FISHERIES MANAGEMENT, FISHING RIGHTS AND REDISTRIBUTION WITHIN THE COMMERCIAL CHOKKA SQUID FISHERY OF SOUTH AFRICA

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ABSTRACT

The objective of this thesis is to analyse the management and redistribution policies implemented in the South African squid industry. This is done within the broader context of fisheries policies that have been implemented within the South African fishing industry as the squid industry has developed. The study therefore has an institutional basis, which reviews the development of institutional mechanisms as they have evolved to deal fisheries management problems. These mechanisms (which can either be formal or informal) consist of committees, laws and constitutions that have developed as society has progressed. Probably the most prominent of these, in terms of current fisheries policy, is the Marine Living Resources Act (MLRA) of 1998. The broad policy prescription of the MLRA basically advocates the sustainable utilisation of marine resources while outlining the need to restructure the fishing industry to address historical imbalances and to achieve equity. It is this broad objective that this thesis applies to the squid fishery.

The primary means of achieving the above objective, within the squid industry, has been through the reallocation of permit rights. These rights also provide the primary means by which effort is managed. A disruption in the rights allocation process therefore has implications for resource management as well. Permits rights can be described as a form of use right or property right. These rights are structured according to their operational-level characteristics, or rules. Changing these rules can thus affect the efficiency or flexibility of a rights based system. This is important because initial reallocation of rights, by the Department of Environmental Affairs and Tourism (DEAT), was based on an incomplete set of rights. This partly led to the failure of early redistribution attempts resulting in a "paper permit" market.

Nevertheless, this thesis argues that redistribution attempts were based on ill-defined criteria that contributed to the failure described above. In addition to this the method through which redistribution was attempted is also questionable. This can be described as a weak redistribution strategy that did not account for all equity criteria (i.e. factors like capital ownership, employment or relative income levels). This thesis thus recommends, among other things, that an incentive based rights system be adopted and that the design of this system correctly caters of the operational-level rules mentioned above. In addition to this a strong redistribution, based on fishing capital, ownership, income and the transfer of skills, should be implemented.

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CAF	Consultative Advisory Forum
CPR	Common Property Resource
CPUE	Catch Per Unit Effort
DEAT	Department of Environmental Affairs and Tourism
EEZ	Economic Exclusive Zone
ESS	Economic and Sectoral Study
FAO	Food and Agricultural Organisation of the United Nations
FPDC	Fisheries Policy Development Committee
FPDWC	Fishing Policy Development Working Committee
FTC	Fisheries Transformation Council
MCM	Marine and Coastal Management
MEY	Maximum Economic Yield
MLRA	Marine Living Resources Act of 1998
MSY	Maximum Sustainable Yield
RAU	Rights Allocation Unit
RVU	Rights Verification Unit
SASFTG	South African Squid Fishing Task Group
SCCLFA	South Cape Commercial Line Fishing Association
SFAC	Sea Fisheries Advisory Committee
SFRI	Sea Fisheries Research Institute
SASLIA	South African Squid and Line Industrial Association
SASMIA	South African Squid Management and Industrial Association
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TURF	Territorial Use Rights in Fishing
UNCLOS	United Nations Convention on the Law of the Sea

CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Prior to the 1900s it was largely believed that marine resources were unlimited, and that there were few factors that could disturb most world fisheries. This belief seemed to be the norm and is best reflected the following statement made by Thomas Huxley in 1883: "I believe that the cod fishery...and probably all the great sea-fisheries are inexhaustible; that is to say that nothing we can do seriously affects the number of fish" (cited in Eggert, 1999:4). The management approach at the time was thus based on the concept that all people had the right to harvest marine resources, and that market forces would regulate the rate of exploitation. This was a time when fish stocks were large and fishing fleets were small. However, by the mid-19th century fishing in the inshore waters of countries increased and Huxley's words were soon forgotten. During this time very few regulations had however existed (Scott, 2000b).

As offshore fishing activities increased, fishermen began to realise that they had to compete with each other for catch. The race-for-fish had begun. Gradually fishermen started to use bigger vessels, equipped with better technologies and more powerful fishing gear. All of these resulted in increased fishing effort. Fishermen thus began to pressurise governments, to ban foreigners and part-time fishers, as catches started to decline (Scott, 2000a). Gear restrictions and closed season were among the first regulations to be introduction. These restrictions were mainly based on biological principles but are still very popular regulations used today. After the Second World War, it was understood that the world's fisheries were being overfished, so new regulatory measures were proposed, some of these being international. Countries soon began to increase their jurisdiction over waters adjacent to their coasts, eventually leading to the worldwide adoption of Economic Exclusive Zones (EEZs) in the 1970s. These gave coastal states jurisdiction over a 200-

mile zone stretching from the coastal baseline. Throughout this time fishing fleets, and fishing capacity, continued to increase and catches gradually declined (FAO, 2000). Within their EEZs states thus developed new methods, based on restricting access. Limited entry licences were the first among these (Anderson, 1986). These measures restricted the number of vessels within a given fishery, thus establishing a level of exclusivity within fisheries. This can be seen as the beginning of the present day establishment of property rights within fisheries. Up until this point most fisheries had been subject to the "law of capture", meaning that no person owned any fish until they had been caught[1] (Scott, 2000a:4). Limited licences thus created exclusive use rights (Charles, 2000).

Other controls, either restricting effort (inputs) or limiting catch (output quotas), were also soon introduced. Although most of these were still motivated by biological concerns, they soon evolved into some form of property right used to regulate fishing activities. Probably the most popular output controls of this nature currently used are individual transferable quotas (ITQs), which reduced or even eliminated the incentive to overcapitalise within a fishery (Townsend, 1998). Other restrictions also evolved into forms of property rights, referred as *use rights* by Charles (2000). Rights-based management systems have thus evolved to become an important part of fisheries management as they internalise the external effects associated with fishers' behaviour (Pejovich, 2001a). They provide incentives for fishermen to take better care of resources they "own", while at the same time reducing transactions costs (Pejovich, 2001a:xvi). This is because the more rights an individual has, the closer that person's private cost is to the social cost of using that good.

Rights-based systems thus determine some level of exclusivity among users. The performance of these systems however depends on their design, implementation and their operational aspects (Anderson, 2000). These factors in turn depend on the biological, economic and social aspects of the fishery for which the programme is being developed.

[1] Although most fish stock were subject to the "law of capture" quasi-private property rights had existed since the 17th century. However, individual ownership of fisheries was largely restricted to freshwater fisheries or inshore fishing grounds (Scott, 200b).

For example, because these systems limit users, what criteria should be used to determine access? Where social issues demand that equity considerations are important, one group of users will be given preference over another. This only highlights one possible issue that that adds to the complexity of designing such a system. This thesis will thus attempt to deal with more of these within the context of the South African chokka squid fishery. These are issues that will be discussed and dealt with in more detail throughout this thesis.

1.2 CONTEXT OF RESEARCH

From section 1.1 above it can be argued that the overexploitation of marine resources is primarily due to the failure of traditional market rules to properly regulate valuable natural resources. Fisheries are the classic example of the "tragedy of the commons" (Hardin, 1986), which means that if a resource is unregulated and open for all to use it will be over-utilised (Gordon, 1954). The argument is that if access is open to all, the ecological costs of fishing are transferred to no one individual, yet everyone has an incentive to fish as much as possible (Friedel, 2000). This is based on the standard neo-classical model of rational behaviour (Guyader & Thĕbaud, 2001). The only way to avert this rational incentive is to define some form of ownership over a resource. As mentioned in section 1.1, this can be done through the establishment of property rights. Property rights thus define some form exclusive right over the use of a resource (e.g. the granting of exclusive fishing rights). Although fishing rights help to maintain sustainable use rates for a resource, they exclude portions of the public from its use.

Sustainable use of marine living resources is thus a challenging management task. The motivation for most governments, including South Africa's, is the conservation of marine resources for exploitation by future generations. In South Africa this issue is however more complicated. With the advent of democracy in 1994 the new South African government was faced with the task of normalising society by correcting inequalities caused by apartheid. In terms of the fishing industry, fisheries management must thus confront issues of race, equity, and historical injustice – a mandate broadly described as the "transformation" of an industry from which non-whites had for the most part been systematically excluded (Paul, 2000b and Friedel, 2000). This mandate has been translated into policy with the establishment of the Marine Living Resources Act (MLRA) of 1998 (RSA, 1998). A major goal of the MLRA is to broaden access to the "historically disadvantaged" non-white South Africans. This is because fisheries management under the apartheid system generally benefited white South Africans while excluding the majority of non-white citizens. According to Friedel (2000), Whites owned the majority of fishing companies, owned most of the vessels, and received fishing rights for the most lucrative species; this is a view supported by Van Sittert (2002), Hauk & Sowman (2001) and Hersoug & Holm (2000).

One of the major challenges for fisheries authorities is thus to redress the obvious imbalances in a fair and rational manner while at the same time recognising that the resources to be reallocated are not infinite. The broadening of access rights and the sustainable use of marine resources are thus both necessary elements for creating a stable and equitable fishing industry. The major question to be addressed therefore is: *how can a more equitable and fair distribution of power and wealth be achieved without destroying the biological and economic basis of the industry?* The challenge for the South African government is to translate their political goals into actual programmes that are designed to achieve their objectives. The MLRA (of 1998) can be seen as the beginning of such a process. This formed the basis for redistribution and restructuring attempts after 1998. Initial attempts at redistribution were however fraught with many different problems. Some of these relate to ill-conceived redistribution criteria, incomplete management systems and a lack of capacity, by relevant authorities, to effectively management programmes. These are only a few of the issues that will be addressed within this thesis.

1.3 OBJECTIVES OF STUDY

This study is undertaken with reference to the South African commercial squid fishery as a renewable marine resource. As a renewable resource the squid fishery can be utilised on a sustainable basis as long as harvesting rates do not exceed its regeneration rate. Keeping this in mind, the fishery, within the context of South Africa, is also subject to social and economic factors that affect society. As mentioned in section 1.2, Government policy currently demands that all resources be used on a sustainable basis, while at the same time granting access to all racial groupings (RSA, 1998). Within the context of the Marine Living Resources Act, this can broadly be translated into granting access to those parts of society who had previously been denied access. The resource in question is however limited and cannot accommodate additional participants without jeopardising its long-term viability. Apart from these biological concerns, the squid industry also consists of people and businesses that exploit the resource. Their livelihoods will therefore also be disrupted if the industry is restructured. After all, if access is granted to historically disadvantaged individuals, the access of existing participants will have to be reduced. This in essence amounts to a redistribution of fishing rights from existing participants to new entrants.

Against this background the study therefore aims to achieve the following:

(i) Based on literature reviewed and data collected (from the EES and MCM database), to highlight the current status of the South Africa commercial squid fishery from a biological, economic and socio-economic viewpoint.

(ii) To review the current management system (based on the allocation of permit rights) and procedures, and to highlight possible flaws within these.

(iii) Within the context of (ii) to review the initial redistribution attempts by the Department of Environmental Affairs and Tourism, and to highlight any possible shortcomings in the approach adopted.

(iv) Lastly, based on the objectives above, to make recommendations, if necessary, that help to address any deficiencies within systems or procedures.

All of the above objectives essentially culminate in the review of the "transformation" (equitable redistribution) agenda adopted for the South Africa commercial squid industry. This process involves the reallocation of fishing rights to accommodate for new entrants. The central focus is thus on this rights-based system and the factors that either affect, or are affected, by it.

1.4 STRUCTURE OF THESIS

The focus of the thesis is thus to examine the logic behind the fisheries policy and redistribution attempts in the South African squid fishery. The approach adopted in largely institutional in nature as current policy is informed by changes in society, both locally and internationally. And as Pejovich (2001a) states, institutions gradually evolve over time to address pertinent issues in society. These institutions can either be formal (i.e. government) or informal (i.e. social groups). Nevertheless they play a vital role in structuring behaviour within society.

In terms of the structure of the thesis, Chapter 2 outlines the nature of natural resource use and defines the economic objective behind this. The role of renewable resources is also highlighted, and within this context the South African commercial squid fishery is classified. It is necessary to characterise a marine resource because its attributes determine the potential wealth and transactions costs of different property rights arrangements (Edwards, 2000). Keeping this in mind, both biological and operational classifications of the fishery are outlined. This thus provides a context for further analysis. Chapter 3 outlines the current status of fisheries around the world. This provides an international context for the problems that all fisheries managers currently face. The chapter also outlines a simple bioeconomic model, which serves as the basis for fisheries management throughout the world. Although the model is largely normative it is useful because it provides reference points in terms of management objectives. It also outlines the principle result affecting all marine resources worldwide, namely that if resources are free for all to use they will most likely to over-utilised (Gordon, 1954). This thus provides the argument behind all fisheries management initiatives. The final part of the chapter outlines the various tools available for fisheries management authorities in dealing with resource management.

