes for fisheries:

- The degree to which the fishery is subsistence or market oriented (i.e. is the fishery subsistence, artisanal or industrial?);

- The structure of the market (including the number of buyers and sellers, power relationships between buyers and sellers; the roles of men and women in the market);

- Market orientation (ie. are the products destined primarily for local, domestic or international buyers?);

- The value of products (Are values high or low? Increasing or decreasing?).

The impact of market attributes will vary in large part according to whether participants in any particular CPR situation can or cannot control, for example, prices or the relationships between buyers and sellers. In some fisheries where property rights have been specified (e.g. through individual or collective quotas), harvesters have succeeded in raising prices and in changing the "balance of power" between themselves and those who buy their fish (Macgillivray, 1996). In other (perhaps most) fisheries, harvesters are "price takers" and are unable, by institutional or other means, to affect prices, although they may be able to substantially reduce production costs by the creation of appropriation and provision rules.

In the case of price changes, Libecap (1989:16) observes that,

> ... an increase in relative prices or a fall in production costs will raise the stream of rents attainable from ownership and encourage new competition for control. Old enforcement mechanisms may no longer be adequate, leading to rent dissipation as inputs are diverted from production to protect against trespass and theft.

The implications of heterogeneous user preferences with respect to common pool resources are discussed below.

D. Attributes of Users, Communities and Other Interests

Attributes of users, communities and other interested parties are extensively

addressed in the CPR literature. In order to facilitate discussion, the very broad range of variables in this category is here organized as follows:

1. *Size* (including the number of participants in a group and the number of competing interests)

2. *Other key attributes*, including heterogeneity or assymetries along a number of dimensions:

- preferences and strengths of preferences
- attitudes toward risk, uncertainty and the future, including discount rates and degree of dependency on the resource
- residence and geographic mobility (relative to the CPR in question)
- capabilities (including wealth and technological capacity)
- information and belief
- distribution of costs and benefits of existing and proposed rules

3. The "*institutional history*" of the CPR, including the extent of existing social capital, and the history of previous attempts to achieve institutional change.

1. Size and Numbers

From a number of analytical perspectives (e.g. Olson, 1965, Taylor, 1987), the conventional wisdom on group size and successful collective action has been that "small is better". Ostrom (1990:211) suggests that the prospects for institutional change are enhanced when the "group appropriating from the CPR is relatively small and stable", although she considers this factor less important than others. All else being equal, increasing the number of actors increases the costs of communication and decision-

making and the difficulty of rule monitoring and enforcement (Ostrom, 1992; Lueck,1993; Keohane and Ostrom, 1995). It is possible, of course, for groups to be **too small** to be able to achieve collective benefits or to be able to defend their collective resource against outsiders (Acheson, 1987; Ostrom, 1990).

In most contemporary CPR situations, more than one group is interested in obtaining benefits from the resource or resource system; in such cases, the **number of groups** can affect the success of collective action. On the one hand, a large number of competing interests means that there are more claims that must be addressed (Libecap, 1989; Pinkerton, 1994). On the other hand, increasing the number of interests may expand the opportunities for constructing coalitions that facilitate cooperation (Keohane and Ostrom, 1995) or increase the possibility of creating a "critical mass" in favour of institutional change.

The verdict on "size and numbers" remains somewhat ambivalent. Keohane and Ostrom (1995) suggest that a) "numbers" may not have strong effects by themselves, but that changing the number of actors changes other aspects of the problem and b) other factors such as common understandings of interests, and efficiencies in distributing information and otherwise lowering transactions costs, may be more important factors than group size and number of interests in facilitating cooperation.

2. Other Key Attributes: Dimensions and Heterogeneity

In their 1995 comparison of collective action at local and global levels, Keohane and Ostrom note that most theoretical analysis of problems in both domains assumes homogeneous actors, despite the fact that heterogeneity occurs along a wide

range of dimensions, and is the rule rather than the exception Relaxing the assumption of homogeneity reveals a multitude of characteristics that are likely to be of importance in explaining the nature and success of CPR regimes. In some cases, the position of individuals or groups along a particular dimension is considered most significant; in others, "positions" appear to be less important than heterogeneity or asymmetries. The following table summarizes the dimensions of heterogeneity believed to be most important in predicting successful collective action in CPR situations and indicate sources for these conclusions. A discussion of these dimensions follows.

Factor or Attribute **Suggested Impact on Success**

	Positive	**Negative**
Distribution of Costs and Benefits . Heterogeneity		Ostrom, 1990; Pinkerton, 1994; Mitchell,R.,1995; Keohane and Ostrom, 1995; Oye and Maxwell, 1995; Lueck, 1993
Attitudes Toward Risk and the Future **Discount Rate** . Low Discount Rate **Dependency on Resource** High Dependency	 Ostrom, 1990; Pinkerton and Weinstein, 1995; Schlager, 1994 Pinkerton, 1994	

Preferences and Intensity of Preferences . Heterogeneity	Buchanan and Tullock, 1962, Mitchell,R., 1995	Ostrom, 1990
Capabilities (Endowments, wealth, skills, technology) . Heterogeneity	Mitchell,R., 1995; Ostrom, 1995; Martin, 1995; Olson, 1962	Libecap, 1989; Ostrom, 1995; Martin, 1995.
Residence . Local residence/geographic immobility (as opposed to "footloose" or migratory interests	Pinkerton and Weinstein, 1995; Ostrom, 1990 and 1992	
Information and Belief		Libecap, 1989; Ostrom, 1990; Hackett et al, 1995

Table 3.5. Dimensions of Heterogeneity

As the above table indicates, the implications of heterogeneity for institutional success are far from clear, and may vary widely depending on the dimension or attribute under consideration. The CPR literature has generally assumed that homogeneity fosters successful collective action and that certain positions on some dimensions are to be preferred to others. Low discount rates, a high degree of dependency on the resource, local residence and low geographic mobility, and shared norms and beliefs are among those attributes widely considered to contribute to institutional success in CPR situations. Many of these characteristics are those attributed to small-scale, traditional, geographic communities (Singleton and Taylor, 1992); such communities have been the usual setting

for studies of successful common property regimes (Berkes and Folke, 1995).

Expanding the scale of analysis beyond relatively small-scale geographic communities to situations in which there are several interest groups and in which the "commons" in question is regional, national, international or global in scope, reveals more complexity in the significance of individual dimensions of heterogeneity, and in their interactive or cumulative effects (Keohane and Ostrom, 1995). For example, R. Mitchell (1995:237-239) addresses the issue of heterogeneity of preferences in the context of international efforts to control marine oil pollution. He observes that:

> ... (in the case of many pollution problems)...actors perceptually and actually are either the contributors to, or the beneficiaries of, a clean environment, *but not both.* This heterogeneity of preferences translates into a division across, rather than within actors. The conflict becomes externalized between those who can provide the public good but do not benefit from it, and the quite separate group who benefit from it but cannot provide it..A cleaner ocean does not benefit those who must provide it, but rather is only a 'good' in the social aggregate. Therefore, contributors lack the incentives to contribute that are traditionally assumed to provide the solution for public good and CPR problems. (emphasis in original)

In such circumstances, divergent preferences among groups exacerbate the problem of matching costs and benefits within groups. However, as R. Mitchell (1995:248) observes, this same condition of heterogenous preferences can

> provide 'natural' monitors and enforcers whose incentives independently lead them to undertake these activities. The rules need only to give them the authority and to define compliance in ways that provide the practical ability to monitor and sanction.

Martin (1995:81) observes that asymmetries in preferences and in preference intensity are common in international negotiations, and that such heterogeneities may be a "necessary condition" for cooperation, allowing as they do for tradeoffs on different

aspects of the negotiation, and for the possibility of issue linkages. Especially where unanimous agreement is required, only proposals that give "something to everyone" (i.e. that rely on preference asymmetries) may gain approval (Martin, 1995, citing Buchanan, 1959).

Differences of capabilities (wealth, income, technological capacity, power) can also cut both ways. Libecap (1995:176) observes in the case of fisheries that "(d)ifferences among fishers according to skill, capital and size create conflicting interests and incentives for regulating fisheries" and thus form barriers to institutional change. Keohane and Ostrom (1995:19, citing Martin, 1995) observe that,

> ... actors possessing substantially more capabilities than others - whose interests are also greater - adopt strategies that make agreement on cooperation easier to achieve, monitor and sustain. Even when actors are relatively homogeneous, their agreement frequently creates rules and enforcers of these rules whose powers are asymmetric with those of regular actors.

This finding is consistent with Olson's (1965) observations about privileged groups, which have been carried into international relations literature as "hegemonic stability theory" (Keohane and Ostrom, 1995).

There is greater convergence on the impact of levels of information and heterogeneity or asymmetries of information. Better information reduces the transaction costs entailed in creating, monitoring, enforcing and changing rules, but the process of acquiring information is itself costly and will weigh in the calculation of benefits to be gained from potential collective action (Ostrom, 1990). On the question of information asymmetries, Keohane and Ostrom (1995:18) conclude that in both the local and global commons, extensive common knowledge and information encourage cooperation, while

Libecap (1989) observes that distributional conflicts will be intensified if there are known serious information asymmetries among the competing parties regarding, for example the value of individual claims.

Even some of the less contentious factors such as "degree of dependence" on the resource as a factor in promoting institutional reform and long-term resource sustainability become less clear when issues of scale and intensity are introduced (Durrenberger, 1994; Global Change and Canadian Marine Fisheries Panel, 1997). For example, industrialization, regulatory efforts to limit fishing capacity by discouraging participation by "part-time fishermen", and other factors (including rising incomes and changing preferences) have resulted in increasing the reliance of coastal communities in developed countries on fishery-based economies (Global Change and Canadian Marine Fisheries Panel, 1997). Where such communities formerly relied on several resources (i.e. when individuals worked as fishers, loggers, farmers, mechanics or builders at various times of the year), such "occupational pluralism" has declined as "professionalizaton" has increased. As fishing communities and families become less self-reliant in food, clothing and housing, demands increase on the resource - fish - that produces cash income (Global Change and Canadian Marine Fisheries Panel, 1997). Hence, "dependency on the resource" may create incentives for over-exploitation, rather than conservation, and reduce the ability of communities to devise flexible and adaptive rules for managing the *resource* within the capacity of the *resource system.* In developing countries, **over-**dependence on fisheries follows from overpopulation, poverty, and the traditional role of fisheries as the employer of last resort (Pomeroy, 1996). In such circumstances, fishers

literally cannot afford to innovate and take risks, as there is no margin of error between current circumstances and starvation.

Key to the question of whether heterogeneity (along a particular dimension) is "good" or "bad" is the effect of a particular **distribution** of attributes on the current and proposed distribution of income, wealth and other benefits under existing and proposed property regimes. In general, Libecap (1989:22) suggests that

> Institutional change ...will be limited if the bargaining parties are very heterogeneous. Important differences across the parties in information regarding the resource, as well as in production cost, size, wealth and political experience, will make the formation of winning political coalitions and a consensus on the proposed assignment or adjustment of property rights more difficult.

As noted earlier in this Chapter, Knight (1992) carries the discussion of heterogeneity and consequent distributional impacts beyond their effects on the efficiency of institutions and the likelihood of institutional change. Knight argues that a theoretical reliance on the intentions and actions of rational actors requires that institutions be seen as the product of strategic action on the part of self-interested individuals who focus, **not on collective goals, but on the institutions that produce those social outcomes that are best for them as individual strategic actors** (Knight, 1992:38). Collective gains are produced, but these gains are byproducts of the pursuit of individual gain, not the motivation for collective action:

> Strategic actors can constrain the actions of others through various types of institutions, but they are faced with the fact that social institutions constrain the choices of all actors in some ways. This fact may help explain why standard conceptions of social institutions focus on constraining all of the members of the relevant group or society. But such a conception mistakes an effect for the motivation for developing those institutions. Strategic actors want to constrain themselves only in those situations in which they feel it necessary to secure the

strategic advantage (Knight, 1992:64).

Knight's focus on the primacy of distribution in institutional formation, maintenance and change is extremely useful in applying the general theoretical approach of institutional analysis to CPR situations in which there is substantial heterogeneity of interests, preferences, and capabilities, and in which overlapping and conflict interest require a complex "nesting" of individual, joint, and government institutions to effectively constrain the "tragedy of the commons". The theme of distributional impacts will be revisited at several points later in this study.

Institutional History and Social Capital

Many analysts (including Coleman, 1990; Ostrom, 1990,1992, 1995; Putnam, 1993) have emphasized the importance of accumulated social capital as a key element in predicting the success of groups of participants in resolving problems of collective action. The concept of social capital was discussed earlier in this paper, so the discussion will not be repeated here, except to emphasize the importance of iteration and learning to the achievement of successful outcomes. Analysts generally agree on the importance of "repeated games", such that participants face punishment for defection in future, if not in current, rounds (Axelrod, 1984; Putnam, 1992). More specifically, Wilson (1982, cited in Schlager, 1993:251) underlines the importance of "repeated encounters in roughly similar circumstances in which opportunistic behaviour is seen to destroy the possibilities for collective gain". Repeated attempts to resolve problems may bear fruit as mutual learning (and trust) accumulate. As Libecap (195 168) observes, the sequence and timing of negotiation may also be important relative to changes in the magnitude of common pool

losses and the corresponding potential for gains from collective action. Citing circumstances that are dismally familiar in fisheries management, Libecap notes that, while all parties can frequently agree on the *aggregate* gains that may be achieved by new institutional arrangements,

> ... the problem is reaching agreement on the (distribution of) benefits and costs of collective action.. If the negotiations are lengthy, many resource rents can be lost before collective action is initiated. Finally, after conditions have become so severe regarding the state of the resource and the ability of the parties to obtain income from its use, agreement on closing some of the margins for rent dissipation becomes possible through collective action.
>
> Unfortunately, delays in such cases may result in resource rents having been permanently dissipated, or in the resource having been physically destroyed.

Negotiation over newly discovered resources by parties with little previous financial interest in the resource may avoid this pattern of late agreement (Libecap, 1995). One might expect such circumstances to be relatively rare, although the pattern might be short-circuited by individuals with a previous history of successful collective action (and the ability to foresee problems at a fairly early stage of development) or by interventions (on the part of the state) to structure benefits and costs in such a way as to create (one might say "contrive") incentives for collective action.

E. Macro-Level Variables

The issue of endogenous and exogenous variables was discussed in Chapter 2. As was noted in that discussion, it is frequently difficult to define a particular variable as "exogenous" or "endogenous", per se. It is probably reasonable to suggest however, that there are some factors which are beyond the influence of *many or most* groups that are addressing CPR problems (although some are not [one hopes] beyond the influence of

international and global actors). Such "macro-level" factors may include drought (and other large scale environmental changes), war, technological change, and demographic changes (Hechter, 1990) ; changes in prices and consumer preferences and economic globalization (Global Change and Canadian Marine Fisheries Panel, 1997), and macro-level political, legal, and social instititutions (the courts, parliamentary democracy, educational systems, etc.).

3.8. The Challenge of Mixed Systems: Can We Get There from Here?

The challenge of CPR management in mixed systems arises from the presence of multiple actors playing multiple, interactive games in multiple, interactive biophysical, social, economic and institutional environments. As Young (1995:40) observes, most discussions of CPR management have focussed to date on relatively small scale systems, and have emphasized the spontaneous or "self-generating" nature of the evolution of management regimes:

> ... this stream (of analysis) does better in dealing with self-contained traditional societies than with contemporary situations featuring complex mixes of traditional common-property arrangements and recent interventions stemming from the policy initiatives of modern states....there is a real danger...that the design principles emanating from stream of analysis will be most relevant to a universe of cases encompassing a shrinking set of members.

The answer to "can we get there from here?" depends on how we ask the question in regard to any particular CPR dilemma. It also relies upon how widely we cast the net of inquiry. In contemporary CPR situations (at least in developed countries), it is rarely the case that groups of resource appropriators are able to either preserve or evolve traditional "trial and error" methods for dealing with appropriation or provision problems,

or both. In many cases (British Columbia fisheries, for example), the relevant institutional transformation is not from "open access" or from "informal community control" to "recognized community control". The relevant transformation is, rather, from a state regulated management regime (which frequently entails complex and often conflicting entrenched rules about the use of resource stocks and the resource systems of which they are a component) to a regime in which smaller scale collective property rights or individual rights, or both, are more fully specified.

How (and if) this transformation is achieved is profoundly affected by (or in Knight's terms, driven by) competition among conflicting interests - new and old. The "currency" of these interests varies widely , and may include jobs, income, votes, avoidance of blame, attainment of prestige, moral commitment, cultural tradition, and numerous other non-pecuniary measures of resource value. When resource interests overlap, as they often do, even greater complexity arises. Not only will there be conflict over different elements of the resource system (fish, trees, land for municipal development, etc.), but the magnitude and distribution of the payoffs in each "game" may create profoundly perverse incentives for other "games". Investment and employment incentives created by subsidies, taxes and income support programs are some examples (Pinkerton, 1987; Matthews, 1993). Frequently, the time horizons relevant to decision makers (e.g. the electoral cycle or the quarterly financial cycle) are far shorter than the horizons relevant to the resource (Gunderson et al, 1994). In such a context, it is naive to think that the prospect of aggregate gains from collective action will galvanize institutional reform.

As noted above, the concentration in the CPR literature on small-scale, self-generating, self-enforcing common property regimes may limit its applicability to more complex systems. In particular, the emphasis on a particular set of contextual and institutional arrangements obscures the analytical distinctions among the following questions:

1. What is the appropriate scale of CPR management systems?
That is, what are the appropriate institutional boundaries within which significant externalities can be contained? (Ostrom [1990] specifically excludes from analysis the problem of externalities imposed outside the group.)
2. Under what conditions are institutions likely to be generated as a result of the voluntary actions of participants?
3. Under what conditions are institutions likely to be self-enforcing?

The answer to any one of these questions does not dictate the answer to any of the others. For instance, it is quite possible for a small group of participants to form a self-enforcing regime which achieves large gains from collective action within the group at the expense of imposing enormous externalities on those outside the group, unless the imposition of those externalities is constrained by some external set of institutional arrangements. By the same token, it is possible for a group to voluntarily establish a management regime which achieves aggregate gains to the collectivity, but requires external enforcement to maintain the regime because the gains from collective action are unequally distributed among members of the group, the more disadvantaged of whom have a continuing incentive to break the rules.

Chapter 4: Fisheries Management Arrangements: A Diagnostic Checklist

4.1. Introduction

The general framework for analyzing common pool resource situations which was introduced in Chapter 2 and developed in Chapter 3 requires consideration of the independent and interactive effects of several classes of contextual and institutional factors upon the incentives of individuals to engage in collective action. We are concerned, in general, with 1) attributes of the physical world; 2) attributes of individuals and communities, and 3) decision-making arrangements. In order to develop property regimes that are "context specific" , i.e. that appropriately link natural and human systems (Hanna et al, 1995), we need detailed information about each of these sets of attributes. We also need such detail to evaluate existing arrangements and, as suggested in Chapter 2, to supply appropriate protocols for researching and comparing case studies.

In their work on the application of institutional analysis to fisheries management problems, Nielson et al (1996) suggest the use of a common checklist or framework for assessing and comparing fisheries management arrangements in order to provide a standard set of questions about outcomes, contextual factors, and decision-making arrangements relative to a fishery management regime. As Nielson et al (1996) observe, the use of a common analytical framework or checklist permits a systematic approach to the analysis of information collected in case studies of fishery management regimes. As noted above, such a framework can also provide guidance for the research and development of case studies, and for the design of "policy experiments" in fisheries co-

management.

The attributes and key questions included in the checklist which follows are based on the key factors and concerns identified in the theoretical framework discussed in the preceding chapter and reflect the bio-physical, economic, social, institutional and other variables that are considered relevant to the successful resolution of collective choice problems in fisheries management. Those indicators or questions marked with a single * are derived in whole or in part from Nielsen et al (1996); those marked with a double * are suggested by Pido, Pomeroy et al (1996) in their work on fisheries management (primarily in developing economies, but more broadly applicable to fisheries management generally). Other indicators and questions follow from the theoretical literature previously discussed, and from my understanding of fisheries issues in British Columbia and other jurisdictions. While this checklist is not considered to be either complete, nor necessarily appropriate to all fisheries management situations, it does offer a basis for analysis and a degree of discipline in policy research and design.

Following narrative accounts of the three fisheries studied for this dissertation, the checklist developed in this chapter will be applied to each case.

4.2. Biological, Physical and Technical Characteristics

Characteristic/Indicators	Key Questions
*Multi-species of single species	*What species are caught?
* Migratory or sedentary fishery resources	*Are the fish resources sedentary or migratory?
Storage of resource units	Can resource units be stored for later appropriation?

Temporal heterogeneity	Is the resource available: . seasonally? . year round?
Species lifespan	Is the target species long-lived , short-lived, or ephemeral?
Spatial heterogeneity	Is the resource: . common within the area of the subject fishery? . common outside the area of the fishery? Are some fishing sites more productive than others?
* Level of Stock exploitation	*What is the catch history? *What are the results of stock assessments? If quotas are established, have they been met (exceeded)?
*Status of habitat	*Has there been loss of habitat? (How much?) Has habitat been degraded by e.g. pollution? If so, what sources? Is loss or degradation stable, improving, or worsening?
*Harvesting method	*What types of gear/vessels are used?
Impact of harvesting method	Does the harvesting method damage the target stock (e.g. juveniles)? Does the harvesting method damage other species or habitat?

*Geographic boundaries	Are geographic boundaries defined for this fishery? How are they defined and by whom? Are natural boundaries congruent with relevant political or administrative boundaries?
Proximity to population centres	Is the fishery close to major population centres? Is the fishery isolated? remote?
*Range of the fishery	Is the fishery seasonal? *What is the range of fishing operations?
Resource sensitivity/complexity	Is the resource (or resource system) vulnerable to damage from other uses? If so, what are the competing uses and how sensitive is the resource to them?
*Artisanal or industrial fishery	*Is the fishery mainly artisanal or industrial?

4.3. Market Characteristics

Market Characteristics	**Key Questions**
*Subsistence or market-oriented	What proportion of the catch is sold/consumed?
* Market structure	*Are there many buyers? *Are there many sellers? What are the power relations between buyers and sellers?

* Fishery value	. What is the price per kilo/tonne? . What is the landed value of the catch ? . What is the wholesale value as a percentage of the landed value? . Are prices, rising, stable or falling (over the past five years)?
*Market orientation	*Are the fish mainly sold in local, domestic or international markets?

4.4. User and Community Attributes

User and Community Attributes	Key Questions
Number of user groups	How many user groups are there in this fishery (including commercial, subsistence and recreational)?
Heterogeneity among groups	*What are the main differences among user groups (ethnic, wealth, gear type, residency, preferences re. resource use, attitudes toward risk and the future).
Size and composition of (subject) user group	What is the size of the user group? Is there more than one "sub-group" within the user group?
Heterogeneity within (subject) user group	*What are the main differences among members of the user group ?
*Dependence on the fishery	How important is the fishery as a source of income to the users? (minor, major, sole)

Residence	Do all users live in the vicinity of the fishery? Is there more than one geographic community of users? Are users geographically mobile?
Occupational Mobility	Is it easy or difficult for users to find other employment?
Income	What is the mean (gross) annual income per license holder or user in this fishery (from all sources)?
* Information and knowledge on the fishery and about its management	Is there a good information base about this fishery? * What sources of knowledge (scientific, local, indigenous) are used in the management of the fishery?
*Leadership	What are the main sources of leadership within the user group? How are decisions made within the user group?

4.5. Decision-Making Arrangements

This section of the checklist should be applied to circumstances in the fishery both before and after the key institutional change(s) under review. If there have been several distinct changes in management arrangements, the questions should be addressed at each phase of the fishery's development.

Decision-Making Arrangements	**Key Questions**

**Organization of Fisheries Management	** Which agencies or authorities have management responsibilities in the fishery? ** What are the main legislative, regulatory, policy or other sources of legal authority that govern the fishery?
**Characteristics of "community" or user organization	What are the characteristics of the community or user organization? . legal status? . membership? . human, financial and other resources? . mandate/objectives? . date organization formed? . date organization became involved with the fishery?
Institutional History	Do members of the user organization have a history of successful collective action? Do management agencies and the user organization have a history of successful collective action?
**Rights of Access and Withdrawal (Operational Level Rules)	Who has rights of access to, and withdrawal from, the fishery resource? What do the rights of access and withdrawal entail? (e.g. individual quotas, leases, licenses, etc.) Who makes rules regarding how rights of access and withdrawal shall be exercised?

** Management rights (Collective Level Rule)	Who specifies and allocates rights of withdrawal? Who specifies and allocates rights and responsibilities about other management activities (e.g. research, development, enhancement)? Who carries out management responsibilities (list by agency)?
** Right of Exclusion (Collective Level Rule)	Who determines rights of access and rules about how rights of access may be transferred? Can rights be transferred, and how?
** Right of Alienation (Collective Level Rule)	Who determines whether and how the rights of management and of exclusion can be alienated?
**Monitoring and Enforcement	Which agencies have monitoring and/or enforcement responsibilities and what are they?
** Conflict resolution	How are conflicts adjudicated?
Impetus for institutional change	** Where the did the main source of pressure for change in the fishery originate?

4.6. Outcomes and Evaluative Criteria

Outcomes/Evaluative Criteria	**Key Questions** **(How have outcomes changed since a new management regime was implemented in the fishery?)**

Ecological Outcomes (also see 4.2. Biological Characteristics)	Are stocks healthier? Has habitat been affected positively or negatively? Are quotas, if established, better adhered to since the change? Are poaching, quota busting, high-grading and other enforcement problems worse or better?
Economic and Employment Outcomes	Is the fishery more or less economically efficient? What has been the effect on fishers' incomes? Have enforcement costs changed? Has capitalization of the fishery changed? Have levels of employment in the fishery changed?

Social Outcomes	Are new arrangements perceived to be "fair" by those involved with the fishery? Are new arrangements perceived to be "fair" by those who have been excluded from the fishery, or who are negatively affected by it? Who are the main beneficiaries of the fishery? Who bears the costs of the fishery? Are costs and benefits better matched since the institutional change? What is the degree of concentration in the fishery (and has it changed)? Does the fishery distribute more income and employment to poorer individuals and communities than under previous arrangements?
Human health and safety	Are there concerns about the safety of the product and its fitness for human consumption? Are there concerns about the health and safety of harvesters?

Operational and other Criteria	Do those involved with the organization and management of the fishery appear to learn from their mistakes and improve problem solving abilities and processes? Has the management regime produced better information about the resource and is this information more widely disseminated among stakeholders? Is the management regime adaptable (to changing political, economic, social, environmental conditions)? Has the management regime been relatively stable over time? In general, are management rules complied with by users? By outsiders?

Chapter 5: Case Studies in Institutional Innovation: The Intertidal Clam Fishery in British Columbia

> Clams don't know what it's all about. They have no heads, so they do not bother with that sort of thing.
>
> Will Cuppy. *How to Attract the Wombat*

5.1. The Intertidal Clam Fishery in British Columbia

5.1.1. The Nature of the Resource

Of the more than 400 species of bivalves found along the coast of British Columbia, only a few are harvested in the commercial, recreational or aboriginal food fisheries. Of these, four species of clams comprise the majority of intertidal clam landings: butter (*Saximodus giganteus*), littleneck (*Protothaca staminea)*, manila (*Tapes philippinarum*) and razor clams (*Siliqua patula*).

With the exception of razor clams, the main commercial species are found primarily in bays, inlets and estuarine areas, and are often described collectively as "bay clams". In contrast, razor clams inhabit surf-swept ocean beaches such as those on the west coast of Vancouver Island and the Queen Charlottes.

Historically, butter clams were the major species harvested in commercial, recreational and subsistence fisheries.[1] This species, which can attain a shell length of 110 mm, is relatively slow growing and may take up to seven years to achieve the minimum legal harvest size of 63 mm.

Since 1971, the commercial fishery in British Columbia has focussed primarily on native littlenecks and the introduced manila clam. Native littleneck and manila clams are

similar in size and appearance, with each species attaining a shell length of about 65 mm. The shell of the littleneck is oval to round, with distinct radial and concentric ribs, and is white, grey or brown in colour. Littlenecks usually occur on firm gravel or mud-gravel beaches at slightly higher intertidal levels than butter clams. Manila clams (which were accidentally imported to British Columbia with Japanese oyster seed in the 1930's) are grey, brown or variegated in colour. The shell is more oblong and compressed than that of the native littleneck, and the tip of the siphon is split. Manila clams live just below the surface of the substrate on gravel, sand or mud beaches and closer to the high water mark than do littlenecks. As a result of growing closer to the surface of more exposed areas of the beach, manila clams are particularly susceptible to winter kill. The minimum legal shell size for both littleneck and manila clams is 38 mm, a length which can be achieved in about three and half years in the Strait of Georgia and in five to six years in more northerly waters.

Razor clams, which occur in large concentrations only on the west Coast of Vancouver Island and on the northeast coast of Graham Island in the Queen Charlottes, have a long, thin shell covered with an olive green or dark brown shiny layer. The shell can reach a length of 180 mm, with legal harvest size of 90 mm being achieved in three to four years.

The life histories of the major commercial species are similar to each other. Sexes are separate, with sexual maturity depending on size rather than age of the animal Spawning depends on environmental conditions such as water temperature, salinity and availability of nutrients, and may occur as early as February or as late as October,

depending on the species and the geographic location of the clam population. At spawning time, eggs and sperm are produced simultaneously in a "mass spawning", with each individual releasing vast numbers of eggs or sperm.

The clam larva is initially planktonic. After a few weeks of floating freely in the water column, the larva settles to the bottom and attaches itself to the substrate by means of threads called *byssus* that are secreted by a gland in the larval foot. This event in a clam's life is referred to as *setting* or *spatting*. In general, survival to *setting* is very low, perhaps less than five per cent of the original number of larvae. For the *spat*, attachment is only temporary, and it eventually breaks free and burrows into the substrate, where it remains for life.

Mechanical harvesting is illegal in British Columbia. The wild clam fishery is harvested exclusively by hand, using some form of rake, fork or shovel. Manila clams, which occur close to the surface of the beach, can be harvested very efficiently with rakes; on a good clam beach a proficient harvester can take about 135 kilos per tide. Harvests may rise to nearly 455 kilos on a particularly productive beach.

5.1.2. The Commercial Clam Fishery in British Columbia

The Wild Fishery

A commercial fishery for clams in British Columbia began at the turn of the century, but landings of individual species were not recorded until 1951. Since 1951, total landings by weight have ranged from a low of 581 tonnes in 1969 to a high of 4,515 tonnes in 1988 (DFO, 1994a). Since 1988, landings have dropped dramatically; declining to 1,340 tonnes in 1992. Landed value also reached a peak in 1988, totalling $7,770,000,

before dropping to approximately $2.7 million in 1993. Landed values rebounded to $4.2 million in 1995, as a result of both price increases and larger harvests. Since 1983, the manila clam has been the dominant species in the commercial fishery (DFO, 1994a).

The growth of the commercial clam fishery began in the recession years of the early to mid-1980s, when limited alternative employment opportunities led to increased competition in the clam harvest, especially by itinerant harvesters (many of them new Canadians). Rising prices further increased competition for the clam harvest, while older accumulated stocks on many beaches attracted harvesters with the prospect of high catch per digger ratios. It is now believed that accumulated clam stocks in southern British Columbia have been exhausted and that future harvests will largely depend on annual recruitment. Since 1991, total annual landings and landed values have remained fairly consistent (i.e. less than 2,000 tonnes). Prices for manila clams (landed value) have fluctuated between about $2.64 and $4.00 per kilo, on average.

Increased harvest pressure since the early 1980's has coincided with accelerating losses of shellfish habitat due to contamination from municipal sewage outfalls, faulty septic tanks, agricultural and other upland run-off or discharge from vessels. Most of the closures have occurred in the most popular and accessible harvesting areas, particularly the Strait of Georgia. In 1990, more than 70,000 hectares of clam habitat were closed to harvesting as a result of bacteriological pollution (Environment Canada, n.d.). As the main source of contamination is municipal sewage together with landwash from urban and agricultural areas, rapid population growth in the Lower Mainland, Sunshine Coast and eastern Vancouver Island can be expected to result in continuing loss of shellfish habitat to

the commercial fishery.

The federal Department of Fisheries and Oceans is responsible for the management of the wild clam fishery. Beginning in 1988, DFO introduced significant changes in the management of the wild clam fishery. First, opening times were reduced in 1988, due to increased numbers of harvesters. The following year, fishing times were further reduced, and openings were staggered through the year in an attempt to maintain a continuous market supply. At the end of 1989, Savary Island, once a highly productive fishery, was closed. Currently, statistical area 27 is closed for conservation purposes.

Licensing policies were also changed to attempt to better control harvester effort and to provide better information to fishery managers. Before 1989, anyone possessing a Personal Commercial Fishing Licence (PCFL) was permitted to harvest wild clams. The Department of Fisheries and Oceans estimates that 3,000 to 4,000 of the 20,000 PCFL holders in 1988 harvested clams on a commercial basis. In 1989, however, area licensing was introduced, and clam harvesters were required to purchase a clam licence specific to one of six newly created clam management areas in addition to their Personal Commercial Fishing License (recently renamed "Fisher's Registration Card"). In 1992, Queen Charlotte Sound became a seventh licence area.

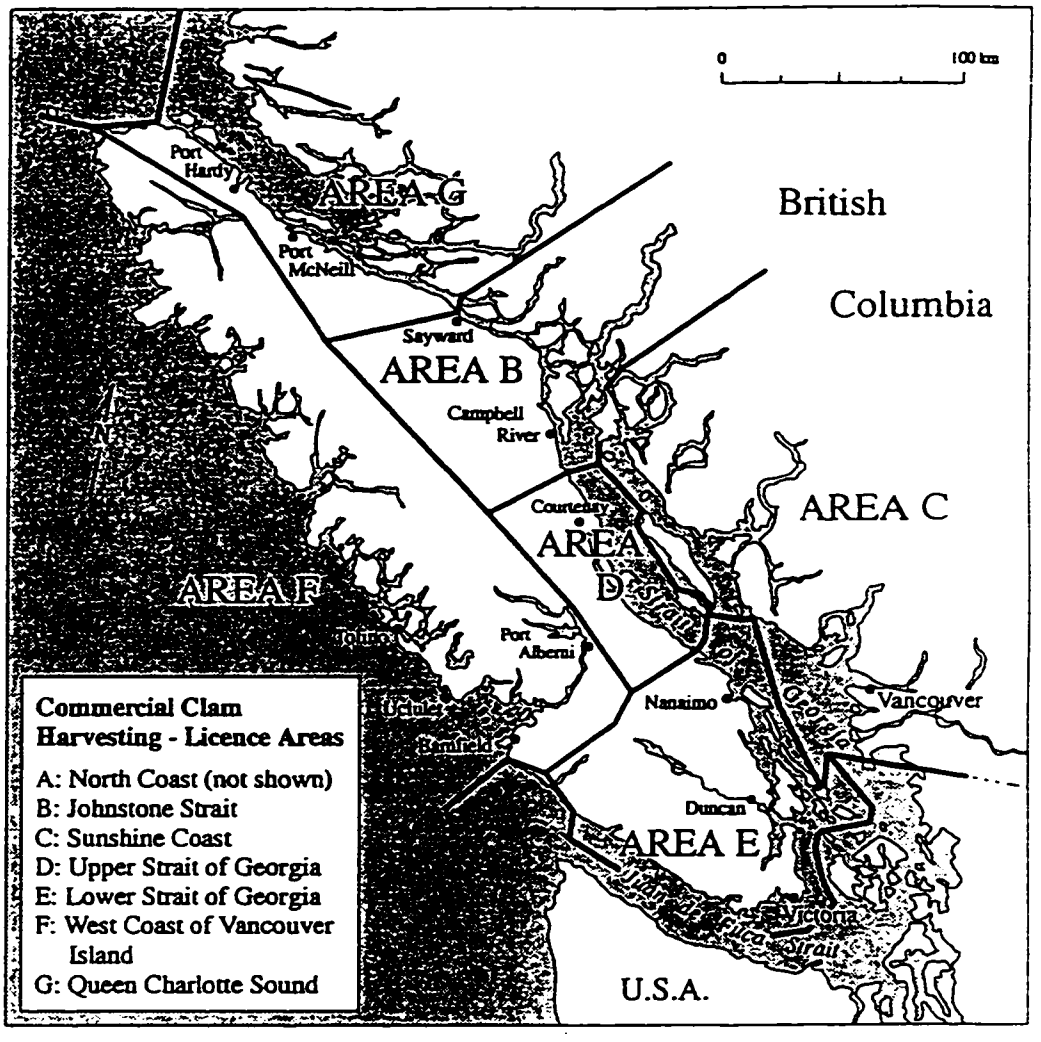

Figure 5.1. Commercial Clam Harvesting Licence Areas

In 1989, a total of 1,870 licences were issued, rising to 2068 in 1990 and dropping back to 1,843 in 1991, 1814 in 1992 and 1,639 in 1993 (DFO, 1995). After 1993, the number of licences began to increase, reaching 2,500 in 1995.

With the exception of Savary Island in Area C and the Heiltsuk pilot project, neither overall nor individual quotas are established for commercial clam harvests. The main conservation method used in the management of the commercial fishery is a minimum size limit that is designed to ensure that clams are able to spawn at least once before they are harvested, together with area and time restrictions. Conservation closures (i.e. closures to harvesting) may be triggered on the basis of a number of criteria, including:

- high incidence of sublegal clams occurring in clam landings;
- repeated digging on beaches, which is considered to contribute to clam mortality because of breakage and exposure;
- declines in catch per unit effort, i.e. in the digger catch per tide;
- incidences of digging in contaminated areas;
- a shift in species composition from manilas to littleneck or butter clams, which are less preferred species;
- digging in marginal habitats, which suggests that major beaches have been heavily harvested;
- encroachment on clam/oyster leases in areas such as Baynes Sound;
- an increase in the amount of sand, mud and rocks in the sack (MAFF, 1990:24)

The wild commercial fishery is also restricted by the designation of recreational reserves, provincial park closures and Aboriginal fish reserves.