Chapter 4 looks at the nature of property rights structures and how these can be applied to fisheries systems. The chapter emphasises the evolution of property rights regimes. For example, in the past most fisheries systems occurred within an open access regime, but this has gradually been transformed into a state property regime (through the formation of EEZs), then common property and private property regimes (through the issuing of exclusive use rights). The evolution of these regimes depends on the structure of property rights that have been introduced into various environments. These, in turn, are informed by the operational rules that govern property rights. These operational-level rules provide the foundation for the design of property rights systems, by creating incentives structures that allow for the minimisation adverse effects. This provides the basis for the designing of a rights-based management system in the squid fishery.

The institutional and organisational evolution of the South Africa squid industry is outlined in Chapter 5. This shows how the fishery has steadily moved from a situation of *de facto* open access to one that is regulated by effort limitations. It thus outlines the how various institutional mechanisms (i.e. the Sea Fisheries Act of 1988 to the Marine Living Resources Act of 1998) formed to help regulate the development of the squid fishery. Chapter 6 attempts to structure the dynamics of the chokka squid fishery in terms of its industry, economic and socio-economic trends. It therefore highlights the dynamic nature of the squid fishing fleet and how this has impacted on catch and effort trends. All of these issues obviously have implications for resource management. It therefore seems like a logical progression to review the current management systems used within the fishery. Lastly, the chapter highlights the social and economic aspects of the fishery. This is done with the aid of the Economic and Sectoral Study (EES). All of these factors highlight the motivation behind the redistribution policies to be implemented by Government.

Chapter 7 highlights the "transformation" agenda of the Department of Environmental Affairs and Tourism (DEAT), as outlined by the MLRA. The chapter thus reviews the initial redistribution initiatives instituted by DEAT, which have attempted to reallocate permit rights to new entrants. The process is however riddled with many flaws, and has thus resulted in chaos within the squid industry. One manifestation of these problems is the formation of a "paper permit" market, which essentially undermines all redistribution attempts. Chapter 8 concludes on the discussions of the various chapters and makes recommendations based on this.

CHAPTER 2

ECONOMICS AND RENEWABLE RESOURCE USE: A CLASSIFICATION OF THE SQUID FISHERY

2.1 INTRODUCTION

The use and allocation of resources is a fundamental part of any economic system. Most economists see the ultimate objective of this process as the efficient allocation of resources for the purposes of satisfying society's wants. This myopic view has however evolved over time to encompass many different objectives. Most of these now include social, equity and economic considerations. Generally, the pursuit of these objectives has been through economic progress (turning resources into productive assets). The traditional (neoclassical) view of this process has focused primarily on the conversion of capital (physical capital) and labour (human capital) into productive means. Nevertheless it has increasingly been recognised that natural resources are also an important economic asset. If the role of these resources is marginalized, then it is likely that they will be overexploited. Their rate of exploitation will however partly depend on their characteristics, or the environment in which they occur. It is thus important to understand the characteristics that these resources possess and how these enable people to use these resources on a more sustainable basis. A classification of various natural resources is thus useful. And for the purposes of this thesis there is a specific need to classify marine resources, squid being the resource in question, within such a framework.

A classification of squid thus provides a framework to aid in the analysis of this resource. Squid resources are divided into their biological and operational categories. Firstly, this will help to determine how the resource behaves with respect to its reproduction (among other things). This is essential, especially from a biological perspective, as it gives managers on idea of how to maintain the resource. The operational categories relate to the harvesting of the resource. In essence these look at the characteristics of the fishing industry surrounding the exploitation of squid. Yet again setting a foundation for further discussion and analysis in later chapters.

2.2 ECONOMICS AND NATURAL RESOURCE USE

2.2.1 Introduction

The use of resources in the production process adds value to society through the achievement of the economic objective (discussed in section 2.2.2). This objective can be described as the efficient and equitable transfer of resources into productive means. Resources are thus inputs into the economic process with the objective of achieving a desired level of output. However, most economic theory only considers the use of two primary inputs (physical and human capital). This situation can be misleading. There is a need to move away from considering the economic process, of producing goods and services and generating human welfare, to be solely dependent on the accumulation of physical and human capital. The importance of natural capital also needs to be highlighted. It is therefore essential to classify natural resources, and their use, within this framework (as is done section 2.2.3). This classification can help characterise the nature of a resource and thus aid its sustainable utilisation and management.

2.2.2 The Economic Objective

Since the time of the Classical economists' economics has been concerned with the use of resources to enable economic growth. In fact, the problem of resource scarcity dates back to the conception of economics as a distinguishable discipline. This is obvious in the works of two classical economists, Malthus and Ricardo. Malthus's gloomy prediction was that a growing world population would be faced with limited resources, thus contributing to a fall in living standards over time. This pessimistic view of human welfare contributed to the reputation of economics as a "dismal science" (Heilbroner, 1986). David Ricardo extended on Malthus' analysis, but importantly, he took into account quality differences in agricultural land.

Ricardo argued that as a population increases (and the demand for food rises), more land of poorer quality is brought into production. Food prices thus increase to cover the higher costs of farming the marginal fields, the owners of the more fertile lands thus earn a surplus, commonly referred to as economic rent or Ricardian rent. Output per worker also falls as in Malthus' world. However, the reason for the decline is the inferior quality of the new lands brought into production, rather than the addition of more workers to a given amount of (similar quality) land (Heilbroner, 1986). Ricardo is thus both more and less pessimistic than Malthus, however resource use and availability for both was still a major problem.

The analysis of the classical economists, with regard to resource use, was extended within the neoclassical paradigm. Around the late 1800s, neoclassical economics began to form the mainstream of modern day economic thought. It abandoned the labour theory of value and used prices as a value of scarcity. Through the interaction of production activity and utility theory (consumption activity), resources could be allocated efficiently. This was based on Pareto criterion that were deemed to be socially desirable. Pareto optimum is a situation where it is impossible to make any individual better off without making someone else worse off. This situation could be achieved in competitive markets when market equilibrium was attained. This equilibrium is considered to be efficient. Government intervention was only viewed necessary if market failure occurs. Government is thus seen as an ethical agent only intervening in the interest of the public. Collective social welfare is thus achieved.

The axiom of the social objective is not restricted to economics alone, but in fact has its roots in social philosophy and ethics (Arnason, 2000). It is justified on the basis of social contract theory prescribed by Locke, Kant and Rawls (Rawls, 1971 in Arnason, 2000). According to this social contract, society should be organised in such a way so that the supply of valuable resources should be as high as possible and the distribution of these to individuals should be equitable. It can thus reasonably be assumed that the social purpose of production (from resources) is to maximise the net production of goods in an equitable manner.

From the above paragraphs it can be seen that people derive value from resources by using them as inputs in the production process or by consuming them directly. Resources are thus seen to be both useful and valuable. The economic objective with regards to this thesis is thus to achieve the social objective described above. To restate this in another way, the production sector (with regards to marine resources in this case) should be organised and operated so as to maximise social welfare[1]. The challenge is thus to effectively manage resources, on a sustainable basis, so as to maximise the satisfaction derived from these resources while enabling an equitable distribution of resources. Economics, for the purpose of this thesis, is thus essentially concerned with how society allocates scarce resources with the aim the maximising social welfare. It is thus more apt to refer to the "economic objective" as the achievement of the "social objective".

2.2.3 Classification of Natural Resources

The field of resource/environmental economics is the area of economics that deals with how society allocates scarce resources. Natural resources are seen as one of the factors[2] that contributes to the "increase in net production of goods and services" (Arnason, 2000:15), which in turn leads to the achievement of utility maximisation (through the consumption of these goods and services). Resources can basically be classified into three categories: physical capital resources, human resources and natural resources (Barbier, 2002 and Charles, 2001). The accumulation of physical capital occurs through the investment of physical capital units (e.g. buildings, etc.). Human capital, on the other hand, is accumulated through education and training (e.g. knowledge and skills development). Natural resources, or natural capital, by their nature can however not be produced (Arnason, 2000)[3]. They only acquire value once they are extracted from nature and used within the economic system. It is this characteristic of natural capital, as will be highlighted throughout this thesis, that adds to the complexity of its sustainable exploitation and management.

The classification of natural resources is thus vital, and will now be the primary focus of the discussion. Natural resources can be classified in many different ways (Dusgupta, 1988; Conrad, 1999 and Risvand, 2002). According to Risvand (2002) resources are

[1] The allocation of resources stems from the need to determine the most appropriate use for a resource, and thus to assign that resource to a purpose that results in its maximisation. Maximisation in terms of an aggregate measure that avoids waste and increases production – thus benefiting society as a whole. Lionel Robbins (1935) thus aptly defines economics as "the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses."

[2] The other two factors (Arnason, 2000) are physical capital and human capital (the physical and mental ability that human labour add to the production process).

[3] Although natural capital is not a primary product of man, the natural production rate of some resources can be influenced (as will be highlighted below).

commonly classified with respect to their exhaustibility. However this characteristic only focuses on the quantitative availability of resources and not on their potential for natural growth and recycling. It is preferable to classify resources on a somewhat different basis within two main classes: renewable and non-renewable resources. This differentiation is not necessarily identical to the exhaustibility classes. As Risvand (2002) points out, many renewable resources (fish or forests) are exhaustible, and many non-renewable resources (stones and various metals) are, economically speaking, inexhaustible. Conrad (1999) uses this classification to arrange natural resources along a continuum, from those that are most renewable in the short term, to those that are least renewable in the long term[4]. Natural resources can thus be classified within this range according to their term characteristics.

Non-renewable resources do not display significant growth or regeneration over an economic time scale. An example of this would be coal that has been built up over millions of years on the Earth. The regeneration time scale is thus too great for current economic consumption purposes. Increased use in one period diminishes the quantity available in another period. The degree to which future use is sacrificed is closely related to the possibility for re-use or recycling of the resource. This can thus be used as a criterion for dividing this group of resources into sub-classes (Risvand, 2002).

Non-renewable resources can either be depletable or recyclable. Depletable resources exist when full utilisation of the resource results in its total destruction. Examples are coal, oil and gas. With a recyclable resource the possibility of reusing the material exists. Therefore, in this case utilisation of one unit of the resource does not imply that it is totally and permanently lost[5]. Typical resources of this category are metal ores like iron, lead and copper.

From section 2.2.2 above the classical economists focused mainly on renewable resources, namely land. However, at least one classical economist also had something to

[4] The length of time thus required to replace a given quantity of a resource could be seen as its cycling period. However, any resource can become exhaustible if demand, and hence the rate of utilisation, exceeds its cycling period.

[5] The material from the resource is locked in a particular use in a certain period, from which a process of industrial recycling can release it, and thus be available for another use.

say about non-renewable resources. While Malthus ignored non-renewable resources, Ricardo pointed out that mineral deposits also vary in quality just like land. As a result, he claims, his analysis of land is equally applicable to minerals. He also recognizes that it is possible to discover new mineral deposits and to develop new mining technology (Heilbroner, 1986). Interestingly, though, he does not consider the depletable nature of mines, and so fails to focus on what many consider to be the fundamental difference between non-renewable and renewable resources.

Jevons (1865), however, in his book *The Coal Question* does seem to make this distinction. In his book he wrote that Britain's industrial vitality depended on coal and, therefore, would decline as that resource was exhausted. As coal reserves ran out, he wrote, the price of coal, relative to its cost, would rise. This would make it feasible for producers to extract coal from poorer or deeper seams. Although he was right about his forecast for Britain, he was wrong that the main incentive factor was the cost of coal. Jevons failed to appreciate the fact that as the price of a resource rises, firms have a strong incentive to invent, develop, and produce alternate sources. He also did not take into account the incentive of a rise in the price of coal leading to it being used more efficiently. Although Jevons, like the classical economists, did express concern about the problem of resource scarcity, more specifically coal, in was Harold Hotelling (1931) who developed an important breakthrough in the optimal use of depletable resources.

Hotelling (1931), in his seminal article *The Economics of Exhaustible Resources,* explores the optimal output over time for a mine with a given amount of known resources. Under competitive assumptions Hotelling shows that firms exploiting an exhaustible resource will increase price over time at a percentage rate equal to the resource owner's discount rate. This was termed to "Hotelling rule", which states that with no cost or constant marginal cost, dynamic efficiency is achieved by the real price rising at a rate equal to the rate of interest (Conrad, 1999). Hotelling's work has since served as a platform for many further developments in the theory of exhaustible resources, their management and use (Saville, 1997). While Hotelling contributed much to non-renewable resource management, there is also a need to explore the utilisation of renewable resources, which relates to the primary focus of this thesis. This is especially important in the light that most non-renewable resources are finite in an economic sense. There is thus a need to increasing shift to sustainable renewable resource use.

According to Conrad (1999) renewable resources are capable of growth or are renewable over a relevant economic time scale. This economic time scale, he argues, must be a time interval that is meaningful for the management of the resource. It is therefore possible, as in the case of fish, to harvest the resource indefinitely[6] if it is managed on a sustainable basis. This also means that the possibility of storing or transferring the resource for future use exists. Man can thus influence natural production of some renewable resources (Risvand, 2002). Based on these characteristics it is possible to distinguish between three sub-classes of renewable resources.

Firstly, there are renewable resources that do not have storage possibilities. Examples of these include wind and solar radiation. If the resource is not used when it is available, then it is lost. These are resources that typically have a continuous flow. This means that present use of the resource does not diminish future flows. Secondly, there are renewable resources that are capable of being stored. One common example is rainfall. Rainwater can be stored in dams and the stored flow is thus treated as a stock that can be used in a future period[7]. Finally, the last class of resources comprises of biological resources that are by definition livings organisms. Here the availability of a reproducible stock is probably the main characteristic of the resource. Production is thus usually related to the size of the stock, as is the case with fish or trees. Because human action can influence the resource flow, there is a "critical zone" for renewal[8]. That means that there is a more or less a clearly defined level below which a decrease in production cannot be reversed. This can thus lead to extinction of a species if exploitation continues (Clark, 1990 and Risvand, 2002). From the above discussion, of both renewable and non-renewable resources, it is possible to establish a diagrammatic framework to aid with the classification of resources. This is done in Figure 2.1 below.

[6] Seijo, Doefeo & Salas (1998:1), thus state that renewable resources exhibit the characteristic of "renewability". Risvand (2002:2) states that renewable resources are commonly referred to as "flow resources", as it is possible to maintain use indefinitely, provided its production (the flow) continues.

[7] Note that although the resource can be stored, the production is independent of the quantity stored.

[8] This is the case with most fish stocks and will be explained further with the use of the Gordon-Scheafer model in Chapter 3. The critical zone of a biological stock was emphasised by Scheafer (1957).

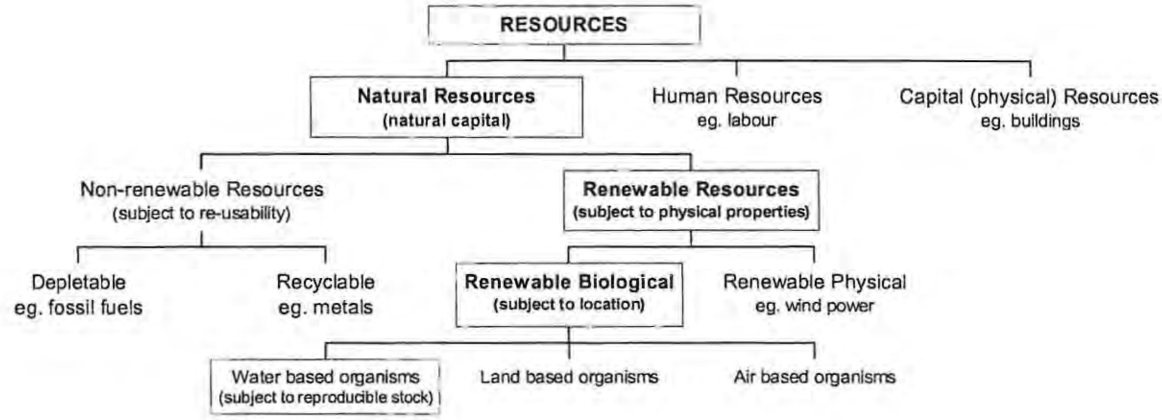

Figure 2.1: A Classification of Valuable Resources
Source: Adapted from Risvand (2002), Conrad (1999) and Sweeny (1993)

2.2.4 Fisheries as an Exploitable Renewable Resource

Although the renewable resource use problem has in part been highlighted since the classical economists, the interest in renewable resource economics increased greatly after the seminal paper of Gordon (1954) entitled *The Economic Theory of a Common Property Resource: The Fishery.* In this article Gordon developed an economic model for fisheries[9]. The model was based on the contemporary microeconomic principles of the time, and was used to help explain low-income levels in Canadian fisheries. However, based on the discussion in section 2.2.3, why are fisheries or fish stocks considered renewable resources?

According to Conrad (1999), a primary characteristic of a renewable resource is that it is able to regenerate within a relevant economic time scale. This is the case with most living marine resources that are able to regenerate from a given stock. This given stock must be above the "critical level" described in section 2.2.3. In addition to this, no renewable biological resource can regenerate to levels above the carrying capacity of

[9] According to Anderson (1986:19), a fishery can generally be thought of as a stock of fish and the enterprises that have the potential for exploiting them. For a more formal definition we can turn to Everhart & Young (1981:21) who describe a fishery in the following way, "A fishery is the complex interactions between the population of fish being harvested, the population of fishermen, and the environment of each."

the ecosystem in which it exists (Pearce & Turner, 1990). These resources can however become extinct due to the ability of humans to overexploit them. This will occur if the rate of exploitation persistently exceeds the natural growth rate. Fisheries are thus not renewable resources that have a continuous flow (like wind or solar energy). The optimal use of fisheries renewable resource thus needs to be determined. This is a view highlighted by Gordon (1954) as well.

One of the findings, arguably the most important one, of Gordon's (1954) work was that renewable resources (fisheries, in this case) where subject to overexploitation (this argument will be expanded in Chapter 3). Indeed Gordon (1954) went on to argue that, unless regulated, a fishery will be driven to harvesting rates that are beyond a sustainable level. In their expansion of Gordon's work, Munro & Scott (1985:623) noted the following:

> If a [renewable] resource is commercially valuable and is open to unrestricted exploitation, the resource will certainly be subject to excessive depletion from society's point of view. Since the resource is open to all and owned by none, [there is] no incentive to conserve the resource.

It is thus clearly recognisable that although renewable resources can regenerate, if they are "mined", that is, removed at a rate that does not permit renewal, they can be reduced to levels below those that are sustainable. This is a conclusion reached not only by economists (Gordon, 1954; Scott, 1955; Crutchfield, 1956; Smith, 1969; Wilen, 1985; and Conrad, 1999 to mention but a few), but also by environmentalists and ecologists alike. Any fishery, being a renewable resource, is thus subject to these effects.

From an economic viewpoint, the reason why most fisheries resources are subject to overexploitation is due to the characteristics that these resources exhibit. Most renewable marine resources are referred to as common pool resources (Berkes, 1989; Ostrom, 1990; McCay, 2000 and Jensen, 2000b). These resources are however loosely known as "common property" resources due to the institutional state within which they occur (discussed in Chapter 4). The use of the term "common-pool" resource is however more accurate as it refers to the characteristics of the resource (Jensen, 2000b:639). Common pool resources are resources with features similar to those of congestible public goods (Cullis & Jones, 1992). This is because common-pool resources are those for which it is difficult to exclude outsiders, but use of the resource by one person reduces its availability for other users. These resources, like fisheries, are thus degradable and their renewable nature is mitigated if too many users exploit them. They are thus not able to regenerate in a relevant economic time scale. There is thus a need to ensure that these resources are used on a sustainable basis for the benefit of all.

2.2.5 Conclusion

Economics, for the purpose of this thesis, thus deals with the achievement of the "social objective" in the sense that resources should be used for the achievement of social welfare maximisation. Maximisation that goes beyond the narrow definition imposed by traditional neoclassical economics, where a role for government (through intervention to achieve equity) is necessary. This is especially important given the characteristics of natural resources and the role that they play in social and economic development. And with future growth and development increasingly dependant on renewable resources, it is imperative that these are used on a sustainable basis.

2.3 CLASSIFICATION OF THE SQUID FISHERY

2.3.1 Introduction

As mentioned above (section 2.2) a renewable resource is one that regenerates within a relevant economic time scale. According to the classification in Figure 2.1, the second tier of classification within renewable resources is between those that are biological in nature and those that are physical in nature. It then makes sense to divide biological resources into water-based organisms, land-based organisms and air-based organisms. This provided the third tier within the classification. For the purposes of this thesis, water-based organisms (fresh water and marine) can be further divided into those that are exploitable and those that are not. Renewable exploitable resources are either exploited for commercial purposes, subsistence purposes or recreational purposes (Cochrane & Payne, 1998). Most of the prominent squid fisheries, worldwide, are utilised on a commercial basis (Rodhouse, 2001 and Roeleveld, 1998). The South African chokka squid fishery is no different in this regard.

2.3.2 Biological Classification

The squid caught within South Africa are scientifically classified as *Loligo vulgaris renaudii* (Augustyn, 1986), and are locally known as "chokka" squid (Augustyn *et al*, 1994). Most squid fisheries around the world target one of two major categories of squid. All squid, which are part of the cephalopod family, are divided into two broad groupings, the near-shore *myopsid* squid and the oceanic *oegopsid* squid (Jackson, 2002). The myopsid squid have covered eyes and inhabit continental shelf regions. The major families exploited are the Loliginidae, whose major classes consist of *Loligo*[10], *Photololigo* and *Sepioteuthis* (Nesis, 1998). The second group of squid consists of the oegopsid squid[11] that form a hugely diverse group of oceanic and deepwater-species that have a wide diversity of body forms. The main distinguishing feature of oegopsids is that they have an eye that is exposed to the seawater.

Through the development of reliable ageing techniques (Jackson, 1994 and Jackson & O'Dor, 2001), it has been established that squids have very short life spans and fast growth rates. According to Jackson & O'Dor (2001) their lives are very much 'life in the fast lane'. In fact it is unusual to find a squid with a life span of much greater than a year and many tropical species have life spans that are around 6 months or less (Jackson, 2002). *Loligo vulgaris renaudii*, the squid exploited in South Africa, is no different in this regard. It has an average lifespan of between 1 and 2 years, reaching reproductive maturity in its first year of life (Augustyn, 1990).

Squid caught in South Africa, as well as those exploited worldwide, can be classified as biological renewable resources that are commercially exploitable. Their short life spans mean that these resources, as a population, have a rapid regeneration rate. In fact short life spans, especially for species that are less than a year old, often result in multiple cohorts per year (Roel, 1998). This can however pose problems for the management of the resource as heavy exploitation of the resource in one year can reduce the reproducible population to levels below the 'critical zone'. There has thus been increased concern in most squid fisheries worldwide as world squid catch, like most cephalopods, has increased substantially in recent years (Rodhouse, 2001). This has

[10] The squid exploited in South Africa, *Loligo vulgaris reynaudii*, belong to this grouping.
[11] As a point of interest the giant squid (*Architeuthis*) is an oegopsid squid.

primarily been due to the increase in demand for seafood, coupled with the reduction in most fin-fished stocks. In addition to this most squid species are, however, typically unstable (Roel, 1998 and Jackson & O'Dor, 2001). They react dramatically to any changes in environmental conditions[12]. Squid fisheries are thus, not only of interest for their contribution to the protein content of human consumption, but also as possible indicators of global ecological change.

2.3.3 Operational Classification

Cochrane & Payne (1998) have broadly classified the South Africa's exploitable marine resources into those that are exploited on a commercial basis, a recreational basis and/or for subsistence purposes. Within South Africa, the chokka squid fishery is a commercially exploited fishery. The squid fishery is however not the only commercially exploited fishery in South Africa. The South African fishing industry can be divided into the demersal[13] fishery, the pelagic[14] fishery, the rock lobster fishery[15], the abalone fishery and various line fisheries. These various fisheries will be discussed in more detail in Chapter 5. The squid fishery can essentially be classified as one of the various line fisheries that exist. This is because squid are caught using hand-line with Japanese squid jigs (Sauer, 1992).

South African fisheries can further be divided by the different types of vessels used within these various fisheries. The most popular way of distinguishing between the different types of vessels is their length distribution. However other characteristics such as gross registered tonnage (GRT) or engine power (measured in kilowatts) can also be used. In terms of length, vessels can divided into four categories (Mather, 2004); (a) micro, with a length between 5 to 8 meters, (b) small, between 8 and 12 meters, (c) medium, between 14 and 25 meters, and lastly (d) large, which are greater than 25

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[12]The variability in *Loligo vulgaris reynaudii* is apparently driven by storm conditions during their spawning period (Rodhouse, 2001 and Schön, 2000).