Reduced seasons and area closures have severely limited employment opportunities in clam harvesting and incomes are generally low. According to sales slip records for 1990, 87% of clam harvesters earned less than $5,000 from the sale of clams in that year (DFO and MAFF, 1993:3).

Monitoring and Enforcement

Illegal harvesting, particularly harvesting in areas closed because of pollution by Paralytic Shellfish Poison (PSP), is a major and growing concern in the intertidal clam fishery. When interviewed after a series of arrests in the spring of 1997 netted about 10 tonnes of illegally harvested manila clams, DFO official Bryan Jubinville observed that:

> Right now the price paid to legal clam diggers is about $2.00 a pound, and that kind of price makes it a lucrative market for poachers.... Poachers are stealing clams from beaches anywhere in the Pacific region, from Prince Rupert to Vancouver (Globe and Mail, April 5, 1997).

While conservation of clam stocks is of concern, risks to human health are the major issue:

> 'A healthy person might eat some bad clams and then feel like they had a touch of the flu...but for someone with a weakened immune system, eating bad shellfish could be devastating,' says Mr. Jubinville. It is common practice for poachers to mix smuggled clams from closed areas with legally harvested clams, or to manufacture counterfeit tags so that buyers think the clams are coming from beds that have tested clean. This makes it very difficult to trace contaminated shellfish to its source (Globe and Mail, April 5, 1997).

Depuration

Depuration plants, which allow clams from waters marginally contaminated by

sewage (but not industrial pollutants or PSP) to be purged in sterilized sea water, have permitted the harvest of clams from some areas that were formerly closed, including the Sooke Basin and Harbour and Ladysmith Harbour. Depuration is not presently available to deal with PSP or contamination by industrial waste. The proportion of clams now being depurated in British Columbia may be as high as 20% (DFO and MAFF, 1994:41).

Aboriginal Fisheries Strategy

DFO has entered into a number of arrangements with First Nations organizations under the Aboriginal Fisheries Strategy to increase aboriginal involvement in the harvest and management of shellfish. These include an agreement with the Heiltsuk Band Council for exclusive access to shellfish within a designated area (this project is discussed later in this chapter) and a three-year agreement with the Council of the Haida Nation (CHN) concerning the razor clam fishery, effective from 1995 to 1997. Under this agreement, the CHN receives a Communal Licence for the Haida fishery, while non-Haida harvesters continue to receive clam licences from DFO (CHN, 1995).

Clam Culture in British Columbia

In 1989, there were 13 clam culture tenures in British Columbia, most of them coincident with oyster tenures (Bayley, 1989). By 1992, this number had risen to 70 licences on 255 hectares. Twenty-tonnes of cultured manila clams were produced in 1990 and 305 tonnes in 1992 - a more than 10-fold increase (DFO and MAFF, 1993 and DFO and MAFF, 1994). The value of cultured clams in 1992 was about $2 million (DFO and MAFF, 1994). Both landings and landed value of cultured manila clams have continued to increase, reaching 800 tonnes and $3.8 million in 1995.

The Department of Fisheries and Oceans, the British Columbia Ministry of Agriculture, Fisheries and Food (MAFF) and the B.C. Ministry of Environment, Lands and Parks (MELP) are all involved with the administration of clam culture activities, with MAFF being the lead agency for shellfish culture.

Reforming Management of the Intertidal Clam Fishery

In 1992, DFO and MAFF jointly initiated a review of clam fishery management. The following year, a discussion paper entitled "The B.C. Intertidal Clam Fishery: Options and Opportunities" was distributed to clam harvesters, processors, aquaculturists, First Nations, municipal and regional governments, the Islands Trust and other interested individuals and organizations (DFO and MAFF,1993). The discussion paper outlined the history of the intertidal clam fishery in British Columbia and identified "key concerns" in the management of the wild clam resource. The paper observes that:

> The wild clam fishery has been treated as common property shared by an unlimited number of licensed harvesters. The tragedy of this commons is that the harvesters are not willing or able to husband the resource because they must compete with other harvesters for part of the harvest. The pressing issues in clam management are classic symptoms of common property management (DFO and MAFF, 1993:8).

In addition to issues noted earlier in this paper, i.e. shortened fishing seasons, lost clam beds, reduced income and employment opportunities and underfunded programs for PSP monitoring and growing water surveys, DFO/MAFF also identified as key concerns

- illegal harvesting in closed areas (poaching), especially poaching of contaminated clams;
- market considerations, including frequent gluts of fresh

product resulting from short, intense commercial fisheries;

- uncertain stock levels. (Relatively little is known about the effect of repeated digging on clam survival and growth rates or about the effects on recruitment of removal of an entire legal sized clam population.)

As Jamieson and Francis (1986) note, stock surveys of shellfish are expensive and difficult to carry out. Populations are widely dispersed geographically and, being immobile, do not periodically congregate in greater concentrations that would facilitate estimates of abundance. Further, rates of recruitment in clam populations vary widely from year to year as a result of environmental, as well as harvesting, factors. As clam harvests now depend almost entirely on annual recruitment, poor scientific information is a major obstacle to improved resource management.

The 1993 Discussion Paper proposes three options for increasing harvester incentives for protection and enhancement of the clam resource:

1. Limited participation, based on catch or license history;
2. Fixed harvest shares, through either individual quotas or enterprise allocations; and
3. Site specific access, such as foreshore tenures or wild harvest area stakes.

Benefits and drawbacks of each of these options are discussed in the paper. To the extent that the document reflects the preferences of the two governments, limited participation (i.e. limited licensing) appears to be the least preferred option because it does not alter harvesting incentives and provides no individual responsibility or motivation for

husbanding or enhancing the clam resource. Allocation of shares of the harvest, either through individual or group quotas is considered a more desirable option, with a preference indicated for enterprise (group) allocations. The Discussion Paper notes, however, that establishing a sustainable harvest level in the clam fishery is extremely difficult, due to annual variations in recruitment and lack of resources for stock assessment. From the perspective of the Discussion Paper, the preferred option appears to be site specific access, whether through expansion of foreshore leases or "staking" of wild clam areas. The anticipated objections to this option are, as would be expected, further restrictions in public access to foreshore areas; displacement of casual or part-time harvesters; overall losses of employment, particularly if mechanical harvesting is introduced on shellfish tenures; and windfall gains to those who receive exclusive harvesting privileges. On this last point, the Discussion Paper notes that:

> ...windfall gains rightfully belong to the people of Canada, the owners of the clam resource. Auctioning the privileges or taxing the landings could recover the resource rent from the fishery (DFO and MAFF, 1993:16).

In addition to these three major options for management reform, the Discussion Paper proposes increased funding by industry of programs which would enable new fisheries to be developed, including stock assessment and health and safety monitoring, and suggests the creation of Community Management Boards to increase stakeholder involvement in fishery management.

Consultation with individuals and groups concerned with the intertidal clam harvest yielded a number of common themes in stakeholder concerns, including the problem of pollution and other causes of lost clam habitat, and perceived needs for

increased local input into local management, improved marketing, increased management resources, more stable employment opportunities and increased government coordination. Surcharges or landing taxes were proposed by some as a means of supporting enhanced management activities. Not surprisingly, all stakeholder groups were concerned that they maintain or increase their share of the clam resource. There were no clear preferences for any of the management options proposed in the Discussion Paper; while the DFO/MAFF Summary of Stakeholder Consultations (1994) is rather vague, it appears that preferred management options coincide rather directly with the current position of individuals or groups in the industry - clam farmers prefer expansion of shellfish tenures, First Nations prefer communal licensing or quotas with a minimum allocation of harvest share to aboriginal interests, and so forth.

The impact of uncertainty surrounding treaty negotiations was highlighted in the course of the consultations as was the concern that auctioning rights to the clam resource would prejudice economically disadvantaged groups who have traditionally comprised the majority of clam harvesters.

5.2. Case Study One: The Area C Commercial Clam Fishery

5.2.1. The Clam Fishery in Area C

Licence Area C (Sunshine Coast) comprises most of DFO statistical areas 15 and 16 as well as area 29-1 (See Figure 5.1).

The communities most involved in the commercial clam fishery in Area C are 1) those situated within the Regional District of Powell River and 2) three First Nations - Sliammon, Klahoose (on Cortes Island) and Sechelt. The Regional District covers almost

10% of the land area of B.C., but contains less than 1% of the provincial population - about 19,250, including the aboriginal population (B.C. Stats, 1994).

In the past, Savary Island (in statistical area 15) has been the most productive location in Area C; in 1989, area 15 landings peaked at 753 tonnes. When Savary Island was closed for conservation reasons at the end of 1989, Area 15 landings fell to an estimated 66 tonnes in 1990.

In conjunction with the closure of Savary Island, the number of Area C licence holders dropped dramatically, from 400 in 1989 to 184 in 1990. Between 1990 and 1993, the number of licence holders fluctuated between about 170 and 200. It appears that many of those who did not renew Area C licences after 1989 were non-resident harvesters.

From 1990 to 1993, the number of openings in Area C dropped steadily; the Area was open for 48 days in 1991 and only 16 in 1993.

5.2.2. Initiation of the Project

The Area C Clam Management Project originated in two sets of events: 1) the decision by DFO to re-open Savary Island for a small **controlled** commercial fishery and 2) discussions with and proposals submitted by the Area C Clam Harvesters Association and the Sliammon Nation during the consultation process concerning the Federal/Provincial discussion paper about reform of the clam fishery in British Columbia. Both the Sliammon Nation and the Area C Harvesters Association supported a community-based management program with a limited number of harvesters and, perhaps most significantly, both groups agreed that for the purposes of the pilot project, 50% of

harvesting opportunities should be ensured to aboriginal harvesters. Support by community groups facilitated implementation of a limited entry fishery for Area C, while the Federal/Provincial Discussion Paper (which had contemplated increased opportunities for a community management reform process) provided a sort of policy "umbrella" for the establishment of a Community Management Board.

The project was launched at a meeting hosted by the Sliammon Nation on February 3, 1994. The meeting was attended by about 60 harvesters, representatives of the Klahoose Nation, a few processors, and a Savary Island resident, together with a number of DFO officials. Those present at the meeting gave their support to establishment of a limited entry fishery with 50% aboriginal participation and indicated their preference among options for 1994 licence eligibility criteria. Those present also supported the creation of a Community Management Board, with 50% aboriginal participation. The members of the board were, initially, two Sliammon representatives and two members of the Area C Clam Harvesters Association, together with DFO involvement on an ex officio basis.

5.2.2. Eligibility Criteria

At its initial meeting, the newly formed Community Management Board ratified the 1994 licence criterion as possession of an Area C Clam licence in two of the three years 1991, 1992, and 1993. Based on this criterion, 93 individuals in total were expected to be eligible to purchase 1994 licences; of these about 24 were identified as Band members. In order to bring participation up to the stipulated 50%, an additional 27 "make-up" licences were to be issued to First Nations for distribution to their members.

(DFO's original intention was to issue these licences as communal licences under Aboriginal Fishery Strategy agreements; such agreements had not been implemented as of 1996). The Board also established criteria for licence appeals. These were:

1) The appellant must have been a resident of Area C for 5 years (1989 to present); and

2) The appellant must have held an Area C clam licence for two of the years, 1989 to 1993 inclusive; and

3) The appellant must have had significant income from the clam fishery supported by Income Tax returns for those two years; and

4) The appellant must have had a medical reason (supported by a doctor's certificate) or educational reason for not meeting the criteria; and

5) Lack of training for any other job opportunities may be considered.

It was agreed that DFO officials would conduct the licence appeals process for the 1994 pilot project.

Following the appeals procedure and the final calculation of required aboriginal "make-up" licences, 129 individuals were deemed eligible to purchase Clam licences for Area C in 1994. Of these, eighteen individuals did not apply for a licence before the end of December, 1994 (DFO, 1994a).

5.2.3. Board Membership

As noted above, the Board originally consisted of two Sliammon members, two non-aboriginal harvester members, and an ex officio member from DFO. During the first few months of operations, membership on the Board changed. One of the Sliammon representatives was replaced by a nominee from the Sechelt Nation and a third aboriginal

member joined the board on behalf of the Klahoose Nation. To balance the increased aboriginal membership, an additional non-aboriginal representative was recruited. The process of selecting members for the Board was rather informal; individuals who had traditionally been interested and active in clam harvesting and management issues volunteered to represent the non-aboriginal harvesters while Sliammon was represented by members of the Sliammon Clam Diggers Committee. The other First Nations were represented by staff members responsible for marine resource management activities of the respective First Nation governments. The third non-aboriginal member was suggested by DFO to provide some processor/buyer perspectives to the Board. The Savary Island Residents Association and the Sport Fishing Advisory Board were invited to participate in the board, but neither group sent representatives to meetings in 1994.

5.2.4. The 1994 Fishery

Harvest Levels

Savary Island and the remainder of Area C were treated, in some respects, as separate management areas for the 1994 fishery. There were, for example, no overlapping openings for Savary Island and the remainder of Area C. The Department of Fisheries and Oceans established a quota of 114 tonnes for Savary Island; no quota was established for the rest of Area C, although it was expected that an additional 114 tonnes would be harvested. By the end of the 1994 season, landings of 120.5 tonnes were reported for Savary, and 76 tonnes for the rest of Area C. (Fisheries officers believed that some of these landings were in fact Savary Island clams).

The Area C Management Board established fishing plans for the Area in

consultation with DFO, generally on a monthly basis. In 1994, Savary Island was open for a total of 11 days and the rest of Area C for 25 days, for total openings in the Area of 36 days - more than twice the number of 1993 openings.

Marketing and Distribution

Clam prices in Area C were relatively higher than those in other areas, reaching, on occasion, $3.50 per kilo, compared with an average of about $3.00 in 1993. The 1994 average price was about $3.30 per kilo. In other parts of the Coast, prices were more in the range of $2.60 per kilo - close to recent historical averages. The higher prices may be accounted for by three factors: competition by buyers, fewer harvesters (and hence smaller harvests per/opening and less "glut"), and higher quality clams.

Monitoring and Enforcement

Fisheries officers patrolled Savary Island during four openings: September 10 and 14, October 28 and November 15. Officers also did periodic patrols of Area C beaches accessible by motor vehicle, but the main focus of monitoring and enforcement effort was the highly productive Savary Island fishery.

Although the involvement of Aboriginal Fishery Strategy (AFS) guardians in the monitoring and enforcement of the 1994 fishery was discussed by the Board, no formal arrangements were made for such involvement. The AFS guardian for Klahoose (who brought the Klahoose harvesters by boat from Cortes Island) helped DFO on some patrols, and also carried out some monitoring alone.

The Sliammon AFS Guardian monitored Band oyster leases during openings, but was not involved in patrols in other areas.

DFO enforcement officials state that the enforcement situation in Area C in 1994 was quite different from that in other Areas. Relatively few complaints were received from Area C about illegal harvesting in contaminated areas or poaching on oyster leases (which are the commonest type of complaints on other parts of the Coast). Rather, numerous reports of illegal harvesting during closures were received from "stakeholders" (i.e. licensed harvesters) in Area C. In the view of DFO officials, the high level of complaints in Area C is related, at least in part, to an increased sense of ownership and investment in the Area C clam resource by licensed harvesters.

As will be discussed later in this case, actual levels of illegal harvesting (poaching) in Area C in 1994 are unknown and perceptions of the nature and severity of poaching vary among different groups and individuals, as do recommendations for addressing enforcement problems.

Board Structure and Operation

The Board is not established as a legal entity (e.g. a society) and receives no direct funding from government or other sources. DFO did not supply formal terms of reference for the Board nor were they negotiated between the Board and the Department. In the absence of federal legislation, regulation or formal policies concerning the role, mandate and responsibilities of community management institutions, the Board has functioned as an advisory body to DFO on the management of the Area C clam fishery.

5.2.5. Issues Raised During Review of the Area C Clam Management Program

A large majority of those interviewed stated that the 1994 fishery was very acceptable in terms of orderliness, harvester opportunities, and quality of product. There

were no complaints reported to DFO from Savary Island residents; a representative of the Residents' Association noted that the problems which had occurred in the fishery when Savary was previously opened (noise, vandalism, and littering) were not present in the 1994 fishery. Most respondents mentioned some level of poaching as a problem; this issue is discussed in detail in a later section of this case. In comparison with Savary Island fisheries in the late 1980s, which were variously described by interview respondents as "crazy" or "uncontrollable", the 1994 fishery was considered a great improvement, primarily due to the implementation of limited entry to the fishery and the establishment of a harvest quota for Savary Island.

The balance of this section addresses six issues raised during the review:

1. What were the objectives of the Area C Clam Management project?
2. Have these objectives been achieved?
3. Were opportunities in the commercial fishery allocated on a reasonable and equitable basis?
4. Was there adequate compliance with fishery management objectives and rules?
5. Did the fishery meet the needs of processors and markets?
6. How can management of the fishery be improved?

1. What were the objectives of the program?

Project documentation and interviews with board members, harvesters and government officials suggest that those involved with setting up the project had two major objectives:

a. To better ensure conservation/sustainability of the resource

b. To develop the commercial fishery as a more viable livelihood for clam harvesters, especially for local residents.

Many of those interviewed felt that greater local participation by, and control over, the management of the fishery was critical to achievement of both these goals. Board members and harvesters tended to emphasize the socio-economic impacts of the new management regimes, while DFO officials tended to emphasize conservation and hoped-for improvements in DFO's ability to more effectively carry out its management responsibilities.

2. Were these objectives met in the 1994 fishery?

a. Impacts on conservation

Some, but not all, board members and harvesters expressed the view that the quota established for Savary Island was overly conservative and that abundant stocks encouraged illegal harvesting. Other interview respondents felt that it was best to err on the side of caution, and pointed to low numbers of sub-legal clams as a sign that, while current stocks may be high, recruitment may be quite low.

Based on buyers' reports to DFO (hailed landings), the Savary Island quota was slightly exceeded. In addition, some Savary Island clams may have been reported as having been harvested in other parts of Area C.

b. Socio-economic impacts

In 1994, licence limitation in Area C was very effective in increasing average returns to harvesters in comparison with other management areas. The mean number of kilos per licence issued in Area C in 1994 was about four times the mean landings in other

areas - some 1820 kilos per Area C licence issued compared with between 340 and 545 kilos per licence issued in Areas where licence limitation has not been introduced (Webb,1995).

Based on 1994 reported landings of 196 tonnes and an average price of $3.30 per kilo, the average income available to a licensed harvester in Area C in 1994 was about $5,900, spread over a four-month season.

Even with licences limited to approximately the current number of harvesters, the wild clam fishery cannot be said to provide a "full time" living for commercial harvesters. With good management, however, the resource should be able to provide a substantial source of income for persons whose other employment opportunities may be limited, especially in the winter months when seasonal employment is less available.

3. Were opportunities in the commercial fishery allocated on a reasonable and fair basis?

The Area C Clam Management project was launched on two points of agreement between aboriginal and non-aboriginal communities: that licences should be limited and that 50% of licences should be reserved to aboriginal harvesters. Since the inception of the project, consensus on these points appears to have eroded.

During 1994, both aboriginal and non-aboriginal members of the Board experienced substantial pressure from individuals who feel aggrieved at having been excluded from the 1994 commercial fishery. These former harvesters contended that the licence criteria do not adequately reflect long-standing involvement with the commercial fishery and penalize those who sought more productive fisheries after the closure of

Savary Island. Aboriginal harvesters and First Nations representatives pointed to the predominance of native harvesters in the clam fishery before the manila clam "bonanza" of the 1980s; some contend that the allocation of harvesting opportunities should reflect this earlier concentration of aboriginal harvesters in the fishery. In the face of this pressure, both non-aboriginal and aboriginal Board members proposed that additional licences be issued to accommodate individuals with a long-standing involvement in the commercial fishery, but limited recent participation. At the same time, the majority of Board members and harvesters interviewed continue to support a range of 100-125 licences as the optimal number of licences for the fishery, at least for the foreseeable future.

Some First Nations harvesters and officials expressed the view that, while 50% is a minimum entitlement for aboriginal harvesters, the percentage should be higher, based on historic aboriginal involvement in the fishery and relatively greater employment needs among the native population. From the Sliammon perspective, at least, the distribution of "make up" licences among the three First Nations is also a matter of concern, with some individuals feeling that Sliammon should be entitled to a larger share of existing "make up" licences or to additional communal licences for distribution by the Band. Non-aboriginal Board members, and most non-aboriginal harvesters interviewed, continue to support the allocation of 50% of licences to native harvesters.

The treaty negotiation process is an additional and important consideration in the question of how commercial fishing opportunities will be allocated. Decisions taken under the current management arrangements are "without prejudice" to aboriginal rights and interests, and a final determination of opportunities in the fishery will not likely occur

until treaties are concluded with the First Nations involved. In the meantime, the Board faces a number of decisions:

1. Can the three First Nations and the non-aboriginal harvester community agree on a recommendation to DFO concerning allocation of harvesting opportunities among the various groups, pending a definitive settlement of the issue which may not occur for a number of years?
2. Are there any possibilities for involving individuals who wish to participate in the commercial harvest, but are now excluded, without undermining the objectives of limited entry? Some options that might be considered include:

- re-allocating some, or all, of the licences that were not purchased in 1994 and which remain unissued in 1995;
- providing for the re-allocation of licences that are not renewed in future;
- allowing some licences to "float", i.e. to be issued to successive users during the season. This may meet some of the needs of the aboriginal communities in particular;
- establishing minimum landings requirements to qualify for retention of a licence. (Even quite low quantities may be sufficient to deter speculation in clam licences, which has been identified as a concern in this and other fisheries.)

4. Was there adequate compliance with fishery objectives and rules?

How much poaching actually occurred in the 1994 fishery? In the absence of documentation, it is impossible to say. As noted above, however, DFO enforcement officials consider that the situation in Area C was fairly well under control, especially as compared with other years, and with other management areas. Board members and non-aboriginal harvesters tended to believe that monitoring and enforcement were inadequate in 1994 and that poaching was a "very serious" or "somewhat serious" problem; aboriginal harvesters were less likely to view enforcement as lacking and poaching as a problem. DFO acknowledges that additional resources for enforcement would be highly desirable, but that, given current and expected funding levels, significant increases in enforcement effort are not likely unless new sources of funding become available, such as payments by harvesters toward the expenses of managing the fishery.

Who is responsible for illegal harvesting? Different individuals and groups had differing views about the most likely candidates; suggestions included:

- currently licensed harvesters;
- harvesters from other areas;
- previously licensed harvesters who were excluded from obtaining licences in 1994;
- holders of clam tenures;
- processors and buyers;
- individuals with Aboriginal food fish permits

With few exceptions, most individuals interviewed believed that illegal harvesting

by non-resident (transient) diggers was not a major factor in the 1994 Area C fishery. Several respondents expressed the view that poaching would not be so prevalent if some processors were not buying clams that they knew (or ought to have known) were not legally harvested.

According to interview respondents, poaching takes various forms. Some of those mentioned are:

- harvesting clams before openings and storing them;
- digging on beaches with contamination closures;
- harvesting wild clams and "laundering" them through clam leases from which product may be sold year round;
- harvesting clams in one area and selling them into another area opening;
- harvesting clams under an Aboriginal food fish permit and then selling them under another individual's commercial licence.

While firm conclusions cannot be drawn about the nature and extent of clam poaching, the comments of most interview respondents suggest that much of the activity in Area C is a "local problem". At least some of the poaching scenarios described by respondents would require either active participation by, or the cooperation of, licensed harvesters. While many harvesters interviewed expressed a growing sense of ownership of the local clam resource, one year under a new, and possibly temporary, licensing regime is probably not sufficient to induce harvesters to act like textbook stewards of the resource.

Some individuals from both the aboriginal and non-aboriginal communities feel

that the criterion for distributing licences was not fair. In the case of aboriginal individuals, some perceive their exclusion from harvesting not simply as an individual grievance, but as an injury against their community or Nation as a whole. To the extent that this perception exists, non-compliance with fishery regulations, whether they are made by DFO or by a Community Management Board, may be viewed by the individuals involved and others in their community as a case of (justified) civil disobedience rather than infraction of reasonable and fair rules and laws.

5. Did the fishery meet the needs of processors and markets?

Most processors were relatively well satisfied with the 1994 Area C Clam fishery, although several expressed reservations about the wild clam fishery in general. Quality in Area C was considered good. Concerns raised included the following:

- Because of the productivity of Savary, less effort was expended on other parts of the Area than processors had expected and yields were consequently lower.
- Harvester effort, particularly on the latter days of multiple-day openings, was unpredictable. Sometimes processors were unable to purchase enough clams to make the buying trip worthwhile.
- Buyer competition and "shopping around" for higher prices by harvesters also made it difficult for some processors to predict purchases.

6. How can management of the fishery be improved?

As noted above, an essential requirement for the effective management of the Area C fishery is for the parties involved to agree, at least on a provisional basis, about the allocation of opportunities in the commercial clam fishery. Without such agreement, this issue will continue to dominate management concerns and will make it very difficult to deal with other issues.

Effective monitoring and enforcement of the fishery was identified by most respondents as a management priority: the benefits of controlling harvests at sustainable levels or investing in improved stock assessment or enhancement cannot be secured to investors unless the resource can be protected.

Interview respondents suggested a number of approaches to improving monitoring and enforcement, with the most frequently mentioned proposals being

- increase DFO patrols, both during and before openings;
- increase monitoring of processors and/or increase penalties for infractions
- regulate leaseholders more closely to reduce "laundering";
- more self-regulation by harvesters;
- increase penalties for illegal harvesting;
- make greater use of AFS guardians;
- avoid issuing food fish permits during commercial openings.

As mentioned earlier in this chapter, the involvement of AFS guardians in the clam fishery has been discussed, as has the possibility of volunteer monitoring by licence

holders, especially during fishery closures. DFO officials have indicated their willingness to facilitate a joint session of harvesters, AFS guardians and DFO enforcement staff to coordinate monitoring and enforcement efforts.

With respect to concerns about clams "laundered" through leases, DFO and the provincial Ministry of Agriculture, Fisheries and Food (which is responsible for management of shellfish tenures) have agreed to jointly investigate this concern.

In the matter of Aboriginal food fish permits, the Chief and Council of the Sliammon Band have advised that they are concerned about misuse of these permits for commercial sales, are reviewing the permit system, and have requested local fisheries officers to enforce the conditions of the permits.

Part of the enforcement problem is, however, a straightforward lack of resources for more DFO patrols. As discussed below, the Area C Board has proposed that funds be raised from harvesters for management purposes; if this can be achieved, Board members and harvesters have identified enforcement as a major priority for increased funding.

Board members and harvesters also expressed concern about

- the accuracy and reliability of clam stock assessments as conducted by DFO;
- lack of funding for growing water surveys, with the result that some areas are closed on a year round basis, when only seasonal closures might be required.

On the issue of stock assessment, DFO has advised the Board that the department is developing a standard protocol for stock assessment that would provide guidelines for

independent third-party surveys.

As noted above, the Area C Clam Management Board has repeatedly stated that commercial harvesters should contribute financially to management of the Area C clam fishery, preferably through a tax or levy on clam landings. (Such a landings fee was proposed by both the Sliammon Nation and the Area C Harvesters Association in their submissions concerning a new management process for Area C). At present, however, it is not clear how such a funding mechanism could be implemented or enforced. There is also an important issue of accountability: how will those who expend the funds be responsible to those who provide them, i.e. commercial harvesters?

5.2.6. The Area C Project - Co-Management or Consultation?

In its first year of existence, the Area C Clam Management Board assumed very few management responsibilities for the fishery. Its role in the management of the fishery was limited to advising DFO on :

- criteria for limiting licence eligibility
- appeal criteria
- appropriate dates for fishery openings and closures.

The Board also provided a forum for issues and concerns of individual stakeholders and stakeholder groups to be brought to the attention of DFO.

While DFO continued to pay the majority of the costs of managing the fishery, stakeholders have assumed new costs in time and expenses associated with their involvement in the management of the clam fishery.

As of 1995, the Area C Clam Management Project faced a number of challenges

in achieving a greater degree of community self-management.

1. There are at least four "communities" involved - the three First Nations and the group of non-aboriginal harvesters - and these communities are separated geographically and culturally (although there many relationships between the Sliammon and Klahoose membership).
2. The resource system to be managed is large and there remain many questions about how best to manage the clam resource to ensure long-term sustainability.
3. Because of geographic and cultural isolation, the various stakeholders are not all familiar with one another. There is some degree of mistrust and conflict among the stakeholder groups. Stakeholders do not have easy access to a common source of information, and cannot easily meet together to share information and concerns.
4. The new rules about eligibility for commercial licences resulted in "winners" and "losers", and there continues to be debate and conflict concerning the effects of licence limitation.
5. There has been considerable turnover among commercial licence-holders; there continue to be relatively large number of harvesters; and, for most harvesters, clam digging

is a supplementary source of income, rather than their major livelihood. In the past, it has been easy to enter and leave the commercial clam harvest, both because of unrestricted licensing, and because of the low capital investment required.

The stakeholders involved did, however, appear to share some common beliefs:

1. That the commercial clam resource in Area C should be reserved to local residents.
2. That more effort is required in the management of the clam resource, and that harvesters should contribute toward increased management activities.
3. That local knowledge and understanding of the clam resource are important contributions to good management.
4. That aboriginal communities should be guaranteed a substantial share of commercial clam harvesting opportunities, based on their historic involvement in the fishery and scarcity of other employment opportunities.

Movement toward greater community control of the commercial clam resource requires, of course, not only the cooperation and commitment of those who benefit from the resource, but the support and commitment of government. At the time the Clam Management Board was established, the Federal-Provincial Intertidal Clam Management

reform process was not concluded (and as of mid-1997 was not yet concluded). Consequently, the Board was established in the absence of a clear vision for the long-term management of the fishery, and without a clear understanding on the part of governments or stakeholders as to what the responsibilities, membership and organizational structure of community management bodies should be.

5.2.7. Conclusion

The two components of the pilot project - licence limitation and the Management Board - are closely linked. They are however, separable, in the sense that either could exist without the other. Licence limitation could be continued without any degree of stakeholder involvement in the management of the fishery, and, indeed, many of the benefits that have been achieved by the project are more directly attributable to the limitation of access to the commercial fishery than to the existence and operations of the Community Management Board.

5.2.8. Post Script to the Case Study: Update for 1995-96

The Area C Clam Management Pilot Project was extended for a further two years, from 1995 through 1996. Summary data for these two years of the project are presented in the following tables.

	1995	1996
Savary Island		
Quota	114 tonnes	114 tonnes
Landings	110 tonnes	115 tonnes

Balance of Area C (No Quota established) Landings	114 tonnes	135 tonnes
Average price/kilo	$3.10	$4.00
Number of buyers	8	8

Table 5.1. Selected statistics - Area C Project, 1995 and 1996 (Webb, 1997).

Type of License	1995 and 1996
Sliammon Regular	27
Sliammon Make-up	30
Klahoose Regular	5
Klahoose Make-up	15
Sechelt Regular	0
Sechelt Make-up	15
Other Aboriginal Regular	4
Non-Aboriginal (original and lottery)	64
Non-Aboriginal Appeal	2

Table 5.2. Allocation of 1995 and 1996 Area C commercial clam licences (Webb, 1997)

Problems with illegal harvesting seem to have increased in 1995 and 1996. In 1996, 68 charges were laid under *Fisheries Act* regulations, including 15 charges in connection with harvesting of clams in contaminated areas. About 85% of those charged reside in Area C, and about half of the charges were laid against currently licensed harvesters. Local fisheries office staff point out, however, that there was a considerable increase in enforcement effort in 1996, and that the larger number of charges may more accurately reflect better enforcement, rather than more offenses.

5.3. Case Study Two: The Heiltsuk Commercial Clam Fishery

5.3.1. Introduction

In 1992, a commercial fishery for intertidal clams was initiated by the Heiltsuk Tribal Council (HTC) in the vicinity of Bella Bella on the Central Coast of British Columbia. The fishery was established by a series of agreements between the HTC and the Minister of Fisheries and Oceans beginning in September, 1992. The most recent agreement extends the Heiltsuk Commercial Clam fishery project to March 31, 1999. This fishery is the first off-reserve commercial fishery managed by a Tribal or Band Council in cooperation with the Department of Fisheries and Oceans (DFO) in which access to the fishery is limited to Band members.

5.3.2. The Community

The community of Waglisla (Bella Bella) is located on Campbell Island on the Central Coast of British Columbia, approximately 250 kilometres south of Prince Rupert and 160 kilometres north of Port Hardy (See Figure 5.2.). The population of the census division which includes Waglisla (reported as the Bella Bella Indian Reserve Census Division in the 1991 Census) was 1,095 in 1991, an increase of about 25% over the 1986 population (Statistics Canada, 1995). About 90% of the population are members of the Heiltsuk Indian Band, which totalled 1,874 members in 1994, of whom about 60% reside in Waglisla on reserve lands (Indian and Northern Affairs Canada, 1995:60). Shearwater and "old" Bella Bella are located on Denny Island, separated from Campbell Island by Lama Passage.

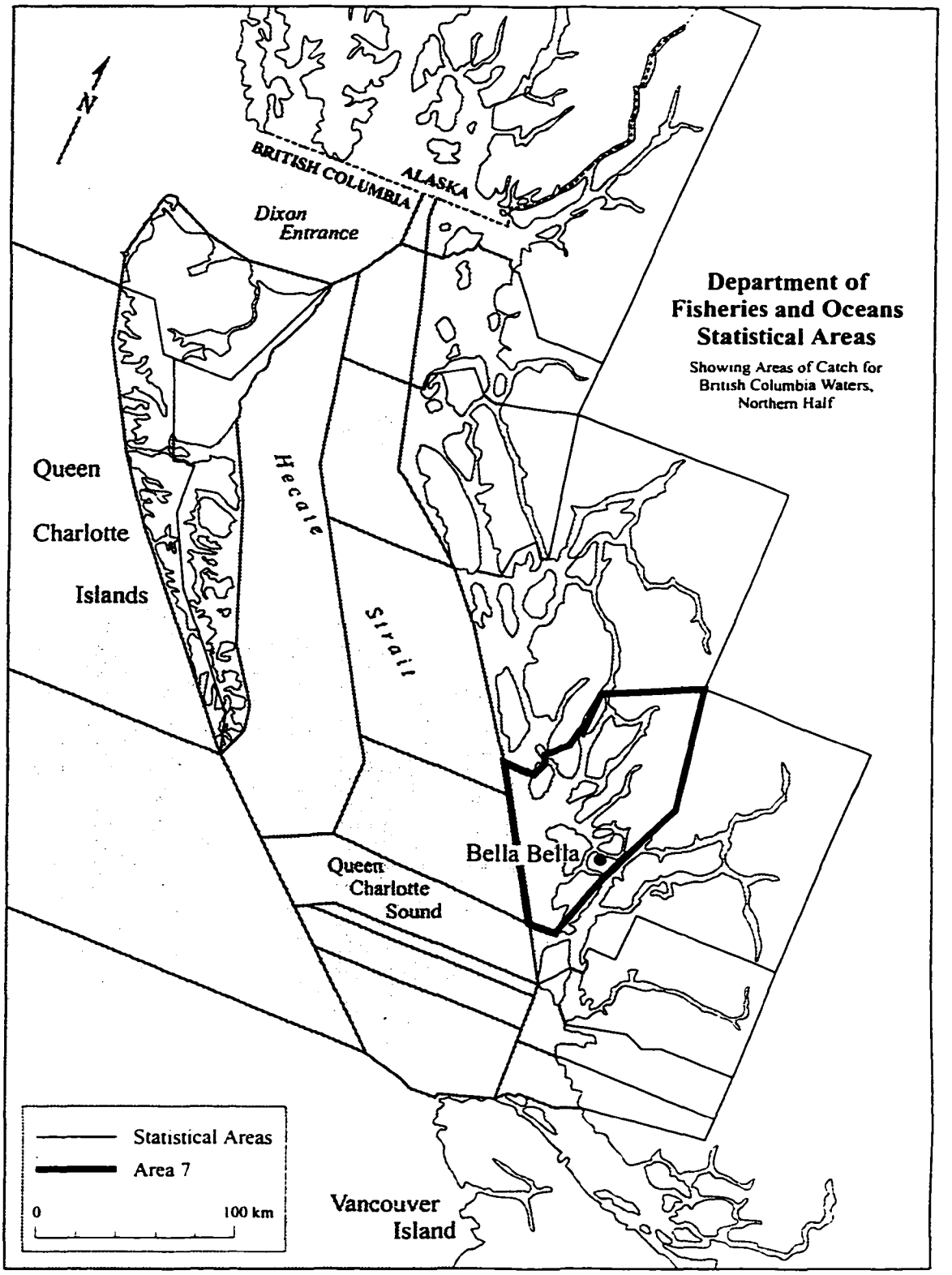

Figure 5.2. Fisheries Statistical Areas, Central and North Coast of British Columbia

Bella Bella is located in the Central Coast Regional District (RD#45). Total population of the Regional District was about 3500 in 1991, of which almost 60% were of aboriginal original - the highest percentage of aboriginal population of any RD in the province. Labour force and employment statistics for the community can be summarized as follows (all data for 1991).

Total Population	1100
% of Population under Age 15	30%
% of Population in the Labour Force	
Age 15-24	55%
Age 24+	72%
Unemployment Rate (as of census date)	
Age 15-24	35%
Age 24+	35%
% of Total Population Age 25+ Employed	47%
Total Employed Population Age 25+	290

Table 5.3. Bella Bella (Waglisla) Employment Statistics
(Statistics Canada:1995)

The unemployment rate in the community is about twice that of the Regional District as a whole.

Employment opportunities are concentrated in the primary and manufacturing sectors - principally the fishing and forestry industries- and in government, health and social services. As is typical of resource dependent communities, many jobs tend to be seasonal. Data for the Regional District as a whole (1995) show twice as many Unemployment Insurance beneficiaries in the winter months as in other seasons, compared with a provincial picture that is much more consistent throughout the year (B.C. Stats:1996). There is relatively little employment in industries such as construction, transportation, financial services, and trade.