[13] Demersal fish are species occurring in deeper waters near the bottom of the sea. Such species include hake, kingklip, snook and sole and are usually caught with trawl nets. Demersal species can however also be caught through longlining, which is a less capital-intensive method.

[14] Pelagic species (such as anchovy, pilchard, redeye, sardine and mackeral) occur in schools nearer to the ocean surface and are thus caught with purse seine nets.

[15] The rock lobster fishing industry consists of the West Coast rock lobster fishery operating in the rocky inshore areas of the Western Cape, and the South Coast rock lobster fishery where catches are mainly in deeper water.

meters. The squid fishery consists of vessels that are predominantly within the small to medium categories. Along within vessel length, each fishery can further be separated into their primarily management method. Fisheries with South Africa are either managed through a total allowable catch (TAC) or total allowable effort (TAE). A TAC fishery is managed by regulating the amount of output or catch, while a TAE fishery is managed by restricting the amount of effort (or inputs). These concepts will be expanded on in Chapter 3. It is now possible to classify the squid fishery within the context of the above discussion. A diagrammatic framework is illustrated below.

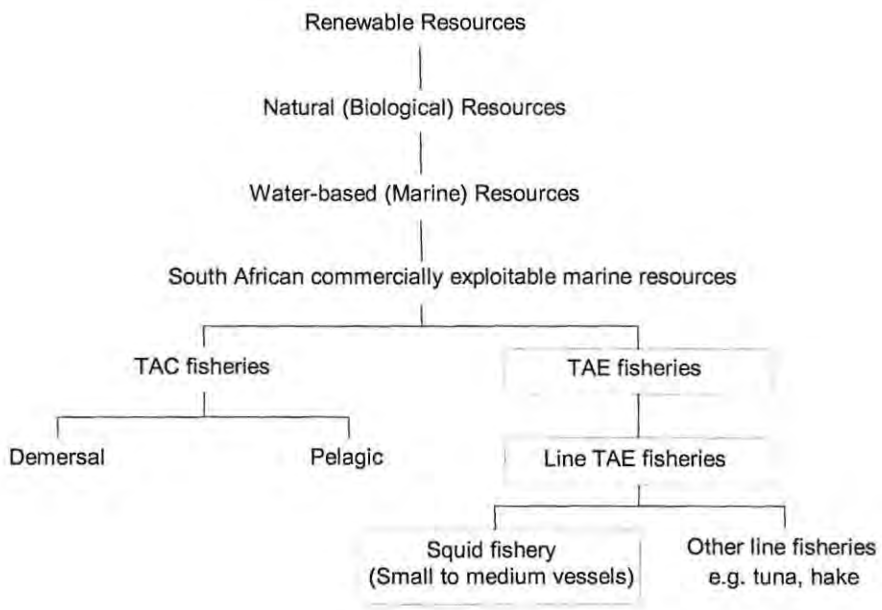

Figure 2.2: A Classification of the South African Commercial Squid Fishery
Source: Adapted from Mather (2004) and Cochrane & Payne (1998)

The above classification scheme (Figure 2.2) is useful from both a biological perspective and an operational perspective. It provides a logical basis from which to analyse the South Africa commercial squid fishery. Although both TAC and TAE managed fisheries have been mentioned, the primary focus of this thesis will be on effort-based fisheries (under which the squid fishery falls). The discussion in future chapters will hence be biased towards the sustainable management and utilisation, and implications thereof, of effort-based fisheries. However, where it is deemed necessary, for purposes of comparison, TAC or output management methods will be mentioned.

The operational criteria used within the classification will also be expanded on in Chapter 6, specifically with regards to the South African squid fishery.

2.3.4 Conclusion

In terms of its biological classification, South African chokka squid are classified as *Loligo vulgaris reynaudii* (Augustyn, 1986). Like most squid species there are short-lived and are subject to much variability (largely due to erratic environmental changes). This variability can pose a problem for sustainable management as determining accurate stock estimates is difficult. In terms of its operational classification, the squid fishery is primarily a commercial line fishery managed by TAE. In order for the fishery to be managed on a sustainable basis, the effectiveness of TAE management needs to be explained (as will be done in Chapters 3 and 6). These management mechanisms however also need to account for the biological constraints imposed by the characteristics of the species.

2.4 CONCLUSION

The classification of the South Africa commercial squid fishery provides a good starting framework from which to apply an economic logic to the use and management of such a resource. The operational classification provides a management framework that includes the physical and human characteristics in terms of the harvesting of the resource. The biological characteristics however provide an additional constraint in terms of maintaining the viability of the resource (which is in line with the idea of sustainable utilisation). All of these factors need to be considered when attempting to deal with effective resource redistribution. In addition to these, issues of equity also need to be considered (as outlined by the "social objective"). This is especially important when focus is turned to the resource distribution issues facing South African fisheries today. These place an even further constraint on sustainability. All of these issues will be dealt with in greater detail in later chapters.

CHAPTER 3

RESOURCE USE, EXCESS CAPACITY AND BIOECONOMICS: THE FISHERIES MANAGEMENT PROBLEM

3.1 INTRODUCTION

In Chapter 2 fisheries resources were classified as renewable resources that are subject to exploitation. It was established that these resources can be used on a sustainable basis or be subject to overexploitation. In this chapter an attempt is made to highlight the current status of most fisheries resources worldwide. From this it will be clear that most of these resources are in fact either fully utilised or overexploited. According to Gréboval & Munro (1999) the apparent reason for this stems from the build up of fishing capacity (i.e. due to overcapitalisation caused by increases in the size of fishing fleets). This thus results in excess capacity. To better aid discussion a clear definition of excess capacity is thus needed. Faced with these problems, fisheries management authorities need to find a way to reduce the pressure imposed on marine stocks. However, to determine possible reference points, in terms of the desired levels of effort or output that authorities strive to achieve, a bioeconomic model is derived. Although this is a static bioeconomic model (the Gordon-Schaefer model), it is useful in so far of the principle result that it outlines. The remainder of the chapter focuses on some of the *operational* aspects of fisheries management while dealing with such issues as enforcement and regulatory instruments.

3.2 THE FISHERIES PROBLEM

The ocean and the natural capital stocks that they produce are important from an ecological, economic and social viewpoint (Costanza, 1999). Natural resources contribute significantly to human welfare, both directly (in terms of consumption) and indirectly (through production and employment). The FAO (2000) estimates that international trade in fishery commodities was worth about US$51.3 billion in 1998 and contributed to the employment of about 36 million people. It is therefore crucial that living marine resources be managed on a sustainable basis.

In the case of fisheries, however, the ability to maintain sustainable marine populations has become increasingly difficult. The result being that fish stocks[1] are becoming increasingly limited. Many authors (Harder, 2001; FAO, 2000; Iudicello *et al*, 1999 and World Bank, 1994) agree that virtually all commercial fisheries have experienced drastic declines in fish stocks over the last fifty years. According to the FAO (2000) about 47% to 50% of global stocks are fully exploited with no room for further expansion. This means that nearly half of the world's stocks have either reached, or are very close to, their maximum limits. A further 18% are already overexploited and are in danger of total collapse if no immediate action is taken (FAO, 2000). The situation in South Africa is not much different. As the largest fishing nation in Africa (Penxa, 1999), total production (catch) in South Africa is greater than 500 000 tons. Since fishing activities began in the 1930's there has been a dramatic increase in catch, with landings doubling in South Africa's most important fisheries by the late 1960's (Paul, 2000b). Most of South Africa's fisheries are currently fully utilised with no further room for expansion (Booth & Hecht, 2000).

If the total collapse of fisheries stocks is to be averted, a major amendment, to revert uncontrolled and excessive fishing pressure, needs to be undertaken. The ability to manage fisheries is however a very complex process that requires the integration of various disciplines. This is because it involves the management of a dynamic resource, which incorporates various issues. Fish stocks are not only a renewable resource, but are also a variable[2] and valuable one. They are subject to environmental conditions, such as *El Niño*, as well as being a very important source of food, employment and revenue. The fishing industry plays a small (about 0.4% of GDP) but important part in the South African economy. It employs about 25 000 people in the commercial sector and affects about 60 000 people in related sectors, in total grossing about R2.5 billion a year (Paul, 2000b). Management issues, in world fisheries, thus range from biological concerns (related to maintaining sustainable marine stocks), to social, economic and political concerns (related to individual fishermen, communities and countries alike).

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[1] Stock size is either the number of individuals or the weight, of a particular biological marine resource, at any given time.

[2] The variability of a species refers to the fluctuations in the population/stock size over time. For example most squid populations fluctuate on an annual basis.

The problems facing fisheries are indeed multi-faceted, but from an economic perspective the problem is essentially one of having too many vessels, or excess capacity[3], in many fisheries worldwide (Gréboval, 2000). The problem is that although many marine fisheries have remained relatively stagnant over the last decade, actual fishing capacity[4] has been steadily increasing over the last fifty years (FAO, 2003 and Gréboval & Munro, 1999). This has indeed been the case in some of South Africa's larger commercial fisheries, where effort creep and capacity build-up have become a problem (Mather *et al*, 2003a). The South Africa chokka squid fishery is no different in this regard. Although the fishery is still relatively "new", there has been an increase in effort and capacity within its 20 years of existence, a fact that will be highlighted in Chapter 6.

The issue of managing fishing capacity at both a national and international level is thus important. At an international level concerns about capacity management were formally raised by the FAO Committee on Fisheries (COFI) in 1997 (Gréboval, 2000). Concern was expressed about the growing use of excessive fishing inputs and the incidence of over-investment within world fisheries. Gréboval (2000) and Pearse (1994) state that excess capacity in world fisheries was gradually influenced by various factors. Some of these factors include: a) the profitability of fishing activities, either through technical progress[5] and/or relatively inelastic prices, compensating for diminishing catches; b) ineffective policies related to the national exploitation of fisheries within their jurisdictions, generally accompanied by sizable subsidisation programmes and; c) the failure of fisheries management in general to effectively monitor their fisheries.

At an individual fishery level, however, all the factors mentioned above essentially stem from the widespread tendency of over-investment (leading to increased infrastructure

[3] This can be due to the enhancement of efficiency caused by advances in technology, the refitting of older vessels and the failure of fisheries management authorities to effectively monitor and control their fisheries (Gréboval, 2000 and Pearse, 1994).

[4] Ward (2000:5) states that fishing capacity is the ability of a vessel or fleet to harvest more fish. He further states that excess capacity results because fishermen do not have an incentive to conserve fish stocks which causes them to over-invest in capital used to harvest fish as well as other production inputs.

[5] Technical progress is due to advances in technology, which improves the harvesting efficiency of fishermen. This can result in increased revenue, as more fish are caught, without a dramatic increase in costs (Matthiasson, 1996:173).

and expanded fishing fleets)[6] which in turn lead to overfishing under *open access*[7] conditions (discussed in more detail in Chapter 5). This is a textbook case of market failure, brought about by a divergence between rational individual investment behaviour and societal optimality. This is because common-pool resources have characteristics that encourage adverse economic incentives (due to their public good[8] nature as stated in Chapter 2). Excess capacity its dynamics and control thus seem to be one of the most pressing economic[9] issues facing fisheries (Charles, 2001; Gréboval 2000; Garcia *et al,* 1999; Gréboval & Munro, 1999; Buckworth, 1998; Hannesson, 1998; Matthiasson, 1996 and Pearse, 1994). It seems to have broader implications for all other issues. There is thus a need to define what capacity and excess capacity are from an economic viewpoint and to highlight how these phenomena affect a dynamic fisheries' system. These issues, and their effects, will now be discussed in more detail.

3.3 FISHING CAPACITY AND OVERCAPITALISATION

3.3.1 Introduction

Within most world fisheries the presence of excess fishing capacity is, and has been, a matter of growing concern and the result of the wide-ranging phenomenon of overcapitalisation (Gréboval & Munro, 1999). Ward (2000) and Paul (2000a) state that excess capacity and overfishing (mainly due to a lack of monitoring and compliance) have been identified as the two main problems facing fisheries managers. Overcapacity seems to result from overcapitalisation, and in turn results in increased fishing effort[10]. Excess fishing capacity thus affects the sustainability of many fisheries, undermining

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[6] This is known as overcapitalisation and will be defined in section 3.3.