Median family income in 1991 was $23,000, substantially lower than the median income of $31,000 for the RD as a whole. Outside the Bella Bella and Bella Coola Reserve Census Divisions, the median income of the RD was $45,000 in 1991, suggesting that there are substantial discrepancies between aboriginal and non-aboriginal income levels - a finding consistent with circumstances in British Columbia and Canada generally. The median income for males was $11,000 and for females, $8,200 (Statistics Canada, 1995).

5.3.3. Project History

As noted earlier in this chapter, a commercial clam fishery north of Cape Caution ceased in the early 1960's due to concerns about PSP. In 1987, the Heiltsuk Tribal Council commissioned a consultant (D.J. Gillis and Associates) to investigate the possibility of initiating a commercial clam fishery to supply product for the new Bella Bella Processing Plant (an enterprise of the Tribal Council). The consultant's report recommended that a fishery be initiated in Statistical Area 7, based primarily on butter

clams and, to a lesser extent, on native littlenecks. It was anticipated that butter clams would be shucked and sold in frozen blocks, while littlenecks would be sold in the shell, either fresh or frozen. Financial projections for the project were based on an annual harvest of about 360,000 kilos. The report suggested 100 harvesters would be employed in the clam fishery for approximately 32 days per clam harvesting season. An additional 14-18 workers would be employed in processing the clams. The consultant projected a gross profit on the operation (sales less direct costs) of approximately 35% of sales (Gillis, 1988). The report did not identify as costs of the fishery either start-up requirements (such as site identification and surveys, PSP and sanitary testing) nor the capital or operating requirements for harvester training, staff training, and ongoing monitoring, enforcement and administration of a commercial clam fishery. As a result, the Gillis report does not provide a good baseline for comparing the fishery's current benefits and costs to the Heiltsuk Nation with the benefits and costs that were anticipated prior to its implementation.

Although the Gillis report did not make reference to manila clams as a possible species for harvesting in the proposed Heiltsuk clam fishery, it had been known since the early 1980's (Bourne, 1982) that populations of manila clams extended to just north of Bella Bella. In 1990, a survey of intertidal clams populations on selected intertidal populations in the north coast areas was undertaken by the Biological Services Branch of the Department of Fisheries and Oceans to

> ... determine if manila clams had spread farther north than recorded in 1981, and to determine if commercial harvest of steamer clams, particularly manila clams, is

> possible in the Bella Bella area (DFO Management Area 7). (Bourne and Cawdell, 1992:2)

The 1990 DFO survey concluded that butter clams were widely distributed throughout the area sampled, although many were stunted. Littleneck clams were the most common clam found during the survey, and displayed a wide size and age distribution, suggesting consistent recruitment in years prior to the survey.

The northernmost populations of manila clams found during the survey were located at Hird Point in Mathieson Channel. Manila clams were very abundant in some survey locations and very large clams were found on many beaches. The 1990 survey noted further that growth rates of manila clams in the area were similar to optimum growth rates in the Strait of Georgia, although slower rates would have been expected as a result of colder water temperatures. It was noted further that

> Abundance of small manila clams... varied from area to area and beach to beach. This may be due to inconsistent annual recruitment. Manila clams in Area 7 are at the periphery of their northern distribution and recruitment is probably sporadic and varies greatly with local environmental conditions. The fact that recruitment is probably sporadic should be considered if commercial harvest is undertaken (Bourne and Cawdell, 1992:27).

Based on the population studies and on assessment of the economic benefits of the fishery, the HTC proposed the initiation of a commercial fishery to DFO. In its first year of operation, the fishery was opened under an experimental permit. In November, 1993, DFO and HTC signed a Clam Fishery Agreement that established detailed roles and responsibilities for management of the new fishery. The agreement was renewed with amendments in subsequent years, primarily to include additional statistical sub-areas to those initially allocated to the fishery. Since 1993, the clam fishery has proceeded under

an Aboriginal Communal Licence issued annually to the Heiltsuk Tribal Council under authority of Section 4 of the *Aboriginal Communal Fishing Licence Regulations* and the *Fisheries Act.*.

5.3.4. Project Description

Geographic Boundaries

During fiscal 1992-93, the clam fishery was carried out in Sub-areas 7-12 (Seaforth Channel), 7-17 (Hunter Channel, Gun Boat Channel and Lama Passage), 7-18 (Stryker Island and Tribal Group), 7-19 (Thompson Bay) 7-20 (south Bardswell Island), 7-21 (Gale Passage), 7-22 (Dundivin Inlet), 7-23 (Boddy-Joassa Channel), 7-24 (Raymond Channel) and 7-32 (St. John Harbour). These areas were tested by Environment Canada for fecal contamination in 1991. Tests in these areas were repeated in 1994 season, and several new sub-areas were surveyed. During fiscal 1994-95, 6 additional Sub-areas were added to the fishery: 7-8 (Ivory Island and Berry Inlet), 7-13 (south Spiller Channel), 7-15 (Return Channel and Toup Passage), 7-24 (Sans Peur Passage), 7-27 (Kildidt Sound) and 7-18 (Kildidt Lagoon).

Mandates and Decision-Making Processes

The Heiltsuk Clam Fishery Agreement prescribes management roles for the Department of Fisheries and Oceans, the Heiltsuk Tribal Council, HFP Guardians and Technicians, and Environment Canada. The B.C. Government is also involved through its regulation of processing plants and fish buyers. These roles are described in the following sections of this project description. Internal arrangements of the Tribal Council and the community for the management of the fishery are not prescribed in the agreement, but

roles have evolved through the life of the fishery and the implementation of other fishery-related enterprises by the band. For the purpose of the clam fishery, groups involved in the internal management process include:

The Chief and Council, Heiltsuk Tribal Council

The Director and staff of the Heiltsuk Fisheries Program (HFP)

The Shellfish Committee (Heiltsuk clam harvesting permit holders)

Bella Bella Fisheries Ltd. (the processing plant)

Allocation and Licensing

In Year One of the fishery (1992-92), the HTC was authorized to fish for a combined total of 114 tonnes of manila, littleneck and butter clams. In 1993, this allocation increased to 114 tonnes each of the three species for a total of 750,000 pounds annually.

Since 1993, up to 75 harvesters at any one time have been eligible to be designated as participants in the fishery by the communal licence holder. Of these, no more than 50 people are to participate in the manila clam fishery and no more 25 in the littleneck fishery. Any of the participants may fish butter clams. Names may be changed at the discretion of the Tribal Council, so long as the maximum number is respected. The Clam Fishery Agreement requires that DFO be informed of changes in the names of participants.

The HFP initially set a quota of 2, 270 kilos per individual permit for manila clams and 4,545 kilos per permit for littlenecks, in order to ensure that the returns from the fishery were spread equitably among the harvester group. However, as the season progressed, a number of participants left the fishery, and their unharvested quota was

transferred to the remaining harvesters.

In the first year of the program, 91 permits were issued, of which only 61 permits recorded landings (many of them single landings). The maximum number of harvesters active at any one time was 41, the minimum 19, and the mean number of active diggers was 29 (HTC, 1995).

Comparative figures for 1993-94, 1994-95 and 1995-96 are as follows:

Fishing Season	# Permits Issued	# Permits Active	Max. # Participants	Min. # Participants	Mean # Participants
1993-94	64	61	50	7	33
1994-95	56	54	42	20	31
1995-96	figures not available for 1995-96				

Table 5.4 Permits and Participants - Heiltsuk Commercial Clam Fishery (HTC 1994, 1995, 1996)

After an initial period of time in which many members of the community tried their hand at the clam fishery, there quickly emerged a "core group" of about 35-38 individuals who have been responsible for the majority of the clam harvest. In the first year of the fishery, permits were allocated on the basis of a draw open to all eligible applicants. Eligibility for the draw was based on current membership on the Band enrollment list and a minimum age of 16. Students and employed members were not eligible to submit their names in the lottery. All names submitted were drawn "from the hat" and numbered sequentially in the order of the draw, and the first fifty individuals whose names were

drawn were then offered a permit. (Individuals who were not present for the draw forfeited their eligibility.) The names of individuals with draw numbers 51 and above were placed on a waiting list for permits that might become available through loss or surrender by the first cohort of permit holders. As the season progressed, available permits were offered to individuals on the waiting list in the order of draw number. (Individuals who did not attend the lottery could submit their names to the waiting list in the order of "first come-first served".) Before receiving a permit, all successful applicants were required to attend a workshop organized to acquaint them with the quality requirements of the fishery and the provisions of the DFO/HTC fishery agreement. (Such workshops have been held periodically since 1992-93, as new permit holders have entered the fishery.)

One of the initial concerns about the project was the lack of experienced commercial clam harvesters in the community. As noted above, there had been no commercial clam harvest in the area for many years, and there had never been a commercial harvest of manila or littleneck clams. Further, few if any, community members harvested manila clams for food. One harvester who had previous experience with manila clams gained on the South Coast was instrumental in training other diggers in the fishery. In other steps to help develop and maintain a core group of experienced diggers, the Heiltsuk Fisheries Program staff in consultation with the Shellfish Committee (a committee comprised of clam fishery permit holders) established a roster of "reserved" permits to be allocated each year to the previous year's "top diggers". Twenty of the fifty manila clam permits were thus reserved for male diggers and five for female diggers. The balance of the permits were available by draw, with unsuccessful applicants placed on a

waiting list. All the littleneck permits issued were distributed by draw. In addition, the 5,000 pound permit quota was waived for manila clams, again to encourage committed harvesters to maintain a consistent supply of product throughout the season. This system for allocating permits and quotas was in place as at the end of the 1995-96 fishery season.

A harvester may lose his or her permit if he or she misses three deliveries of product to the processing plant without a valid medical reason. This rule was adopted by the Shellfish Committee to replace an earlier rule stipulating that harvesters would lose a permit after missing three **consecutive** deliveries. Harvesters may also lose permits if they are found harvesting clams in closed areas, for violations of stipulations in the Shellfish Agreement, or for drug or alcohol abuse during processing. If a harvester does not personally make a delivery and take part in processing (see Section D. below - Processing and Marketing), he or she forfeits 50% of the value of his or her clams to the Heiltsuk Fisheries Program for management of the clam fishery.

Unused permits are to be transferred to the next person on the waiting list, but a harvester inactive for part of the harvesting season may retain his or her permit if he or she cannot use it because of medical problems or educational commitments. If a harvester obtains other employment, he or she is expected to surrender his or her permit. Penalties and other provisions for allocation and transfer of permits have evolved during the course of the clam fishery and appear to remain somewhat flexible.

Openings and Harvest Data

Although the Heiltsuk fishery is licensed for three species of clams, no butter clams and only a small quantity of littlenecks have been harvested. Butter clams have not been

harvested due to unacceptable PSP levels and poor markets (HTC, 1995:3). Low prices for littlenecks relative to manilas have discouraged harvest of this species.

Season (April - March)	Manila Clams Landings in Kilos	Littleneck Clams Landings in Kilos	Total Landings in Kilos
1992-93	79,300	nil	79,300
1993-94	64,830	1,118	65,948
1994-95	114,110	nil	114,110
1995-96	81,940	nil	81,940

Table 5.5. Landings by Weight - Heiltsuk Commercial Clam Fishery (HTC, 1993,1994, 1995, 1996)

The fishery takes place in the late fall, winter and early spring, reflecting the usual "PSP- free" season (see Section E. PSP and Sanitary Surveys). In 1994-95, the first year in which the manila clam quota was reached (and slightly exceeded), the fishery was also open in April and May (of 1994).

In 1992-93, harvesters were able to dig throughout the open season; in subsequent years, openings have been regulated by the HFP to facilitate scheduling of deliveries to the buyer, and to address problems of clams being held for too long prior to delivery. The target for deliveries is twice (two openings) per week. This schedule may be disrupted by bad weather, including cold temperatures, as manila clams are not harvested in this fishery when air temperatures drop below -5 degrees Celsius. (Below this temperature, shelf life drops and mortality of clams left on the beaches becomes unacceptable).

1992-93	50 (10 deliveries)
1993-94	35 (13 deliveries)
1994-95	57 (13 deliveries [estimated])
1995-96	57 [estimated] (13 deliveries)

Table 5.6. Openings and Deliveries - Heiltsuk Commercial Clam Fishery (HTC, 1993, 1994, 1995, 1996)

	April	May	Nov.	Dec.	Jan.	Feb.	March	Total (kilos)
1992-93				6,011	27,80	30,626	14,856	79300
1993-94			3,434	16,355	28,077	12,540	4,424	65948
1994-95	17,720	3,820		15,540	39,372	29,665	7,993	114110
1995-96			12,386	20,063	6,683	18,768	24,040	81940

Table 5.7. Manila Clam Landings by Month , Heiltsuk Commercial Clam Fishery (HTC, 1993,1994, 1995,1996)

Financial Profile of the Fishery

Distribution of returns from the first four years of the fishery has been as follows.

Season	Total Sales (Processed Value from Plant)	Harvester (%)	Plant (%)	Packing (%)	Admin (HFP) (%)	Liaison (%)
1992-93	$188,260	150,680	15,570	21,480	10,550	nil
1993-94	$170,900	153,950	?	?	16,950	nil

1994-95	$451,042	288,693	137,249 (estimated)		25,100 (estimated)	
1995-96	$270,408 (estimated)	225,341 (estimated)	18,027 (estimated)		21,632 (estimated)	5,408 (estimated)

Table 5.8. Distribution of Returns from Clam Sales, Heiltsuk Commercial Clam Fishery (HTC, 1993, 1994, 1995, 1996)

This study did not include a detailed financial analysis of the fishery. In general, HTC responsibilities for the Heiltsuk Commercial Fishery are funded through the Aboriginal Fisheries Program (DFO), through a check-off from clam sales, and from other revenues of the Heiltsuk Tribal Council, including revenues from other communal fishing licences. Funds are specifically identified in DFO contribution agreements for the Heiltsuk Fisheries program to be used for PSP testing and for harvest monitoring and enforcement. These amounts total approximately $20,000, but do not cover all costs of HFP staff and other resources (vessel operation, maintenance, depreciation, etc) for the management of the clam fishery.

In the 1995-96 fishery season, an average price of $3.30 per kilo of clams (F.O.B. the Bella Bella Fish Plant) was distributed as follows:

Harvesters (who also clean and pack the clams)	$2.75	(83%)
Fish Plant rental	.22	(6%)
Administration (HFP)	.26	(8%)
Liaison (with clam buyers)	.07	(2%)

Harvester Expenses and Returns

Harvesters are responsible for supplying personal equipment and for transportation

for themselves and their clams to and from the harvesting sites and from the beaches to the processing plant. Some harvesters also participate on a volunteer basis in beach surveys and collection of mussel samples. The average cost of transportation is $50.00 per trip, paid to one of several harvesters who have equipped herring punts for the clam fishery. The return per hour of labour will differ for each individual harvester, but a ballpark estimate of a harvester's "hourly wage" might be as follows:

13 deliveries of 227 kilos	
each @ $2.75/kilo	$8,115
Transportation costs - $100/delivery	1,300
Net return to harvester	6,815
Time required for each delivery:	
2 days @ 8 hours plus 8 hours processing	
for 13 deliveries (24 hours x 13)	312 hours
Returns per hour of labour	$21.84

Participation in the commercial clam fishery has also enabled some harvesters to qualify for Unemployment Insurance (UI) benefits.

Expenses of the Heiltsuk Fisheries Program (Clam Project)

The HFP is responsible for management activities designated in Fisheries Agreements (described throughout this review) and also purchases sacks, vexar (for packaging), tags for identifying clam shipments, and harvest logs.

Cheques to individual harvesters are issued by the HTC (through the Fisheries Program), which also maintains UIC records and issues UI stamps to eligible harvesters.

In the absence of a detailed determination of the costs of managing the clam fishery, it is impossible to compare the benefits and costs. HFP staff indicate, however, that the 26 cents/kilo checkoff on clam sales covers a relatively small proportion of the total cost of the program; (HFP staff estimate that most of these funds are expended for costs of sacks, vexar and other materials provided to harvesters). About 80% of the direct returns from the fishery accrue to harvesters. Compared with other clam fisheries in the province, returns to harvesters have been roughly 4 times that of the provincial average, on a per licence basis (based on 1994 data).

PSP Sampling and Sanitary Surveys

The Heiltsuk Clam Fishery Agreement requires that the HTC supply Heiltsuk Technicians to establish and maintain mussel stations at prescribed locations, and collect, preserve and provide to DFO, shellfish samples for PSP testing. This testing is carried on throughout the year in accordance with a monitoring program developed by the DFO Inspection Branch and the HFP; the monitoring protocol is stipulated by the HTC Fisheries Agreement and the Clam Fishery Agreement, and is a condition of the Aboriginal Communal Fishing License. Mussel stations are used to monitor PSP levels in waters adjacent to harvest beaches. If the PSP results for the mussel stations are acceptable, clam samples are taken from harvest beaches to test for PSP in clams.

The results of samples from mussel sampling stations and from potential harvest areas (beach samples) are used to determine times and locations for commercial openings. Once the appropriate PSP sampling result criteria are met, DFO harvest prohibition orders may be lifted on a beach by beach basis (DFO, 1993:2). Typically, the prohibition

orders are lifted on a statistical sub-area basis that affects harvest on a number of beaches.

Growing Water surveys (which test for fecal contamination) are necessary to meet the human health requirements of the Canadian Shellfish Sanitation Program (which is essential if clams are to be exported) and were first carried out in 1991 and again in 1994. The next survey is scheduled for 1997. These surveys are conducted by Environment Canada and jointly funded by DFO and the HTC. A number of harvest locations (12 beaches) are closed as a result of these surveys, due to sewage contamination (HTC, 1995:3).

Monitoring and Enforcement

Under the terms of the Clam Fishery Agreement, the HTC is required to provide to DFO catch statistics in form of approved clam sales slips and participant harvest logs. Each harvester is required to maintain a log which records the date of the fishery, hours fished, pounds landed and the area/beach location.

Under the Agreement, the HTC is required to supply technicians and guardians to monitor the fishery in operation, and to verify dockside deliveries in terms of harvest dates, areas, species and amounts. HFP staff may be accompanied by DFO officers at the Department's discretion, but joint DFO/HTC patrols are less common in this fishery than in others which raise more significant enforcement issues (such as the roe herring fishery) . HTC and DFO have developed a monitoring and enforcement protocol dealing with a range of issues stipulated in the Clam Fishery Agreement.

HFP staff monitor every opening of the commercial clam fishery and are also present during deliveries of product to the plant, and during processing and packing.

Monitoring patrols generally involve two boats with two staff per boat. Many fisheries take place at night when harvesters must use lights and are relatively easy to observe. Monitoring is facilitated because all of the authorized participants are Heiltsuk Band members known personally to the HFP staff; there is only one authorized outlet for the product; and the fishery is conducted in a relatively small, clearly delineated geographic area. There have been a small number of incidents involving harvesting in closed areas, but the majority of these appear to be legitimate errors about the location of closed areas (HFP, 1995). In each of these cases, product was returned to the beach.

The extent of poaching by "outsiders" cannot be known with certainty, but both HFP and DFO officials interviewed expressed the belief that this is not a serious problem. The geographic isolation of the fishery, and the communal nature of the fishery make it unlikely that poaching would go unobserved. One Heiltsuk respondent did describe an incident in which a packer boat collected poached product, but was intercepted. Other respondents expressed concern about clams being sold on the "black market" (i.e. not through a licensed plant) under Heiltsuk tags. This concern prompted the HFP staff to tighten up security around the issuance and use of tags identifying clams as Heiltsuk product.

Monitoring and enforcement of the HFP is eased by the isolation of the fishery and by its status as the only commercial manila clam fishery on the Central or North Coast. If other - less rigorously managed - fisheries developed in this area, however, the remoteness and isolation of this area of the B.C. Coast might well prove to be a major problem for enforcement, as it would be extremely difficult to pinpoint the source of

clams and to monitor their destination.

In sum, the HFP dedicate many more resources to monitoring this fishery than DFO is able to commit to monitoring and enforcement of commercial clam fisheries on the South Coast. Monitoring and enforcement are facilitated by the communal nature of the fishery (which tends to encourage harvesters to monitor their peers), the small number of harvesters involved, the limited geographic extent of the fishery, and its relative isolation. If infractions of fishery rules occur, permits can be immediately confiscated from individual harvesters, and the researcher was advised that this has, in fact, occurred.

Processing and Marketing

Under the B.C. *Fisheries Inspection Act* and regulations, all shellfish must be processed in a federally licensed fish processing facility. As of the conclusion of the 1995-96 fishery, all product was processed through the Bella Bella fish plant.

Product quality and marketing have been important issues for the HTC Clam Fishery since its inception. The community is relatively remote, so transportation costs are high, most of the product is sold in relatively distant markets, and bad weather and other factors are a constant concern in terms of delays which may affect product quality, and hence, price. Commercial openings must be carefully coordinated with deliveries to the buyer.

Several different approaches to marketing have been attempted. After some unfortunate early experiences in which buyers took delivery of product without paying for it, the HTC has dealt primarily with one buyer based in Port Hardy who sends a packer boat twice a week on average, and trucks clams from Port Hardy to southern markets.

During one season, clams were sold directly to the Fish Plant which resold them to a U.S. buyer. This arrangement was terminated at the insistence of the clam harvesters who felt that they could obtain better returns by dealing directly with a clam buyer. In the current arrangement, the harvesters rent plant facilities to process (wash, grade and pack) their own product. Initially, harvesters each processed their own clams; now all harvesters work on the entire delivery. This has proven to be more efficient, and also reduces incentives for individuals to retain broken clams, etc. to increase the final weight of their individual delivery. Undersized or broken clams are returned to beaches by HFP staff.

Because harvesters pack their own clams, it is important that each harvester be present, on time, for each delivery, and that harvesters take responsibility for ensuring that sanitation and other standards are maintained. Infringements of processing regulations could result in closing the plant for shellfish processing, with very serious implications for the fishery, as the Bella Bella plant is currently the only operating federally licensed plant in the Bella Bella area. As noted above, the Shellfish Committee has established a rule that any harvester who does not appear for the delivery is docked half the value of his or her clams. This sanction has been applied on some occasions. Harvesters may also be sanctioned for wearing incorrect clothing, use of alcohol, or other infringements of the rules.

The Status of the Resource

Research for this case did not include independent assessment of the biological status of the stocks upon which the Heiltsuk fishery is based, i.e. the "conservation" question and the biological well-being of the fishery. However, it is clearly impossible to

evaluate the success of a fishery without knowing how the resource itself has fared under the management regime.

HFP staff and volunteers have conducted abundance surveys on several beaches since the inception of the project, and some heavily used beaches have been temporarily closed as a result. In consultation with the Shellfish Committee, harvesters have been encouraged to distribute effort on lesser used beaches, and it was reported by HFP staff that most harvesters respect these conservation concerns. In 1994, staff of the Pacific Biological Station conducted abundance surveys in the area, and in the summer of 1996 returned to the area to investigate the success of recruitment to the manila clam fishery. Although no formal analysis and report of these investigations is yet available, anecdotal evidence suggests that clam populations appear to be healthy and that recruitment has been more successful than expected on the basis of previous investigations. During the 1996 survey, HFP staff and volunteer harvesters took part in the assessment to assist them in carrying out DFO approved protocols in future.

The possibility of stock enhancement (e.g. reseeding beaches or transporting clams to more favourable locations on beaches) has been discussed by clam harvesters, HFP staff, and DFO officials. Pending a fuller understanding of recruitment in the fishery, it seems unlikely that such projects will be undertaken, especially in the absence of agreement on who should pay for such work. Some harvesters interviewed expressed willingness to fund enhancement projects from clam income, but stated that many of their colleagues would not be willing to do so.

Although this fishery is conducted in what would be considered to be a remote

location, pollution arising from fecal contamination and fuel spills is a growing concern. Twelve beaches have been closed to clam harvesting as a result of these problems. HFP staff attribute this growing problem, not only to local settlement, but to increasing numbers of remote fishing lodges and the growing popularity of ocean kayaking and camping. Seasonal concentrations of the roe herring fleet (generally in March) frequently result in beach closures, as boats anchor in sheltered bays while they await the opening of the herring fishery.

5.3.5. Issues in Managing the Fishery

Boundaries

The Heiltsuk Commercial Clam Fishery is among the clearest examples in British Columbia of a fishery in which two fundamental "design principles" for successful property regimes are met:

1. There is a clear understanding about **who** is entitled to use the resource.
2. There is a clear understanding about the **physical boundaries** of the resource (i.e. **where** it can be harvested).

While these boundaries exist on an "aggregate" basis, i.e. it is clear that the Heiltsuk Tribal Council is entitled to the total allowable catch of clams within the defined harvesting area, the delineation of boundaries within the group (i.e. who may harvest clams, how much they may harvest, and where) is much less clear, and has been somewhat controversial. In this respect, the Heiltsuk fishery is a good example of the persistent problem of the "commons within the group", a problem that must be explicitly addressed in the design of joint property arrangements.

Heterogeneity and Social Capital

As discussed in Chapter 3, a number of "clues" about successful community managed systems relate to the nature of the community, its size, the relationships among the individuals or groups who are involved in the use and management of the resource, and their various interests. Singleton and Taylor (1992:315) suggest that joint (community) management is more successful when those involved with the resource are a true "community", i.e. when the "community" of users consists of a set of people who a) share some beliefs and values, which extend beyond the particular resource situation; b) have a more-or-less stable group of members; c) expect to continue interacting with each other for some time to come and d) who relate to each other directly and in a number of ways (eg. as fellow fishers, as kin, as neighbours, as members of the school board, etc.)

Similarity of interests and commitment to the success of the resource regime is also very important. It has been observed that, in many fisheries, fishermen who are doing well under current management arrangements will resist changing the rules (even though the fishery as a whole is losing money). It has been argued that the only times at which changes are likely to occur are either at the beginning of a new fishery, when everyone is relatively equal in terms of access and income, and at the final stages of a failing fishery, when things have become so bad that everyone sees the need to change (Libecap, 1995:177).

These observations may have some relevance for the Heiltsuk commercial fishery, and for some of the tensions that have arisen in the fishery. First, is there "one community" involved in the fishery - or several? In discussions with harvesters, program

staff and elected officials and others, there do seem to be different interests in the fishery, or at least different degrees of interest. Second, different points of view have probably become more pronounced as the fishery as progressed. As one respondent observed, "At the outset, everybody was excited and learning together. We were all in the same boat." In the intervening years, this has changed. The roles of "harvester", "manager" and "Band Council" are quite clearly defined in this fishery, and tensions have arisen about the management of the fishery - who should do it, who should benefit, who should pay. As a result of these kinds of issues, the Heiltsuk Tribal Council has appointed a Co-Management Committee involving officials, HFP staff and harvesters to resolve these questions, and to develop a better defined and more "transparent" process for decision-making in this fishery.

From the perspective of the HFP, much of the problem has arisen from the concentration of harvesting activity among a small group of individuals, who have come to think of the fishery as "their fishery", to want to exclude new entrants, and to view fishery management decisions as limiting their potential for earning income from the clam resource (HFP, 1996). HFP recommendations to address these issues include a return to a broad distribution of harvesting opportunities, i.e. the termination of permits reserved for "top diggers". The HFP point out that many of the decisions taken to help encourage a "core" group of experienced diggers (waiving the quota, looking after paperwork, training, etc) are no longer required, but once in place, they have come to be considered as normal entitlements by the harvesters. Once expectations are established, of course, they are difficult to change.

Distributional Issues

A third set of conditions that affect the success of community-management regimes concern two sets of questions:

1. Who makes the decisions? Are those who make the decisions "responsible" in the sense that they benefit from good decisions and bear the consequences of bad ones?

2. Do those who benefit from the fishery bear a proportional share of the costs?

Unlike common property management systems which have evolved from traditional use of a resource, without interference from external agencies, the Heiltsuk Clam Fishery involves the administration by the Tribal Council of a wide set of rules and regulations that are established by DFO, Environment Canada, and the B.C. Government for application to all intertidal clam fisheries. Although this project goes much farther toward local or community management than most others in B.C., the HTC does not in fact have a great deal of independent control over a number of fundamental management decisions, as it has only very limited property rights in the resource. Some of the tensions which have arisen between harvesters and the HFP are, not surprisingly, analogous to those which arise between harvesters and DFO officials elsewhere on the B.C. coast. The relationship is in many ways the same, although the manner in which HFP is able to carry out their responsibilities, their relationship with the harvester group, and the resources which they commit to the process are quite different.

As noted earlier in this study, most of the benefits of this fishery accrue to harvesters, while most of the costs are borne elsewhere (either through the AFS

agreement or from other revenues of the Tribal Council). One way of redressing this balance - to spread the benefits around more equally - is to encourage broader participation in the fishery. This is the overall intent of the HFP recommendations to Council. There may be other approaches, however, that build on experience in other projects which suggests that individuals and groups with a substantial, long term commitment to a resource are more likely to be concerned with its sustainability and to invest resources in maintaining it.

Conclusions

The Heiltsuk Commercial Clam Fishery appears to have been very successful relative to the British Columbia intertidal clam fishery as a whole in terms of:

1. Monitoring and enforcement
2. Product safety
3. Harvester incomes

Anecdotal evidence suggests that resource stocks are not being overharvested, in general, although some of the more popular and accessible beaches are subject to some degree of over-use. Aggregate quotas established by DFO have not been exceeded; in most years, the quota has not been attained.

As the first commercial fishery that was undertaken by the Heiltsuk Tribal Council, the commercial clam fishery has been important in the development of the Heiltsuk Fisheries Program. Through the clam project, Heiltsuk personnel have gained management skills and experience which (together with growing confidence on the part of DFO officials in HTC management abilities) have enabled the Council to take on other

fishery management projects offering significant economic benefits to the community.

The major outstanding issues in the project appear to be those internal to the community, i.e. to the relationships among the various actors in the commercial clam fishery. Addressing such concerns is important, because, in the long term, they could result in problems for conservation and product quality, and may be costly in terms of project management.

Chapter Notes

1. This brief description of the intertidal clam resource is based primarily on Jamieson, G.S. and K. Francis, 1986.

Chapter 6: Case Studies in Institutional Innovation : The Geoduck Fishery in British Columbia

> Well, he hasn't got a front and he hasn't got a back.
> He doesn't know Donald, and he doesn't go "quack".
>
> Ron Konsack and Jerry Elfendahl. *The Gooey Duck Song*

6.1. The Nature of the Resource

6.1.1. Description

The Pacific geoduck (*Panopea abrupta)* is the largest subtidal clam in British Columbia, and one of the largest burrowing clams in the world (Harbo and Peacock, 1983; Goodwin and Pease, 1989). The geoduck (pronounced "gooey duck"), which may attain a shell length of 22 centimetres and a live weight of more than 3 kilograms (Gordon, 1996), is found in the lower intertidal zone to depths of more than 110 metres, primarily in mud or sand bottoms. Adult clams are completely sedentary and, from their position deep in the substrate, extend long, contractile *siphons* as much as one metre to reach the surface of the seabed. Except for very small juveniles, geoducks cannot retract the siphon and body *mantle* into the shell. The siphon (also known as the "neck") encloses *inhalant* and *exhalant* channels within a sheath of muscle, which is in turn covered by a wrinkled brown "skin". The shell of the geoduck is more or less rectangular, and is covered with a thin, light brown layer called the *periostracum*. Beneath the periostracum, the *prismatic layer*, which is formed of calcium carbonate crystals, may be up to 1.25 centimetre thick.

Overall (see Fig 6.1), the appearance of the geoduck is such as to generate embarrassed laughter among first time viewers, and may explain the possible use of the clam in Asia as a supposed aphrodisiac.

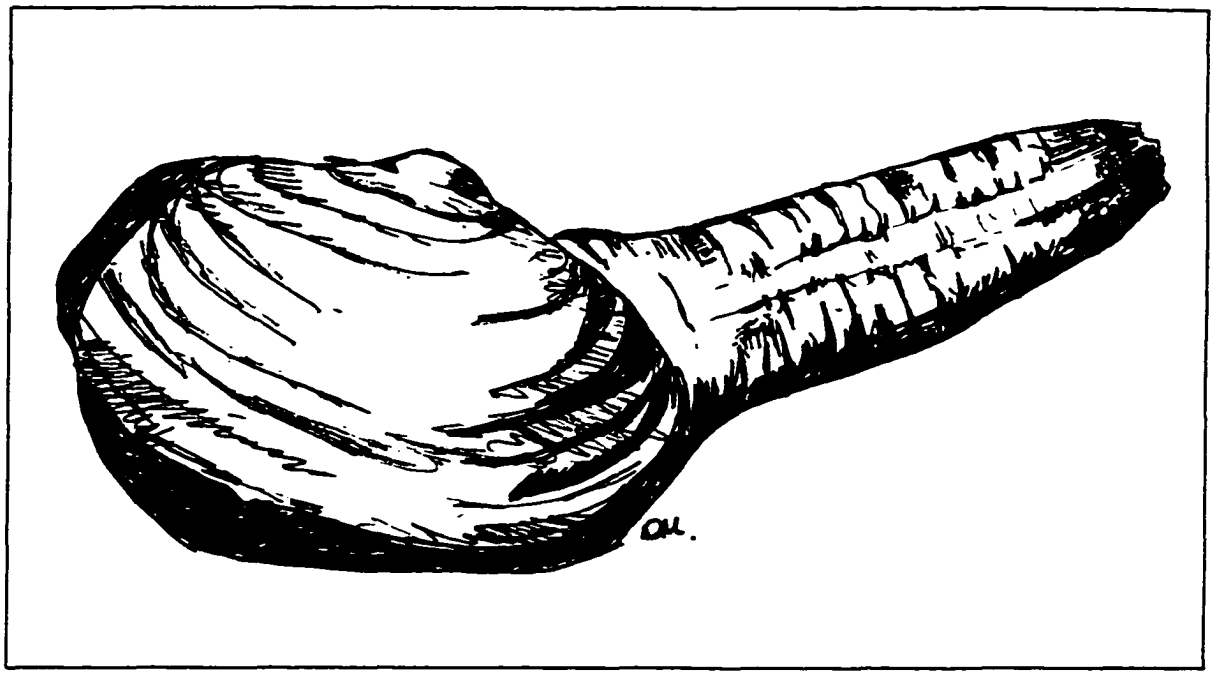

Figure 6.1. Geoduck Clam (*Panopea abrupta*)

6.1.2. Life History

The life history of the geoduck clam is similar to that of other bivalves. By the time adult clams (which are either male or female) have attained a shell length of about 7.5 centimetres, 50% have reached sexual maturity and are between 2 and 8 years old. Initial growth rates are rapid, with clams achieving near maximum shell length and size after 10 years (Harbo et al, 1992) Geoducks are extremely long-lived, often reaching ages in excess of 100 years. The oldest specimen found to date was 146 years old (Gordon, 1996).

Like most other marine molluscs, geoduck clams are broadcast spawners, releasing eggs and sperm into the water column several times during the spawning season (generally March to July in British Columbia). The fertilized egg passes through three larval stages , and a distinct post-larval stage called the *dissoconch*, at which time the

animal (previously known as a *veliger)* lose its *velum* (a swimming organ) and starts to crawl about the sea bottom on a newly developed foot. The dissoconch is also able to anchor itself to sand grains with *byssal threads.* When detached from this "sand anchor", the animal is able to use these threads as a parachute that carries it down current (Goodwin and Pease, 1989). When the geoduck has attained a shell length of 1.5 to 2 millimetres, the siphon develops and the clam starts to burrow into the substrate. The juvenile clam continues to dig itself into the substrate, reaching a depth of about .6 metres (which is beyond the reach of most clam predators) by the end of the second year (Gordon, 1996). Once geoducks have achieved a depth of about .9 metres, they lose the ability to dig, and, if removed from their burrows, are unable to bury themselves again (Goodwin and Pease, 1989).

Geoduck growth slows in the winter, when the clams feed less actively and spend considerable time with their siphons retracted (Goodwin and Pease, 1989).

6.1.3. Populations and Predators

Populations

Geoduck clams are found in coastal waters from Alaska to Baja California, with the largest populations found in Puget Sound, Washington and British Columbia. (A slightly smaller member of the same genus, *Panopea japonica,* is found in Japan.) The original biomass in British Columbia waters is estimated at 248,350 tonnes (Harbo et al, 1995); while the standing stock in Puget Sound has been estimated at 127,000 tonnes before commercial fishing began in 1970 (Goodwin and Pease, 1989). The heaviest concentrations are believed to occur at depths of between 9 and 18 metres (Gordon,

1996).

Not all of this biomass is harvestable, however. In Puget Sound and on the South Coast of British Columbia, there have been substantial losses of harvestable stocks due to pollution (Harbo et al, 1995). While paralytic shellfish poisoning (PSP) has not been a significant problem in Washington or British Columbia, it may be a deterrent to commercial fisheries in Alaska (Goodwin and Pease, 1989). Geoduck clams can be very abundant within their range (up to 36 clams per square metre [Harbo et al, 1986] with average densities in British Columbia of between .45 and 3.5 clams/square metre [Harbo et al, 1995]). However, density of juvenile clams is generally very low. Juveniles appear to "clump" near adult clams, suggesting that juvenile recruitment is related to adult abundance (Harbo et al, 1995; Goodwin and Pease, 1989). This conclusion is strengthened by studies that have found juveniles to be less abundant in areas where geoducks have been harvested (Harbo et al, 1995).

Predators

Despite the high fecundity of geoduck clams, recruitment of juveniles into the population is low and nearly constant (Goodwin and Pease, 1989, Harbo et al, 1995). Mortality during the early stages of life is very high, decreasing as the clam passes through each life stage. As plankton, geoduck clams are subject to predation by fish, other plankton and other suspension-feeding invertebrates. Once settled on the bottom, juvenile clams may be attacked by fish (such as soles and flounders), worms, snails, starfish and crabs.

Natural mortality of adults is very low, however, with survival being directly

related to the depth that the clams are dug into the substrate. As noted above, clams are safe from virtually all predators except human beings once they have reached a depth of about 60 centimetres, although even fully buried adult clams are subject to "siphon grazing" by marine animals such as dogfish shark and some groundfish (Gordon, 1996). Sea otters have been found to dislodge and eat adult geoducks (Gordon, 1996).