[7] Open access conditions result from the fact that most fisheries resources have been unregulated and subject to the "law of capture". This means that no one owns fish swimming in the ocean until they have been caught, i.e. taken into possession. (Scott, 2000c)

[8] Public goods exhibit characteristics that make it difficult to exclude nonusers, this is also the case with fishery resources.

[9] The fisheries problem is referred to as an economic problem because the incentives that cause overcapacity are essentially economic incentives (due to human behaviour). This does however not mean that issues pertaining to the biological management of fish stocks are not important.

[10] The economic concept of fishing effort refers to the boats, men, gear, etc. that are required for the fishing activity.

many of the conservation and management efforts undertaken, and thus leading to significant economic waste[11]

3.3.2 Defining Capacity

Although there is agreement that excess capacity and overcapitalisation are among the major problems within fisheries (as highlighted in section 3.2 above) there is still much confusion, within literature, about the definitions of these of concepts. This apparent confusion arises from the inconsistent use of these terms. It is therefore useful to turn to Gréboval & Munro (1999) and Cunningham & Gréboval (2001) to aid with possible definitions of capacity and overcapitalisation. It is also useful to firstly differentiate between localised overfishing and excess capacity in general. Localised overfishing is clearly a case of excessive effort being applied to an isolated stock (Gréboval, 2000). Whereas excess capacity, after allowing for possible reallocations, is clearly about having excessive and redundant harvesting capacity throughout the fishing sector or for a large group of fisheries, which cannot easily be re-allocated (Gréboval, 2000).

Given the discipline that this thesis is grounded in, it is sensible to begin with an economic definition of capacity. According to Cunningham & Gréboval (2001:part 2), economic capacity, based on cost minimisation, is "the level of output of fish caught over a period of time (year, season) where short-run and long-run average total costs are equal, for a given fleet size and composition, resource condition, market condition, state of technology, and other relevant constraints".[12]

However, since cost minimisation is not the only objective[13] that can govern a fisherman's behaviour, a technical definition of capacity is also vital (Primont, 2000).

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[11] This manifests itself in the form of redundant fishing inputs and the overfishing of most valued fish stocks. There is also the issue of the dissipation of food production potential.

[12] For an economic definition that is more in line welfare criterion, economic capacity levels are "those levels of output of fish caught over a period of time where objectives such as net social benefits are maximized for a given fleet size and composition, resource condition, market condition, state of technology, and other relevant constraints" (Cunningham & Gréboval, 2001:part 2).

[13] Economic rationale assumes that individuals attempt to maximise profits, which can also be interpreted as the minimisation of costs. In addition to this fundamental premise fishermen also need to account for technical factors, e.g. the inputs on a given vessel and how these affect the safety of the crew.

Here Cunningham & Gréboval (2001) again provide a useful definition. Technical capacity is "the level of output of fish over a period of time (year, season) that a given fishing fleet could reasonably expect to catch if variable inputs are utilized under normal operating conditions, for a given resource condition, state of technology, and other constraints" (Cunningham & Gréboval, 2001:part 2). Under this definition, excess capacity exists when technical capacity exceeds a target catch level set to rebuild or maintain the stock at a long-run target size (the Gordon-Scheafer bioeconomic model provides a useful framework to illustrate this, as will be shown in section 3.4).

The above definition indicates that capacity may be defined with reference either to fishing inputs (vessels, potential effort) or to fishing output (potential catch). In both cases, it is essential to further clarify the word potential. A general definition can aid in this regard (Cunningham & Gréboval, 2001:part 2):

> Fishing capacity is, for a given resource condition, the amount of fish (or fishing effort) that can be produced over a period of time (e.g. a year) by a vessel or a fleet if fully utilised, that is if effort and catch were not constrained by restrictive management measures.

Taking into account, the idea of localised overcapacity, it is also useful to have a definition of fleet capacity. Gréboval & Munro (1999) define the capacity of a vessel, or a fleet, as its ability, or power, to generate fishing effort per period of time. Capacity thus depends on things like, the size of each vessel, the technical efficiency of vessel operations, and the potential fishing time of each vessel per specified period of time, e.g. year or season. Measuring capacity on this basis is clearly an input measure.

Whether capacity is measured on an input or output basis, it is important to note that both approaches refer to the same fundamental conceptual framework, namely that the identification and measurement of excess capacity relates to possible deviations between the current capacity of a fleet (input or output measures) and a given target level of exploitation that can only be defined in reference to both inputs and outputs. Overcapacity therefore describes a situation whereby the capacity of the current fleet is higher than that required to ensure a target level of sustainable exploitation. Undercapacity and full capacity can be defined on the same basis (Cunningham & Gréboval, 2001).

3.3.3 Overcapitalisation and Excess Capacity

It is generally agreed (Charles, 2001; Cunningham & Gréboval, 2001; Ward, 2000; Gréboval & Munro, 1999; Christy, 1996 and Matthiasson, 1996) that excess capacity is largely a result of overcapitalisation, which in turn leads to increased fishing effort thus overfishing. According to the World Bank (1994) gross overcapitalisation of the world's fishing fleet increased by 180% from 1970 to 1989, a signal of major excess capacity problems. Buckworth (1998) argues that capital investment in a fishery tends to build up during good times with the anticipation that better gear or more boats or processing equipment will increase future revenues. But when the fishery stabilises (possibly due to environmental or biological reasons), this over-investment can result in unemployment and redundant infrastructure (economic waste). This is outcome that Crutchfield (1956) alluded to as early as the mid-1950s.

Before attempting to define overcapitalisation in the case of fisheries, it is useful to see how the concept is dealt with in standard economics. When dealing with an individual firm in the traditional theory of the firm, there is a stock of capital (i.e. plant) that would be optimal for its given level of output. At this "optimal" capital size, the firm would be minimising its costs (i.e. long run average costs). This optimal stock of capital can vary over time, due to changing demand and cost conditions. There is thus a time path for the optimal stock of capital. However at any given time the actual capital stock can be greater or smaller than the optimal one[14]. Under normal conditions a firm can only adjust its capital stock gradually (in the long run). This means that the gap between the actual and optimal size will persist for a period of time[15] (in the short run). During this time if the level of actual output is greater than the optimal level, there is overcapitalisation. The economic consequence is that the firm is producing its given level of output at greater than minimum cost because its plant is larger than the optimal

[14] This means the level of actual output (for a given level of actual capital stock) and the level of optimal output (for which the given plant would be the optimal) can follow a similar path.
[15] The reason why the plant size is adjusting slowly is because capital lacks "malleability" (Gréboval & Munro, 1999). Perfectly "malleable" capital is capital that one can dispose of without fear of capital loss at a moment's notice. Capital is thus perfectly mobile. The other extreme, perfectly non-malleable capital is capital that, once acquired, cannot be disposed of, other than by destroying it.

size. When the opposite occurs there is undercapitalisation. These concepts of overcapacity/under-capacity can be applied to fisheries.

If optimal harvesting capacity is defined as the minimum amount (of capital) required to harvest a desired quantity of fish at the least cost (OECD, 1996), then this definition is consistent with the above definition of capacity as taken from standard economics. The same basic principles pertaining to the neoclassical theory of the firm, with regards overcapitalisation (and the reverse), can be applied to fisheries.

Gréboval & Munro (1999) however note that there are at least three fundamental differences between the case of the firm discussed in standard economics and the problem facing fisheries. Firstly, in the theory of the firm, owners are generally faced with one stock of capital (although this one stock may contain complex components). This degree of simplicity does not exist in fisheries. When dealing with natural resources (i.e. fisheries) it is commonplace among economists to describe these resources as "natural" capital (as has been defined in Chapter 2, section 2.2.3). These resources are thus regarded as assets that are capable of yielding a stream of economic benefits through time, with the one difference being that the natural capital assets initially come to us as an endowment from nature. If this concept were applied to fisheries, then the fish stock would be regarded as a form of natural capital, which, if properly maintained, is capable of yielding a stream of economic benefits to society indefinitely (as Risvand, 2002 noted). One can thus invest, positively or negatively, in the stock. In terms of the economics of fisheries, there are hence at least two types of capital, the "natural" capital, and the capital in form of the fleet, referred to as "conventional" capital[16] by Gréboval & Munro (1999). Of fundamental importance is the fact that the two stocks of capital interact with one another.

The second key difference arises from mobility. Capital in the standard theory of the firm is treated as stationary. However, conventional capital in fisheries is, more often than not, highly mobile. This means that a stock of conventional capital may be

[16] This was classified as physical capital in Chapter 2 (see Figure 2.1).

interacting with several different stocks of natural capital. Moreover, a given biomass may be subject to exploitation by several fleets, i.e. by several different gear types.

The third difference relates to the open access problem afflicting most capture fisheries. In the theory of the firm, it is the firm who endeavours to adjust the level of capital to the level that is optimum. In the case of fisheries, the optimal stock of conventional capital is the stock of capital that is *perceived* as optimal by the resource managers, as opposed to those who are actually doing the investing in such capital, the fishermen. Under conditions of open access, it is invariably the case that the fishermen, collectively, will have an incentive to invest in capital to an extent that far exceeds the resource managers' perceived optimum (Ward, 2000). This is, in fact, just another way of restating the open access problem.

Finally, it should also be noted that the stock of conventional capital should properly be expanded beyond the fleet to include capital in the processing sector and "human" capital in the form of fishermen's skills[17]. These skills determine the relative efficiency of an effort unit. Fishermen with better skills, should be perceived to catch more fish, this can thus also manifest in excess capacity.

3.3.4 Conclusion

Excess capacity is a severe problem in most of the world's fisheries (as highlighted in section 3.2). The primary cause for this is believed to be the overcapitalisation of fisheries through the expansion or improvement of fishing fleets. Section 3.3 thus shows how overcapitalisation exists with regards to a target reference point set by management authorities. This measure is implicitly assumed to be the optimal level (that which is desirable for the maintenance of the fishery). It therefore seems important to gain a better idea of the various reference points available. The Gordon-Schaefer bioeconomic model can provide some insight in this regard.

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[17] This is of vital importance when dealing with equity issues relating to skills distribution in a fishery especially in cases where a fishery is perceived to be overcapitalised, reducing capacity can result in unemployment.

3.4 A SIMPLE BIOECONOMIC MODEL

3.4.1 Introduction

Section 3.3 outlined the fact that most fisheries around the world are overexploited or close to full utilisation. However, how do these problems relate to the management measures that authorities attempt to institute? In order to determine some reference points, with regards to policy options, a basic model is needed. This section thus outlines the Gordon-Schafer bioeconomic model, which incorporates both biological and economic information. Although this model is not practical in all cases, it is useful, firstly because it is widely used and understood, secondly because it can be used to determine reference points in terms of both biological and economic efficiency.

3.4.2 Bioeconomics: A Background

According to Scott (2000b), by 1920 European governments realised that fisheries were being overutilised; a belief further supported by evidence complied using 'new' scientific quantitative methods. Scott (2000b: 3) argued that it was from this point that "fisheries science came of age" and it heralded the beginning of biological fisheries management. Biologists have thus played a major role in fisheries management since its inception. They have dominated management decisions on the quantities of fish to be caught and to some extent the allocation of such catches. Pearse (1994) however states that regardless of all the policies implemented by biologists, fishing capacity continued to expand through to the 1970s. Conrad (1999:52) agrees that there was a continued decline in commercial fish stocks worldwide and this has given rise to questions about the effectiveness of "any combinations of traditional policies". Fisheries biologists and managers, trying to conserve stocks in the face of expanding fishing pressure, began to realise that something was fundamentally wrong.

Fisheries management in South Africa was also initially based on biological principles. Six years after South Africa gained independence from Britain, the Sea Fisheries Act of 1940 was passed. This gave the central government the sole powers of maintaining fisheries resources (van Sittert, 2002). However it was not until 1954, with the formation of the Sea Fisheries Research Institute, that regulations were put in place.

These measure were based primarily on biological principles with the aim of conserving the resource. These measures however did nothing to halt the entry of vessels, especially foreign vessels, into important fisheries (Mather, 2004). The same holds true for the squid fishery. Soon after its initial development, increased effort led to the implementation of measures based on biological principles (as will be elaborated in Chapter 6).

According to some economists (Charles, 2001; Cunningham & Gréboval, 2001; Scott, 2000a; Buckworth, 1998 and Pearse, 1994) the problem lay with the fact that profitable catches attracted more fishing power, which in turn threatened biological productivity. Fishery scientists thus reacted to a symptom of overfishing by introducing restrictions (these and other regulations will be discussed in more detail in section 3.4). Pearse (1994:13) referred to this as the "conservation problem[18]". These biological management measures are however regarded as sub-optimal as they ignore the second consequence of overfishing, which Pearse (1994: 13) termed the "economic problem".