6.2. Subsistence and Recreational Fisheries

The name "geoduck" is believed to derive from "gwe duc", a word in the Nisqually language (one of the Coast Salish dialects) meaning "to dig deep" (Milne, 1948; Gordon, 1996). While the extent of the aboriginal fishery of geoducks is not known, the fishery is assumed to have been limited by the clam being available on only the very lowest tides. (However, some First Nations in British Columbia refer to a traditional method of digging geoducks subtidally, using long poles .)

European settlers in the Puget Sound area also harvested the clams for subsistence, as well as for commercial purposes, and an unsuccessful attempt was made in the 1880s to transplant geoducks to the Atlantic seaboard (Gordon, 1996). Recreational "duck hunting" took place in both Puget Sound and southern British Columbia (notably on Sidney Spit near the City of Victoria), but intertidal stocks appear to have been virtually fished out well before the Second World War (Milne, 1948; Gordon, 1996). In the mid-1920's, the Washington State legislature banned the geoduck fishery for conservation reasons; it was reinstated in 1931 with a daily limit of three clams (Milne, 1948).

Prior to 1994, recreational harvesters in British Columbia were permitted by regulation to gather up to 75 clams, by hand digging only. In June of that year, the sport

fishery was closed, mainly in order to reassess appropriate limits in light of rapidly increasing prices for the clams and growing incentives for a quasi-commercial fishery based on "recreational" clams. In April of 1996, the sport fishery was reopened in southern waters, with a reduced limit of three clams per day and a possession limit of six. Because of PSP concerns, the fishery remains closed to recreational fishing in northern waters except for those areas declared open for commercial fishing.

6.3. The British Columbia Commercial Fishery

6.3.1. The Conduct of the Fishery

Commercial geoduck divers excavate the clams from the substrate with a high pressure hydraulic hose equipped with a 1.6 centimetre nozzle, called a "stinger". The divers, who wear dry suits and full face masks and are supplied with air from compressors on tender boats, search for geoduck siphons or for "dimples" - depressions in the bottom that indicate retracted siphons (Pacific Fishing, 1984). Locating clams is most difficult in winter when, as noted above, the clams frequently go dormant and retract their siphons. Under good conditions, however, a diver may collect five or more clams per minute (Harbo et al, 1993).

Geoduck harvesters are also permitted to fish horse clams, but catch levels have been low throughout most of the life of the fishery, and have mainly occurred as incidental to the geoduck harvest. (Recently, however, concerns about increasing harvests and about the impact of harvests upon eel grass beds or other herring spawning locations have resulted in suspension of a targeted horse clam fishery [DFO, 1996]).

6.3.2. The Commercial Geoduck Fishery Prior to Introduction of Individual Quotas

The Early Years (1976-1980)

In July, 1976, the Department of Fisheries and Oceans issued seven geoduck harvest permits for areas in the southern part of the Strait of Georgia (Harbo and Peacock, 1983). The permits provided area-based harvesting rights, with the fishery to be conducted from bottom deeper than ten feet (three metres) below chart datum, a restriction that has since remained in effect. The total harvest in 1976 was 44 tonnes, taken by five operators (Harbo and Peacock, 1983).

The fishery resumed in 1977 on a special permit basis until July of that year, when the *Pacific Shellfish Regulations* were amended to require licences, and to prohibit the taking of geoducks with any "mechanical device" (e.g. a "stinger"), except under a licence. Thirty licences were issued, although only 14 reported landings. The season remained open all year, with no quotas in effect, and continued to be concentrated in the Strait of Georgia, with a small catch from the Tofino area. The total catch for 1977 was 254 tonnes.

The fishery continued to expand rapidly in 1978; by the end of the year, 54 licences had been issued , of which 27 reported landings. Annual landings totalled nearly 1,000 tonnes, a four-fold increase over the preceding year's catch About 25% of the total catch was harvested from the west coast of Vancouver Island, primarily the Tofino area.

Alarmed by the explosive growth in the fishery (particularly in light of very sparse information concerning the status of stocks, spawning success, and recruitment), the

Department of Fisheries and Oceans announced a moratorium on the issuance of geoduck licences, effective June 13, 1979. Further, existing licences were made nontransferable from one individual or company to another (Harbo and Peacock, 1983). In the same year, additional measures were taken to control the fishery. A coastwide quota of 3,628 tonnes was announced, divided into separate quotas for the South Coast and the (hitherto unfished) North Coast. Also, some areas in the Strait of Georgia and Clayoquot Sound were closed for part of the harvesting season. An even more radical change was initiated in late 1979, when the Department announced that geoduck licences would be restricted in 1980 to licence holders with landings of more than 136 tonnes (30,000 pounds) in either 1978 or 1979 (Harbo and Peacock, 1983). (This provision was not, however, implemented until 1981.) The total catch in 1979 was more than 2,460 tonnes, about half of it from the west coast of the Island.

In 1980, the geoduck fishery expanded from the South to the North Coast (separate licences were required for each area). A coastwide total of ninety-five licences were issued in 1980, with 63 of these reporting landings. On the North Coast, seven vessels landed 68 tonnes from an approved quota of 1,587 tonnes. On the South Coast, the fishery exceeded the established quota of 2,041 tonnes by 700 tonnes, mainly from the west coast of Vancouver Island. On August 31, the entire South Coast was closed to harvesting.

The actual geoduck harvest for the years 1976 to 1980 (and subsequent years as well) was probably considerably higher than reported. Prior to 1981, geoduck processors were not required by regulation to accept geoducks with dark coloured meat. (There is no

difference i n the quality of "dark" or "light" geoducks, but the predominantly Asian market places a much higher value on the latter ; in 1984, processors established a grading system based on colour, and many refused to accept those with dark meat [Harbo et al, 1992; Doherty, 1990]) "Dark" clams not accepted by processors were not included in catch data (Harbo and Peacock, 1983). As the proportion of these clams in the geoduck harvest varies from 0 to 75% depending on the site, the number of geoduck harvested may have been well in excess of reported landings, although harvesters generally tried to avoid known areas with large percentages of dark coloured clams. Unfortunately, even if left in the water after having been excavated, rejected clams inevitably die as they are unable to re-bury themselves into the safety of a burrow.

Rapid growth in geoduck landings between 1977 and 1980 was accompanied by rising prices. The average price in 1977 was $.37 per kilogram; this climbed to $.81 per kilo in 1980. Overall, the reported landed value of geoducks increased from under $90,000 to nearly $3 million over a three year period.

The geoduck fishery rapidly became one of the largest employers of commercial divers on the B.C. coast. Between 1978 and 1980 the number of divers increased from 92 to 236; during these years, diver turnover was high (ranging from 44% in 1978 to 65% in 1979) (Harbo and Peacock, 1983). Until the dramatic increases in geoduck prices that followed the institution of individual vessel quotas in the late 1980's, most of the license holders themselves worked as divers.

The work was both demanding and dangerous, requiring that divers spend many hours in cold water, in conditions of heavy currents and poor visibility. Because the only

way to increase earnings in the fishery was to fish as much and as quickly as possible before quotas were filled, there were strong pressures for licence holders and their crews to dive long hours, in all weathers and conditions. The consequences included several deaths, cases of decompression sickness ("the bends"), and early indications among some divers of the development of bone necrosis (Harbo and Peacock, 1983).

	Landings (tonnes)	Permits/ Licences	Price/Kilo	Landed Value
1976	44	5	not available	not available
1977	254	30	.36	$74,380
1978	1,000	54	.56	560,000
1979	2,463	101	.68	1,700,000
1980	3,628	95	.82	2,300,000

Table 6.1. Landings, Values and Licences - Geoduck Fishery, 1976-80

The Era of Licence Limitation: 1981 - 1988

Licence limitations planned for 1980 were implemented the following year. Of the 95 licences in place in 1980, only 52 qualified on the basis of landing criteria. However, successful appeals led to the issuance of an additional 3 licences, for a total of 55. "G" licences (vessel licences for geoduck and horse clams) were formally introduced in 1983, and were transferable from the original licensed vessel to a vessel of equal or shorter length.

Between 1981, when limited licensing was introduced, and 1988 (the year before introduction of a vessel quota system) the fishery followed a pattern of relatively low prices, increased landings, and growing problems with enforcement.

Even with the introduction of licence limitations (which reduced the number of licences by almost half) the Department faced severe problems in enforcing the established quotas. This difficulty arose in part from the fact that, although licences dropped by almost 50%, the number of vessels fished was virtually unaffected. In 1980, 63 vessels were active in the fishery; this dropped to 49 the following year, but rose to 52 in 1985; in 1986, there were a total of 55 vessels operating in the fishery (Harbo et al, 1992). Thus, limited entry had very limited, if any, effect on existing fishing capacity, although it did limit the potential for expansion. Meanwhile, harvesting efficiency improved, as divers became more experienced and skilled, and more became known about the location and extent of productive geoduck beds. Thus, with each passing year, less time was spent looking for clams, and more time spent harvesting them. The following table displays the history of landings versus quotas from 1979, when quotas were first introduced, until 1988.

Year	Quota (tonnes)	Landings (tonnes)	Landings in Excess of Quota
1979			
. North Coast	1,587	0	(1,587)
. South Coast	2,041	2,463	422
Total	3,628	2,463	(1,165)
1980			
. North Coast	2,587	68	(1,519)
. South Coast	2,041	2,733	692
Total	3,628	2,801	(827)

Year	Quota (Tonnes)	Landings (Tonnes)	Landings in Excess of Quota (Tonnes)
1981			
. North Coast	986	509	(477)
. South Coast	1,815	2,733	380
Total	2,801	2,704	(97)
1982			
Coastwide	2,930	3,134	204
1983			
. North Coast	907	501	(406)
. South Coast	2,041	2,134	93
Total	2,948	2,635	(313)
1984			
. North Coast	907	575	(332)
. South Coast	2,086	2,909	832
Total	2,993	3,484	500
1985			
. North Coast	907	1,436	529
. South Coast	2,063	3,934	1,871
Total	2,970	5,370	2,400
1986			
. North Coast	1,474	1,692	218
. South Coast	2,506	3,313	807
Total	3,980	5,005	1,025
1987			
. North Coast	1,608	2,148	540
. South Coast	2,630	3,587	957
Total	4,238	5,735	1,497

Year	Quota (Tonnes)	Landings (Tonnes)	Landings in Excess of Quota
1988			
. North Coast	1,576	2,026	450
. South Coast	2,196	2,541	345
Total	3,772	4,567	895

Table 6.2 Geoduck Quotas and Landings, 1979 - 1988
(Harbo et al, 1992:36)

As the above table indicates, pressure on the fishery peaked in the mid-1980's. Landings in each of 1985, 1986 and 1987 exceeded 5,000 tonnes per year, and exceeded the established quota by at least 1,000 tonnes in each of those years - even though the quotas themselves were increased by more than 40% between 1985 and 1987. In 1985, landings were nearly double the allowable catch.

Processing and Marketing

The edible parts of the geoduck are the siphon and body meat (i.e. the mantle or "belly"). There was little market for the body meat in the earlier years of the fishery and it, together with dark coloured geoducks, was routinely "dumped" (Harbo and Peacock, 1983:12). Before a partial export ban imposed in 1979, it was common practice to truck live geoducks to the United States for processing. After that time, live geoducks could not be exported live except by air; this step was taken to protect the new Canadian geoduck processing industry.

The geoduck fishery has always served a predominantly export market, primarily Japan and other Asian countries. For many years, most of the product was shipped to Japan in the form of frozen neck (siphon) meat. The main markets for live clams and fresh

shucked meat were the United States and Hong Kong (Harbo and Peacock, 1983). After 1981, dumping of body meat became illegal, although it still occurred, in the absence of sufficient market demand.

Although, as discussed below, attempts were made to try to ensure a year round supply of product for the frozen (and more lucrative fresh) markets, competitive "shot gun" openings resulted in repeated gluts on the market, alternating with product shortages.

Several respondents observed that these circumstances placed processors in a position of considerable power over harvesters. Typical comments included:

- "There was always a glut on the market (so) processors could keep the prices down"
- "Fishermen were obligated to processors who could drop prices in the middle of an opening"
- "It was all processed product; the buyers had the upper hand"
- "Processors pushed for quality control (so) we dumped a lot (of clams) to avoid dark ones"

Prices and Incomes

Between 1980 and 1986, geoduck prices stabilized at about $.85 per kilogram. Rising prices in 1987 and 1988 are attributed to appreciation of the Japanese yen, increasing Japanese demand for product, and a larger proportion of product supplied to the higher-valued live market.

Year	Value $000	Average Price $/KG	Mean Value/Operating Vessel # Vessels	Mean Value
1981	2,163	.80	49	44,140
1982	2,821	.90	53	53,230
1983	1,792	.68	53	33,810
1984	2,927	.84	44	66,520
1985	4,618	.86	52	88,810
1986	4,204	.84	55	76,440
1987	6,194	1.08	56	110,610
1988	9,807	2.14	56	175,125

Table 6 3. Prices and Incomes - 1981-1988 (Harbo et al, 1992:35)

Mean income per vessel showed a sharp increase in the mid-1980's, but this was related almost entirely to sharp increases in catch. If landings had been equivalent to quotas, earnings per vessel would have dropped to $49,100 per vessel in 1985, $46,440 in 1986, and $82,730 in 1987. Respondents indicated that much of the "goldrush" in the geoduck fishery was dissipated by increased harvesting costs, as vessels "chased openings" around the coast. In the rush for the spoils, some harvesters went broke. (Doherty, 1990). For those who remained in the fishery, mean **net** revenues in 1988 reached about $115,000 (Kerr, 1991).

Stock Assessment and Quota Management

As noted above, the commercial fishery in British Columbia began on the basis of very limited information concerning the extent, abundance and productivity of geoduck

stocks. Accurate information about each of these factors is necessary to produce appropriate fishery quotas, i.e. appropriate determinations of the long term sustainable (annual) yield from the fishery for a particular geographic (management) area.

Quota Calculations

Quota calculations are derived from the formula:

Quota = (HARVEST RATE) x (AREA) x (GEODUCK DENSITY OF THE ORIGINAL BIOMASS)

Harvest rates reflects assumptions concerning productivity, and is expressed as a percentage of virgin biomass (Harbo et al, 1992:5-6). For example, if a population is estimated to increase at a rate of 5% per annum, then this percentage is assumed to be harvestable annually without reducing the original biomass.

Estimates of geoduck bed areas are based on harvest charts submitted by fishers, and, since 1984, on data submitted in harvesters logbooks. As the fishery developed, estimates of the total geoduck bed area increased each year, as new beds were identified by commercial divers. The first published estimates of geoduck bed area (in 1984) were 10,180 hectares for the South Coast, and 704 hectares for the North Coast. (1994 estimates were 12,742 hectares for the South Coast and 3,155 hectares for the North Coast [Harbo et al, 1994].)

"Density" represents the product of average geoduck weight and the estimated number of geoducks per square metre of seabed. Density estimates are based on surveys and on data supplied by harvesters. As information has accumulated about each of these factors, the assumptions underlying quota calculation have changed.

The first geoduck surveys were conducted in 1977 by the Marine Resources Branch of the provincial Ministry of the Environment in the Queen Charlotte, Johnstone and Georgia Straits. In 1978, the Branch surveyed additional portions of the Strait of Georgia, and parts of the west coast of Vancouver Island. Joint federal/provincial surveys were carried out in 1980. Although a North Coast fishery was initiated in 1980, no formal surveys were carried out until after 1984.

Harbo and Peacock (1983:2) observe that

> Surveys were initially intended only to establish the extent of economically harvestable geoduck stocks in British Columbia. However, they have been used as estimates of geoduck standing stocks.

Based on initial surveys, an arbitrary "conservative" annual harvest rate of 2% to 5% of the estimated standing stock was suggested (Harbo et al, 1992). The Department of Fisheries and Oceans adopted a lower figure of 1.5% for the years 1980 and 1982. Quotas were sometimes set at high levels (in excess of documented stock)

> ...to promote exploration and development of the fishery into new areas. In some instances, "exploratory" quotas were set, or timed openings without quotas set for new fishing grounds. These quotas were (later) rationalized to a number based on estimated fishing area and geoduck biomass (Harbo et al, 1992:4).

During the initial stages of the North Coast fishery (1980 to 1984), the entire quota was exploratory - and fluctuated dramatically. For example, quotas in 1979 and 1980 of more than 1,590 tonnes were reduced to less than 1,000 tonnes for 1980.

Jamieson (1984:65) suggests that sustainable yield was not the original

management objective for the geoduck fishery, noting that while,

> ...the present objective is to stabilize landings at approximately the maximum sustainable yield...(this is) in contrast to a management proposal in the early years of the fishery that geoducks, because of low and sporadic recruitment, were effectively a non-renewable resource and could be 'mined'. This management proposal was not accepted because of some strongly argued views that geoducks could and should be managed on a long-term sustainable yield.

Unfortunately, sufficient biological information to support the achievement of this objective remained elusive for many years after the initiation of the fishery (Jamieson, 1984). As discussed in the concluding sections of this case study, the accuracy and adequacy of such information is still a matter of concern to both officials and harvesters.

Quota Management

Until the late 1980's, the issue of whether or not quotas were properly set was, in some degree, an academic question, as quotas were consistently either underfished (before the fishery expanded into the North Coast) or overfished (thereafter). Before 1989, the Department of Fisheries and Oceans attempted to manage the geoduck fishery through two main strategies: 1) licence limitation (discussed above) and 2) time and area closures combined with area quotas. Management areas and sub-areas were established in an attempt to spread out fishing effort, and reduce the potential for local overharvesting (Harbo et al, 1992). Rather than declaring coastwide openings, Fisheries and Oceans opened and closed each management area as its particular quota was taken (or, quite often, exceeded). The Department attempted to distribute openings throughout the year, to provide a more consistent year-round supply of product, but the majority of landings continued to be concentrated in the early part of the year (Wipfli, 1993). Product quality

suffered, as well, from the race to take area quotas as quickly as possible.

In the first ten years of quota management of the fishery (1977 to 1987), two general trends emerged: the quota was divided up into increasing number of management areas, and (in most management areas), the openings became shorter each year. Harvesters were not restricted to particular areas, but were free to move to new areas, as they were opened. By 1987, some management areas on the South Coast were open for as little as 2 days.

Harvesters interviewed described the conditions in the fishery during this time in the following terms:

> . Quotas were filled earlier and earlier every year. The fleet became more efficient and chased openings all over the coast.
>
> . The North Coast was very disorganized - sometimes not enough product to fill packers (but gluts in other places).
>
> . It was a "shotgun" fishery. Boating accidents; packer sank. Often pushing boats beyond their limits
>
> . Always overrunning the area quota. Competing in bad weather. Looked like it was going the way of the abalone.
>
> . It was like a war. You'd be away fishing for months at a time.
> . Nobody helped each other. Areas were mobbed by boats. Went over the quota 90% of the time.

Information is not available concerning the amount of money and staff time expended by DFO in attempting to control the fishery during these years, but it was not the Department's first priority (this was reserved for higher profile fisheries such as salmon and herring) (Turris, 1988). It is difficult to imagine how the fishery as then organized **could** have been effectively policed: it was highly efficient, conducted (albeit in

sporadic bursts) over a huge geographic area - and carried out primarily underwater. Further, the structure of the fishery encouraged harvesters to fish as much as possible and as fast as possible before the available quota was taken by their competitors. By the mid-1980's, the geoduck fishery in British Columbia was a barely restrained "tragedy of the commons" in the making.

6.3.3. The Transition to Individual Vessel Quotas

In 1982, the Commission on Pacific Fisheries Policy recommended that the geoduck fishery immediately be converted to individual quota licensing (Pearse, 1982) and anticipated that the fishery might eventually progress to mariculture leases. Commissioner Pearse (1982:139) contended that

> The transition to quota licences will have several important benefits: it will eliminate incentives to overexpand fishing capacity; it will facilitate management and regulation of the catch by areas; and it will afford greater security to licensees.

It was proposed further that, for the longer term development of the fishery,

> ... the Department, in consultation with the geoduck licensees (in each management zone) should begin to identify appropriate geoduck management areas and their sustainable yields, with a view toward identifying mariculture lease areas for licensee's quotas in future (Pearse, 1982:139)

The Commission's proposals were not adopted; however, some five years later, geoduck harvesters themselves advanced proposals for a fishery based on individual vessel quotas.

By the mid-1980's, the extent and severity of problems in the geoduck fishery were widely recognized by both harvesters and DFO. Under the leadership of a new president, the Underwater Harvesters Association (the geoduck harvesters' association which had

been founded in 1981) began to seriously debate the idea of individual vessel quotas for the fishery. On April 5, 1988, the Association (UHA) presented DFO with a formal proposal recommending individual quotas (IQ's) in the fishery, with equal shares of the coastwide quota to be allocated to each quota (Turris, 1988).

The recommendation was not supported by all geoduck licence holders. The majority of opposition came from "highliners", that is, harvesters with a history of very high landings, whose annual harvest would be much reduced under the proposed allocation of quotas. Most of the "highliners" were active in the North Coast fishery. With larger boats (and sometimes with processing licences), these harvesters were able to stay out longer, fish in worse conditions, and handle larger volumes of product. Some of these individuals held more than one licence; one held five.

Support for the proposal was strongest among licence holders with smaller vessels and histories of smaller landings. Licence holders who fished mainly in the Strait of Georgia were particularly supportive, as they had already begun to focus on supplying the much more lucrative live market, but were hampered in this process by short-lived "shotgun" openings in the heavily fished South Coast.

Interview respondents noted that several factors (in addition to widespread appreciation of current problems in the fishery) contributed to majority support for the proposal:

> some influential "highliners" supported "equal shares" even though they themselves would be negatively affected, at least in the short run;
>
> prices were rising, and promised to rise even more if harvesters could take full advantage of opportunities in the live market;

> "Most harvesters were young people - no long history in fishing - they could see what was going on".

The Department of Fisheries and Oceans did not share the UHA's enthusiasm for "coastwide" individual quotas. While acknowledging that IQ's offered economic advantages to the harvesters, the Department expressed two major concerns:

> 1) that Individual Quotas would increase incentives for "high grading", especially for rejection of dark-coloured geoducks;
>
> 2) that, in the absence of area licensing, pressure on the best and most accessible geoduck beds would continue, as
>
> ...fishermen eager to catch their quota from the most productive and economical areas are expected to continue to catch as much geoduck as quickly as possible making it difficult for DFO to estimate closure time (Turris, 1988:6).

These concerns led the Department to conclude that:

> IQ's provide greater incentive, and perhaps more opportunity, for fishermen to high-grade catch, fish in closed areas, and misreport catch. To offset these problems, DFO may have to improve enforcement by increasing Fishery Officer presence at landing sites and on the fishing grounds, levying heavier penalties against violators, and/or by bringing more offenders to trial and publicizing convictions (Turris, 1988:7).

The Department contended that area licensing and area quotas were preferable to Individual Quotas from every perspective (i.e. biological conservation, administration and enforcement, and DFO resource requirements) except that of economic efficiency (Turris, 1988).

After a series of meetings extending through the summer of 1988, the UHA and the Department reached agreement on a hybrid proposal that combined area licensing and

Individual Vessel Quotas (IVQ's), and committed the licence holders to pay for independent dock-side monitoring and validation of catch. (As a small number of the geoduck licence holders continued to refuse to support the proposal, the rest of the licence holders contributed additional funds to pay for the required monitoring activities.) The new arrangement was launched on a trial basis in January 1989 for two years, and subsequently extended for an additional year.

6.3.4. Individual Vessel Quotas: The First Three Years (1989-1991)

The New Regime

The total coast quota for 1989 was set at 3,992 tonnes - an increase of 6% over the 1988 aggregate quota - or 72.6 tonnes (72,730 kilos) per licence. (The UHA had proposed equal vessel shares of 91,000 kilos or a total quota of 5,000 tonnes.) Quotas were distributed among three harvest areas as follows:

South Coast (inside)	12 quotas
West Coast Vancouver Island	21 quotas
North Coast	22 quotas

Each licence holder was required to make an annual selection of the harvest area in which to fish. Transfer and stacking of licences/quotas were permitted, and there were no restrictions placed on vessel length.

Quota continued to be distributed among management units. In 1989, there were 7 management units on the North Coast and 13 on the South Coast. However, to facilitate catch monitoring and validation (by minimizing the number of landing ports) and to reduce fishing pressure at some locations, the fishery in each management unit was

established on a three-year rotation. That is, each management unit was to be fished only once in every three year period, at three times the annual rate. (The exception to this procedure was Area 24, on the west coast of Vancouver Island, where the fishery remained on an annual basis as it (the fishery) "... is important to resident geoduck fishers, the local community and a processor located in Tofino" [Harbo et al, 1992:12].)

An independent contractor (Archipelago Marine Research) was retained to conduct catch monitoring and validation. Geoducks could be landed only at designated ports, where vessel and/or packer loads of geoducks were scrutinized by observers as the clams were landed and weighed. Observers were also assigned to monitor deliveries to processing plants, to ensure that landings matched deliveries.

Total and individual quotas remained at the same levels in 1990 as in 1989, as did the overall distribution of quotas among the three harvest areas. The number of management areas on the North Coast was reduced from 7 to 4.

In 1991, the final year of the trial period, the coastwide quota was reduced by almost 16%, and the number of management units increased from 17 to 41, coastwide.

Evaluation of the Fishery - 1991

In mid-1991, the Department of Fisheries and Oceans conducted a cost-benefit analysis and an impact analysis of the new IVQ/Area Licensing system. On the basis of these analyses, which included a review of log book data, two financial surveys of vessel owners, and several surveys of fishery stakeholders (including licence holders, divers, DFO staff, processors, and contracted observer staff - i.e. staff of Archipelago Marine

Research), the Department pronounced the changes in the fishery to be "dramatic" (Kerr, 1991):

- The landed price of geoducks increased from an average of $2.13 per kilogram in 1988 to $3.19 per kilogram in 1989, (although the price declined somewhat - to $2.67 per kilo- in 1990);
- Live product as a percentage of all geoduck sold in the wholesale market more than doubled from 39% in 1988 to 84% in 1990;
- The number of active vessels decreased from 55 in 1988 to 45 in 1990, due to licence stacking;
- Fewer crewmen (divers and tenders) were employed in the fishery, due to a reduction in the number of vessels fished, a drop in the average crew size and a decrease in the Total Allowable Catch. However, divers who remained in the fishery were employed for more days per year under improved working conditions.

The Department estimated an increase in the net annual value of the fishery attributable to the new management regime of nearly $5.5 million (1991 dollars). Increases in net value resulted mainly from increases in wholesale value of the product, which were attributed to:

> ...higher prices (resulting from)a more valuable product mix, higher quality, improved product handling, an extended fishing season, and greater matching of supply with demand brought about by the new regime. (In addition) cost savings have been identified in the areas of vessel fuel consumption and labour/material used in harvesting and processing. (Kerr, 1991:5).

The financial benefits of the new regime were captured mainly by licence

holders. Surveys carried out for the years 1988 and 1990 indicated an increase in vessel owners' mean net revenue (before leasing and interest expenses) of 27% (from $115,000 to $145,000 on average). There was a sharp increase in hull expenditures in 1989, which was explained by vessel owners increasing their investment in hull and equipment partly to buy out other vessels, and partly to accommodate the additional quota they had purchased. "As anticipated, vessel owners ...bought out the less efficient fishers, thus improving the overall productivity of their fleet while lowering fixed harvesting costs" (Kerr, 1991:14). Capital expenditures declined the following year.

The initial sharp rise in landed values following the introduction of IVQ's was not maintained in 1990 and 1991. Aggregate landed values dropped to $10.6 million and $9.7 million respectively in these two years. However, as discussed below, this decline halted and reversed in 1992.

The DFO survey found processors' net revenues to have increased overall - due to a higher proportion of high-value live product in deliveries from harvesters - but the processors' share of revenues declined. "This suggests that fishermen were able to strengthen their bargaining position with processors" (Kerr,1991:12).

As a group, crew members benefitted least from the new regime. The total number of divers employed dropped sharply - from 192 in 1988 to 125 in 1989 (excluding owner/divers). Most of the divers who left the fishery appear to have been less active, part-time workers; some were displaced to other (non-quota) dive fisheries, such as sea urchin and sea cucumber (Kerr, 1991:9). While the response rate of divers to the DFO survey was low, those who did respond indicated that earnings had declined for

those crew paid on a "production" as opposed to a "share" basis, and that vessel owners were increasingly shifting to a production basis of payment (Kerr, 1991:12). For those divers remaining in the fishery, however, working conditions were much improved. Wage loss claims under Workers Compensation declined markedly (Kerr, 1991), and crewmen indicated that fishing safety and vessel maintenance had improved, and that crews were less likely to be required to fish in poor weather conditions.

From the perspective of economic efficiency, the new regime was clearly a success. Licence holders, DFO officials, processors and observers surveyed by DFO expressed the belief that conservation objectives were also well served by the IVQ system. With respect to over-fishing, it was found that

> In the opinion of licence holder/operators and DFO staff, overfishing had decreased...It is now much less likely that an area quota will be exceeded because of a miscalculation in fishing effort. Licence holders/operators and DFO staff believed that misreporting of catch/area had decreased. The licence holders would have a vested interest in watching each others' activities since any violation would effect (sic) their overall well-being (Kerr:1991:30).

Further, poaching was believed to have declined, with this decline due in part to the fishery requiring a significant investment in vessel and equipment. Improvements were also seen in the area of stock assessment, with industry working more closely with DFO to determine the true state of the stocks (Kerr, 1991).

Most respondents to the DFO survey expressed the belief that (contrary to DFO concerns about the impact of IQ's) the problem of "high-grading" (especially with regard to dark-coloured clams) had not worsened under the new system, except on the West Coast of Vancouver Island. Divers, however, believed that high-grading had become

more widespread.

All groups surveyed by DFO found that the level and accuracy of monitoring (i.e. dock and plant monitoring by the independent contractor) were much improved over the previous system which relied solely on "hails" (that is, fishermen's reports) and sales slip data. The level of enforcement (by DFO) was believed to have decreased; but many respondents observed that the decrease was not significant because DFO had never dedicated sufficient resources to enforcement in the geoduck fishery.

In general, all groups surveyed, except for crewmen, applauded the new program, and many respondents felt it ought to be extended to other fisheries. The new regime was confirmed in 1992.

	1989	**1990**	**1991**
Aggregate Quota			
. N. Coast	1,597	1,597	1,347
. S. Coast	2,395	2,395	2,021
Total	3,992	3,992	3,368
Aggregate Landings			
. N. Coast	1,600	1,596	1,327
. S. Coast	2,387	2,387	2,006
Total	3,987	3,983	3,333
# Management Units			
. N. Coast	7	4	19
. S. Coast	13	13	22
Vessels Fished	47	46	47
Quota Distrib.			
. N. Coast	22	22	22
. S. Coast (inside)	12	12	12
. W. Coast	21	21	21

Price per Kilo	$3.15	$2.67	$2.84
Landed Value	$12.6 million	$10.6 million	$9.5 million
Landed Value per Licence	$229,000	$192,730	$172,730

Table 6.4. **Geoduck Fishery Statistics - 1989-1991** (Harbo et al, 1992; Harbo et al,1994)

6.3.5. "More Pay - More Say" - The Geoduck Fishery in the 90's

The following table summarizes landings and values in the geoduck fishery between 1992 and 1995, a period marked by falling quotas, rapid price increases, and a growing role for harvesters in the management of the geoduck industry.

	1992	**1993**	**1994**	**1995**
Aggregate Quota				
. N. Coast	1,197	1,061	1,102	1,144
. S. Coast	1,666	1,371	1,143	953
Total	2,863	2,432	2,245	2,097
Aggregate Landings				
. N. Coast	1,199	1,063	1,091	
. S. Coast	1,666	1,371	1,136	Not available
Total	2,865	2,434	2,227	
Management Units				
. N. Coast	24	27	32	37
. S. Coast	37	20	30	41
Vessels Fished	45	44	42	Not available
Quota Distribution				
. N. Coast	23	24	27	30
. S. Coast	12	12	10	12
. W. Coast	20	19	18	13

Price per Kilogram	$5.65	$10.99	$14.97	$20.05
Landed Value	$16.2 million	$27 million	$33.4 million	$42.5 million
Landed Value/Licence	$295,000	$491,000	$607,700	$773,000
Wholesale Value	Not available	$33.6 million	$40 million	$47.4 million
Wholesale Value as % of Landed Value	Not available	124%	120%	111%

Table 6.5. **Selected Statistics - 1992-1995** (Harbo et al, 1995; MAFF,1995; DFO,1996 [Catch Statistics]).

Although quotas declined by 27 % from 1992 to 1995, prices increased by 355% on average, and total landed value increased by more than 260 %. The ratio of wholesale to landed values declined during these years, reflecting a larger proportion of live product in the market.

The Role of Harvesters in Management of the Fishery

Geoduck harvesters (as represented by the Underwater Harvesters Association) are involved in the management of the fishery in three ways: first, in a consultative capacity through membership in the Department of Fisheries and Oceans Geoduck Advisory Committee (which is chaired by DFO and includes representatives of the Provincial Government, the processing sector, Archipelago Marine Research (AMR), and First Nations; second, through their financial support of monitoring, validation and other activities carried out by a contracted agency (AMR); and third, through both financial support for, and direct involvement in, the areas of research and

industry development.

Role of the Geoduck Advisory Committee

The Geoduck Advisory Committee is primarily responsible for reviewing the Annual Management Plan for the geoduck and horse clam fisheries.

IVQ Monitoring and Management

In 1989, geoduck harvesters contributed about $230,000 to monitoring, validation and other management activities. By 1995, this contribution had grown to more than $1.6 million, and the range of management and research activities undertaken with UHA funding had greatly expanded. These funds are collected by the UHA, not the Department of Fisheries and Oceans which at present has no regulatory authority to collect fees other than licence fees. Payment of the fees is not a condition of the "G" license, nor is membership in the UHA. Thus, payment is, technically, voluntary (but all licence holders pay the fee).

Of the amount contributed by licence holders to the UHA, about 13 cents per pound of geoducks landed is expended for dockside monitoring and validation and for the services of a patrol vessel on the north coast. These activities are conducted by Archipelago Marine Research. Specific duties of AMR include:

> ...providing a group of trained observers, ensuring quality control of validation procedures and validation data, maintaining a database of all geoduck and horse clam landings coastwide, and reporting information on remaining vessel quota, the status of geoduck quota areas and any regulatory infraction. (Archipelago Marine Research, 1996:1).

AMR provides both dockside and plant monitoring. In the course of their duties, observers are required to report any "geoduck incident", i.e. any situation involving a

breach of the Geoduck and Horse Clam Management Plan or other unusual or suspicious incident in the fishery. Such incidents are to be reported by observers, with reports serving a number of functions (Archipelago, 1996a:1):

> First, they (the reports) notify vessel operators of any non-compliance with fishery regulations. Secondly, they provide Archipelago, the Underwater Harvesters' Association (UHA) and DFO with the information to identify and rectify the most troublesome aspects of the geoduck fishery and the validation program, both on the fishing grounds and in the delivery system. Finally, they give Fishery Officers the information required to investigate violations of fishery regulations and to lay charges if necessary.

The UHA also provides funding for:

- PSP sampling on the North Coast (since 1992) and, increasingly, on the South Coast;
- Water Quality (Growing water) surveys for Environment Canada;
- Stock assessment surveys coastwide. This work has included joint surveys between UHA and First Nations on the central and north coasts, and in the Gulf Islands;
- investigative activities directed to reducing poaching and "high-grading";

As is discussed below, a major issue in the development of the fishery has been the lack of adequate and reliable data on stock abundance, recruitment, harvesting impacts, and other information critical to the establishment of appropriate harvesting plans and quotas. Although considerable data have accumulated in the form of harvester logs, chart data and survey results, DFO has been unable, because of resource limitations, to analyze all of the accumulated data and incorporate the results into management decisions. To address this problem, the UHA arranged with DFO in 1996 to fund the services of a Management Biologist employed by the Department to provide liaison between the

Department and the UHA and to ensure that the UHA is integrated into assessment and management activities as fully as possible.

In 1994, the Association initiated a "reseeding" or geoduck enhancement program, in response to persistent concerns about low rates of natural recruitment and hence low rates of natural productivity. The firm contracted with Island Scallops, a Vancouver Island firm, to produce geoduck seed and to develop a "seeding machine" (which resembles a small underwater dune buggy). Very small numbers of seed clams were planted in the first year (mainly by hand), but in the second year of the project (which was now under the direction of a full-time UHA staff biologist), about a million seed clams were produced and planted both by hand and with the seeding machine.

Under the program, small clams are planted at densities of about 100 per square metre. (Originally, it was hoped that 10% of the seed would survive to reach market weight (about a kilogram) in 5 to 10 years; with protection of the young clams from predators, however, much higher rates of survival have been achieved.) As of 1996, enhancement efforts were limited to the Strait of Georgia, where the wild fishery is most accessible and has been most heavily exploited, but if the technique proves to be effective, coast wide enhancement projects are planned (Skog,1996). The UHA owns a vessel dedicated to the reseeding project and the reseeding itself is carried out by G license holders and their crews. The project has been undertaken without government subsidies or other funds, except for a small provincial contribution toward the development of the seeding machine (Skog, 1996).

The UHA describes its activities as "enhancement" rather than as aquaculture, as

the reseeded areas are not held under lease or other form of tenure by individuals or companies. An aquaculture project has been initiated, however, by Fan Seafoods, a company which includes "G" license holders and other parties. In 1996, Fan Seafoods was granted 5 subtidal lease sites by the Province of British Columbia and has initiated aquaculture operations on these sites. As of mid- 1996, Fan Seafoods had invested approximately $ 2 million in developing methods and equipment for deep water nurseries and benthic growout (Northern Aquaculture, 1996:11).

By agreement between DFO, Fan Seafoods, and the Underwater Harvesters Association, no additional tenures are to be granted before these pilot projects are evaluated. Before seeding, the lease sites are "purge fished" by "G" licence holders, as part of the quota for the management area in which the sites are located.

6.3.6. The Geoduck Fishery: Current and Emerging Issues

Interview respondents were asked two summary questions about the geoduck fishery:

1. From your perspective, has the management of the geoduck fishery been a "success"? Why or why not?
2. What are the current issues and concerns in the management of the fishery, from your perspective?

Responses to each of these questions repeated a number of common themes.

Success in the Fishery

All respondents agreed that the implementation of Individual Quotas has been a critical factor in the development of a fishery which is economically efficient, financially

prosperous, and comparatively secure from biological over-fishing. Most respondents expressed the view that the small number of licence holders (fewer than 40) has been important in both achieving the transition to an IVQ system, and in facilitating continued cooperation in management, research, marketing and other activities. The new regime is said to have reduced costs, improved safety, and enabled the fishery to supply high value markets with "steady high-quality product".

Several respondents observed that the implementation of a rigorous monitoring and validation program is key to protection and conservation of geoduck stocks, and attributed the failure of individual quotas to halt declines in the abalone fishery to the absence of such a program. The involvement of an independent agency (i.e. AMR) was seen to offer other benefits as well: it provides a "neutral" source of information and a considerable degree of liaison and informal mediation between harvesters' concerns and those of DFO.

The success of the fishery was not attributed entirely to the management regime, however. Underlying market conditions - rising demand for a relatively rare product - have generated high levels of rents which the industry has been able to capture.

The example of the geoduck fishery has certainly been a major factor in the recent transition of other British Columbia dive fisheries (sea urchins and sea cucumbers) to an individual vessel quota system. It is common for "G" licence holders (and their crews) to participate in other dive fisheries as well, and thus bring with them direct experience with the benefits of IVQ regimes.

Issues and Concerns

Several issues emerged repeatedly in discussions about the future of the geoduck fishery: quotas, prices, conservation and protection, Aboriginal fisheries and treaty negotiations, aquaculture, and property rights or "tenure" in the fishery.

The Question of Quotas

Geoduck quotas have declined substantially since the introduction of the IVQ regime in 1989. These reductions reflect the continuing concerns of DFO management biologists that (Harbo et al, 1995):

. the fishery is depleting the most accessible stocks of highest quality;

. fishing areas have been lost because of contamination;

. stocks in "exploratory fisheries" were overestimated.

Over the years, yield estimates have been reduced to a standard 1% of the virgin biomass.

Many harvesters contend that the DFO quotas are too conservative and argue, further, that quotas have been reduced without adequate supporting information. Typical observations include:

. "UHA information (and Archipelago information) are not taken into consideration"

. "UHA has been counting (stocks), but the data is not processed. And DFO drops the quotas anyway."

. "DFO is overly conservative. Data is way behind. There are lots of new beds not counted (and they're not counting stocks below 60 feet)"

The impact of lower quotas has been buffered (indeed overwhelmed) by rising prices. (As one harvester observed, "People flip over (reduced) quotas, but prices have

gone up much more.") Should prices decline, however, pressure to increase quotas would likely grow.

Some harvesters expressed the concerns that, if quotas fall too low, the fishery may not be able to maintain a "critical" level of supply, and will lose markets as a result.

As noted above, a management biologist is now dedicated to the geoduck fishery on a full-time basis; a better information base may help alleviate conflicts about the appropriate level of annual quota.

Maintaining High and Stable Prices

High prices in the geoduck industry have hinged on the ability of harvesters to control supply of product to live export markets, principally Hong Kong and mainland China. (In 1995, geoducks accounted for almost a third of the value of B.C exports to Hong Kong [Asia-Pacific Reporter, 1995, citing B.C. Stats].) The UHA has spearheaded attempts to coordinate the B.C., Washington and (much smaller) Alaskan geoduck fisheries in order to achieve supply management throughout the industry, although (as of 1996) with little success. While royalties (up to $5.00 per pound) charged by the State of Washington have tended to maintain prices in the Washington fishery , British Columbia harvesters are concerned that recent court decisions allocating 50% of shellfish stocks to Washington tribes may result in lower prices, as supplies of "royalty-free" product enter the market. Supply management is also central to the concerns of many licence holders about the potential impact of aquaculture and of stock and/or license allocations to B.C. First Nations. These two issues are discussed below.

Some licence holders expressed concern that the "high price bubble" may burst, that the product may price itself out of markets, and that the costs of the current management regime could not be supportable in the face of substantial price drops. A contingency or "rainy day " fund was suggested by one licence holder as a prudent response to such a possibility.

High prices also provide incentives for more people to get involved in the fishery in a direct way - by poaching - and contribute, therefore, to problems of harvest monitoring and enforcement.

Protection and Conservation

Poaching (ie. harvest by unlicensed fishers or harvesters in other dive fisheries) and "quota-busting" (by licensed harvesters) are not generally seen as major problems in the geoduck fishery, although high prices increase incentives to poach, and some product undoubtedly finds its way into domestic, and perhaps U.S. restaurant and other markets.

Several characteristics of the fishery reduce the likelihood of extensive poaching. Because the timing and location of the legal fishery is tightly controlled and monitored by the industry itself and by the monitoring agency, the likelihood of unauthorized fisheries is much reduced. In the geoduck fishery (unlike many others), illegal supplies of product on the market directly affect the profitability of licensed harvesters in this small, closely held industry. There are thus, strong incentives for geoduck harvesters to keep a sharp eye on activities in the fishery.

The relatively small domestic market, and the small size of the processing industry (there are only about half a dozen buyers), also reduce the risks of poaching or of

smuggling excess quotas past the validation process.

High-grading - especially dumping of dark-coloured clams - remains a concern in this fishery. Although processors are required to purchase all geoducks at the same price, the pronounced market preference for "white" clams creates continuing incentives to minimize the supply of less preferred product. Some respondents suggested that informal bonus arrangements may exist for premium (light) clams.

Both the DFO and the UHA are concerned to eliminate the practice of high-grading, but have been frustrated by difficulties in detecting the practice (the clams are simply left on the bottom after being excavated) and by difficulties in laying charges and securing convictions under current regulatory arrangements. For example, in a 1996 case, a licensed harvester was acquitted on a charge of dumping dark-coloured geoduck, because of the judicial interpretation of the term "harvesting". Regulations have since been amended, but both fisheries managers and the UHA have pressed for greater use of licence sanctions (i.e. loss or suspension) of licences in such cases.

Aboriginal Fisheries and Treaty Negotiations

The potential re-allocation of geoduck quota and/or the creation of new licences under the Aboriginal Fisheries Strategy or in the settlement of treaties with First Nations, is a matter of concern - in some cases great concern - among existing geoduck harvesters. Licence holders do not generally object to the purchase of existing licences on behalf of First Nations, nor to the continuation of a (primarily intertidal) food fishery. Most do, however, object strenuously to the creation of a "separate aboriginal commercial fishery".

In support of this position, licence holders argue that there is no traditional

aboriginal fishery in subtidal geoduck stocks. Harvesters also express concerns that a separate aboriginal fishery would detract from the cooperative, coordinated achievements of the current group of licence holders, including supply management and stock enhancement. As one respondent put it, "There would be a new group that didn't think the same way (as the UHA members)".

As of 1996, no geoduck licences had been purchased and re-allocated to First Nations as part of the Aboriginal Fisheries Strategy. While most coastal First Nations may be expected to be interested in the geoduck harvest as part of broader claims to marine resources, more specific interest has been expressed mainly by aboriginal communities on the central and north coast - especially those with whom the UHA has carried out cooperative geoduck surveys.

Aquaculture and Enhancement

"Aquaculture" versus "enhancement" is a contentious issue within the geoduck fishery. Proponents of aquaculture argue that it is the rational response to a wild fishery that is subject to overuse and, possibly, to commercial exhaustion. Aquaculture, in this as in other fisheries, is seen as an efficient, prudent response to the vagaries of a commercial fishery based on wild stocks. Those who support "enhancement" contend that aquaculture will result in the conversion of productive wild geoduck beds to "private" tenures (held outside the current industry) and that the benefits of supply management will be lost if too many aquaculturists produce too much product. One respondent expressed his concern in the following terms:

There'll be a bunch of new players that aren't thinking the same as

- "G" holders. Maybe big corporations. Supply would go up so much it (the wild fishery) won't be economic anymore.

As noted above, the expansion of a geoduck aquaculture industry will remain "on hold" for several years, pending evaluation of the initial tenures. Several respondents expressed some scepticism as to whether aquaculture (or enhancement) will be economically viable, given the length of time that must elapse between "sowing" and "harvesting" the crop. Aquaculturists, however, suggest that the clams can be grown out to market weights in as little as 4 to 6 years (Northern Aquaculture, 1996). In addition to Fan Seafoods, other companies in both B.C. and the State of Washington (where research on geoduck culture began in the mid 1980s) are "in the geoduck game" (Northern Aquaculture, 1996:11).

Property Rights in the Geoduck Fishery

As geoduck prices have risen, so has the value of geoduck licences; the estimated market price for a "G" licence exceeded $2 million in 1996. As licence values rise, so too does the level of debate over the nature and extent of property rights in the fishery that are represented by individual vessel quotas.

On the one hand, licence holders are concerned that licences are **not** considered as property rights and are not, for example eligible as collateral for bank financing. They fear that licences can be "devalued" at any time by the allocation of quota outside the current industry and by the creation of additional licences. Typical observations include:

- You can't give a licence as collateral (but) they're too expensive if you can't get a loan and only the processors can afford to buy them.

- Years ago, nobody thought about property rights. But now they're

> valuable and we're a lot more motivated to protect them. We are the main stewards of the resource and have a much longer time horizon (for the fishery).

In general, licence holders wish to see the rights represented by individual vessel quotas clarified and strengthened.

Arguments are made, on the other hand, that such a lucrative fishery should not be concentrated in so few hands, that crew members should share more fully in the returns from the fishery, and that geoduck fishers should not be entitled to a "closed shop". There is resistance in many quarters of the Pacific fishery (and in some quarters of the fishery policy community) against individual quotas in principle, on the grounds that they convert to private property that which has long been considered to be "common" or "public property" (Cruickshank,1995). Not surprisingly, such concerns are intensify when the returns from what is referred to as "privatization" are very high.

Given the current trend in other fisheries (there are now 7 IVQ fisheries in British Columbia), it seems unlikely that the vessel quota system will be abandoned, or substantially changed, in the geoduck fishery. Indeed, the geoduck fishery will likely be among the first of the new "Partnerships" anticipated under the proposed *Fisheries Act*, and "Partnership" agreements are likely to confer greater security of tenure in return for explicit (and expanded) management responsibilities. There will, however, continue to be pressure to "share the wealth", particularly from First Nations communities, and perhaps from non-aboriginal coastal communities as well. Whether this is accomplished by increasing access to the resource (by issuing new licences, for example) or by extracting and distributing some of the scarcity rents (through royalties, for example) could have a

significant impact on the future of this fishery.

6.3.7. Conclusion

The Underwater Harvesters' Association is unusual, perhaps unique, among British Columbia fishing industry groups in the extent to which it has acted to advance the joint interests of licence holders and to assume costs and responsibilities for management activities normally carried out by the Department of Fisheries and Oceans. In a 1996 interview with *The Westcoast Fisherman* (Skog, 1996:16), President Jamie Austin was asked about the characteristics of the geoduck fishery that, in his view, contributed to enabling activities like the reseeding project to come about:

> One of (the) natural advantages is the fishery's small size. The geoduck fishery possesses only 55 licences, all of which are organized under the UHA. Austin feels that it would have been much more difficult to get the consensus needed to proceed with a major enhancement project from a larger group. And having such a small group contributes to a sense of familiarity where co-operative efforts are more common. The seeding program conducts itself largely by the efforts of divers and boat operators involved in the UHA who volunteer much of their free time. 'If we would have had more people involved, says Austin, 'there would have been a lot less organization in the fishery and maybe this program wouldn't have come about'.
>
> Austin also feels that having a small fishery made it possible to make the transition to a quota-managed fishery - another major step in the success of the project. ...when asked if it would have been possible to initiate such a program if the fishery had not gone to quota, the association's president said, 'Probably not because what you get with a quota system is that you feel you own part of the fishery...which creates the incentive in the fishermen to put something back in the fishery'.

Chapter 7: Analysis of the Case Studies: Application of the Diagnostic Checklist

This chapter applies the checklist set out in Chapter 4 to the three case studies presented above. The primary purposes of this chapter are to highlight key contextual and institutional factors in each fishery and to demonstrate the use of the checklist in describing and assessing fishery management regimes. Consequently, the full history of institutional change is not reflected in the "Decision-Making Arrangements" Section of the checklist. This set of questions would normally be applied at each distinct phase in the institutional history of the fishery (in case study research) or would serve as an agenda or protocol in the case of institutional design.

7.1. The Area C Clam Management Pilot Project

7.1.1. Biological, Physical and Technical Characteristics

Key Questions	Results from Case Research
What species are caught?	Mainly manila clams; small quantity of native littleneck
Are the fish resources sedentary or migratory?	Sedentary when adult. Mobile in larval stages.
Can resource units be stored for later appropriation?	Not in wild fishery. "Storage" possible on leases or tenures where clams may be harvested over longer periods of time.
Is the resource available seasonally or year round?	Year round
Is (are) the species long-lived, short-lived or ephemeral?	Fairly long-lived (up to 14 years). The fishery is mainly for younger, smaller clams.

Is the resource: . common within the area of the subject fishery? . common outside the area of the fishery? Are some fishing sites more productive than others?	Manila clams are common in B.C. as far north as the Central Coast. Manila clams and similar species (i.e. "steamer" clams) are common worldwide. In Area C, Savary Island beaches are by far the most productive fishing areas. In the past, the Island has produced as much as a quarter of the annual manila clam harvest.
What is the catch history?	Catch History (Area 15) Peak year: 753 tonnes (1989) Low year : 66 tonnes (1990) (Savary Island closed) 1994: 196 tonnes 1995: 224 tonnes
What are the results of stock assessment? If quotas are established, have they been met (exceeded)?	Stock assessments indicate relatively health stocks on Savary Island (assessments not done elsewhere). Quota established for Savary Island of 114 tonnes for 1994 - 1996. Landings in 1994: 120.5 tonnes 1995: 110 tonnes (It is believed that some of the landings elsewhere in Area C may have been Savary Island clams) Quotas are expected to be increased for 1997

Has there been loss of habitat? Has habitat been degraded by pollution? If so, what sources? Is loss or degradation stable, improving or worsening?	In the Strait of Georgia generally, more than 70,000 hectares of shellfish habitat have been contaminated by pollution from municipal sewage outfalls, faulty septic tanks, agricultural runoff or discharge from vessel holds. This is an increase in habitat contamination of 40% between 1972 and 1990. The overall situation is probably worsening, as it is strongly related to the spread of human settlement and (seasonally) recreational boating. Harvesters identified the pulp mill at Powell River as a particular pollution threat in the harvesting area.
What types of gear/vessels are used in harvesting?	Clams are harvested by hand digging (generally with small rakes). Small vessels are used to transport diggers and clams back and forth to the beaches.
Does the harvesting method damage the target stock (e.g. juveniles)? Does the harvesting method damage other species or habitat?	Juvenile clams left exposed by digging may be affected. Very heavy levels of harvesting may damage clams by e.g. compacting the beach or breaking shells. not available

Are geographic boundaries defined for this fishery? How are they defined and by whom?	Boundaries are those of the Clam Management Area C, defined by the Department of Fisheries and Oceans. Savary Island is treated as a sub-area within the fishery for the purpose of establishing quotas and openings. In effect, the fishery is comprised of Savary Island and the rest of Area C.
Are natural boundaries congruent with political or administrative boundaries?	Area C Management boundaries do not coincide with political boundaries (such as municipalities, regional districts, etc.) nor with fishery statistical areas. The boundaries include numerous clam beaches. Harvesting areas are not allocated or determined by reference to settlements or communities. The greatest coincidence of natural and administrative boundaries is in the treatment of Savary Island (see above).
Is the fishery close to major population centres? Would the fishery be described as isolated or remote?	The major fishing area (Savary Island) is accessible by small boat from the B.C. mainland (Lund) and by larger vessel from Vancouver Island and other locations in the Strait of Georgia. Other beaches are more or less accessible (some have road access; some only boat access). Lund is accessible by road and car ferry from the southern Sunshine Coast and the Lower Mainland and Vancouver Island. Thus, the fishery is readily accessible from major population centres.
Is the fishery seasonal? What is the range of fishing operations?	Mainly from fall through spring. Fishing range is generally within a few hours boat ride of a harvester's residence.

Is the resource (or resource system) vulnerable to damage from other uses? If so, what are the competing uses and how sensitive is the resource to them?	Clams to be used for human consumption are extremely sensitive to contamination from sewage-related bacteria and viruses, chemicals such as metals, pesticides and chlorinated compounds and PSP. For example, harvesting of bivalve molluscs is prohibited when the median fecal coliform count exceeds 14/100ml. By comparison, swimming beaches are closed when the coliform count exceeds 200/ml. (Environment Canada, n.d.) Most harvesting closures result from bacteriological pollution. While posing a threat to human health, PSP and fecal contamination generally do not damage the organisms themselves. Thus, areas closed for contamination may be valuable in replenishing clam stocks.

7.1.2. Market Characteristics

Key Questions	Results from Case Research
What proportion of the catch is sold/consumed?	All sold. Industrial fishery, rather than artisanal fishery.
What is the structure of the market: Are there many buyers? Are there many sellers? What are the power relations between buyers and sellers?	There were 6-8 buyers in 1994. There were 129 sellers in 1994 (the number of licence holders). Number of licence holders increased to 162 in 1995. Each licence holder sells his/her clams as an individual, although there are informal 'crew' arrangements. There is no marketing co-op or other sellers' association. Licence holders contract to deliver to a particular buyer, but in this fishery, there was some price-shopping on the part of sellers, due to less "glut" on the market than is usual in the intertidal commercial clam fishery. Greater competition for available clams may have contributed to higher prices in the Area C fishery than elsewhere in B.C.
What is the price per/kilo (1995)? What was the landed value of the catch (1995?) What is the wholesale value as a percentage of landed value (1995)? Are prices rising, falling or stable?	$3.10 per kilo $738,000 (B.C. average) 155% Rising
Are the fish mainly sold in local, domestic or international markets?	United States, domestic (mainly B.C. and Ontario)

7.1.3. User and Community Attributes

Key Questions	Results from Case Research
How many user groups are there in this fishery (including commercial, subsistence, and recreational)?	Commercial, Aboriginal Food Fish, and Recreational (probably minor)
What are the main differences among user groups? (ethnicity, wealth, gear type, residency, preferences re. resource use, attitudes toward risk and the future)	The commercial fishery involves both aboriginal and non-aboriginal communities; the food fishery is exclusively aboriginal; the recreational fishery is probably mainly non-aboriginal. The same harvesting method is used in all fisheries. Commercial and Aboriginal fishers reside in Area C or on its border. Use preferences, and attitudes toward risk and the future were not specifically researched in the case study. It is likely that recreational fishers are less concerned with maximizing yield from the fishery than either of the other two groups. There is considerable pressure from the commercial fishery to increase quotas; and expressed concerns that DFO quotas are too conservative.
What is the size of the (subject) user group?	In 1994, there were 129 licence holders in the commercial fishery (50% aboriginal/ 50% non-aboriginal). In 1996, there were 162 licence holders (60% aboriginal/40% non-aboriginal)
Is there more than one "sub-group" within the user group?	There are four distinct sub-groups within the commercial fishery: three First Nations (Sliammon, Klahoose and Sechelt) and non-aboriginal harvesters.

What are the main differences among members of the user group?	The three aboriginal user groups are all Coast Salish, but belong to three First Nations with traditional territories although there are many interrelationships between Klahoose and Sliammon membership). Within the Sliammon First Nation, there is considerable competition for commercial licences. Such internal conflict is less apparent among the Sechelt harvesters (who are not very active in the Area C fishery) and the Klahoose harvesters. Klahoose First Nation is much smaller than Sliammon, there is less competition for licences, and the Klahoose have access to other commercial clam opportunities closer to their community. The aboriginal/non-aboriginal divisions are the most obvious within the group; non-aboriginal participation is primarily on an individual, rather than a community or organizational basis. Possible divisions within the non-aboriginal community may include differences between harvesters with shellfish leases and those without, and between those who perceive the clam fishery as a potential full-time occupation, and those who consider it part-time and seasonal.
How important is the fishery as a source of income to the users?	For many users, the fishery is an important source of employment income particularly as the fishery takes place in winter when other seasonal employment is relatively scarce. Few if any harvesters earn the equivalent of a full-time income the fishery, but limited licensing has enabled some to qualify for Unemployment Insurance benefits on the basis of clam income; this eligibility considerably enhances the value of participating in the fishery.

Do all users live in the vicinity of the fishery? Is there more than one geographic community of users? Are users geographically mobile?	Yes. Four communities: Sechelt, Klahoose (Cortes Island), Sliammon, and the Powell River/Lund area. The extent of geographic mobility is unknown, but First Nations individuals are likely less mobile than non-aboriginal harvesters.
Is it easy or difficult for users to find other employment?	It is probably relatively difficult for users to find alternative employment, especially full time jobs. Unemployment is high among the aboriginal communities involved, especially Sliammon. Clam harvesting has traditionally been carried out by persons with relatively few other occupational possibilities, or as part of a seasonal-round of part-time and self-employment.
What is the mean (gross) annual income per license holder or user in this fishery (all sources)?	Not available

Is there a good information base about this fishery?	Information about the Savary Island fishery is improving, but is subject to the many uncertainties about intertidal clam biology (e.g. recruitment) that hinder management of the intertidal fishery generally. Relatively little information is available about other clam beaches in Area C.
What sources of knowledge (scientific, local, indigenous) are used in the management of the fishery?	Scientific knowledge gained through surveys and assessments is the main source of knowledge used in the management of the fishery. There has been considerable conflict in this fishery about the accuracy of that information; with harvesters generally arguing that DFO's estimates of sustainable yield are too low and that large populations of clams are being "wasted" or being left to be poached by unlicensed fishers.
What are the main sources of leadership within the user group?	Leadership among the aboriginal harvester sub-groups has generally been assumed by the respective Band Councils or their officials. The role of the Sliammon Clam Diggers Committee has been ambiguous. A small number of non-aboriginal harvesters have been active in attempts to achieve greater local responsibility for fisheries management. For example, one of the Area C Board members spearheaded a project in 1996 to move undersized clams to more hospitable locations on the beach; this project was not initiated by the Board, however. The Board, as an organizational entity, has been maintained largely through the leadership of a DFO official.

How are decisions made within the user group?	Decisions at the Board level are, in principle, made by consensus (and by DFO if no consensus is reached). Information is not available on the internal decision-making processes of the four sub-groups.

7.1.4. Decision-Making Arrangements

Key Questions	Results from Case Research
Which agencies or authorities have management responsibilities in the fishery?	Department of Fisheries and Oceans, Environment Canada, B.C. Ministry of Agriculture, Fisheries and Food, B.C. Ministry of Environment, Lands and Parks. Three Band Councils, Area C Clam Management Board, Intertidal Sectoral Committee
What are the main legislative, regulatory, policy or other sources of legal authority that govern the fishery?	Federal *Fisheries Act* and regulations (Pacific (General) Regulations, Pacific Fisheries Management Regulations, B.C. Sports Fishing Regulations), Canadian Shellfish Sanitation Program (DFO and Environment Canada), B.C. *Fisheries Act*, B.C. *Fish Inspection Act*

What are the characteristics of the community or user organization? . legal status . membership . human, financial and other resources . mandate/objectives . date organization formed . date organization became involved with the fishery	The Area C Clam Management Board is an informal advisory/consultative group to the Department of Fisheries and Oceans. DFO, the Band Councils, and M.A.F.F. senrepresentatives to the Board. Non-aboriginal harvesters are represented by harvesters interested in the management of the fishery (there appears to be no formal nomination procedure). The Savary Island Residents Association and the Sport Fishing Advisory Board were invited to participate, but have not done so. The Board has no administrative or other personnel, and no financial resources. Expenses such as meeting room rental are paid by the Department of Fisheries and Oceans. The Board has no mandate outside the clam fishery, and no formal mandate within it. The Board was formed in early 1994.
Do members of the user organization have a history of successful collective action?	The four sub-groups have no common history of collective action. Relationships between government agencies and clam harvesters have traditionally been adversarial ones of monitoring and enforcement of harvesters by DFO.

Who has rights of access to, and withdrawal from, the fishery resource?	Individuals eligible under the 1994 licence conditions established for the pilot project, or individuals designated by their respective Band Council as recipients of Aboriginal "make up" licences, or successful applicants under appeal.
What do the rights of access and withdrawal entail?	Right to purchase an Annual Clam "Z" licence and to harvest clams under the conditions established by DFO and other authorities (see next question)
Who makes rules regarding how rights of access and withdrawal shall be exercised?	Annual quota for Savary Island established by DFO; dates and times of opening established by DFO with advice from the Area C Management Board. Contamination Closures established by Environment Canada on the basis of growing water surveys. PSP or domoic acid closures established by DFO. Digging on shellfish tenures subject to approval by tenure holders. Other management rules such as minimum size, harvesting method, etc. established by DFO. Intertidal Sectoral Committee advises on Annual Intertidal Clam Management Plan (Coastwide).

Who specifies and allocates rights of withdrawal?	Eligibility criteria, including 50% aboriginal allocation, were supported by a public meeting of aboriginal and non-aboriginal harvesters in 1994. Appeal conditions were established by the Clam Management Board. As of 1995, appeals were heard by the general fisheries License Appeal Board appointed by DFO. (Prior to that DFO reviewed applicants' appeals) Clam Management Board recommended increasing aboriginal share of licences to 60%. Role of public/community processes is advisory in all cases. DFO has final decision-making authority.
Who specifies and allocates rights and responsibilities about other management activities (e.g. research, development, enhancement)?	DFO, MAFF and Crown Lands. Management Board or other community groups may propose projects (require authorization by Federal/Provincial agencies)
Who carries out management responsibilities?	Federal and provincial officials, except as noted above re. Community Management Board and Intertidal Sectoral Committee.
Who determines rights of access and rules about how rights of access may be transferred?	See above re. rights of withdrawal (no separate right of access)
Can rights be transferred and how?	Regular commercial clam license is a non-transferable personal license. Band Council's may designate different persons to receive "make up " licenses annually, but they are not transferable from one person to another within the year.
Who determines whether and how the rights of management and of exclusion can be alienated?	Shellfish tenures grant tenure holders the right to regulate harvest of wild clams on their leases (tenures under the authority of the B.C. government). Federal government cannot alienate its right and responsibility for the clam resource itself.

Which agencies have monitoring and/or enforcement responsibilities and what are they?	Monitoring and enforcement of the wild fishery is the responsibility of DF0. (human health concerns regulated by DFO, Environment Canada and MAFF (processing). Minor involvement of Klahoose Aboriginal Guardians, but these individuals do not have full enforcement capabilities in this fishery. Sliammon Aboriginal guardians patrolled Sliammon owned shellfish leases.
How are conflicts adjudicated?	Depending on the nature of the conflict, issues are addressed within the user sub-group (e.g. First Nation) or at the Area C Clam Management Board. No formal conflict resolution mechanism except for licence appeals. DFO makes final decisions. As Board has no legal mandate, conflicts cannot arise over interpretation of its decisions, or similar matters.
Where did the main source of pressure for change in the fishery originate?	Department of Fisheries and Oceans (to facilitate re-opening of Savary Island fishery and to find possible models for intertidal clam reform process); Sliammon Band (to obtain greater access to commercial fishery opportunities); non-aboriginal harvesters (to exclude non-local harvesters).

7.1.5. Outcomes and Evaluative Criteria

Key Questions	Results from Case Research
Ecological Outcomes (See also 7.1.1. - Biological Characteristics)	
Are stocks healthier?	Yes, at least on Savary Island. Stocks have recovered from extreme overfishing and quota increases appear possible for 1997 and beyond.
Has habitat been affected positively or negatively?	Positive impacts from less intensive harvesting.
Are quotas, if established, better adhered to since the change?	No quotas prior to current management regime.
Are poaching, quota busting, high-grading and other enforcement problems worse or better?	Difficult to determine. Increasing number of charges being laid, but may relate mainly to increased enforcement effort. Rising prices have increased incentives for poaching by both licensed and unlicensed fishers.

Economic and Employment Outcomes	
Is the fishery more or less economically efficient?	More efficient. Mean of 1,520 kilos per harvester in this fishery (1994) as compared with 730 kilos per harvester in intertidal fishery in general.
What has been the effect on fishers' incomes?	Fishers' incomes were $5900 per license holder in 1994 (compared with $1500 coastwide) and $4545 in 1996 compared with $2130 coastwide.
Have enforcement costs changed?	Probably more enforcement, but not directly related to the management regime, except for involvement of Aboriginal guardians. Re-opening the Savary Island fishery would have required increased enforcement under any regime.
Has capitalization of the fishery changed?	Information not available. The clam fishery is not heavily capitalized.
Have levels of employment in the fishery changed?	Fewer harvesters, but more employment per licensed digger. Some harvesters able to qualify for U.I. on basis of clam earnings.

Social Outcomes	
Are new arrangements perceived to be "fair" by those involved with the fishery? Are new arrangements perceived to be "fair" by those who have been excluded from the fishery, or who are negatively affected by it?	Allocation of newly limited licensing opportunities has been a major source of conflict in this fishery. Allocation within and among sub-groups has been controversial, and there has been continuing pressure to increase the number of licences to meet group demands. Increasing the proportion of aboriginal licences to 60% (in 1995) resulted in a significant increase in the total number of licences; appeals have resulted in issuance of several more licences. The one point of agreement on the part of the groups involved with the management board is that "non-local" harvesters (many of whom are Asian) should be excluded. In 1995 and 1996, the number of harvesters licensed in Area C was not far short of the number licensed prior to the introduction of the new regime, although it is certainly lower than the number who would otherwise have entered the fishery with the re-opening of Savary Island. As the consultation process leading up to the eligibility criteria for licence limitation involved only current licence holders, the views of "non-local" harvesters were not heard, but respondents outside the local area noted that their exclusion could be perceived as arbitrary and unfair.
Who are the main beneficiaries of the fishery?	Harvesters . Processors benefit in some degree from better product quality, but must pay correspondingly higher prices.

Who bears the cost of the fishery?	Mainly DFO (and by extension Canadian taxpayers). There are no landing taxes or royalties in the fishery and at the time of writing, there was no legal mechanism to compel collection of landing taxes under the *Fisheries Act*, or other legislation.
Are costs and benefits better matched since the institutional change?	No significant change.
What is the degree of concentration in the fishery?	No corporate licence holders; individuals can hold only one personal licence each.
Does the fishery distribute more income and employment to poorer individuals and communities than under previous arrangements.	Yes, in that 60% of licences are held within aboriginal communities where unemployment is significantly higher than among the general population. However, non-aboriginal clam harvesters also tend to have low incomes, so the net effect of this redistribution is not clear.
Human Health and Safety	Illegal harvesting of contaminated clams remains a significant concern in this fishery, as it is in the intertidal fishery in general. 15 charges were laid in 1996 in connection with harvesting in contaminated areas. Harvester safety is not a major concern in this fishery, although there is some risk due to openings usually being held at night in the winter months.

Operational and Other Criteria	
Do those involved with the organization and management of the fishery appear to learn from their mistakes and improve problem solving abilities and processes?	This is a difficult question to answer. No steps appear to have been taken to deal with problems such as representation, accountability, lack of organizational mandate, lack of administrative and other resources, etc. This may not reflect a lack of "learning" however, but may reflect the belief of those involved that the Clam Management Board is of little significance in determining outcomes in this fishery. Hence, there may be few incentives to invest in its development and operation.
Has the management regime produced better information about the resource and is this information more widely disseminated among stakeholders?	A small group of harvesters has joined DFO in carrying out stock assessments; the results of assessments have been presented to the Board. How widely this information is then circulated is not known.
Is the management regime adaptable to changing political, economic, social, and environmental conditions?	The initial allocation of harvesting privileges has been under continuing pressure. A number of mechanisms that would facilitate adaptation (such as transfer rules for licences) have not been put in place. There appears to be little or no ability on the part of the Board itself to change rights or rules of the management regime.
Has the management regime been relatively stable over time?	The "pilot project" status of the regime tends to promote instability (as a result of stakeholders pressing to secure benefits before the regime is established on a permanent basis). If anything, the Board has become less effectual over time, in the absence of a formal mandate, and other resources.

In general, are management rules complied with by users? By Outsiders?	Acceptance and compliance with the rules (including eligibility and enforcement) have been problematic throughout the project.

7.2. The Heiltsuk Commercial Clam Fishery

7.2.1. Biological, Physical and Technical Characteristics

Key Questions	Results from Case Research
What species are caught?	Mainly manila clams. Small quantity of native littleneck in one year of the fishery.
Are the fish resources sedentary or migratory?	Sedentary when adult. Mobile in larval stages.
Can resource units be stored for later appropriation?	Not in wild fishery.
Is the species long-lived, short-lived or ephemeral?	Relatively long-lived - up to 14 years. Principal harvest is on younger, smaller clams.
Is the resource available seasonally or year round?	Year round.
Is the resource: . common within the area of the subject fishery? . common outside the area of the fishery?	Manila clams are common in B.C. as far north as the Central Coast. The Bella Bella area is near the northern boundary of the species' range. Manila clams and similar (i.e. "steamer") clams are common worldwide.
Are some fishing sites more productive than others?	Some beaches are larger than others and therefore more efficient to harvest.

What is the catch history? What are the results of stock assessments?	Catch History: (all manila clams) 1992-93: 80 tonnes 1993: 66 tonnes (plus 1.2 tonnes littlenecks) 1994: 114 tonnes 1995: 82 tonnes No formal results of stock assessments available to date. Anecdotally, stocks seem healthy except on a few beaches (close to Bella Bella) that have been more heavily harvested. Recruitment appears to be more successful than originally believed.
If quotas are established, have they been met (exceeded?)	Quotas 114 tonnes (all species in 1992-93) and 114 tonnes each of manila, littleneck and butter clams in each year (1993-1996). Landings given above. Quotas have been adhered to except for one year, and often are not reached due largely to low temperatures and other adverse weather conditions.
Has there been loss of habitat? Has habitat been degraded by pollution? If so, from what sources? Is loss or degradation stable, improving or worsening?	Twelve beaches have been closed to commercial clam harvesting due to fecal contamination. Main sources of pollution are human settlements, recreational fishing lodges, recreational boating/kayaking, and season commercial fishing (especially the roe herring fleet). Compared with the South Coast, pollution is a minor problem, but will likely worsen unless steps are taken to control the sources.
What types of gear/vessels are used in harvesting?	Clams are harvested by hand digging (small rakes). Small craft (usually converted herring skiffs) are used to transport diggers and clams to and from the beaches.

Does the harvesting method damage the target stock (e.g. juveniles)?	Clams are vulnerable to exposure to cold temperatures. The fishery is closed when air temperatures drop below -5 degrees Celsius. Juvenile clams left exposed by digging may be adversely affected. Very heavy levels of harvesting may damage clams by breaking shells or compacting beaches.
Does the harvesting method damage other species or habitat?	Not available
Are geographic boundaries defined for this fishery? How are they defined and by whom?	The fishery is conducted within the traditional territory of the Heiltsuk First Nation in 16 statistical sub-areas, all within statistical area 7. Areas are defined under Clam Fishery agreements between the Heiltsuk Tribal Council and DFO. Sub-areas have been opened where growing water surveys have been conducted by Environment Canada. Factors influencing the boundaries of the fishery include the cost of additional growing water surveys and the potential for conflict with traditional territories of other First Nations.
Are natural boundaries congruent with political or administrative boundaries	As noted above, fishery boundaries are related to the Heiltsuk Traditional territory, but not with formal political boundaries. There are numerous clam beaches within the boundaries of the fishery. 90% of the population of the area resides in Waglisla (Heiltsuk lands), thus the coincidence between "community" and the fishery boundaries is quite high.

Is the fishery close to major population centres? Would the fishery be described as remote or isolated?	Only nearby communities are Waglisla (Bella Bella) and Shearwater, about 1200 people in total. There is no road access to Waglisla (Bella Bella) or Shearwater; there is scheduled ferry and air access. The fishery would be considered relatively isolated and remote
Is the fishery seasonal? What is the range of fishing operations?	Mainly November through March (determined by PSP levels - PSP levels are normally too high at other times of the year) Local. Generally within an hour or two by small craft from Bella Bella.
Is the resource (or resource system) vulnerable to damage from other uses? If so, what are the competing uses and how sensitive is the resource to them?	Clams are extremely susceptible to contamination by sewage-related bacteria and viruses, chemicals such as metals, pesticides and chlorinated compounds, and PSP. (See above re. habitat/pollution and Section 7.2.5. - subsection Human Health and Safety). Most harvesting closures result from bacteriological pollution. PSP closures are not related to other (human) uses of the resource system. While posing a threat to human health, PSP and fecal contamination generally do not damage the organisms themselves. Thus, areas closed by reason of contamination may be valuable in replenishing clam stocks.

7.2.2. Market Characteristics

Key Questions	Results from Case Research
What proportion of the catch is sold/consumed?	All sold. Industrial, rather than artisanal, fishery.