The 'economic problem' resulted from the open access nature of a fishery attracting additional inputs, and thus fishing effort, into the fishery, which was due to the rational investment behaviour of fishers. This is the classic case of overcapitalisation (described in section 3.3.3), which manifests itself in the form of wasted capital and labour as these inputs become redundant when catches decline (a disinvestment in natural capital). This means that social welfare will probably not be maximised.

While governments based their regulatory endeavours on policies constructed by scientists, in the form of controls on vessels, on fishing gear and other restrictions like closed seasons, they ignored this second problem related to commercial fishing. They were thus continually trying to find new ways of reducing fishing effort. To quote Pearse (1994: 13):

> In many cases regulators found themselves on a treadmill, designing new restrictions on fishing to keep pace with the continuing tendency of fishing fleets to expand their capacity to harvest fish.

[18] The 'conservation problem' arose from the need to protect a given population of marine resources, thus ensuring that sustainable fish populations persisted.

Appreciation for the economics of fishing only came about in the 1950s[19]. This materialised following the works of economists like Gordon (1954) and Scott (1955). They explained that fishermen where encouraged to expand fishing power to catch more fish in an unregulated fishery. If profitable, then this attracted addition fishing effort into the industry.

Management measures based solely on biological principles was strongly criticised by Gordon (1954) as they failed to incorporate the costs of harvesting as part of the management problem. To quote Gordon (1954:128):

> The term "fisheries management" ...focuses attention on the quantity of fish caught, taking as the human objective of commercial fishing the derivation of the largest sustainable catch. This approach is often hailed in biological literature as the "new theory" or "modern formulation" of the fisheries problem. Its limitations, however, are very serious, and, indeed, the new approach comes very little closer to treating the fisheries problem as one of human utilization of natural resources than did the older, more primitive, theories.

Biological management therefore, according to Gordon, ignores the human side to fisheries management and the costs associated with it. Gordon (1954), Scott (1955)[20] and others (including Crutchfield, 1956; Smith, 1968; Plourde, 1970; Wilen, 1976 and Clark, 1985) then went on to expand on existing work or to design alternative management models. These were to serve as the basis for the merging of biological and economic principles, namely the establishment of bioeconomic modelling.

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[19] The major breakthrough in extractive resource use was developed by Harold Hotelling (1931). Hotelling (1931) in his seminal article, *The Economics of Exhaustible Resources* explores the optimal output over time for a mine with a given amount of known resources. Although Hotelling's (1931) paper was indeed influential when dealing with non-renewable resource management from an economic perspective, it was only twenty years later that decisive work on renewable resources was conducted. The origins of renewable resource economics can in fact be traced back to Gordon (1954) and Scott (1955)

[20] Scott (1955) in his paper entitled, *The Fishery: The Objectives of Sole Ownership,* expanded on Gordon's (1954) work. According to Saville (1997), Scott's article can be seen as the most successful extension of Gordon's work by shifting his model into a dynamic state. Scott (1955) recognised that the optimal management of a dynamic resource was based on maximising the net present value of all future net returns of the fishery. Subsequent analysis in the 1960s and 1970s however showed that the objective of present value maximization, with a positive discount rate, would not be optimal. In 1955, however, this direction made eminent sense.

Two broad approaches to bioeconomic modelling have been developed within fisheries economics. These are commonly known as the *cohort approach* and the *general production* or *surplus production approach* (Munro & Scott, 1985). The cohort approach was primarily developed by Beverton & Holt (1957). Their models are based on the cohorts, age or year classes, of a particular population. The approach looks at the dynamics of the population, looking at growth as affected by natural mortality and fishing mortality[21]. The cohort model suggests that effort should be directed at a particular age-class in a given stock. Stock biomass[22] is thus influenced in this way.

According to Wilen (1985), the cohort approach suffers from several weaknesses. This type of modelling calls for fishing gear that is able to precisely select fish of a certain age or size[23]. However it is very difficult to accurately measure the size of individual cohorts in a fishery. The success of using the Beverton-Holt type model, on a bioeconomic basis, is thus extremely limited (Munro & Scott, 1985 and Wilen, 1985).

In contrast to the Beverton-Holt type models, the surplus production or general production approach[24] typically ignores cohorts by assuming that the most important determinant of stock size is the biomass itself. Although these models have their drawbacks as well, they have been employed in most fisheries economic studies. These single variable models are what served as the foundation for Gordon's work and thus as the focal point of bioeconomic modelling.

3.4.3 The Gordon-Schaefer Bioeconomic Model

A number of bioeconomic models have been developed over the years. However, the most straightforward and widely used is the Gordon-Schaefer model. This model is based on the work of Gordon (1954) and Schaefer (1957) and has become the basis for most bioeconomic models associated with fisheries management. The model was

[21] Fishing mortality relates to the number of fish that are removed from a population due to harvesting activities.
[22] The biomass is the amount of a resource or population expressed in terms of its weight.
[23] An example of such fishing gear is selecting an appropriate mesh size to allow smaller fish, of a particular age, not to be caught. However, harvesting cohorts on an individual basis, what Munro and Scott (1985:625) refer to as "knife-edge selectivity", is the exception rather than the rule.
[24] These are the Schaefer type biological models based on a logistic function referred to in section 4.4.3.

centred upon a surplus growth model, based on simple biological theory of population dynamics. It thus has a strong biological foundation, provided by Schaefer (1957) himself. Munro & Scott (1985) agree that every economic model of the fishery has its base within a biological framework. The Gordon-Schaefer model is one of a single species fishery, in isolation, in which demand for fish and the supply of fishing effort are both assumed to be perfectly elastic (Munro & Scott, 1985: 628).

Fish stocks are renewable resources. They consist of populations of individuals that grow, reproduce and die. As with all renewable resources, it is important to distinguish between their *stock* and *flow* characteristics. The stock, in most marine resources, refers to biomass. This is the amount of a resource expressed in terms of its weight, existing at a given point in time. The flow refers to the change in stock over an period of time. There is a need to consider the crucial variables that affect a fishable biomass (a given stock) capable of growth (represented as a flow). These variables can be explained by making reference to Munro & Scott (1985: 624).

The first two factors deal with the growth of the biomass. Firstly, there is recruitment, which is the entry of new fish into an existing biomass. Secondly, there is the growth of individual fish. This occurs through an increase in body weight as fish mature. These two variables ensure growth of the biomass. However, growth is kept in check by mortality. Natural mortality can be due to age, environmental factors and/or predictors alike. Net natural growth is thus the difference between the recruitment and natural mortality and is referred to as *surplus growth*[25] (Schaefer, 1957). There is also fishing mortality[26], which is as a result of fishing activity. In the absence of fishing mortality there is a natural equilibrium, where growth is just offset by natural effects (Anderson, 1986). Recruitment and individual growth thus add to stock size while mortality diminishes it.

To commence with the derivation of the model, the biological aspects developed by Schaefer (1954, 1957) will first be explored. This model provides a good approximation

[25] If surplus growth is positive then the fish stock is growing, if it is negative then the fish stock is declining. A basic surplus growth model can be expressed in a discrete form as: $X_{t+1} - X_t = f(X_t)$, where X_t is the initial stock size at the beginning of time period (t), and $f(X_t)$ is surplus growth.

[26] Fishing mortality occurs due to the harvesting of fish, by fishermen, from a given fish stock/population.

of what happens among marine populations, given different starting levels of stocks. The fundamental underpinning is that growth, *G* (in terms of weight), of the population, *X*, over a time period, *t*, will be a function of the initial size of the population:

$$\frac{dX_t}{dt} = G = f(X_t) \tag{3.1}$$

It is reasonable to assume that population growth is roughly proportional to the initial population. Therefore there is the following:

$$f(X_t) = rX_t \tag{3.2}$$

Where *r* is called the *intrinsic growth rate* and represents the fastest growth rate attained by the stock. A given area in the sea is however limited in size and there thus is a maximum quantity of fish that can be supported. This limit is determined by the *environmental carrying capacity* (*ECC*), which is denoted by *K*. Thus according to the logistic function, at any moment, the growth rate will be proportional to the difference between the ECC and the population at that time. Therefore:

$$f(X_t) = rX_t\left[\frac{(K - X_t)}{K}\right] \tag{3.3a}$$

$$= rX_t(1 - \frac{X_t}{K}) \tag{3.3b}$$

In the above equation, both *K* and *r* are positive constants. According to Anderson (1986:20) the biomass of the unexploited fish stock will tend to increase at various rates and will grow towards some maximum weight (X_{Max}) that, when reached, will be maintained. This, as mentioned above, is termed the *natural equilibrium size*. There are two important features of this model (Saville, 1997). The first feature relates to the two equilibrium solutions when $X_t = 0$ and $X_t = K$ (X_{Max}). In other words, in an unexploited state, there are two levels of biomass at which population growth is stable; a zero population and *K* (the environmental carrying capacity).

Therefore:

$$0 < X_t < K \text{ implies } \frac{dX_t}{dt} > 0$$

and

$$X_t > K \text{ implies } \frac{dX_t}{dt} < 0$$

The above states that the resource will exhibit positive growth as long as the existing biomass lies between zero[27] and the ECC; and the biomass exhibits negative growth if the existing biomass exceeds the ECC. As mentioned above, K (and X_t) is therefore a stable equilibrium, where new growth and mortality balance each other and the system is in a natural equilibrium (Clark, 1985; Anderson, 1986 and Iudicello *et al*, 1999). The Schaefer model thus shows the surplus growth, which is zero at K, and there is thus no tendency to move away from the point, as explained above.

The second important feature of the above model is that the population at which the productivity is maximised is not the stable equilibrium. Rather the maximum growth of the stock occurs when the population size is half the environmental carrying capacity[28]. This occurs when $X_t = K/2$ and is know as the *maximum sustainable yield* (MSY). Smith (1968), Munro & Scott (1985) and Lokina (2000) supports this view by stating that growth is large when stocks are small, and as the stock increases, growth increases at a decreasing rate until it reaches a maximum and the eventually falls. Growth thus reaches a maximum at intermediate stock levels[29]. Figure 3.1, below, shows the growth function and the MSY of the population as based on equation 3.3a.

---

[27] A consequence of the simplicity of the model is that the *minimum viable stock* is zero. This implies that as long as there is any fish, the stock will grow. The model thus does not capture the fact that a certain critical mass of fish is needed to sustain the stock. This is referred to the "critical level" described in Chapter 2. However, it can be assumed that the model deals with sustainable growth; levels below this could represent the "critical zone".

[28] It should be noted that the above situation is a special case evident in the Schaefer logistic model where we are dealing with lumped parameters. In this type of model no attempt is made to distinguish among the factors that determine net biological growth. However, the study of population dynamics consists of many variables, where fish populations are concerned, these include: age, the rate of maturity, spawning conditions, availability of prey, to mention a few. Nevertheless the actual shape of the curve, in this case, will depend on the values assigned to r and K.

[29] Fish stock is thus restricted by K, so that $K \geq X_t \geq 0$, then $f(X_t)$ reaches a maximum sustainable yield at X_{MSY}, and then $f(X_t)$ declines as X_t goes from X_{MSY} to K. The fact that $f'(X_t) < 0$, beyond X_{MSY}, means that there is more competition among fish for food or they may be more easily located by predators.

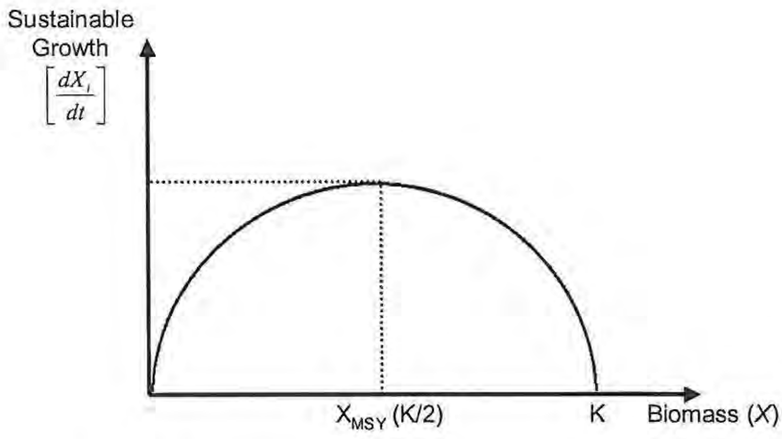

Figure 3.1: The Schaefer Logistic Growth Model
Source: Munro & Scott (1985:627)

When Gordon introduced the concept of fishing effort drawing on Schaefer's (1954) work, Schaefer (1957) altered his logistic population dynamics equation to reflect fishing effort. This means that a new source of fishing mortality affecting population size was introduced. Firstly, the catch in a given period *(t)* will be denoted by Y_t, which is also known as the *yield* or *harvest rate*. This yield is dependent on two factors: the size of the population at the beginning of the period, and the amount of fishing effort in the given period (*t*), E_t[30]. Therefore:

$$Y_t = h(X_t, E_t) \tag{3.4}$$

There is also a need to define the *catchability coefficient*, *q*, which can be seen as the state of technical efficiency of the fishing fleet. Seijo *et al* (1998:8) defines the catchability coefficient as "the fraction of the population fished per unit of effort". The short run yield equation thus becomes:

$$Y_t = qE_tX_t \tag{3.5a}$$

[30] It is assumed that $E = \sum_{i=1}^{n} e^i$, where *n* is the total number of fishermen or vessels in a fishery. Total effort in the industry is thus an accumulation of the effort exerted by all individual fishermen or vessels. This could thus be an index measure of the use of all inputs in the fishery.