What is the structure of the market: Are there many buyers? Are there many sellers?	There was one buyer in 1994. There were a maximum of 50 sellers (the number of permit holders) in 1994. All clams are processed through the Bella Bella fish plant (owned by the Heiltsuk Tribal Council). In 1994-95, the commercial clam harvest was purchased directly by the Fish Plan and resold to a U.S. buyer. For most of the life of the fishery, product has been sold to a buyer from Port Hardy who sends a packer boat to Bella Bella twice a week, on average, during the season.
What are the power relations between buyers and sellers?	Sellers are at some disadvantage because of the geographic isolation of the fishery, and resulting higher costs for transportation, risk of spoilage, etc. By coordinating clam sales, however, sellers are able to market a consistent supply of good quality product in circumstances that would probably not be economically viable for a more "individualistic" fishery. The influence of sellers versus buyers is enhanced by the absence of competition among sellers and potential fragmentation of the market. In this fishery the buyer gets "all or nothing".
What is the price per/kilo? (1994-95)	$4.00 per kilo (unusual, generally about $3.30/kilo)
What was the landed value of the catch (1994-95)?	$451,000 (processed weight (i.e. packed and graded). Return to fishers about $2.50 x 114,000 kilos. = $288,000
What is the wholesale value as a percentage of landed value (1994-95)?	B.C. Average - 155%
Are the fish mainly sold in local, domestic or international markets?	Sold to B.C. buyer - resold in B.C. and U.S. markets.

7.2.3. User and Community Attributes

Key Questions	Results from Case Research
How many user groups are there in this fishery (including commercial, subsistence and recreational)?	Aboriginal Commercial, Aboriginal food (minor fishery for manila clams), non-Aboriginal recreational (minor)
What are the main differences among user groups? (ethnicity, wealth, gear type, residency, preferences re. resource use, attitudes toward risk and the future).	The dominant group in this fishery are Heiltsuk commercial clam fishers. As the Shellfish Committee, this group is also concerned with the aboriginal food fishery in clams. Manila clams are not a major species in the food fishery, however. There is likely a small recreational/subsistence clam fishery among non-aboriginal residents of the area. Recreational digging by kayakers and boaters is unlikely given that the entire area is closed to bivalve harvest in the summers as a result of chronic PSP.
What is the size of the (subject) user group? Is there more than one "sub-group" within the user group?	A maximum of 50 permit holders for manila clams , with a core group of 35-40 harvesters ? Possible family or kin groups and informal "crew" arrangements.

What are the main differences among members of the user group?	The group is quite homogeneous. All users share a common ethnic background and relatively similar educational/income/ occupational characteristics. A small number of harvesters are women. As there was no survey carried out of the entire harvester population, other dimensions of heterogeneity were not determined. Some respondents suggested differences between "established" harvesters (who were interested in long-term enhancement of the fishery, etc.) and younger, more recent participants in the fishery who are more interested in a "fast buck". All harvesters reside in the community of Waglisla and are Heiltsuk Band members.
How important is the fishery as a source of income to the users?	Income from this fishery is of considerable importance. Median income for males in the community was $11,000 in 1990 and $8,200 for females. In 1991, only about 300 people were employed. The fishery provides employment opportunities for 50 individuals at a mean income level (based on returns to the harvester of $2.75/kilo) of over $6,000 (based on 50 permit holders). For the 35-40 harvesters who are most active in the fishery, incomes of over $10,000 a season are quite common. Clam income also enables some harvesters to qualify for U.I., which provides significantly higher benefits than social assistance.
Do all users live in the vicinity of the fishery? Is there more than one geographic community of users? Are users geographically mobile?	Yes. No. The extent of geographic mobility is unknown, but is probably limited.

Is it easy or difficult for users to find other employment opportunities?	Unemployment is high in the community. One of the criterion for a commercial clam permit is that individuals do not have other employment.
What is the mean (gross) annual income per license holder or user in this fishery?	1994-95: $5,800 1995-96: $4,500
Is there a good information base about this fishery?	DFO and the Heiltsuk Fisheries Program have conducted beach surveys, but results have not been tabulated or published. See Section 7.2.1.
What sources of information (scientific, local, indigenous) are used in the management of the fishery?	Standard scientific approaches are used by both DFO and the Heiltsuk Fisheries Program. "Local knowledge" is probably a significant factor in the management of the fishery, as harvesters are involved in decision-making to a significant degree, and HFP staff are consistently present during the day to day operation of the fishery .
What are the main sources of leadership within the user group?	Leadership is exercised by the Director/Assistant Director of the HFP; the Heiltsuk Shellfish Committee and the Chief and Band Council.
How are decisions made within the user group?	The HFP is under the direction of the Band Council; the Heiltsuk Shellfish Committee was established under the authority of the Council. Day to day decision making appears to be conducted between the HFP and Shellfish Committee; decisions within the authority of the HTC concerning several aspects of the conduct of the fishery , especially the rules governing harvesting, processing, sanctioning of harvesters, etc. are made or approved by the Committee (see Section 7.2.4.).

7.2.4. Decision-Making Arrangements

Key Questions	Results from Case Research
Which agencies or authorities have management responsibilities in the fishery?	Department of Fisheries and Oceans, Environment Canada, B.C. Ministry of Agriculture, Fisheries and Food, B.C. Ministry of Environment, Lands and Parks, Heiltsuk Tribal Council, Heiltsuk Fisheries Program, Heiltsuk Shellfish Committee, Intertidal Sectoral Committee
What are the main legislative, regulatory, policy or other sources of legal authority that govern the fishery?	Federal *Fisheries Act* and regulations (Fishery (General) Regulations, Pacific Fishery Regulations, Aboriginal Communal Fishing Licences Regulations) Canadian Shellfish Sanitation Program (DFO and Environment Canada), Federal Aboriginal Fisheries Strategy, B.C. *Fisheries Act*, B.C. *Fish Inspection Act*

What are the characteristics of the community or user organization? . legal status . membership . human, financial and other resources . mandate/objectives . date organization formed . date organization became involved with the fishery	The Heiltsuk Fishery is established by agreement between DFO and the Heiltsuk Tribal Council under the Aboriginal Fisheries Strategy. The population of the Heiltsuk Indian Band is about 1900, of whom about 1100 reside in Waglisla. Responsibilities of the HTC under the Clam Fishery Agreement include: . to designate Heiltsuk Indian Band members as clam diggers under the Communal Commercial Clam license, to provide the list of participants to DFO and provide amended lists as necessary; . to consult with DFO concerning harvesting areas and times (to be announced jointly from DFO and HFP offices); . to ensure that all clams harvested are inspected at a federally registered shellfish plant prior to sale; . to ensure that all sacks or containers of clams are properly tagged; . to provide to DFO information as may be required by the Department (including catch statistics in the form of sales slips [at the time of sale] and harvest logs at the termination of the annual fishery) . to provide Heiltsuk Technicians to collect, preserve and supply to DFO shellfish samples for PSP testing; . to provide Heiltsuk Technicians and a Heiltsuk Guardian to monitor the clam harvest (monitoring to take place during all fishery openings); . to jointly develop with DFO a monitoring and enforcement protocol

	Heiltsuk management responsibilities for the clam fishery are funded by DFO, by landing fees levied on the commercial clam harvest, and by other revenues of the Band Council, including the lease of other Band-owned fishing licences. Staff of the Heiltsuk Fishery Program (which is responsible for other fisheries as well as the clam fishery) include a Director, Guardians, and Technicians. The Heiltsuk Commercial Clam Fishery was initiated in the fall of 1992.
Do members of the user organization have a history of successful collective action?	All members belong to the same (small) geographic, ethnic, cultural and political community. Most economic and social activities and services in the community are developed and delivered through the Heiltsuk Tribal Council.

Who has rights of access to, and withdrawal from, the fishery resource?	The Heiltsuk Tribal Council holds harvesting rights under an Aboriginal Communal Fishing Licence. The HTC (through the HFP and according to procedures approved by the Shellfish Committee) designates individuals to hold permits under the authority of the communal licence.
What do the rights of access and withdrawal entail?	The HTC is authorized to harvest up to 114 tonnes annually of each of manila, littleneck and butter clams, subject to conditions set out in the Communal Licence. Individuals may harvest during specified openings, subject to the terms to the Clam Fishery Agreement and all applicable federal and provincial laws. Individual quotas have been set by the HFP/Shellfish Committee, but these are flexible, and are of little impact in limiting individual or aggregate catches.
Who makes rules regarding how rights of access and withdrawal shall be exercised?	Aggregate quota is set by DFO; dates and times of openings jointly determined by DFO and HFP (primarily by HFP). Contamination closures established by Environment Canada on the basis of growing water surveys. PSP closures established by DFO on basis of samples supplied by the HFP. Management rules such as harvesting method, minimum size established by DFO under regulation and included in the Heiltsuk Clam Fishery Agreement. HTC is responsible for ensuring that regulatory requirements and terms of DFO/HTC agreements are met. HFP/Shellfish Committee discuss and develop "internal" protocols for disciplining licence holders (e.g. suspension or other sanctions), and harvester responsibilities for processing. Intertidal Sectoral Committee advises on Annual Intertidal Clam Management Plan

Who specifies and allocates rights of withdrawal?	The Heiltsuk Fisheries Program staff developed a process for determining eligibility : a lottery or draw of interested individuals, assignment of permits to top 50 names drawn, and the use of a waiting list for additional applicants. Those drawn in the lottery were required to attend an orientation workshop before permits were issued. The HFP in consultation with the Shellfish Committee establishes rules about sanctioning permit holders for infringements of federal/provincial or locally established rules. Until 1996, clam harvesters were required to hold both a federal Fisher's Registration Card and a HTC permit. This requirement has been replaced by a single HTC issued photo identification card.
Who specifies and allocates rights and responsibilities about other management activities (e.g. research, development, enhancement)	Some activities are specified in the Clam Fishery Agreement (e.g. PSP testing); HFP has undertaken others individually or in cooperation with DFO (e.g. abundance surveys); DFO has responsibility for stock assessment and other biological research. Provincial authorization may be required for enhancement projects.
Who carries out management responsibilities?	DFO staff (mainly stock assessment and other research ; processing plant inspection; negotiation of agreements), Environment Canada staff (growing water surveys); HFP staff (monitoring and enforcement, stock assessment, other research) , clam harvesters on volunteer basis [expenses for e.g. boat gas paid by HFP] (PSP testing, stock assessments).

Who determines rights of access and rules about how rights of access may be transferred? Can rights be transferred and if so, how?	See above re. rights of withdrawal (no separate right of access). The HTC cannot transfer rights under the Communal Fishing licence, nor can individual permit holders transfer their rights. The HTC can, however, transfer permits from one individual to another, so long as DFO is advised of the change.
Who determines whether and how the rights of management and of exclusion can be alienated?	Shellfish tenures grant tenure holders the right to regulate harvest of wild clams on their leases (tenures under the authority of the B.C. government). Federal government cannot alienate its rights in and responsibility for the clam resource itself. Fishery resources are deemed to be "property" only upon capture.
Which agencies have monitoring and/or enforcement responsibilities and what are they?	Most monitoring and enforcement of the shellfish harvest and processing is carried out by HFP staff (DFO may participate, but usually does not). Fish Plant is inspected by DFO officials.
How are conflicts adjudicated?	The Clam Fishery agreement does not specify conflict resolution processes regarding the DFO/HTC relationship. Internally, conflicts are addressed through the Shellfish Committee, the HFP and ultimately through the Tribal Council
Where did the main source of pressure for change in the fishery originate?	With the Heiltsuk Tribal Council (increased employment/economic opportunities, including product for the new Bella Bella Fish Plant). Project facilitated by the objectives of the Aboriginal Fisheries Strategy.

7.2.5. Outcomes and Evaluative Criteria

Key Questions	Results from Case Research
Ecological Outcomes (See also 7.2.1. - Biological Characteristics)	
Are stocks healthier?	The fishery was initiated on a virgin biomass. Some beaches have been overexploited, but in general, stocks appear to be healthy.
Has habitat been affected positively or negatively?	Not available.
Are quotas, if established, better adhered to since the change?	No quotas (no fishery) prior to current management regime.
Are poaching, quota busting, high grading, and other enforcement problems worse or better?	No fishery prior to the current management regime. DFO and HFP staff advise that poaching (for illegal sale) is a minor problem in this fishery; some concern with harvesters fishing in contaminated areas, but minimized by consistent HFP patrols.
Economic and Employment Outcomes	
Is the fishery more or less economically efficient?	More efficient than general intertidal fishery in terms of labour. Mean of 2,270 kilos per harvester in this fishery (1994) as compared with 730 kilos per harvester in intertidal fishery in general.
What has been the effect on fishers' incomes?	Fishers' incomes were $5,800 per licence holder in 1994 (compared with $1,500 coastwide).

Have enforcement costs changed?	No basis for comparison with a previous fishery. However, enforcement effort is high compared with the intertidal fishery in general.
Has capitalization of the fishery changed?	No previous fishery. The clam fishery is not heavily capitalized, in general.
Have levels of employment in the fishery changed?	Fishery has created employment opportunities for 50 individuals (up to 75 if other species were fished). Core group of about 35-40 regularly harvest during the season.
Social Outcomes	
Are new arrangements perceived to be "fair" by those involved with the fishery?	Consensus appears to have eroded somewhat through the history of the project. Conflicts have arisen about decision-making responsibilities and adherence to rules (e.g. when openings should occur, how diggers should be paid, accusations about abuse of waiting list for permits, flouting of harvest rules by"core" diggers). Relationships between HFP staff and clam harvesters resemble to some degree DFO/clam harvester relationships in microcosm. Staff responsibility regarding distribution of harvesting opportunities creates potential for conflict that is not present in "unlimited" fisheries (such as most of the B.C. intertidal clam fishery).

Are new arrangements perceived to be "fair" by those who have been excluded from the fishery or who are negatively affected by it?	There appears to have been little negative reaction to the allocation of the commercial clam fishery to the Heiltsuk Nation. There are few non-Heiltsuk residents in the area. The allocation has not provoked an outcry from provincial commercial fishery organizations, perhaps because of the clam fishery's relatively low profile and limited financial returns.
Who are the main beneficiaries of the fishery?	Harvesters. Also supports jobs in the Heiltsuk Fisheries Program and provides some income to the Bella Bella Fish Plant.
Who bears the costs of the fishery?	DFO (through the Aboriginal Fisheries Strategy) and by extension Canadian taxpayers; other Heiltsuk fisheries through fees paid to the Heiltsuk Fisheries Program; harvesters through a landing fee of about 8% of landed value. Also possible funding from other Heiltsuk Tribal Council revenues. Precise costs of the fishery are not available.
Does the fishery distribute more income and employment to poorer individuals and communities than under previous arrangements?	No previous fishery
Human Health and Safety	Concerns about violations of regulations during clam processing led to a short closure of the Fish Plant; concerns were addressed and the plant re-opened. PSP contamination is a concern in this fishery, due to chronic levels during the period April to September. Harvester safety is not a major concern in this fishery.

Operational and Other Criteria	
Do those involved with the organization and management of the fishery appear to learn from their mistakes and improve problem solving abilities and processes?	During the course of the fishery, harvesters and the HFP have developed a series of procedures and rules for dealing with management issues. The Band Council and HFP have recognized that decision-making processes need to be more "transparent" and open. HFP staff have recognized that early decisions to encourage involvement in the clam harvest have had some negative results in terms of ongoing demands for services from harvesters. DFO and HFP have worked out a variety of protocols and arrangements for meeting regulatory and other requirements in more efficient ways, and for enhancing coordinating and reducing overlap between DFO and HFP roles.
Has the management regime produced better information about the resource and is this information more widely disseminated among stakeholders?	Both DFO and HFP staff and harvesters have carried out stock abundance and other surveys, but the results have not been published. Research on clam mortality from exposure to low temperatures was carried out by HFP and led to rules about closing of fishery when temperatures drop below -5 degrees Celsius. Harvesters are involved on a volunteer basis in survey work. Information about this fishery has increased during the course of the project, and will likely continue to increase with the establishment of a stock assessment protocol approved by DFO for use by non-DFO personnel.
Has the management regime been relatively stable over time?	Yes.

In general, are management rules complied with by users? By outsiders?	Yes. But see above re "fairness".

7.3. The Geoduck Fishery

7.3.1. Biological, Physical and Technical Characteristics

Key Questions	Results from Case Research
What species are caught?	Geoduck clams. Incidental catch of horse clams.
Is the species long-lived, short-lived or ephemeral?	Very long-lived. Oldest specimen found was 146 years old.
Are the fish resources sedentary or migratory?	Sedentary when adult. Mobile in larvale and post-larval stages.
Can resource units be stored for later appropriation?	No, but individuals are suitable for harvest during most of a very long life span (see below)
Is the resource available seasonally or year round?	Year round.
Is the resource: . common within the area of the subject fishery? . common outside the area of the fishery? Are some fishing sites more productive than others?	 Yes. No. Range limited from northern California to Alaska. Commercial harvests only in B.C.; Puget Sound, Washington; and Alaska (minor) Yes, but species is abundant in many locations.

What is the catch history?	Peak year: 5,735 tonnes (1987) Low year: 44 tonnes (1976) 1994: 2,227 tonnes 1995: 2,061 tonnes
What are the results of stock assessments?	"There is substantial loss of fishable product on the south coast due to pollution closures. There is concern about local overharvesting of easily accessible beds of the highest quality. If the biomass (original) estimates are reasonable, it appears that the overall harvest rate is slightly higher than it should have been and that local overharvesting may be a problem." (DFO, 1995:12) Stock assessment is subject to considerable uncertainty (e.g. regarding extent of habitat and density estimates); significant data have not yet been analyzed and additional surveys and assessments are required (DFO, 1995). Assessments do not include geoduck stock at depths greater than 18 metres.
If quotas are established, have they been met (exceeded)?	Quotas have been respected since the implementation of the new management regime in 1989.
Has there been loss of habitat? Has habitat been degraded by pollution? If so, what sources? Is loss or degradation stable, improving or worsening?	31 beds (estimated 1,030 hectares) of geoduck habitat were closed under contaminated closures or permanent closures (as of 1995) . Permanent closures (mainly on the West Coast of Vancouver Island), include park closures, research closures, and closures in other protected areas and sanctuaries. Most contamination closures (which amount to over 80% of all closures) have been implemented in Georgia Strait. Extent of contamination closures relatively stable.

What types of gear/vessels are used in harvesting?	Dive fishery, using high pressure hydraulic hoses equipped with nozzles called "stingers". Divers are supplied with air from compressors on tender boats. Size of vessels differs depending on the area of the fishery (larger vessels used in North Coast fishery).
Does the harvesting method damage the target stock (e.g. juveniles)?	There is some evidence that geoduck harvest affects recruitment of juveniles into the population.
Does the harvesting method damage other species or habitat?	No. Very selective method. May be some minor damage to nearby species (e.g. sea pens), but very small impact compared with, e.g., storms.
Are geographic boundaries defined for this fishery? How are they defined and by whom?	Fishery extends throughout the B.C. Coast, divided into three areas: North Coast; Inside Waters (Strait of Georgia) and West Coast of Vancouver Island. License holders must elect (annually) which area to fish. Within these three main areas, DFO establishes quota management units (78 management units for 1995). The number of management units has varied since 1989 (maximum 170 in the second three-year rotation of the fishery). Because of the use of rotations (each unit is fished only once in every three years [and sometimes less frequently]), the "boundaries" of the fishery change frequently.
Are natural boundaries congruent with political or administrative boundaries?	Quota management units are established to spread out effort in the fishery, find new fishing grounds, and reduce the potential for local overharvesting. Thus, the establishment of boundaries is based, in part, on the biological status of geoduck beds. Boundaries do not coincide with other political or administrative boundaries.

Is the fishery close to major population centres. Would the fishery be described as remote or isolated?	Some fishing locations are close to population centres (e.g. in the southern Strait of Georgia); others are very remote (North Coast and much of the West Coast of Vancouver Island)
Is the fishery seasonal? What is the range of fishing operations?	Year round, but somewhat concentrated in the spring/summer and again in November/December (depends on market conditions and weather). Throughout the B.C. Coast. An increasing number of individual quotas have been assigned to the North Coast (31 quotas on the North Coast in 1995 versus 23 in 1992).
Is the resource (or resource system) vulnerable to damage from other uses? If so, what are the competing uses and how sensitive is the resource to them?	See above re. pollution. Less vulnerable to PSP than intertidal clams, but all north coast product is from tested locations. Compared to intertidal clams, geoduck are relatively less affected by land-based activities. More than two thirds of the fishery takes place in isolated locations (North and West coasts), where pollution is insignificant.

7.3.2. Market Characteristics

Key Questions	Results from Case Research
What proportion of the catch is sold/consumed?	All sold. Industrial fishery.

What is the structure of the market: . Are there many buyers? . Are there many sellers?	There are about 6 buyer/processors in the geoduck fishery. There are about 40 sellers (holding 55 licences). About 15-20% of licences are held by buyer/processors, who may have part interests in additional licences.
What are the power relations between buyers and sellers?	The position of sellers versus buyers is quite strong. Licence holders are able to manage supply; there is very little processing in the industry; the wholesale versus landed value of the fishery has been declining. There are no "gluts" on the market as before the introduction of the IVQ regime.
What is the price per kilo (1995)?	$20.25 per kilo
What is the landed value of the catch (1995?)	$42.5 million
What is the wholesale value as a percentage of landed value (1995)?	111%
Are the fish mainly sold in local, domestic or international markets?	Mainly international (Asian), some U.S.; small amount domestic.

7.3.3. User and Community Attributes

How many user groups are there in this fishery (including commercial, subsistence, and recreational)	Commercial, very minor recreational, very minor aboriginal food fishery
What are the main differences among user groups?	There is no aboriginal commercial fishery. Only the commercial fishery may use mechanical devices (i.e. "stingers") to harvest. Fishery is dominated by the commercial harvesters, all of whom are members of the Underwater Harvesters' Association.

What is the size of the (subject) user group? Is there more than one "sub-group" within the user group?	55 licences; approximately 40 individual or corporate licence holders. About 15-20% of licences are held by processors. Division among harvesters between those (majority) who support enhancement of the wild fishery and those involved with Fan Seafood and in favour of individualized aquaculture tenures.
What are the main differences among members of the user group?	See above question.
How important is the fishery as a source of income to the users?	Major. The fishery earned licence holders about $750,000 per quota in 1995. No information available on diver incomes.
Do all users live in the vicinity of the fishery? Is there more than one geographic community of users? Are users geographically mobile?	No. Most licence holders and crew live on the Lower Mainland or Southeastern Vancouver Island. Residence of users is of little significance in this fishery. Probably. This is a mobile fishery.
Is it easy or difficult for users to find other employment?	Many licence holders are also involved in other fisheries, especially other dive fisheries. Crew generally dive in all fisheries in which their employer holds a licence. Divers interviewed indicated that reduced employment in the fishery has made competition for available jobs more serious, and that it is harder for commercial divers to find work now than before the introduction of IVQ's.
What is mean (gross) annual income per license holder or user in this fishery (from al l sources)?	Not available

Is there a good information base about this fishery? What sources of knowledge (scientific, local, indigenous) are used in the management of this fishery?	Good information relative to other invertebrate fisheries. DFO stock assessments and surveys, UHA funded research, harvester logs and sales slips, harvester input. User information is of central importance in the management of this fishery.
What are the main sources of leadership within the user group? How are decisions made within the user group?	Underwater Harvesters Association Fan Seafoods Not available

7.3.4. Decision-Making Arrangements

Which agencies or authorities have management responsibilities in the fishery?	Department of Fisheries and Oceans, Environment Canada, B.C. Ministry of Agriculture, Fisheries and Food, B.C. Ministry of Environment, Lands and Parks, Underwater Harvesters Association, Geoduck Advisory Committee
What are the main legislative, regulatory, policy or other sources of legal authority that govern the fishery?	Federal *Fisheries Act* and regulations (Pacific (General) Regulations, Pacific Fishery Management Area Regulations, B.C. Sport Fishing Regulations,) Canadian Shellfish Sanitation Program (DFO and Environment Canada) , *B.C. Fisheries Act* , *B.C. Fish Inspection Act*, *B.C. Workers' Compensation Act.*

What are the characteristics of the community or user organization? . legal status . membership . human, financial and other resources . mandate/objectives . date organization formed . date organization became involved with this fishery	The Underwater Harvesters Association is incorporated as the Underwater Harvesters Association Research Society. Membership consists of all geoduck "G" licence holders. The Association collects about $1.5 million (1996) in fees from members, and has a small administrative staff. The organization was formed in 1981.
Do members of the user organization have a history of successful collective action? Do management agencies and the user group have a history of successful collective action?	The UHA has taken on an increasing range of management, research and other activities since the implementation of the IVQ system. The principal division in the Association is between those in favour of aquaculture and those in favour of stock enhancement. The UHA works very closely with DFO, both directly, and through the services of AMR.
Who has rights of access to, and withdrawal from, the fishery resource?	Holders of category "G" (geoduck and horse clam) licences
What do the rights of access and withdrawal entail? Who makes rules regarding how rights of access and withdrawal shall be exercised?	Subject to annual renewal, the right to fish geoduck and horse clams under the conditions established by DFO and other authorities. Each licence holder is entitled to fish 1/55 of the aggregate geoduck quota (per licence). Incidental fishery of horse clams only (see next question). Aggregate and management unit quotas established by DFO in consultation with the user group and the Geoduck Advisory Committee. Contamination closures established by Environment Canada; PSP closures established by DFO. Timing and sequencing of area openings are organized by the UHA.

Who specifies and allocates rights of withdrawal?	DFO established licence limitation criteria and appeal criteria which determined the number and original ownership of "G" licences.
Who specifies and allocates rights and responsibilities about other management activities? (e.g. research, development, enhancement) Who carries out management responsibilities?	DFO has final decision-making (e.g. permitting) authority except where provincial jurisdiction applies (e.g. tenures to subtidal lands for aquaculture). UHA has taken on responsibilities in research and development beyond those normally undertaken by government authorities and conducts these activities within Federal/Provincial regulatory authority. UHA- collection of samples and/or funding of some PSP and growing water surveys, stock assessment, research and development re. stock enhancement. DFO - stock assessment and surveys, some PSP surveys. Environment Canada - some growing water surveys. MAFF and Environment, Lands and Parks license aquaculture and grant tenure for Crown lands (including subtidal lands within provincial jurisdiction).
Who determines rights of access and rules about how right of access may be transferred? Can rights be transferred, and if so, how?	See above re. rights of withdrawal (no separate right of access). Yes. More than one licence (and quota) may be "stacked" on the same vessel
Who determines whether and how the rights of management and of exclusion can be alienated?	Shellfish tenures grant tenure holders the right to regulate harvest of wild shellfish on their leases. The federal government cannot alienate its rights in and responsibility for the geoduck resource itself.

Which agencies have monitoring and/or enforcement responsibilities and what are they?	DFO is responsible for conservation and protection of the resource (UHA members provide some direct financial support, such as funding a patrol boat for the north coast (AMR contract) and providing support for investigative activities). Aspects of human health and product safety are the responsibility of DFO, Environment Canada and Ministry of Agriculture, Fisheries and Food. An independent agency (Archipelago Marine Research) carries out dock side and plant delivery monitoring and validation (funded by the UHA). Diver certification and safety are governed by the Workers Compensation Board (all divers must hold a Workers Compensation Board Seafood Harvesting Certificate.
How are conflicts adjudicated?	Not available
Where did the main source of pressure for change in the fishery originate?	Geoduck licence holders proposed the establishment of an IVQ system in 1988. DFO wished to maintain an area licensing/area quota system. A hybrid of both systems was introduced in 1989.

7.3.5. Outcomes and Evaluative Criteria

Ecological Outcomes (see also 7.3.1. - Biological Characteristics)	
Are stocks healthier?	Yes. Continuing concerns about stocks are mainly those in South Coast/ West Vancouver Island areas that were heavily exploited early in the fishery.
Has habitat been affected positively or negatively?	No effect on habitat
Are quotas, if established, better adhered to since the change?	Better adhered to. This has been one of the principal benefits of the new regime.
Are poaching, quota-busting, high-grading and other enforcement problems worse or better?	Quota-busting and poaching are not serious concerns in this fishery. High-grading continues to be a problem.

Economic and Employment Outcomes	
Is the fishery more or less economically efficient?	More efficient. For example, the number of vessels in the industry declined from 56 in 1988 to 42 in 1994.
What has been the effect on fishers' incomes?	Licence holders' incomes have increased dramatically. Crew incomes (of those remaining in the fishery) have also increased, but by a smaller factor.
Have enforcement costs changed?	Much of the responsibility for enforcement costs is now assumed by the licence holders (see "Social Outcomes"). Changes in DFO resources devoted to this fishery are unknown. Early evaluation of the new regime suggested little change.
Has capitalization of the fishery changed?	Level of capital investment in the fishery is not known.
Have levels of employment in the fishery changed?	There are fewer divers and other crew members employed in this fishery than before the change (93 in 1996 compared with 192 in 1988), but employment for those who remain in the fishery is steadier and less seasonal.

Social Outcomes	
Are new arrangements perceived to be "fair" by those involved with the fishery?	Current licence holders are very satisfied with the fishery management arrangements for the most part. Some level of dissatisfaction among divers and crew re. crew shares.
Are new arrangements perceived to be fair by those who have been excluded from the fishery, or who have been negatively affected by it?	See above re. divers. Relatively little current turnover in divers, but substantial number of divers lost employment in the earlier days of the IVQ regime. First Nations are seeking participation in this fishery, as in others, primarily through current treaty negotiation processes.
Who are the main beneficiaries of the new regime?	Licence holders; divers who have remained in the fishery. Canadian and B.C. governments through income tax revenues resulting from dramatic increases in the value of the fishery.
Who bears the costs of this fishery?	Substantial portion of fishery management costs borne by the licence holders. Other costs are borne by DFO (and Canadian taxpayers by extension). Consumers (mainly in foreign markets) bear costs of supply management through higher prices.
Does the fishery distribute more income and employment to poorer individuals and communities than under previous arrangements?	No. Fishery has relatively little impact on e.g. coastal communities. No aboriginal individuals or communities hold geoduck licences; this has never been a significant aboriginal fishery.
Human Health and Safety	Human health concerns have been relatively unimportant in this fishery. Harvester safety has been much improved by the introduction of IVQ's.

Operational and Other Criteria	
Do those involved with the organization and management of the fishery appear to learn from their mistakes and improve problem solving abilities and processes?	The increasing range of activities and responsibilities undertaken by the UHA suggests that they have established a considerable fund of "social capital" and have been able to achieve, and maintain, gains from collective action. Whether the "aquaculture/enhancement" schism will erode these gains remains to be seen.
Has the management regime produced better information about the resource and is this information more widely disseminated among stakeholders.	Yes - considerable improvement in information, much of it supplied by harvesters themselves. (Divers interviewed suggested that they should be more directly involved in information gathering activities and management activities it is they who are "on the ground".)
Is the management regime adaptable to changing political, economic, social and environmental conditions?	So far, the regime has adapted well to changing conditions.
Has the management regime been relatively stable over time?	Yes. Future instability can be expected from the aquaculture/enhancement schism and in the impact of aboriginal treaty negotiations. Potential instability from price declines and from possible demands from coastal (non-aboriginal) communities. Relationships between government authorities and the licence holders appear very cooperative.
In general, are management rules complied with by users? By outsiders?	Good degree of rule compliance by insiders (main issue seems to be high-grading). Some poaching by outsiders, but considered relatively unimportant compared with other fisheries.

Chapter 8: Context and Design: Understanding Outcomes in Three Case Studies

8.1. Introduction: A Story with More than One Ending

If Aesop's famous mice had employed the services of an institutional analyst, they might have overcome the problem of who was to bell the cat. Or perhaps not. In the original fable of *The Mice in Council*[1], there is unanimous agreement on the gains to be achieved by attaching a bell to the local scourge of the mouse community. While the mice happily congratulate each other on having found an answer to their problem, a wise old mouse asks the question, "But who is to place the bell around the cat's neck?" Several generations later, the mouse community (now somewhat diminished) continues to debate the issue of who will bear the individual cost of achieving a great collective benefit. In Aesop's version, this problem is never resolved.

Let us assume, however, that a visiting mouse (who had spent some time in large American cities) correctly analyses the problem and suggests the following: let us each contribute one ounce of cheese to a common fund. With this fund, we will be able to hire a soldier of fortune who will risk his life in return for the prospect of a great reward. (He will also want hospital and life insurance.)

There are at least three possible outcomes:

1. A hit mouse is duly hired. He pays some younger mice to create a diversion while he bells the cat. Escaping with serious, but not critical, injuries, he collects his fee and moves to New York, where he lives a short but rewarding life. The visiting mouse collects his commission and establishes a consulting practice.

2. A group of particularly fast-running mice (who have - so far - been able to elude the cat) refuse to contribute cheese to the fund. Without their share, the fund is insufficient to attract a competent hit mouse. After twenty-two public meetings, the visiting mouse gives up in disgust, and the carnage continues. The fast mice get eaten last.

3. Let us assume that all mouse communities are part of a federation. The National Council of Mice passes a resolution against unbelled cats, and provides a matching grant to any mouse community that will bell its local cat (who may, after all, move on to victimize other communities). The matching grant is more than enough to compensate for the non-contributing mice. Proceed with outcome # 1.

Substitute "fisheries problem" for the cat, and "fisheries interests" for the mice, and Aesop's fable is a good approximation of current dilemmas in the management of British Columbia fisheries. Each fishery is a different story, however, and the ending of the story will depend, in each case, not only on the potential for aggregate gains from collective action and the development of cost-effective institutional means of achieving those gains, but also on the distributional impacts of current and potential management (property) regimes, and social attitudes toward these impacts.

At this point, let us review the "stories" of each of the cases earlier discussed.

8.2. Key Research Findings

The following three sections summarize the findings of the case studies in the in the context of five key questions:

1. What were the outcomes of the new management regimes in terms of

ecological, economic, social and operational "success"?

2. To what extent do these outcomes reflect gains to collective action undertaken by (non-governmental) participants; how are the gains distributed within the group of participants; and to what extent (if any) were these gains achieved at the cost of externalities imposed on other individuals or groups?

3. To what extent were the new management institutions "self-generated" by the non-governmental participants?

4. To what extent are the new management institutions "self-enforced" by the non-governmental participants?

5. How do the contextual and institutional variables discussed in the case studies help us understand the answers to the preceding questions?

Note about Measuring Success

As there are no absolute measures available to determine the success of these fisheries in either ecological, economic or social terms, each management regime must be judged relative to some existing standard or situation In the two intertidal clam management cases, "success" is measured against the British Columbia intertidal clam fishery as a whole. I have chosen this basis of comparison for three reasons:

1) there was no pre-existing commercial clam fishery in the Bella Bella area with which to compare the current fishery;

2) the problems experienced in the Area C Fishery prior to the closure of Savary Island were similar to, if worse than, the problems experienced

elsewhere in the intertidal fishery; there is no reason to believe that the fishery would have developed any differently from other south coastal fisheries if the management changes had not occurred. Comparing Area C to other contemporary fisheries removes the problems of having to account for intervening demographic, price and other fishery-wide changes.

3) Comparing both fisheries with the general intertidal fishery facilitates some tentative comparisons between the two projects relative to the larger fishery.

The new arrangements in the geoduck fishery are assessed relative to the management regime that was in place immediately prior to the introduction of individual vessel quotas.

8.2.1. The Area C Commercial Clam Fishery

1. Outcomes of the New Management Regime

Ecological

At least on Savary Island (where some surveys have been done), the new management regime appears to have been beneficial from the point of view of clam stocks. Stocks appear to be healthy enough to suggest that DFO will increase the Savary Island quota for the 1997-98 harvesting season. There is no information available concerning impacts in other parts of the Management Area. The regime appears to have had no impact, positive or negative, on habitat degradation or loss, which is primarily caused by municipal sewage, surface runoff and other sources of bacteriological contamination.

A group of harvesters has received approval for a federal government employment creation grant to move undersized clams on Savary Island to better positions on the beach. Pending completion and evaluation of the project, this may be seen as a positive ecological

(as well as economic and social) outcome, and may serve as an example of ways in which conservation and enhancement efforts may help address social/economic problems of fisheries transition and structural change.

Economic

From the perspective of those who have retained (or gained) harvesting rights in Area C, the regime has considerably enhanced opportunities for income and employment. Income per licensed harvester has been about four times that of harvesters in other management areas; some harvesters have also been able to qualify for unemployment insurance benefits as a result of increased earnings from the clam fishery. Prices in the fishery have been slightly higher than prices elsewhere on the coast, which have themselves been on the increase. As a community, the Sliammon First Nation has considerably strengthened its position in the clam fishery and holds 27 individual and 30 "make-up" licences (the latter are distributed by the Band Council.)

Former and aspiring Area C Clam harvesters who have not qualified for licences under the new regime have lost employment and income opportunities. They have not been compensated for this loss.

There is no information on the net effect of the new regime on enforcement costs, but costs may have increased in response to more "tips" from licensed harvesters and the extension of the fishery over a longer season. Individual harvesters have not contributed financially to the costs of the fishery. Two of the First Nations involved (Sliammon and Klahoose) have provided the services of Aboriginal Guardians to assist in patrolling clam openings, but these individuals have no independent enforcement authority . (Only DFO

officers can lay charges under the *Fisheries Act.)*

Social

The original criteria adopted by Sliammon and local non-aboriginal clam harvesters had the effect of excluding most non-local harvesters from the valuable Savary Island fishery. Once this "collective gain" had been realized, co-operative joint action among the remaining interests largely collapsed. Since the inception of the Area C project, there has been persistent conflict in this fishery over the allocation of licences between "eligible" and "non-eligible" harvesters, between aboriginal and non-aboriginal harvesters and among the three aboriginal groups involved. Outside the local harvesting communities, there has been little explicit articulated resistance to the basic criteria for licence limitation (which effectively excluded all non-local harvesters); but it must be recalled that a) clam harvesters are not well-organized as interest groups; b) many of the non-local harvesters are new Canadians (and may not be able or willing to express their concerns); and c) in the absence of licence limitation elsewhere on the South Coast, excluded harvesters have been able to acquire clam licences in other management areas, even if these areas offer poorer harvesting opportunities. The determination of excluded harvesters to participate in the fishery also accounts in part for the problem of poaching in the clam industry.

In response to allocation conflicts, the percentage of aboriginal licences has been increased to 60% of the total, with corresponding increases in total licences. (That is, the additional 10% was not re-allocated from the non-aboriginal quota.) Coupled with successful appeals from non-aboriginal harvesters, the number of licences has increased from the 1994 total of 129 to 162 in 1996 (more than 80% of the pre-limitation number).