A more generalised yield function can however also be expressed. This is as follows:

$$Y_t = qE_t^{\alpha} X_t^{\beta} \tag{3.5b}$$

The short run yield curve expresses catch in terms of effort, where q, the catchability coefficient, is a constant and where α and β are constants[31]. The altered logistic equation showing changes in biomass, including the effect of fishing, is as follows[32]:

$$\frac{dX_t}{dt} = rX_t(1-\frac{X_t}{K}) - Y_t \tag{3.6a}$$

$$= rX(1-\frac{X_t}{K}) - qE_t^{\alpha} X_t^{\beta} \tag{3.6b}$$

Under the above conditions, the population growth rate becomes a function of the intrinsic growth rate (*r)*, the initial population (X_t), the carrying capacity (*K*) as well as the catch rate (Y_t). When the population is in equilibrium, $dX_t/dt = 0$, the equilibrium yield can be defined as:

$$Y_t = rX_t(1-\frac{X_t}{K}) \tag{3.7}$$

By substituting for Y_t from equation (3.5b)[33] into equation (3.7):

$$qE_t X_t = rX_t(1-\frac{X_t}{K})$$

Equilibrium biomass, X_t*, as a function of fishing effort can be found as:

$$X_t^* = K(1-\frac{qE_t}{r}) \tag{3.8}$$

And, in terms of effort:

$$Y_t = qE_t K(1-\frac{qE_t}{r}) \tag{3.9}$$

---

[31] Equation 3.5b is the harvest production function, a special form of the Cobb-Douglas production function.

[32] The change in the natural population, at any given time, taking into account the effects of fishing/harvesting can thus be expressed as a discrete function given by: $f(X_t) - Y_t$

[33] It is assumed that the constants α and β are equal to one, for simplicity. If these parameters are altered, they merely affect the returns to scale property of the function, in other words they determine the shape of the yield curve or harvest production function.

Equation 3.9 represents the relationship between catch and effort at long-run equilibrium. It also gives the long-term production function of the fishery (Seijo *et al*, 1998). The graph is the well-known *yield-effort curve*, as Schaefer (1957) describes it, and is set out in Figure 3.2 below. The yield-effort curve is determined by the biology of fish stock, the environment and the effect that effort has on a given fish stock. It depicts sustainable yield as a function of effort, E. The curve shows the maximum quantity of fish that can be caught in a given year without reducing the stock biomass below sustainable levels.

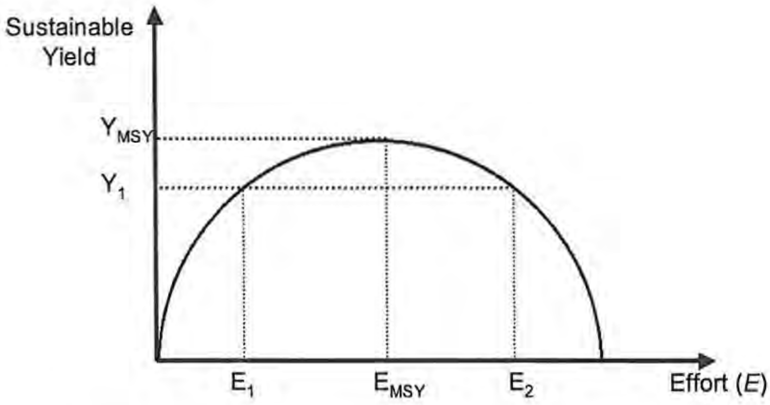

Figure 3.2: The Sustainable Yield-Effort Curve
Source: Munro & Scott (1985:627)

As can be seen from the Yield-Effort curve (Figure 3.2), it reaches a maximum at the MSY then declines as effort increases[34]. At an effort level of zero, no fish are caught[35]. As effort increases, population size can be expected to decrease in relation to the EEC. A sufficient increase in effort (beyond E_2) causes the sustainable yield to fall to zero. When the level of effort exceeds that which is sufficient to generate MSY, biological overfishing is said to occur. The biological explanation for such an outcome, of course, is that intensive exploitation reduces the fish stock to a level at which its productivity

[34] The effort corresponding to MSY is obtained by the solution of the yield maximisation problem (equation 3.9), finding the first derivation (dY/dE) and equating to zero. Thus:

$$E_{MSY} = \frac{r}{2q} \text{ by substituting in equation 3.9 gives: } Y_{msy} = \frac{Kr}{4}$$

[35] However, at lower levels of effort the maximum replacement of fish (*dX/dt*) is limited by the fact that the population (*X*) is large in relation to environmental carrying capacity (*K*).

begins to decline (Clark, 1985). There is thus an inverse relationship between sustainable biomass (X) and effort (E).

According to Lokina (2000), biological overfishing occurs if the same or less fish can be caught using less fishing effort. This occurs when effort exceeds the MSY point. Looking at Figure 3.2, effort level E_2 exceeds the MSY (E_{MSY}) and yields catch Y_1. However, the same catch can be obtained using less effort at E_1. The implication of this is that the *catch per unit effort* (CPUE)[36] is higher at E_1 than at E_2, greater effort is thus used to extract the same quantity.

Since marine biologists have traditionally dominated management of fishery resources, the appropriate management criterion was an attempt at achieving MSY or "full utilization" of the resource, as Munro & Scott (1985:627) described it. It terms of the Schaefer model, this meant that the fishery could expand to E_{MSY}, and stabilise at biomass level X_{MSY} (as seen in Figure 3.1). From an economic point of view however, MSY does not imply an efficient harvesting of resources. Economists (including Gordon, 1954; Plourde, 1970; Munro & Scott, 1985 and Clark, 1985) objected to MSY criterion because it ignored the costs of harvesting and the true nature of benefits to be derived.

Adding Gordon's economic component to the Schaefer model thus completes the bioeconomic model. Gordon's (1954) development introduced the concept of economic overfishing in an open access fishery. According to Munro & Scott (1985), when the price of landed fish is assumed constant[37], the sustainable yield curve mentioned above can be transformed into a sustainable revenue curve. Thus if the sustainable catch (Y_t) is multiplied by the price, p, the total revenue (TR) function is as follows:

$$TR = pY_t \tag{3.10}$$

[36] CPUE can thus be defined as the amount of fish caught when an additional unit of effort is applied to fishing. This can be in the form of an additional vessel or additional fisherman depending on the unit measure of effort. The Schaefer hypothesis asserts that CPUE is a direct index of stock abundance and can be expressed as follows: $Y_t/E_t = qX_t$

[37] Gordon (1954:136) also states that the assumption of a fixed product price is reasonable, if we are dealing with one fishing ground. This effectively means that the fishermen are price takers as no single fisher can influence the price. Nevertheless, in reality price would depend on such factors like size and freshness, related to the length of stay at sea. Turvey (1964) however agrees that it would be extremely difficult to estimate price patterns based on such erratic variables.

Next the total cost curve can be found by calculating the cost associated with one unit of fishing effort[38], c. This includes fixed costs, variable costs and opportunity costs of labour and capital (Seijo *et al*, 1998). The value of c is assumed to a positive constant such that total cost (TC) is as follows:

$$TC = cE_t \tag{3.11}$$

It is implicitly assumed that the price of landed fish accurately represents the marginal social benefit of harvested fish, and that the unit cost of fishing effort is a true measure of the marginal social cost of such effort (Munro & Scott, 1985:628). Accordingly, the difference between total sustainable revenue and total cost, at each level of effort, is the potential economic rent (profit, denoted by π) to be earned, which is as follows:

$$\begin{aligned}\pi &= pY_t - cE_t \\ &= (pqX_t - c)E_t \end{aligned} \tag{3.12}$$

The above equation represents the net revenues derived from fishing as a function of total sustainable revenues and total costs. The revenue, which will look identical to the yield-effort function, and cost curves are represented in Figure 3.3 below.

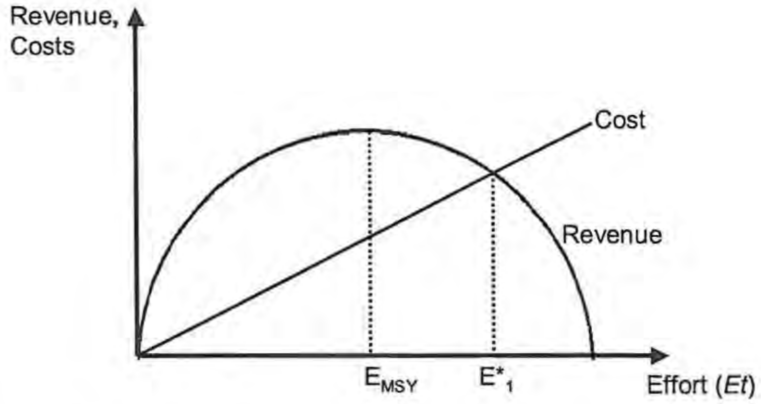

Figure 3.3: The Effort-Revenue/Cost Relationship
Source: Munro & Scott (1985:629)

[38] A unit of fishing effort is not easily quantifiable in reality as there are many different vessels, with various types of fishing gear, a diverse number of crew members and different time periods spent fishing; all of these contribute to total fishing effort.

According to Gordon (1954), in an open access fishery, effort will reach equilibrium at effort level E_l*. This is where total revenue equals total cost. This means that economic rent is totally dissipated[39]. The justification for this is that the fishery will earn profits for any level of effort such that $E_t < E_l$*; and thus in an open access situation this will attract addition fishers until all profits are dissipated (assuming there are no substantive barriers to entry, that is). Thus when economic profits are zero, there will be no stimulus for entry or exit into the fishery. Because access is free, the fish stock is thus exploited until it is worthless. If in addition to the above, the biomass is assumed to be at equilibrium, then the yield equilibrium will be established in both a biological and an economic sense. This thus leads to *bioeconomic equilibrium.*

Under the Gordon yield-effort model, the bioeconomic equilibrium is given by:

$$\frac{dX_t}{dt} = rX_t(1 - \frac{X_t}{K}) - Y_t = 0 \qquad (3.13)$$

Equation (3.13), above, can be solved for a bioeconomic level of effort. This is given by the following equation:

$$E_t^* = \frac{r}{q}\left(1 - \frac{c}{pqK}\right) \qquad (3.14)$$

Biomass at the bioeconomic equilibrium is defined by solving equation 3.12; this is the zero profit condition. It is given by:

$$X^* = \frac{c}{qp} \qquad (3.15)$$

The biomass level, within an open access fishery, at the bioeconomic equilibrium (described by equation 3.13) will thus be at the effort level where total revenue equals total costs. All sustainable rent will thus be dissipated. Turvey (1964:71) agreed with Gordon's outcome by stating the following: "In an unregulated fishery... resource

[39] In economic terms this is when the industry is earning normal profit, where total revenue is just able to offset the total opportunity cost of operations. The zero profit condition is, in theory, encountered in all competitive industries, where it is seen as the outcome socially desirable competitive forces. However, this is not the case in an open access fishery.

allocation is non-optimal [and] free entry means that ... no [economic] rent of the fish stock is achieved". Bioeconomic equilibrium thus corresponds to a zero profit level of effort. Gould (1972:383) also approved of Gordon's principle outcome and noted: "It is a widely accepted doctrine that free-access resources are overexploited – that is, they attract more resources than is required for allocative efficiency". Munro & Scott (1985: 631) referred to this as the '*Class I common property problem*' in which complete non-regulation results in rent dissipation and resource depletion.