Under the new management regime, there are fewer harvesters on Savary Island beaches during any one opening; this reduction in the intensity of the fishery has mollified Savary Island residents who objected to what they perceived as an invasion of clam diggers on "their" beaches.

Operational

The Area C project consists of two components: licence limitation and the creation of a "Clam Management Board". Established without a clear mandate, without mechanisms to ensure accountability or representativeness, and without administrative or other resources, the Board has served mainly as a forum within which the four user groups have pursued additional licences for their respective constituencies and attempted to exert pressure on DFO to increase clam harvest quotas. The Board has not developed and strengthened as a collaborative decision-making organization; however, it may serve as a sounding board for DFO plans and a focus for information sharing among the harvester interests. DFO remains, however, at the hub of a management wheel; most negotiation and consultation occurs between DFO and individual harvesters or First Nation governments.

The level of rule compliance (especially in the absence of draconian sanctions) is a reasonable proxy for stability and for perceived legitimacy of a management regime. While there appears to have been less poaching and other rule infractions in the first year of the project (relative to other areas in the clam fishery), the situation may be worsening.

2. Gains from Collective Action

The impetus for institutional change in Area C came from two sources:

a) DFO was unwilling to re-open a clam fishery on Savary Island without some means of limiting the number of participating harvesters and thereby reducing a) conflict with Savary Island residents and b) the risk of overharvesting Island clam stocks;

b) Sliammon and non-aboriginal harvesters agreed to accept licence limitation as a way of excluding non-local harvesters. Non-aboriginal harvesters were willing to accept a 50% guarantee of licences to native diggers as a condition of this bargain.

Without this agreement, it is unlikely that DFO would have unilaterally imposed limited licensing. Without the prospect of achieving access to the Savary Island fishery (which had been closed for some time), it is unlikely that participants would have agreed on the new arrangements. (There is no evidence that such an agreement was pursued prior to the introduction of the Savary Island "carrot".) Thus, the new arrangements in Area C reflect, at least in part, gains to voluntary collective action on the part of some of the individuals who stood to gain from restriction of access to a productive clam fishery. The new institutions also generated wider benefits for current and future local, B.C. and Canadian residents to the extent that the new arrangements a) reduced social conflict, b) reduced DFO enforcement and other costs, and c) reduced the potential for long-term damage to the clam resource. However, the primary gains (and those which most animated the non-governmental participants), were the capture of financial benefits from a larger potential group of clam harvesters. While some increase in Area C clam prices has been attributable to the new organization of the fishery, this has been a relatively minor

factor in raising clam harvester incomes. Gains to participants have been the result primarily of **redistribution** of returns from the fishery, not an aggregate **increase** in those returns.

Within the group of participants, First Nations (particularly the Sliammon First Nation) have received a larger share of harvesting opportunities relative to the previous management regime, and to fisheries elsewhere on the South Coast. However, First Nations may not perceive this redistribution as a "gain". In the context of treaty negotiations and discussions under the Aboriginal Fisheries Strategy, First Nations typically contend that all fisheries are traditional property of aboriginal peoples; thus any aboriginal allocation of less than 100% constitutes a sharing of what they perceive as their resources with other individuals and groups. The Sliammon First Nation has also resented the inclusion of other First Nations within the group of those eligible for licences in the Savary Island fishery - inclusions which they attribute solely to the definition of Area C boundaries (rather than traditional territorial boundaries) as the boundaries of the relevant fishery. (This argument is rejected by the Klahoose Band who state that they also traditionally fished on Savary Island.)

3. The role of participants in generating the new institutions

As noted above, the new management regime in Area C was formed at the impetus of DFO and of groups in the fishery. As discussed below, it is not currently possible for non-governmental interests to unilaterally form a group with exclusive rights to a fishery resource or a fishing territory.

4. Participant enforcement of the new institutions.

Participants have played a limited role in monitoring and enforcing the new regime. This role has been limited to the involvement of Aboriginal Guardians in DFO patrols, and to a possible increase in the likelihood that licensed harvesters will supply information to enforcement authorities about infractions of fisheries regulations.

5. The impact of contextual and institutional variables

Bio-physical, technological and market attributes

As sedentary creatures (in their post-larval stages), clams ought to be easier to manage than other (mobile) aquatic resources. Manila clams are relatively long-lived and available year round; stocks can be enhanced in various ways and "stored" on beaches as live product for several years, if necessary. Thus, specifying property rights ought to be comparatively straightforward, at least with respect to the stocks themselves. However, the productivity of any particular shellfish bed relies, not necessarily on the reproductive success of the resident population, but on the success of other populations that release free-floating clam "plankton" into the water column. The relationship between the location of the breeding population and the eventual setting of the clam spat is poorly understood.

Like other marine species, clams are highly susceptible to competing uses and degradation of their surrounding ecosystem. Their suitability for human consumption is compromised by even very low levels of bacterial or other contamination, or by (naturally occurring) episodes of Paralytic Shellfish Poison. Anthropogenic contamination results, in turn, from competing uses of the foreshore, and near foreshore, for purposes such as residential and industrial development, agriculture, recreational boat basins and

commercial shipping.

Manila clams are widely found on suitable beaches throughout the South Coast of British Columbia, but some areas are particularly productive, including the Baynes Sound area of Vancouver Island and the beaches of Savary Island. The concentration of productive clam habitat has been a significant factor in the development of the Area C Fishery: most of the conflict over harvesting opportunities has taken place over the allocation of clams on **Savary Island**, not in the rest of the management area. The otherwise extensive distribution of clam beaches within the far flung boundaries of Area C (as defined by DFO) complicates enforcement tasks and makes stock assessment and abundance surveys difficult and expensive.

By restricting harvesting technology to hand digging, DFO regulations limit the degree of stock and ecosystem damage that can be inflicted by techniques such as mechanical dredging. These gear restrictions also limit the incentives for "capital stuffing" in the clam harvest, although larger and faster boats can allow harvesters to take advantage of legal openings throughout a Management Area (as well as illegal "opportunities" throughout the coast). However, low capital requirements encourage "labour stuffing" in the industry. Overcapacity in the clam fishery is the result too many **human beings** chasing too few clams, rather than too many **boats** chasing too few fish. Overcapacity and simple (cheap) harvesting technology exacerbate enforcement problems in a widely dispersed fishery: a crew of clam harvesters can "hit" a beach overnight, and unobtrusively wipe out the clam population.

Rising clam prices and easy access to markets both increase the potential for gains

to collective action **and** increase the temptation for individual harvesters (licensed or unlicensed) to "cheat". Further, when prices are relatively unresponsive to levels of supply, individual harvesters do not experience direct and immediate effects of increasing the quantity of clams on the market. The returns from successful cheating are almost certainly higher than the immediate costs. There is, thus, little independent motivation for any one harvester to monitor and sanction another.

These factors, taken together, suggest some of the disincentives for Area C clam harvesters (or clam harvesters in many areas) to seek and enforce **collective** property rights in a clam fishery. (As noted later in this chapter, several of these same factors both motivate and facilitate the creation of individual or very small scale joint rights, i.e. staked wild areas or, more likely, clam farms.)

User and Community Attributes

As discussed in Chapters 5 and 7, a key feature of this fishery is the presence of at least four identifiable user groups in the commercial fishery, as well as a significant aboriginal food fishery. In the past, there has been considerable conflict with the long-established (and generally well-heeled) recreational home community on Savary Island. Unlike other B.C. clam fisheries, non-local (especially Asian) harvesters have not been a factor in the new Area C fishery. (In other areas of the Coast, conflicts between harvester groups have been bitter and sometimes violent.) There have been some conflicts between clam harvesters and holders of shellfish tenures, but the potential use of tenures to "launder" wild clams is at least as great a concern.

There is much less harvester capacity in the Area C fishery than elsewhere, but still

far more than is necessary to harvest a sustainable annual yield or to generate a full time income from the fishery. At current prices and current quotas, the Savary Island fishery would generate less than $500,000 - an income of $25,000 each for 20 harvesters. Area C (in total) would generate such incomes for between 35 and 40 harvesters. Thus, for most harvesters, clam fishing will continue to be a seasonal, part-time occupation, and for a few, a means of gaining eligibility for unemployment insurance benefits. As in other B.C. (and Atlantic) fisheries, the clam fishery in Area C now includes "fishing for stamps". Landings per licence holder are, however, considerably higher than elsewhere on the Coast. For example, in Area F (West Coast of Vancouver Island), about 200 tonnes of clams were landed in 1994, divided among almost 500 licence holders. This amounts to less than 410 kilos per licence compared to more than 1,370 kilos per licence in Area C (Dovetail Consulting, 1996).

Institutional Arrangements

In the Area C Clam fishery, as in the general intertidal clam fishery, the Federal government dominates fisheries management. As noted above, the Area C Clam Management Board has no independent management authority, nor do individual harvesters hold any property rights in the fishery beyond those of "authorized users". These rights, in Area C, are somewhat more valuable than elsewhere on the Coast (because of licence limitations), but they represent only personal, non-transferable (and so far) annual rights to participate in the Area C clam harvest. First Nations (Band Councils) have authority to allocate so-called "make up" licences among their members , but these licences do not represent any communal or individual right to a specified quantity of

clams, nor to the right of harvest in any specified or exclusive area (other than within Area C generally).

The Area C Clam fishery is subject to all general intertidal clam fishing regulations and to an aggregate quota on the Savary Island fishery. The effect of this quota on fishing effort is debatable - it appears to function primarily as a rough measure of how to allocate fishery openings throughout the potential season and as a trigger to close the fishery. The often cited effects of aggregate quotas in encouraging "capital stuffing" and a race for the fish (e.g. Acheson, 1984; Keen, 1988) are not obvious in a low capital fishery (there is a limit to how much any one individual can dig by hand on any one tide); but the existence of a quota has certainly focussed (and possibly increased) conflict over what the correct quota, and hence the correct upper limit to harvester incomes, should be. (At least one meeting of the Clam Management Board culminated in accusations by harvesters that DFO scientists were systematically underestimating the sustainable harvest on Savary Island and thereby a) cheating harvesters out of their legitimate expectations and b) encouraging poaching by leaving clams on the beach.)

Except for the presence of an observer from the British Columbia Ministry of Agriculture, Fisheries and Food, the Clam Management Board does not include representatives of any interests except for commercial harvesters and First Nations (representing both aboriginal harvester and First Nations government perspectives). Neither clam tenure holders, recreational clam diggers, local governments, environmental groups, nor the "general public" are represented. Sports fishing interests and Savary Island residents were invited to send participants, but declined to do so. One harvester member

also informally represented the views of clam processors. Former licence holders and aspiring licence holders from outside the Management Area are not included. Nor are representatives from regions that are within Area C (i.e. south from the Sunshine Coast to the American border) but are currently closed to clam harvesting, primarily because of municipal and industrial contamination. The only exception to this latter situation is that the First Nations involved have negotiated protocols with other First Nations whose traditional territories lie within Area C, but who have not historically fished in the Powell River area.

The Larger Policy Context

Why were licence limitation and a form of local participation initiated in Area C, rather than elsewhere on the coast, and why in 1994 rather than 5 years earlier (or later?). The answer to this question lies, at least in part, in a) the development of both law and policy concerning the status of aboriginal rights to fishery resources in British Columbia, and b) the beginning of a federal-provincial process to reform the management of the intertidal clam fishery. The latter process itself reflects a broad reorientation of Federal fisheries policy away from centralized management (i.e. state regulation of an open access fishery) toward more involvement of user groups in co-management of fishery resources (i.e. specification of some individual and/or joint property rights).

(As these factors are also relevant to the implementation of the Heiltsuk Commercial fishery, I will defer discussion to a common summary of policy issues in the two intertidal clam fishery cases.)

A factor unique to the Area C project was the 1989 decision to close Savary

Island, which had the result of encouraging non-local harvesters to fish in more productive areas. When the time came to re-open the fishery, eligibility criteria based on recent participation in the Area C fishery **automatically** excluded non-local participants. No explicit **policy** decision of limiting participation to local harvesters was required.

Summary of Findings: The Area C Clam Management Project

Assessment of the contextual and institutional characteristics of the Area C Clam Management Project supports several of the predictions discussed in Chapter 3 about success (and failure) in CPR systems:

1. Individuals will engage in collective action if they believe that, by doing so, they will achieve greater individual benefits than are possible through individual action. It is not the level of **aggregate** benefits that counts. In Area C, concerted joint action lasted only long enough to exclude non-locals from the lucrative Savary Island fishery.

2. Incentives to overexploit and underinvest will persist in the absence of property rights that are sufficiently well specified and defended to ensure that the fruits of both stinting and investment will be reaped by the property holders. The fishery within Area C still reflects most of the features of a state regulated open access fishery: incentives for cooperation are few and weak; incentives for non-compliance are persistent and strong.

3. Ethnic and geographic heterogeneity among sub-groups in the

fishery contributed to communication and other difficulties in developing new institutional arrangements, particularly as groups saw the new regime as a forum for achieving gains for "their" group.

4. The clam fishery has traditionally been an employer of last resort, and is often one of the few ready sources of cash income for marginally employed individuals, especially during the winter months. If both government officials and harvesters perceive the fishery primarily as a source of supplemental income and an "economic safety valve" (Pinkerton and Weinstein, 1995:104), it seems unlikely that either group will be inclined to invest in its long-term economic well-being.

4. Government legal, policy and other arrangements must permit, if not promote, the pursuit of gains to collective action. In this project, it was legally impossible for harvesters to levy landing taxes or raise other revenues from harvesters for monitoring, enforcement, or other purposes; to establish individual or joint harvesting areas; to enhance the fishery; to establish rules for selling or otherwise transferring property rights in the fishery; or to sanction non-compliance. Thus, harvesters lacked not only motivation, but institutional capacity, to generate and enforce common property arrangements.

6. Unlike other British Columbia fisheries (particularly salmon), the absence of organized and committed competition for harvesting opportunities in the Area C fishery permitted an arrangement that would have been much more difficult to achieve in other circumstances. As discussed earlier in this chapter, the particular

situation in Area C permitted DFO to respond to First Nations demands and to test the concept of limited entry with relatively little risk of provoking waves of outrage from the B.C. fishing community. In contrast, one can imagine the response if DFO had agreed to allocate 50% (and later 60%) of licences to First Nations in a salmon or herring fishery, even with the agreement of local licence holders. Officials, as well as clam harvesters, anticipated gains from institutional innovation in Area C, and acted accordingly.

8.2.2. The Heiltsuk Commercial Clam Fishery

1. Outcomes of the New Management Regime

Ecological

Prior to the initiation of this fishery, there was little or no harvesting of manila clams in the Bella Bella region. At the time the fishery began, DFO biologists considered it possible that poor levels of recruitment might preclude a sustainable fishery in the area, and that the Heiltsuk fishery might amount to a so-called "clean up" fishery. (Interestingly, some biologists are not alarmed by the prospect of extirpating manila clams, because the clam is an introduced, rather than a native, species.) Recruitment appears to be more successful than anticipated, however. At current harvesting levels, clam stocks appear to be healthy, although some beaches (generally larger beaches closer to the settlement at Bella Bella) have been temporarily closed as a result of over-harvesting.

There has been little or no harvesting pressure on two of the three species allocated under the fishery (native littleneck and butter clam). In most years, the quota established for manila clams has not been reached.

Economic

The fishery has provided employment income for up to 50 individuals per season (generally November to March); for the approximately 35-40 most committed harvesters, the fishery generates incomes of between $8 and $10 thousand each over a 5 month period. In a community with high unemployment and generally low incomes, clam harvesting represents a significant source of income, especially for individuals who would otherwise be dependent largely on social assistance or other transfers. About 80% of the returns from the fishery accrue directly to harvesters; the balance is divided between rental of the Bella Bella fish plant and payments to the Heiltsuk Fisheries Program.

No previous clam harvesters have been displaced by the new fishery, as there was no commercial clam fishery in the area prior to the Heiltsuk project. The entire commercial clam fishery is allocated to the Heiltsuk Tribal Council; individuals who are not Heiltsuk Band members are excluded from the fishery, by definition.

Although the exact costs of managing this fishery are not available, they are certainly higher than those in other intertidal clam fisheries. For example, every opening is patrolled by two boats and four HFP staff; the HFP staff prepare fishery reports; purchase and distribute materials such as gloves and sacks; conduct dockside monitoring and validation, supervise processing and packing of clams; return broken and undersized clams to beaches, manage PSP monitoring programs and beach surveys, and so forth. The costs of this program are supported by the Federal Aboriginal Fisheries Strategy, by other revenues of the Heiltsuk Tribal Council, and by harvester contributions. While the aggregate returns from the fishery are undoubtedly higher than the aggregate costs, most

of the costs are not borne by the major beneficiaries - the harvesters themselves. The size and distribution of fishery management costs will almost certainly become an issue of greater concern to the Heiltsuk Tribal Council at such time as treaty settlement and increased powers of self-government focus greater attention on the **net** costs and benefits of alternate economic development and employment projects. These aggregate comparisons tend to be obscured when funding is derived from, and expended in accordance with, a variety of special-purpose government programs.

Social

As noted above, the fishery is open only to Heiltsuk Band members. This exclusive allocation has not provoked significant local reaction (perhaps because there are so few non-aboriginal residents in the Bella Bella area). Nor has it provoked much reaction from commercial fishery interests elsewhere on the coast (perhaps because, as noted earlier, clam harvesters are poorly organized; also, the industry itself is considered relatively insignificant by those who consider themselves to be "real fishermen").

Competition within the Heiltsuk community for available permits under the Communal Licence has declined with the evolution of the fishery. There are fewer "hard core" clam harvesters than there are available permits, although individuals periodically wish to dig clams, but are unable to because of the ceiling on permits.

The major conflicts within the fishery appears to be those between harvesters and the HFP and concern the same types of issues that emerge between DFO and harvesters elsewhere on the coast: the size of the quota (relevant to Area C only), the enforcement

of harvesting and processing rules, and generally, the perception that fisheries managers are unreasonably interfering with the opportunity of harvesters to maximize clam harvesting income.

Operational

The management regime appears to be relatively stable. The fishery agreement has been extended between the Heiltsuk Tribal Council and DFO until the end of 1999.. The Heiltsuk Fisheries Program has expanded significantly since its inception (with the commercial clam harvest) in 1992, and the completion of treaty negotiations is likely to consolidate and expand both the First Nation's access to the fishery resource and the extent of its management responsibilities. The nature of the Heiltsuk fisheries management regime closely resembles that of "Communal Claimants" or indeed "Communal Proprietors", the latter status involving the right to exclude users from a defined resource stock or system.

The fishery appears to be relatively immune to incursions from outsiders. Rule compliance is a concern within the user group, however, and reflects the persistent problem of the "tragedy of the commons" even within a relatively small, close knit community. Harvesters benefit in aggregate from compliance with the rules (so that the communal license will not be lost and, in the longer term, so that the fishery will be biologically maintained), but the incentives facing individual harvesters remain imperfectly aligned with the pursuit of the collective good. A schism has also developed between some of the "community of users" and the interests of the community government that is responsible for fulfilling the role devolved to it by DFO.

2. Gains from collective action

The impetus for the Heiltsuk commercial clam fishery came primarily from the Heiltsuk Tribal Council. In its role as the community government of the Heiltsuk First Nation, the Tribal Council negotiated the Clam Fishery and related agreements with DFO on behalf of its members, and achieved access to a new and significant source of employment and income for the community.

3. The role of participants in generating the new institutions

In terms of the genesis of the new institutions, the relevant group of participants was not the current group of clam harvesters (there were no commercial clam harvesters in the community), but the Heiltsuk community government. The results of the negotiation were more in the nature of an intergovernmental agreement that devolved resource responsibilities and revenues from DFO to the Heiltsuk government, than the creation of joint property rights held by a user group. Snidal (1995) describes this arrangement as "local centralization", as opposed to "local decentralization" (to user groups).

4. Participant enforcement of the new institutions

Compared with other intertidal clam fisheries, community managers and participants have assumed considerable responsibility for monitoring and enforcing new institutional arrangements. This role is primarily assumed by professional fisheries managers, rather than participants, but the role of harvesters in developing and enforcing sanctions against their peers is much greater than in the general intertidal fishery (where it is almost certainly entirely absent) and in the Area C Management project.

5. The impact of contextual and institutional variables

Bio-physical, technological and market attributes

Many of the bio-physical, technological and market attributes discussed in the analysis of the Area C project apply equally to the Heiltsuk fishery. However, the Heiltsuk case is distinguished by:

a) the relative geographic isolation of the fishery.

b) the relative importance of PSP contamination as opposed to municipal or industrial pollution.

c) the location of the fishery near the northern limits of the range of the manila clam species.

The geographic isolation of the fishery places some limits on potential harvesting capacity, whether legal or otherwise and increases the feasibility of establishing and maintaining administrative boundaries (by reducing the potential for intrusion or overlap of other fisheries). Because there is relatively little residential or industrial development in the area, anthropogenic sources of pollution are less significant in this fishery than is the incidence of chronic PSP which limits the potential harvest season to five or six of the colder months. Cold, stormy weather limits the number of possible openings during the PSP-free season, thus placing some "natural" limits on the ability of harvesters to reach and exceed established harvest quotas.

The fishery is also remote from potential markets. Joint marketing of the clam harvest may be critical to inducing a buyer to undertake the expense and risk of sending a packer to Bella Bella through what can be extremely hazardous conditions.

User and Community Attributes

All of the harvesters, all of the elected officials of the Heiltsuk Tribal Council, and most of the Tribal Council employees are members of the Heiltsuk Band and live in Waglisla (Bella Bella). Most individuals are related to each other through extended families and interact regularly in the round of activities typical of a small, remote community. Harvesters participate in the project as clam diggers, as members of the Shellfish Committee, and as electors of the Heiltsuk Tribal Council.

Institutional Arrangements

Agreements between DFO and the HTC establish the relative rights and responsibilities of the two parties. While the Heiltsuk fishery is subject to all of the general regulations governing intertidal clam fisheries, the HTC has independent authority to determine "licensing" criteria for individual harvesters, to establish mechanisms for re-allocating harvesting permits, and to establish rules and sanctioning procedures to help ensure that individual harvesters do not commit infractions of regulations governing the Heiltsuk Communal License. As a result of the communal nature of the license, the actions of individual harvesters can result, not only in the loss of individual harvesting opportunities, but potentially in the loss of the communal licence itself.

While this fishery has no formal provisions for individual quotas, the HFP initially established a per-harvester limit to encourage the broadest possible participation of Heiltsuk band members in the fishery. This quota system has not been enforced, however, as the core group of harvesters is small enough, and the aggregate quota large enough, that a "ceiling" on individual harvests has not been necessary as a rationing device.

Individual harvesters have no independent entitlement to a particular share of the total clam harvest, nor to a right to harvest (or to enhance) in any particular area.

The Broader Policy Context

The broader policy context relative to both the Heiltsuk and Area C fisheries is discussed below.

Summary of Findings: The Heiltsuk Commercial Clam Fishery

Assessment of the Heiltsuk Fishery lends support to the following propositions:

1. Bio-physical conditions are an extremely important consideration in the success or failure of a particular management regime. In an isolated fishery (with relatively little competition for available stocks) the costs of allocating fishing rights, and defining and defending geographic boundaries, are much lower than they would be if the fishery were closer to settlements, markets, and a large pool of potential harvesters (see Snidal, 1995). When there is only one community within a particular geographic area, the creation of exclusive rights of access to that fishery appears natural and legitimate.

2. Even with a small, apparently homogeneous group, the issue of individual incentives must be addressed. Incentives to underinvest and overexploit persist in the Heiltsuk fishery and have, so far, been dealt with only by punitive regulatory approaches. To overcome these problems, specification of property rights at the individual or

family/crew level may be required. The latter may be quite consistent with traditional aboriginal systems of allocating rights to natural resources on a family or "house" basis.

3. Although the point is not emphasized in much of the CPR literature, the Heiltsuk case underlines the importance of participants being organized in a legally recognized form (See Ostrom, 1992:97) that is capable of entering into binding contracts with regard to the allocation and exercise of property rights. One of the reasons why most so-called "co-management" arrangements in British Columbia (and Canada) have been established between governments and First Nations is that First Nations are organized as legal entities that are empowered to enter into such agreements. By contrast, many attempts to establish co-management agreements with non-aboriginal or mixed groups have been hampered by the absence of stable organizations. These arrangements have involved, rather, unstable, shifting alliances of interest groups who are not "married", as it were, to the long term consequences of any particular set of decisions and are free to form new alliances when conflict or convenience dictates.

Institutional Change in the Intertidal Clam Fishery: The Role of the Policy Context

There have been four major policy shifts that have directly influenced the development of new institutional arrangements in the intertidal clam fishery:

1) agreement by the B.C. government to negotiate land claims with First

Nations, and the consequent initiation of a modern treaty negotiation process in the province;

2) confirmation and specification of aboriginal fishing rights in British Columbia;

3) a shift in federal fisheries policy away from centralization and toward user group and community involvement in exercising (and paying for) fisheries management activities;

4) the emergence of a greater role for the British Columbia government in fisheries management.

Aboriginal Fishing Rights and Treaty Negotiations

The *Sparrow* decision (*Sparrow v. the Queen [1990]*) clarified the nature and extent of aboriginal fishing rights and confirmed these rights as one of the class of aboriginal rights protected under Section 35(1) of the *Constitution Act.* Among the legal principles established by the *Sparrow* decision were the right of aboriginal people to fish for food, ceremonial and societal purposes and first priority of these rights after fisheries' conservation. In response to the decision, the Federal Government established, in 1992, the Aboriginal Fisheries Strategy, a program designed to protect aboriginal fishing rights and to give aboriginal communities a greater role in fisheries conservation and management, and to provide economic development and employment opportunities (Guerin, 1995:11). While the program has attracted considerable criticism (primarily in connection with the salmon fishery), it has been instrumental in the development of co-management agreements in fisheries. Larry Kreba, a staff biologist with the Kitasoo Band (located north of Bella Bella on the Central Coast) notes that,

The much maligned Aboriginal Fisheries Program has been a relative

> panacea for Kitasoo to assert some control and involvement in local fisheries management issues (Pacific Fisheries Think Tank, 1997)

For coastal First Nations, fisheries are a central element of treaty negotiations. While agreements reached under the Aboriginal Fisheries Strategy are not an explicit commitment to their inclusion in treaties, it seems likely that such arrangements will be folded into eventual treaty settlements. Thus, for First Nations, AFS projects are doubly significant. The treaty negotiation process also provides for Interim Measures Agreements to protect and manage fishery resources pending the completion of treaty negotiations (Guerin, 1995:15).

Since the *Sparrow* decision, there have been several other court cases dealing with the precise definition of aboriginal fishing rights, especially the aboriginal right to legally sell fish. This right has not been recognized by the courts, but it is a matter which First Nations will certainly continue to pursue.

In combination, the Aboriginal Fisheries Strategy and the treaty negotiation process have provided both mandates and mechanisms for the recognition or allocation to First Nations of rights to fishery resources.

Co-management and Intergovernmental Arrangements

As discussed earlier in this study, the federal and provincial governments jointly launched a discussion paper and conducted subsequent consultations about management reform of the intertidal clam fishery. While current attention is focussed on the emergence of a greater role for the provincial government in management of the salmon fishery, there is a much longer history of provincial involvement in invertebrate fisheries. (Under

administrative arrangements with the federal government, the province has had primary responsibility for management of oysters for many years [Bayley, 1987]). It is not unreasonable to anticipate that the provincial government might assume similar responsibility for the clam fishery, once aboriginal treaty issues have been settled.

"Partnerships" under the proposed new *Fisheries Act* would, for the first time, enable the federal Minister to sign legal agreements with fishery groups regarding the management of a fishery. As discussed in the Area C case, the absence of such legislative provisions is a significant impediment to the development of effective co-management regimes.

8.2.3. The Geoduck Fishery

1. Outcomes of the New Management Regime

Ecological

From the perspective of conservation and protection, the IVQ system established in 1989 has been a vast improvement over the previous regime. Although there remain localized problems with overharvesting (at least some of which are a consequence of the pre-IVQ era), harvesters adhere to both area and aggregate quotas. There is now little problem with spoiled or broken product, which was a significant concern in the previous "shotgun" fisheries. High-grading remains a concern, but is probably less serious than under earlier conditions, particularly when processors were not required by law to buy dark-coloured clams

Quotas have been set at what are considered by DFO biologists to be conservative levels, and have been reduced by 47% between 1989 and 1996.

The Underwater Harvesters Association has initiated programs to enhance wild geoduck stocks in recognition of low natural productivity and concerns about recruitment, particularly in heavily fished beds.

Economic

The value of the geoduck fishery has grown from $9.8 million in 1988 to $42.5 million in 1995. During the same period of time, the number of vessels active in the fishery has declined from 56 to 42 (estimated); the number of divers employed has dropped from 192 in 1988 to 93 in 1996 (excluding licence holders). The cost of managing the fishery has grown significantly, but all or most of this increase has been borne by the contributions of geoduck harvesters, and many of the expenditures are incurred in research, development, and other investments in the long term health and economic viability of the fishery. Geoduck harvesters contribute about $1.6 million annually for fishery management (approximately 3.5% of the gross landed value of the fishery).

There are no landing taxes or other means of extracting resource rents in this fishery, but licence holders note that much of their profit in the fishery is returned to the federal and provincial governments in the form of 50+% marginal rates of income tax.

Social

Geoduck license holders have borne an increasing proportion of the management

costs of this fishery and have also received the vast majority of benefits. Processors and employed crews have been relatively disadvantaged by the new regime (although in absolute terms, individual divers and processors are doing better than before). More than half the previous diver group has been displaced from the geoduck fishery and at least some of these individuals have moved to other dive fisheries with, perhaps, negative consequences in terms of increasing harvest pressure on other species. Consumers have borne the costs of increasing product value, although such increases have reflected Asian market demand for luxury foods (a market in which high prices may increase, rather than decrease, the attraction of the product).

The principal question of social equity in this fishery is the extent to which employees in the fishery, potential entrants, and governments consider the concentration of a highly lucrative fishery in a relatively few hands to be "unfair". Even though the major increases in the value of the fishery occurred after the introduction of the IVQ system in 1989 (and the quotas were allocated to a group of harvesters whose size had been limited several years before), the current concentration of wealth certainly attracts the attention of those who would like to get a share. The potential development of geoduck aquaculture (as opposed to enhancement) also raises questions of equity. Should only current license holders be entitled to geoduck leases? If not, who should? If there are new entrants into the fishery and a major expansion of the geoduck harvest, what will be the effect on both the economic and ecological status of the fishery?

Operational

In terms of operational criteria, such as improved information, rule compliance,

investment by licence holders in the ecological and economic well-being of the industry, and cooperation between DFO and geoduck harvesters on matters ranging from research to enforcement, the current management regime is a significant improvement over previous arrangements.

2. Gains from collective action

The participants in this fishery proposed the establishment of an IVQ system as an explicit attempt to overcome the dissipation of rents and other problems of the fishery as previously organized. Support for the new system was not unanimous; it was resisted by some of those who stood to lose from the new arrangements, and supported by those who anticipated significant gains (particularly those who had unsuccessfully attempted to achieve gains by informal and voluntary "rationing" in the South Coast fishery). The continuing joint activities of the harvesters, organized as the UHA, have been extremely successful in enhancing the value of the fishery, mainly through supply management, and in assuming control over many aspects of fisheries management that are generally retained by DFO. The aquaculture/enhancement split within the UHA suggests, however, that conflicts are emerging over the relative benefits of these two strategies for increasing available stock.

3. The role of participants in generating the new institutions

The management regime implemented in 1989 represented a compromise between the coastwide IVQ fishery proposed by the geoduck harvesters, and area licensing and quota management preferred by DFO. DFO approval was critical to the introduction of the quota system, as the harvesters had been previously been unable to create and enforce

a "voluntary" scheme of this type.

4. Participant enforcement of the new institutions

Through their funding of an independent monitoring and validation agency (Archipelago Marine Research), the geoduck harvesters have assumed the majority of costs and responsibility for monitoring and enforcing the new regime. While only DFO can lay charges under the *Fisheries Act*, the UHA pays for north coast patrol (through AMR) and for other expenses, and supports investigative activities. Both DFO and the UHA have supported licence sanctions and other alternatives to the cumbersome and largely ineffectual legal processes for enforcing the *Fisheries Act* and regulations.

5. The impact of contextual and institutional variables

Bio-physical, technological and market attributes

The biological characteristics and geographic distribution of geoduck clams are highly relevant to the design of an appropriate management regime. As a slow-growing, long-lived, sedentary species, geoducks are, on the one hand, vulnerable to being "mined" and, on the other hand, well suited to supporting a conservative , long-term, sustainable harvest. Given the geoduck's low natural productivity, stock enhancement may be required to maintain clam populations; if enhancement is to take place, ways must be found of ensuring that the benefits (which may not be realized for up to 10 years) can be guaranteed to the investors.

The species is abundant within its range, which allows for a coastwide harvest to be widely dispersed so as to reduce pressure on the most accessible stocks. At the same time, the species is not found outside the Pacific Northwest, which enhances the gains to

be achieved from supply management.

High and rising prices for the species have muted harvester resistance to declining quotas, and increased the incentives for individual harvesters to monitor and sanction "quota busting" by other licence holders and poaching by illegal harvesters. In a small, high value fishery, cut-rate or black market clams can seriously affect the returns to legal harvesters. It is fashionable to say that individual quota holders respect quotas because quota busting "steals" from other fishermen (rather than from the common pool of an open access fishery). But this is only true if the allowable catch (aggregate quota) is the same as the total physical stock, which it never is. "Quota busting" more readily steals from the common pool of **unallocated** resources, or from other user groups if they exist. Unless there are strong counter-incentives (including rigorous monitoring), the allocation of individual quotas is not a sufficient incentive to harvest within either individual or aggregate limits. In the geoduck fishery, the nature of the product and the market reinforces the monitoring and validation processes by providing an **independent** incentive to harvesters not to flood the market with product, and thereby bring prices down.

User and community attributes

The commercial geoduck harvest is just over two decades old and has never had more than 100 participants. Limited entry was introduced into the fishery in 1981(more than five years before landings peaked in 1987), and an IVQ system was introduced within 10 years of limited licensing. In fisheries policy terms, the institutional transformation of the geoduck fishery took place at breakneck speed and resulted in the creation of a small, relatively homogeneous group of harvesters whose history of joint action began within 5

years of the initiation of the fishery. Initially reluctant "high liners" soon came to appreciate the benefits of the IVQ fishery. This degree of unanimity has enabled the UHA to collect from its members very substantial contributions to fisheries management and enhancement, even though such contributions cannot be enforced under the existing provisions of the *Fisheries Act.* DFO officials find it comparatively easy to work with the small and well-organized group of geoduck harvesters, both directly, and through the informal mediation and information channels provided by Archipelago Marine Research.

There are only minor recreational and aboriginal subsistence fisheries for geoduck, and the geoduck harvest itself is unlikely to interfere with other uses of the marine environment or, relative to the intertidal clam fishery, to be affected by other users.

Within this small and relatively close knit community of users, however, disagreements have arisen over the enhancement/aquaculture debate; and over the acquisition of licences by processors or consortia from individual owners. This latter concern is also raised by employed divers, who believe that wages and working conditions are less favourable on leased or "corporate" boats than on those owned by individuals who have themselves been geoduck harvesters.

Institutional arrangements

The geoduck fishery is the oldest extant IVQ fishery in British Columbia. It is the only fishery among the three studied in which property rights (in the form of a share of the aggregate catch) are allocated to individual licences. Unlike the Heiltsuk fishery, where access to a communal property right is distributed among members, individual property right holders in the geoduck fishery have coalesced to pursue the benefits of collective

action. The formation and operation of the geoduck harvester group is quite consistent with the model predicted by the CPR literature. The initial, and still significant, collective responsibility for monitoring and validation remains at the heart of the joint activities of the group; this was not voluntarily assumed, but was required as a condition of the approval of the IVQ system. Other activities, however, such as stock assessment and research, and development of stock enhancement, have been voluntarily initiated by the members of the UHA. In this case (and for many bio-physical, market and other reasons), the incentives created by individual property appear to align well with those of the user group as a whole. Under this institutional regime, the fishery has so far avoided both the dissipation of rents and the destruction of the resource.

As noted above, however, the regime has not explicitly dealt with equity issues created by rapid accumulation of resource rents by a small group of property holders.

The larger policy context

As noted earlier in this study, the geoduck fishery is likely to be one of the first first in which a partnership agreement will be implemented under the provisions of the proposed new *Fisheries Act.* Such an agreement will likely provide more secure rights in the fishery to licence holders and more firmly entrench the so-called "you pay-you say" principle in fisheries management. Treaty negotiations, the development of aquaculture, an increased role for the provincial government in fisheries management, and the extension of marine protected areas in British Columbia waters will all, in varying degrees, influence the future of the geoduck fishery.

Summary of Findings: The Geoduck Fishery

Of the three case studies, the Geoduck Fishery best conforms to the model of a self-generating, self-enforcing CPR regime. The current management arrangements were established at a time when there was little competition for the fishery resource outside the small group of existing commercial harvesters. Thus, there were no serious conflicts over the **distribution** of benefits to collective action. The rules established for the treatment of IVQ's were simple - equal shares, no prohibition on stacking, no limitations on vessel length, no transfer or signficant carry-overs of individual quotas. The small size of the harvester group minimizes costs of organizing the fishery so as to both distribute effort and minimize the number of landing ports for monitoring and validation of the catch. High and rising values in the fishery have enabled substantial funds to be devoted to fishery management and investment and have cushioned harvesters against some investment risks. The geoduck fishery bears a large proportion of its management costs and is a net contributor to the British Columbia and Canadian economies.

From ecological and economic perspectives, the IVQ regime for the geoduck fishery has been a success. Pressure is increasing, however, to increase access to the fishery as a way of "sharing the wealth".

8.3. Responses to Management Issues in Three Fisheries

The above review of the three case studies highlights some lessons to be learned from applying the theoretical understanding of common pool dilemmas to the complex, messy world of real life fisheries. Given our resulting understanding of failures and successes in these fisheries, what institutional measures might be taken to reinforce their

achievements and overcome their failures?

8.3.1. The Management of the Intertidal Clam Fishery

It is perhaps ironic that the wild clam fishery is the fishery most amenable to the specification of individual or joint property rights **and** the fishery in which the fewest property rights have in fact been specified. The aquaculture industry (which is regulated primarily by the provincial government) does, of course, involve the allocation of quite specific and extensive property rights in both the resource system and resource stocks; but, from a policy and jurisdictional perspective, the "wild" fishery and the "farmed" fishery in invertebrates are treated as different entities, and the interrelationships between them do not seem to be systematically considered nor addressed.

The federal government has recognized that the continuation of a wild clam harvest without licence limitation is untenable, and plans to introduce major reforms to the fishery beginning in 1998. A joint federal/provincial intertidal clam policy reform process also anticipates the formation of some sort of community management boards or other local management entities. It is not clear, however, whether the proposed changes will represent any greater specification of property rights than that which occurred in Area C. If they do not, then all of the Area C problems (compounded by much more serious local/non-local competition for harvesting opportunities) may be expected to ensue, except in those cases where a single community is the only dominant user of a particular fishery. In such cases, a model similar to that of the Heiltsuk Clam Fishery may be feasible.

Simply reducing the size of the group of authorized users of the clam resource will

not resolve the problems of the wild clam fishery. Individual incentives to overexploit and underinvest will persist and, if there is no legal capacity for individuals to contract among themselves to create enforceable joint property rights, no such collective action will occur. Each member of the smaller group of harvesters will gain access to a larger potential share of the clam earnings (and some will do much better than others). As a result, when it is recognized (by everyone and his blind puppy) that more extensive management reforms are required, there will be an even more firmly entrenched group of stakeholders who stand to lose from changes to the existing institutional arrangements.

In my view, it would be preferable to reform the management of the clam fishery in one bite rather than in a series of small nibbles. Overall, a new policy direction for the management of the intertidal clam fishery should include the following elements:

. Individual or joint property rights should be allocated in specific tracts of foreshore which have been zoned, in advance, for clam harvest or mariculture or both;

. Fees on the tenures should be set at levels sufficient to cover all direct costs of management; to establish a fund for shellfish research and development, and to recover some proportion of scarcity rents (this level could vary by geographic area, by productivity, etc.).

. A commercial wild clam fishery south of Cape Caution should be terminated within a reasonable period of time (perhaps five years)and coastwide within ten years.

. Incentives should be created to encourage current clam harvesters to apply

for clam tenures or to seek employment in mariculture.

. In areas where exclusive clam tenures are not feasible or desirable (see below re. Savary Island), the federal government should allocate an aggregate communal quota to a local government entity (for example a municipality or Band Council) or divide the quota among such entities, and establish the fishery as a "contract" fishery, with monitoring and enforcements costs paid for by the quota holder (s).

. Consideration should be given to devolving some aspects of shellfish management to local governments at the municipal or regional district (or Band/Tribal Council) levels, once the zoning process has been complete. Municipal development is one of the major causes of shellfish contamination - an economic stake in the wellbeing of the clam fishery might provide an incentive for municipalities to control the degradation of marine environments caused by their development decisions. Local governments could be involved, not only in the management of the commercial fishery but in the recreational fishery as well. They could, perhaps, administer and receive revenues from recreational fishing permits and also benefit from the promotion of tourist attractions based on the shellfish resource (community clambakes and the like).

The question of organizational scale in fisheries management will be discussed more generally in Chapter 9.

Area C Clam Fishery

Most of the recommendations above would address problems identified in the

Area C Clam fishery. In the case of Savary Island, it is unlikely that either current user groups or island residents would agree to the creation of exclusive (and intensive) clam tenures. However, it may be possible to harness the existing heterogeneity among user groups (R. Mitchell, 1995) in ways that reduce pressures for overharvesting of these productive beaches. For example, the aggregate quota could be distributed among the existing user groups on a basis consistent with their current licence holdings. Each group would be entitled to harvest the Island on a series of rotational openings, until each of the sub-quotas was taken. All landings would be monitored and validated. Any overages would be deducted pro-rata from the aggregate quota. By dividing the quota in this way and imposing a collective sanction for non-compliance, each of the "non-harvesting" groups would be motivated to ensure that other groups do not exceed their allowable catch.

Heiltsuk Clam Fishery

The principal problems in the Heiltsuk fishery are the imperfect "match" between individual and communal incentives and the relatively high costs of managing the fishery. To address these issues, the Tribal Council could implement the following measures. (Most would require approval of DFO or the provincial government, or both):

. The HTC could auction or otherwise allocate particular beaches and harvest quotas on an individual or small scale collective basis. Casual harvesters would be entitled to fish only on clam tenures, but tenure holders would be required to permit a specified minimum number of casual harvesters to their

beaches. Tenure holders could buy the clams from casual harvesters (at a price less than market value, to cover the tenure holder's costs) or could charge casual harvesters an access fee. (If stock enhancement were found to be desirable and feasible, a system of shellfish tenures would better motivate investment in such projects than would an undifferentiated communal licence.)

- The current joint marketing arrangements should be retained and encouraged. Tenure holders could be encouraged to create a producers' cooperative to manage marketing and product development. The cooperative could form the nucleus of a multi-product shellfish industry organization.
- The aggregate quota and communal shellfish licence should be retained by the Heiltsuk Tribal Council. A Shellfish Committee (which should include members other than those harvesting in the commercial fishery) should be retained to ensure that commercial shellfish activities do not negatively affect food fisheries or otherwise impose costs on community members who are not directly involved in the fishery.

8.3.2. Management of the Geoduck Fishery

The low productivity and extensive distribution of the geoduck fishery does not augur well for community-based management of this fishery. A small, mobile fleet has been an important element in maintaining both the ecological and economic viability of the industry. However, demands for community participation in the fishery, especially from aboriginal communities as part of First Nations treaty negotiations, are likely to increase. From a management perspective, it would be preferable to meet these demands by

collecting royalties from the fishery and distributing them according to a negotiated formula (e.g. so much per capita to communities in the areas where the geoduck are fished) than to increase the number of direct participants in the fishery. In other words, it would be preferable to share output from this fishery, rather than expand access to it.

It is not clear how the aquaculture/enhancement debate will unfold in British Columbia. Certainly, if the financial incentives are great enough, there will be continuing pressure for geoducks to be farmed. However, if this expansion of the industry is not to kill the goose that laid the golden egg (by flooding the market with new product), then the joint fortunes of the wild and farmed industry will need to be linked through appropriate institutional arrangements. If geoduck culture proves to be financially viable, it may be desirable to convert all geoduck harvesting (at least on the South Coast) to mariculture leases in order to avoid problems such as "product laundering" that have emerged in the intertidal clam fishery.

Chapter Notes

1. Coleman (1990) suggests *The Mice in Council* as an example of the "free-rider" problem that arises when the cost to an individual of acting in the public good is greater than the individual benefits received from the same action.

Chapter 9: Lessons for Complex Systems and Suggestions for Future Action

> "It's a poor sort of memory that only works backwards," the Queen remarked.
>
> Lewis Carroll. *Alice's Adventures in Wonderland*

9.1. How Should Property Regimes Be Structured for the Management of British Columbia Fisheries ?

In the Introduction to this study, the problem of the "tragedy of the commons" was characterized as a situation in which private benefits of exploiting a resource exceed private costs, and in which private costs of investing in a resource exceed private benefits. The difficulties (technical, political, economic or otherwise) of carving up a common pool of fisheries resources into individual parcels are well known. So are the challenges, and frequent failures, of designing and implementing effective government regulation. Nonetheless, until recently, the latter approach was virtually the only one adopted by Canadian fisheries authorities. In the past decade, however, the specification of smaller scale joint property rights has gained increasing academic, political and public acceptance and now provides the potential for exploring other management options, including options that recognize legitimate claims by individuals and groups other than fishers themselves. As one would expect, most of the interest in such new regimes has been shown by those who consider themselves to be relatively disadvantaged by current management arrangements. There is no consensus on how such regimes should be structured, how components of the regimes should relate to each other, nor how conflict among competing

claims for a limited and oversubscribed resource should be resolved. A typical comment is that "everyone who is affected should be involved". This provides very little guidance for the implementation of new fisheries management arrangements, unless one assumes that a) there are no differences among the nature, intensity and legitimacy of all possible interests, and b) that every interest should, thus, have equal authority over every decision. From the perspective of property rights, this position is akin to asserting that anyone on the street has the same rights as I do to use, misuse or dispose of my house. Once demand exceeds supply, this approach is neither defensible nor practicable for any type of rivalrous, subtractable or congestible property.

To return to the dynamics of the tragedy of the commons, the general solution to the problem is to achieve a state of affairs in which private decision-makers cannot impose the costs of their decisions upon others and in which private decision-makers cannot be deprived of the benefits of their investments . In other words, the objective is to structure property regimes such that "those who make decisions about resource management are accountable, as far as possible, for the costs, benefits and risks that flow from their decisions" (Pearse and Walters, 1992:182).

To understand how a particular resource management regime would be ideally structured, we need to know 1) can any particular decision-maker create either positive or negative externalities? and 2) who bears (receives) those externalities, if any? Based on the answers to these questions, we can then seek the level of aggregation or "jointness" of property rights where no significant externalities are imposed outside the collectivity. Eliminating externalities may involve changing the behaviour of those who create them, or

providing adequate compensation to those affected by the externality so that they agree to bear (previously uncompensated) costs, or a combination of the two. Decisions made under these conditions can truly be called "responsible" decisions and the corresponding management regime, a "responsible" regime.

As noted earlier in this study, much of the literature concerning CPR problems has not explicitly addressed these questions.

9.1.1. Property Regimes: Questions of Certainty and Scale

Certainty

When property rights are unclear or absent, the gap tends to be filled with claims of "privilege" or presumptive rights (Bromley, 1991:18). Bromley observes that many environmental and resource conflicts are characterized by situations of privilege, i.e. the existence of assumed, but not legally guaranteed rights, and the infliction of costs for which there is no legal redress. Uncertain property rights complicate or preclude the negotiation of voluntary agreements to deal with externalities (Bish, 1971) and tend, of themselves, to increase transaction costs. First, when property rights are unclear, it may be extremely difficult and time consuming to locate and negotiate with everyone who **may** have a right or claim. Second, agreement, if and when reached, may prove to be unenforceable. Third, the effort and costs of negotiation will be magnified when parties are bargaining, not only about exchanges of rights, but about the nature and extent of the rights themselves (Bish, 1971 citing Buchanan and Tullock, 1962). Someone who now holds a claim that may in future become an enforceable property right will understandably demand a price to surrender that claim which reflects his personal perception of its future

value. (And as Kahneman and Tversky [1979] observed, individuals generally attach more value to prospective losses than to prospective gains.)

In British Columbia, the absence of property rights, combined with increasing demands upon fishery resources and increasing degradation of fisheries habitat from competing marine (and terrestrial) uses, has produced what Neher et al (1989:8) describe as

> ... a political and administrative stew, rich in ingredients but distinctly unsavoury. The result has been political and administrative 'gridlock' in many jurisdictions with, at best, passive fine-tuning of policies to minimize administrative pain and political losses.

Because there are no alternative "rules of the game",

> ... players wanting advantage from the fishery...are seeking it in a *political* arena where only political power matters. With many players, having more or less equal or unknown weight, coalitions to share the potential wealth of the fishery are distinctly unstable....As a result of the claimants rivalry, politicians are offered no clear directions. Hence, the political inaction even in the face of a deteriorating situation which is becoming increasingly unacceptable to the principal players and to the public at large. (Neher et al, 1989:8-9).

In this "deteriorating situation", resource rents continue to be dissipated, gains to collective action are foregone, and social conflict is aggravated as the "winners" become increasingly differentiated from the "losers". In the process, formerly "trivial externalities" become "relevant externalities", i.e externalities that affected parties would be willing to pay something to remove (in the case of negative externalities) or to increase (in the case of positive externalities) (Bish, 1971). For example, the annoyance caused by a dozen clam diggers on the beach in front of my cottage may be trivial, but the annoyance caused by three hundred clam diggers is not. Many of the externalities that arise in the conduct

of fisheries are Pareto-relevant, i.e. they consist of circumstances in which "the maximum that affected parties are willing to pay exceeds the minimum the generator of the externality is willing to accept to alter his action" (Bish, 1971:18). For example, if it costs $2 million to remedy failing septic systems in the vicinity of commercial clam beds, but the resulting increase in access to uncontaminated clams is worth $3 million, it would be rational for clam harvesters to pay for new septic systems, **if they could be assured of receiving the benefits of this investment.** However, in the absence of property rights to the clam beds, there can be no such assurance.

Difficulties posed by uncertain property rights for the elimination of Pareto-relevant externalities are complicated by questions of scale. While Chapter 3 suggests that the importance of size in predicting the success of collective action is somewhat unclear, it seems likely that transaction costs generally increase with the number of participants, and with the heterogeneity of participants in terms of preferences, capabilities, wealth, etc. In the case of fisheries management, the pre-eminent role of the federal government creates a set of participants to any decision-making process that is, theoretically, identical to the citizens of Canada, who are, after all, the only recognized "owners" of the resource. The problems of fisheries management in such circumstances have been discussed at some length, and so will not be repeated here. It seems clear, however, that some property rights in fisheries need to be specified at levels of aggregation smaller than that of the nation state.

Scale

It is impossible to specify, in the abstract, the "right" form of management regime

for British Columbia fisheries. In most fisheries, it is clearly not practical to make all management decisions at a scale at which all externalities are contained. Rather, we need to disaggregate the "bundle" of property rights relevant to a fishery and find the scale at which decision making authority conferred by each element of the "bundle" internalizes relevant externalities. Further, we need to specify the level of decision-making authority in which the costs to participants are less than the benefits they receive

As the discussion in Chapter 8 suggests, biophysical and technological factors are crucial in determining the nature and extent of externalities created in a fishery, and the scale within which such externalities can be contained. Establishing rights such as Individual Vessel Quotas or mariculture leases can go a long way to reducing externalities **within** a group of harvesters. But the same rights may encourage arrangements among harvesters that impose many of the costs associated with collective gains to the harvester group upon consumers, regulators, other species and future generations. The desirability of specifying rights at the level of individual harvesters or a group of harvesters is, thus, contingent upon institutional arrangements (such as designation of the total allowable catch by federal fisheries authorities and implementation of independent harvest monitoring and validation) that prevent harvesters from relying on these rights to impose costs upon others. By "nesting" property rights and management authority in this way, the benefits of smaller scale collective action can be achieved, without jeopardizing the rights of others with legitimate claims to benefits from fishery resources.

Until recently, the only possible "nesting" arrangement has been that of individual or corporate rights within a federal regulatory framework. It has generally been

impossible or impracticable for groups with competing (or even complementary) interests in fisheries resources to reach mutually beneficial agreements. Assigning property rights to smaller scale governmental or voluntary organizations could facilitate such agreements.

For example, if a local government or Band Council holds the rights to a designated quota from a specified clam harvesting area, it could raise revenues from harvesting permits or tenures. Suppose that malfunctioning septic systems are contaminating some beaches within the specified harvesting areas, and thereby reducing the potential revenues from the clam harvest. Suppose further that the septic systems are also contaminating their owners' wells and resulting in periodic closures of local swimming beaches. Taken together, the losses to harvesters and to the local government from reduced clam harvesting, the losses to home owners from having to truck in clean water, and the losses to local residents and tourism businesses from beach closures exceed the costs of installing a sewage system to replace the failing septic fields. In this case, the direct interest of the local government in the clam harvest, and the existence of an institutional structure that facilitates bargaining at the local level, could motivate the various parties to reach an enforceable agreement in which their individual contribution to resolving the problem are less than the individual benefits they receive from its resolution.

It is not my purpose here to discuss in detail the range of different forms and levels of "smaller scale" collective property rights, but rather to illustrate the ways in which gains to collective action might be more readily achieved at lower levels of aggregation. In the context of the current research, the Heiltsuk case provides some evidence for this proposition and suggest some of the particular advantages of allocating property rights to

existing community government authorities. While it is beyond the scope of this study, a detailed analysis of the current and potential role of local governments (including municipal, regional district, and First Nations governments) in the management of coastal resources would be a worthwhile undertaking , particularly in light of the growing involvement of the British Columbia government in fisheries management and a broader, indeed global, move toward decentralization or "local centralization" of government roles and functions.

9.2. The Prospects for Realizing Responsible Management Regimes

The tragedy of the commons is not a story about human inability to recognize problems. It is a parable, rather, about human capacity to recognize short term self-interest and, in the absence of incentives to the contrary, to pursue it. In a world with few people, limited technological capacity, and many resources (i.e. the world human beings have known for most of their time on Earth), the relatively unfettered pursuit of private benefits in a global commons was not especially problematic: any particular local tragedy could be avoided by moving somewhere else. And the ability of individuals and communities to externalize the costs of their decisions was limited by their ability to create the costs in the first place.

But in the past two hundred and fifty years, all this has changed. Since the mid-1800's (for technological, economic and political reasons), individuals and societies who benefit from overexploitation of, and underinvestment in, the Earth's natural capital have been able to reap those benefits while imposing the costs of their decisions on distant peoples, other species, and future generations. Western societies as a whole (and

particular groups within those societies) have achieved considerable success in insulating ourselves from the consequences of our decisions. This very success suggests that resourceusers will not eagerly embrace new institutional arrangements that will, in many cases, reduce the benefits which they derive under current management regimes. As Knight (1992) and Libecap (1995) both emphasize, the name of the game in collective action is individual strategic advantage. Creating the potential for collective gains from strategic individual decisions is particularly difficult when the only way to increase aggregate benefits is to remove some current beneficiaries from the game, or, at the least, to keep new beneficiaries out. This is the situation in most British Columbia fisheries.

Consequently, I am not particularly optimistic about the likelihood that current fishers or fishery interest groups will spontaneously generate (or even propose) new property regimes that will lead to sustainable, efficient and equitable outcomes. In the highly centralized context of fisheries management in British Columbia, such arrangements could not, in any case, be implemented without the direct involvement, or at least the approval, of the federal (and increasingly the provincial) government. In such circumstances, the careful "crafting" (Ostrom, 1990) of new institutional arrangements needs to be preceded by some careful *contriving* of individual incentives to consider new institutional arrangements.

As the theoretical framework of this study - and the analysis of the three fishery cases - suggests, the exact nature of those incentives will differ among particular situations. However, I offer the following general suggestions to public decision makers who may be charged with framing incentives for participants to cooperate in the creation

of better institutional arrangements for fisheries management in British Columbia.

1. Act sooner rather than later. New fisheries have developed, and are developing, very rapidly. With current fishing technology, any marine species can be overharvested and possibly destroyed, in an appallingly short period of time. As the capacity is reduced in more established fisheries, this excess capacity inevitably cascades onto so-called "underdeveloped" fisheries. Once investments have been made and expectations established in a new fishery, it is very difficult to induce participants to agree to institutional changes that entail redistributive effects. Consequently, it is best to implement desirable property regimes **before** they seem to be necessary and to do so at a time when the future distribution of returns from the fishery is still somewhat obscured by a "Rawlsian veil".

2. Implement fees to cover management charges and to extract resource rents at the time new property rights are specified and allocated. At this point in the development of a fishery, such fees may be seen as the price of a desirable new business opportunity. At any other time, they will be perceived as the unjust imposition of costs that ought to be borne by government, because they always have been.

3. Enable (and if necessary require) participants to negotiate with each other, and to create and enforce contracts within a policy framework that protects the interests of other user groups and the general public interest. If competitors can always do better by independently lobbying the government than by cooperating with each other, they will always lobby the government. As a corollary to this recommendation, create carrots for cooperation, as well as sticks.

4. Ensure that joint property rights entail appropriate incentives for the decisions of individual members of the collectivity. The tragedy of the commons is possible in small groups as well as large. To the extent possible, encourage arrangements whereby individual malfeasance incurs both individual and collective sanctions. Such conditions will encourage mutual monitoring and enforcement.

5. Clarify rights to compensation, and make the nature and amount of such compensation known before attempting to achieve institutional change.

6. Create bargaining power for individuals and groups who are disadvantaged by, or excluded from, current institutional arrangements, if the preference and interests of such groups promote ecological, social or other societal objectives. (The achievement of such goals frequently imposes costs on current user groups.) As R. Mitchell (1995) suggests, this may require only that such groups be given some degree of independent authority in fishery monitoring or enforcement.

7. Consider the full range of possible management regimes and the full range of possible property holders. If externalities can be contained at the local level, structure management regimes to create property rights at that level. As discussed earlier in this chapter, there may well be a larger role for local governments (including municipalities and regional districts) to play in resource and environmental management. As stable "locally centralized" organizations, local governments may be better suited to co-management arrangements with senior governments than are single purpose resource management committees or boards (which are generally dominated by commercial resource users).

These suggestions are primarily directed at policy formulation and implementation for new and developing fisheries, many of which involve invertebrate or marine plant species. Some may be relevant to problems in the salmon fishery, but action in this fishery is made extremely difficult by, among other factors, a long history of entrenched distributional conflict.

9.3. Suggestions for Research and Action

9.3.1. Extending the Analytical Framework to Other Fisheries

While the analytical approach applied in this study seems useful in understanding the dynamics and outcomes in the fisheries under review, three cases are not sufficient to fully test the theory nor to flesh out a behavioral model that explains and predicts success or failure of institutional arrangements in fisheries management. Toward these ends, it would be useful to study a larger selection of fisheries (there are about 20 individual invertebrate fisheries in British Columbia) to determine which contextual and institutional variables best explain and predict institutional success. Such case studies may generate a "short list" of variables that could be developed into formal mathematical models and tested against results in other fisheries, whether in British Columbia or other jurisdictions.

9.3.2 Extending the Analytical Framework to Other Resources

Co-management is a byword in resources other than fisheries. Case research in community forest management, watershed management and other local or regional co-management arrangements could test and extend the utility of the theoretical approach adopted in this study.

9.3.3. Policy Experiments

The federal and British Columbia governments are currently embarked on a redefinition and realignment of responsibilities in the management of marine fisheries. "Co-management" figures largely in this discussion and in the expectations (or fears) of current and aspiring users of B.C. fishery resources. The analytical framework adopted in this study offers a comprehensive approach to structuring experiments in fisheries management that may accelerate learning about the creation of management regimes and, in the process, anticipate and even avoid, some of the more predictable problems of institutional reform.

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APPENDIX A: Interview Questions

Area C Commercial Clam Fishery - Interview Questions for Management Board Members

Part A - History

A.1. What is the nature of your involvement in the commercial clam fishery?

(If not a harvester, go to B.IV.)

A.2. How many years have you been harvesting clams commercially?

A.3. Did you harvest on Savary Island before the closure at the end of the 1989 season?

A.4. Did you harvest in 1989? (If no, go to A.6.)

A.5. If yes, what was your approximate income from clam harvesting in 1989?

A.6. Did you harvest in 1993? (If not, go to Part B)

A.7. If yes, what was your approximate income from clam harvesting in 1993?

A.8. About how many days did you harvest in 1989 and in 1993?

Part B. - 1994 Fishery

B.I. Participation

B.I.1. Did you harvest clams in the 1994 Area C fishery? (If not, go to B.IV.)

B.I.2. Where did you harvest clams? Savary only, Savary and other parts of Area C, or other Area C only?

B.I.3. Which days did you harvest? (List provided of openings)

B.I.4. About how many pounds of clams did you harvest from Savary Island and from elsewhere in Area C?

B.I.5. What was your approximate income from clam harvesting in 1994?

B.II. Monitoring and Enforcement

B.II.1. When you were digging on Savary Island, did you notice Fisheries officers monitoring the harvest (most of the time, sometimes, rarely, never)?

B.II.2. When you were digging elsewhere in Area C, did you notice Fisheries officers monitoring the harvest (most of the time, sometimes, rarely, never)?

B.II.3. Was there any other monitoring or enforcement activity during the clam harvest? (If yes, who/what?)

B.II.4. Did licensed harvesters do any monitoring or informal enforcement?

B.II.5. Do you think that the monitoring and enforcement effort was adequate?

B.II.6. Are you aware of any illegal harvesting (poaching) taking place during the 1994 fishery? If no, go to B.II.10).

B.II.7. If yes, did most of the poaching take place on Savary Island?

B.II.8. Did you notice any poaching in other parts of Area C?

B.II.9. How did the amount of poaching in 1994 compare with levels of poaching before 1989 (when Savary was still open)? (much more, more, about the same, less, much less)

B.II.10. Do you think poaching is a problem? (If yes, very serious, somewhat serious, not very serious)

B.II.11. If poaching is a problem, who do you think is responsible? (Can select more than one: licensed harvesters, unlicensed commercial harvesters, recreational diggers, harvesters in the aboriginal food fishery, other)

B.II.12. Are there other problems or issues concerning illegal harvesting that you would like to mention?

B.II.13. How could monitoring/enforcement be improved?

B.III. Marketing

B.III.1. Did you sell you clams to one processor, two processors, or three or more?

B.III.2. In your opinion, were landings properly documented? (If yes, go to III.4)

B.III.3. If no, can you suggest ways of improving documentation of landings?

B.III.4. Do you think illegal sale of clams is a problem?

B.III.5. In your opinion, what could be done to reduce or stop illegal sales of clams?

B.IV. Questions for all Board Members

B.IV.1. How many clam harvesters do you think there should be, in total, for Area C? (few than 75, 100-125, 125-150, 150-200, more than 200)

B.IV.2. Licences for 1994 were based on possession of a licence in two of the previous three years. Do you think this is a fair way to allocated licences?

B.IV.3. If not, what would be more fair?

B.IV.4. Do you think that aboriginal people should be guaranteed a minimum percentage of licences? If yes, what percentage?

C. Questions for Buyers and Others - Not Harvesters

C.1. Do you feel monitoring and enforcement during the 1994 fishery was adequate?

C.2. If no, how do you think monitoring and enforcement could be improved?

C.3. Do you believe that illegal harvest was a problem in 1994? If yes, how serious?

C.4. In your view, how did the level of poaching in 1994 compare with poaching in the years when Savary was last open (pre-1989)?

C.5. Who do you think is responsible for illegal harvest? (Can select more than one - licensed harvesters, unlicensed commercial harvesters, recreational harvesters, harvesters in the aboriginal food fishery, other)

C.6. Are there other issues concerning illegal harvest that you would like to mention?

C.7. In your view, were harvesters given sufficient notice of fishery openings?

C.8. In your view, were buyers/processors given sufficient notice of fishery openings?

C.9. Were landings well documented?

C.10. Do you believe that illegal sale of clams is a problem? If yes, how serious?

C.11. If yes, how could illegal sale of clams be reduced or stopped?

D. Area C Clam Management Board - Establishment and Current Operations

D.1. In your opinion, why was the Area C Board established?

D.2. At the time the board was established, what benefits did you expect from having the board in place?

D.3. What objectives were set for the board when it was established?

D.4. Were specific terms of reference established for the board? If yes, what were they? How were they established (by whom)?

D.5. How were the members of the board selected?

D.6. In your view, what has the board accomplished since it was established?

D.7. Has the board met the expectations you had for it when it was established?

D.8. If no, why do you think the board has fallen short of your expectations?

D.9. Do the members of the board work well together as a team?

D.10. What procedure does the board use for making decisions? (formal vote-majority rule; unanimous agreement; other)

D.11. Does this procedure work well? Why or why not?

D.12. Do you feel the board has access to the kind of information it needs to make good decisions? (always, sometimes, rarely, never)

D.13. What kind of information or other resources would help the board work better?

D.14. As a member of the Area C Clam Management Board, who do you represent? (what is your constituency?)

E. Area C Clam Management Board - Possible Future Roles and Organization

E.1. Would you like to see the board take on responsibility for any of the following activities?

a. Developing criteria for licensing
b. Issuing licences
c. Handling licence appeals
d. Carrying out stock assessments
e. Setting harvest quotas
f. Setting dates for fishery openings
g. Monitoring and enforcement
h. Sanitation testing
i. PSP testing
j. Providing information to harvesters about openings, beach closures, etc.
k. Reviewing land use applications where clam habitat may be affected
l. Habitat enhancement
m. Representing those with interests in the clam fishery in regional and provincial land use and economic development planning processes
n. Coordinating sales of clams to processors
o. Clam promotion and marketing
p. Recommending beaches to be harvested for depuration
q. Other activities

E.2. How do you think the members of the Area C Community Management Board should be selected? (appointed by DFO, Aboriginal members appointed by their Bands, other appointed by Area C Harvesters Association, elected at large from harvesters, other?)

E.3. Do you think the board should be registered as a formal legal entity (e.g. a society) with a formal constitution and bylaws?

E.4. Are there groups other than harvesters and First Nations that should be represented on the board?

E.5. Given DFO budget limitations, do you think harvesters should contribute financially to management of the clam fishery?

E.6. If yes, would you prefer that payment be collected through a landings fee, an increased licence fee, a combination of the two, other?

E.7. Are there any other comments you would like to make about the establishment, current operations or future role of the board?

Area C Commercial Clam Fishery - Questions for Harvesters

A. History of Involvement in the Fishery

A.1. How many years have you been harvesting clams commercially? (less than 5, 5-10, more than 10)

A.2. Did you harvest on Savary Island before the closure in 1989?

A.3. In which years have you harvested since 1989?

A.4. Do you usually harvest alone? (as part of a regular team, with family/relatives, with a partner)

B.I. Participation

B.I.1. Did you harvest clams in the 1994 Area C fishery? If no, go to B.IV.

B.I.2. Where did you harvest clams? (Savary only, Savary and rest of Area C, rest of Area C only).

B.I.3. Which days did you harvest? (list of openings provided)

B.I.4. Did you receive adequate notice of fishery openings? (better or worse than other years?)

B.I.5. About how many pounds of clams did you harvest? (Savary, rest of Area)

B.II. Monitoring and Enforcement

B.II.1. When you were digging on Savary Island, did you notice Fisheries officers monitoring the harvest (most of the time, sometimes, rarely, never)?

B.II.2. When you were digging elsewhere in Area C, did you notice Fisheries officers monitoring the harvest (most of the time, sometimes, rarely, never)?

B.II.3. Was there any other monitoring or enforcement activity during the clam harvest? (If yes, who/what?)

B.II.4. Did licensed harvesters do any monitoring or informal enforcement?

B.II.5. Do you think that the monitoring and enforcement effort was adequate?

B.II.6. Are you aware of any illegal harvesting (poaching) taking place during the 1994 fishery? If no, go to B.II.10).

B.II.7. If yes, did most of the poaching take place on Savary Island?

B.II.8. Did you notice any poaching in other parts of Area C?

B.II.9. How did the amount of poaching in 1994 compare with levels of poaching before 1989 (when Savary was still open)? (much more, more, about the same, less, much less)

B.II.10.Do you think poaching is a problem? (If yes, very serious, somewhat serious, not very serious)

B.II.11. If poaching is a problem, who do you think is responsible? (Can select more than one: licensed harvesters, unlicensed commercial harvesters, recreational diggers, harvesters in the aboriginal food fishery, other)

B.II.12.Are there other problems or issues concerning illegal harvesting that you would like to mention?

B.II.13.How could monitoring/enforcement be improved?

B.III. Marketing

B.III.1. Did you sell you clams to one processor, two processors, or three or more?

B.III.2. In your opinion, were landings properly documented? (If yes, go to III.4)

B.III.3. If no, can you suggest ways of improving documentation of landings?

B.III.4. Do you think illegal sale of clams is a problem?

B.III.5. In your opinion, what could be done to reduce or stop illegal sales of clams?

B.IV. Licensing

B.IV.1. How many clam harvesters do you think there should be, in total, for Area C? (few than 75, 100-125, 125-150, 150-200, more than 200)

B.IV.2. Licences for 1994 were based on possession of a licence in two of the previous three years. Do you think this is a fair way to allocated licences?

B.IV.3. If not, what would be more fair?

B.IV.4. Do you think that aboriginal people should be guaranteed a minimum percentage of licences? If yes, what percentage?

B.IV.5. Should licences for aboriginal harvesters be allocated in the same way as for non-aboriginal harvesters, or a different way? i.e. who should decide who gets aboriginal licences?

C. Area C Management Board

C.1. Have you been a member of the Area C Clam Harvesting Association? the Sliammon Clam Diggers Committee?

C.2. Did you attend a public meeting in early February, 1994 (February 3) to discuss the management of clam harvesting in Area C?

C.3. What decisions were made at that meeting?

C.4. Do you know any of the members of the Area C Clam Management Board (names given)

C.5. What do you think the role of the board is? What does it do?

C.6. What do you think the board accomplished in 1994?

C.7. Would you like to see the board take on responsibility for any of the following activities?

a. Developing criteria for licensing
b. Issuing licences
c. Handling licence appeals
d. Carrying out stock assessments
e. Setting harvest quotas
f. Setting dates for fishery openings

g. Monitoring and enforcement
h. Sanitation testing
i. PSP testing
j. Providing information to harvesters about openings, beach closures, etc.
k. Reviewing land use applications where clam habitat may be affected
l. Habitat enhancement
m. Representing those with interests in the clam fishery in regional and provincial land use and economic development planning processes
n. Coordinating sales of clams to processors
o. Clam promotion and marketing
p. Recommending beaches to be harvested for depuration
q. Other activities

C.2. How do you think the members of the Area C Community Management Board should be selected? (appointed by DFO, Aboriginal members appointed by their Bands, other appointed by Area C Harvesters Association, elected at large from harvesters, other?)

C.3. Do you think the board should be registered as a formal legal entity (e.g. a society) with a formal constitution and bylaws?

C.4. Are there groups other than harvesters and First Nations that should be represented on the board?

C.5. Given DFO budget limitations, do you think harvesters should contribute financially to management of the clam fishery?

C.6. If yes, would you prefer that payment be collected through a landings fee, an increased licence fee, a combination of the two, other?

C.7. Are there any other comments you would like to make about the establishment, current operations or future role of the board?

D. Income History

D.1. What was your approximate income from clam harvesting in 1989? (1993? 1994?)

E. 1995 Season

E.1. Do you intend to buy a licence for the 1995 clam fishery?

E.2. If yes, do you intend to harvest on Savary only, elsewhere in Area C?

Other comments/questions

Area C Commercial Clam Fishery - Questions for Processors

1. How many pounds of clams were purchased from Area C in 1994? 1993?

2. In general, how did the 1994 fishery compare with the pre-1989 fishery (when Savary was still open) in terms of orderliness, quality of product, other issues?)

3. Were there any problems in 1994 from the processors' perspective?

4. Did the processor have any direct contact with the Clam Management Board? If yes, what was the nature of the contact?

5. Should the limited licensing pilot project be extended? Why or why not?

6. Does the processor agree with the eligibility criteria chosen to limit licensing? Why or why not?

7. Does the processor anticipate buying clams in Area C in 1995?

8. Of all clams processed by your company, what percentage are wild clams?

9. Does the processor expect to rely less on wild clams in the future?

10. Should the Area C model (limited licensing and more community participation in management) be extended to other areas of the province? Why or why not?

Heiltsuk Commercial Clam Fishery

Questions for project management and staff and DFO officials

- What is the history of the project? When established, by whom, reasons for the project.
- How is the project organized? What are the roles and responsibilities of Heiltsuk management and staff versus DFO and Environment Canada?
- How is the project funded? Project duration? Number of harvesters involved?
- Catch and sales history of the project fishery.
- What has been the impact of the project on employment in the community? Have there been any "spin-offs" from the project?
- What have been the successes and problems?
- What are the plans for community-based shellfish resource management for the future?

Review of Heiltsuk Clam Fishery Project

Harvester Interview

Name of Harvester: _____

Date of Interview: _____

A. History

1. How long have you been involved with the project?

2. Did you harvest clams commercially before the project started (i.e. elsewhere in the province)?

   Yes____ No____

   For food?

   Yes___ No___

3. Are you involved in other commercial fisheries? Which ones?

4. About how many days in the past year have you harvested clams?

5. Are other members of your family involved?

6. How do you get to the clam beaches?

7. Do you usually come home at night or stay over?

B. Project Organization/Issues

1. Are the harvesters involved in making decisions about the clam fishery, such as openings?

2. How are you involved? Meetings? Otherwise?

3. Who makes most of the decisions about the clam fishery?

4. How is it decided who will be able to harvest?

5. Has the decision always been made this way?

6. Are you involved in other activities besides actual harvesting (e.g. stock assessment or PSP testing?)

7. What do you think has been most important/successful about the project for the Heiltsuk community?

8. For you personally?

9. Do you have any ideas/recommendations about the future of the project?

10. How big an impact has the project made in your income?

    Big impact ____ Some impact ___ Not much impact? ___

11. Do you plan to continue in the clam fishery?

    Yes __ No __ Why not?

Other questions/comments

Geoduck Fishery

UHA Interviews

Name of Participant: _____

Address: _____

_____

Telephone numbers: Home: _____ Work: _____ Autotel: ____

Cell: _____ Fax: _____

E-Mail Address: _____

Interview Questions

1. When did you first become involved with the commercial geoduck harvest?

2. How did you start?

License holder? _____

Diver? _____

Other?_____

3. In what areas of the coast were you first active?

4. Can you describe in general terms the early history of the geoduck fishery?(early development, catch history, markets, prices, etc. as understood by the participant)

5. How was the fishery initially managed?

6. What circumstances led to management changes? (limited licensing, ITQ's, Area licensing)

7. What kinds of problems or issues did geoduck harvesters face in organizing themselves and becoming more involved with fishery management?

8. What are the current issues and concerns in the management of the fishery from your perspective?

9. What is the significance of the Aboriginal Fisheries Strategy, interim measures and the treaty negotiation process for the geoduck fishery?

10. From your perspective, has the management of the geoduck fishery been a "success?" Why? or Why not? (try to get specific factors)

Other Data:

. How many licences held? ___

. Are you involved in other fisheries? Yes __ No__

If yes, which?

. Brief description of management of other fisheries

. Would be willing to do future interview on other fisheries?

Yes ___ No___

Suggested contacts to interview in:

Geoduck harvest _____

Other fisheries _____

Other comments?