Some authors saw Gordon's results in a different light. Smith (1968 & 1969) argued that competitive fishing is also subject to various external effects. These external effects can represent *external diseconomies* for a firm, which in turn also influence the cost of fishing. These external effects can thus be defined as negative *externalities*[40]. Three types of externalities where identified by Smith (1969). S*tock externalities* occur if the cost of harvesting decreases as the population of fish increases. *Crowding externalities* arise as the fishing industry increases thus causing the vessel aggregation in a specific area to increase, in turn causing increasing operating costs. *Mesh externalities* (later grouped under *technological externalities*[41]) arise when the use of gear restrictions alters the population structure and growth rate of fish stocks. Crowding and technological externalities can result in higher costs that effectively reduce the level of effort within a fishery.

According to Smith (1968 & 1969) the higher costs of fishing (due to the factors above), will cause a reduction in effort and accordingly catch. An unregulated fishery will thus not necessarily be overexploited. To quote Smith (1968:417- 18):

> "...it is clear that commercial production from a replenishable resource need not in time destroy the resource...the existence of external diseconomies (though it leads to non-Pareto efficient production states) does provide a built-in mechanism tending to resist annihilation of the resource: harvesting depletes the stock, costs rise and ceteris paribus, discourages harvesting, ...

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[40] Externalities in the fishing industry usually result from an external effect caused by individual fishers in an open access fishery. These externalities are commonly negative and occur when fishers can freely enter a fishery and capture a resource, but do not consider the effect imposed on others (Seijo, Defeo and Salas, 1998). This is possible because of the common-pool nature of the resource, which has characteristics that make it difficult to exclude "non-owners".

[41] See Seijo, Defeo & Salas (1998:3)

Fullenbaum *et al* (1971), however questioned the validity of Smith's results and stated that the classical theory [Gordon (1954) and Scott (1955)] of commercial fishing still stood on a firm foundation. Smith (1971, 1972) partly defended his original position only to be refuted again (Fullenbaum *et al*, 1972 and Gould, 1972).[42] In essence though it is the lack of empirical evidence, to show that competitive access does not result in overexploitation, that provides that greatest defence for the traditional fisheries literature, that is, competition results in rent depletion in *open access* fisheries.

Although Smith's (1968) model has been questioned, it did bring to light the fact that (along with Turvey, 1964), external diseconomies do exist in most fisheries. Munro & Scott (1985: 631), thus make reference to what they term the '*Class II common property problem*'. This refers to the view that the dissipation of rents will result because there will be excessive vessels and fishermen competing for a limited resource (this occurs through crowding, when vessels impede one another's movement or disrupt one another fishing activity, thereby leading to economic waste). This is what Smith (1969) termed crowding externalities. Gordon's allusion to rent dissipation at bioeconomic equilibrium nevertheless still seems to hold.

3.4.4 Maximum Economic Yield and Economic Efficiency

Referring back to Figure 3.3 (above) the bioeconomic equilibrium level of effort corresponds to point E_1*. However according to Gordon (1954), if the fishery is competitive and subject to no controls, point E_1* is not the most efficient point. The most optimal size of the fishery is in fact at the point where economic profit is maximised. Munro & Scott (1985), state that this point rests upon elementary welfare economics. By this they mean that the marginal cost of effort, *MC*, must be equal to the marginal product of effort.[43] To illustrate this argument Figure 3.4 has been constructed.

[42] Fullenbaum, Carlson and Bell (1971 and 1972) essentially state that Smith's (1968) model uses the wrong cost function, which doesn't seem to show that industry cost should change in proportion to an increase in the number of vessels.

[43] Munro & Scott (1985:629) state that the marginal product of effort is the value attached to each additional unit of effort. If revenue can be equated with value, this is in fact the marginal revenue curve.

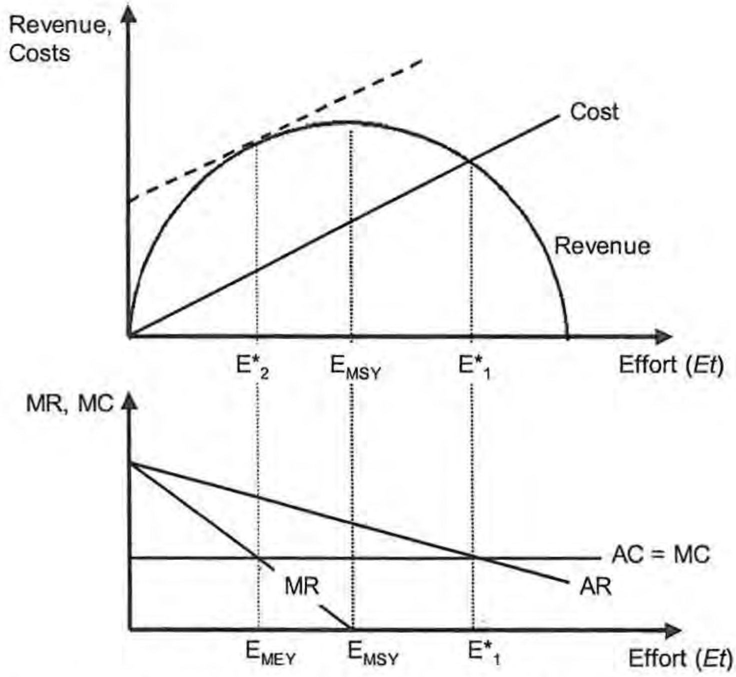

Figure 3.4: Maximum Economic Yield using Marginal Conditions
Source: Anderson (1986) and Lokina (2000)

Referring to Figure 3.4, the point that corresponds with the efficient level of effort is E_2^* (E_{MEY}). This is because the net benefit, represented in the diagram as the difference between total cost and total revenue, is maximised (Lokina, 2000). The vertical distance between revenue and costs is thus maximised. This is the point where marginal revenue (*MR*) equals marginal cost (*MC*). Levels of effort higher than E_2^* are inefficient because the additional cost associated with these levels exceed the value of the additional fish caught[44]. E_{MSY} is thus not efficient since the *MR* at that point is zero while the *MC* is positive. Accordingly the point E_1^* is where $MC = AR$, and is inefficient as well. Point E_2^*, the efficient level of effort, is referred to as the maximum economic yield (MEY). And if effort expands beyond E_2^*, economic overfishing is said to occur[45].

[44] Similarly the use of effort below *E2** is equally inefficient since the additional revenue generated will exceed the addition to costs.
[45] From an economic standpoint, E_{MEY} is associated with the optimal level of effort – resource rent is maximised. Fleet capacity (based on the definition in section 3.3) is thus deemed to exist whenever $E_t > E_{MEY}$ (more vessels are present than is needed). A movement to bioeconomic equilibrium (E^*_1) thus represents a disinvestment in natural capital (the resource).

Gordon's principle result for the *open access* fishery can now be given. This is that if a fishery is left unregulated, it will expand to the bioeconomic equilibrium and will thus be over-utilised. Suppose that, momentarily, the fishery is at its optimal size, E_2*. Since no one governs the resource, the resource rent will accrue to the fishermen and vessel owners who exploit that fishery. These users will be earning returns well in excess of their opportunity cost (Munro & Scott, 1985:629). If the fishery is competitive, additional fishermen and vessels will enter the fishery and will continue to do so as long as super normal profits[46] are being earned. As mentioned, equilibrium will thus be achieved where effort is equal to E_1* (where $AR = AC$). At this point there is economic overfishing ($E_t > E_2$*) and biological overfishing ($E_t > E_{MSY}$).

From the theory above it can reasonably be asserted that an unregulated fishery will result in economic inefficiency. The most popular policy prescription that was proposed at the time was that of *sole ownership* or privatisation (Scott, 1955 and Turvey, 1964). If the fishery belonged to a single owner who could exclude other fishermen, the outcome would tend towards efficiency[47]. Under sole ownership, fishermen would fish at the level of effort that maximises profits (Figure 3.4 shows the rent-maximising level of effort). A sole owner, with exclusive rights[48] to harvest the fish stock, would invest in capital equipment (e.g. fishing vessels) so that effort maximised profit, as described by equation 3.12:

$$\pi = pY(E) - cE$$

The simple first-order condition $d\pi/dE = 0$ implies $pY'(E) = c$, where $Y'(E)$ is the first derivative of the yield-effort function and $pY'(E)$ is marginal revenue. Because c is the unit cost associated with effort (marginal cost), the level of effort thus satisfies the

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[46] In economic terms, super normal profits are synonymous with economic profits and result when total revenue is greater than total cost. In Figure 3.4, above, super normal profits will occur up to the point where AR is equal to AC. At this point all rents will be dissipated.

[47] Clark (1973: 950), however contends that the "extermination of [an] entire population may appear as [an] attractive policy, even to an individual resource owner." Fisher & Peterson (1977) agree with this outcome as well.

[48] An owner with exclusive rights, to harvest fish, would be concerned with present and future catch, he would however not have to worry about leaving fish for others to catch. Whereas in an open access fishery, whatever is left by a forward-thinking fisherman, someone else would catch right now, if it were profitable to do so.

economic profit maximising condition of marginal revenue equal to marginal cost. This thus corresponds to the *MEY* level of output (see Figure 3.4 above).

3.4.5 Conclusion

It is relatively clear that an unregulated fishery will be subject to overutilisation (Gordon, 1954). The point of overexploitation is defined, using the Gordon-Schaefer model, by the bioeconomic equilibrium. At this point biological and economic overfishing will occur. The marine stock will be driven below its maximum level and all economic rents will be dissipated. The Gordon-Schaefer model, although it has its shortcomings, is useful because it provides fisheries managers with reference points in terms of the objectives they want to purse. The model is also useful because it states that a necessary step, towards effective management, is a movement away from an open access or unregulated situation.

3.5 MANAGEMENT MEASURES AND CONTROLS

3.5.1 Introduction

According to the Gordon-Schaefer model, an unregulated or 'free' fishery will be subject to overexploitation. This will occur if there are economic profits to be made which result in the increase in capacity (e.g. upgrading or buying of vessels). There is thus a need to regulate a fishery and prevent the build-up of excess capacity (Matthiasson, 1996). This can be achieved through a variety of measures. Most of these measures attempt to regulate the fishery, or access to the fishery, resulting in a corresponding reduction of fishing effort. It is thus necessary to evaluate the various broad classes of management measures to determine the possible impact that these can have. According to Charles (2001:89), management measures can be divided into the following broad categories: input (effort) controls, output (catch) controls, technical measures and indirect economic measures. The first three of these measures can be classified as 'traditional management measures' (Anderson, 1986 and Conrad, 1999) as they usually deal with the lowest level of management, namely the operational level.

3.5.2 Input (Effort) Controls

Input controls are probably the oldest type of fishery management tool (Scott, 2000a), and are the type of measure adopted when a fishery is first managed. The basic idea behind input controls is that they attempt to regulate fishing effort. The fishery is thus managed by *total allowable effort* (TAE). Although effort *per se* does not measure the specific impact on fishing, if no effort is applied no fishery exists (Charles, 2001). Input controls are thus an indirect means of limiting exploitation of fish stocks and clearly lead to a more variable yield than catch controls. Examples of input controls include the following: restricting the number of vessels or fishermen in a fishery, limiting the capacity per vessel, limiting the time spent fishing and limiting the location of fishing (Charles, 2001: 95-105).

i. Limiting Entry

One of the earliest effort controls implemented to regulate a fishery was limiting the number of participants in a fishery. This can be done through providing fishing licences to a limited number of fishery participants. Entry limitations have been in place in most fisheries around the world since the late 1960s (Iudicello *et al*, 1999). Entry limitations are thus widespread and are often seen as being attractive due to their administrative simplicity (Eggert, 1999).

Limited entry schemes reduce the total effort (TAE) in a fishery and thus allow the resource to regenerate[49]. This means that the fishery is more sustainable in the long term. However if existing participants are able to increase their landings, in order to realise greater profits, effort will increase. This is because the profit incentive can induce more capital investment (to increase the effectiveness of their licensed unit), thus potentially resulting in overcapitalisation or *capital stuffing*[50] (as discussed in section 3.3.3). Licence limitations alone are thus not thought of as

[49] Licences can be viewed as an imposed 'barrier to entry' helping to maintain the profitability of a fishery. Too many vessels can significantly increase landings causing a collapse in markets, as had occurred in the French Mediterranean fishery (Catanzano, Cunningham & Rey, 2000).
[50] This problem can be caused by input substitution where within a licensing system fishers will attempt to substitute unrestricted inputs for restricted ones.

a means of reducing fishing effort, but rather a necessary initial step to constrain further input growth (Anderson, 1986)[51]. The licence limitation approach essentially institutes a form of access right, a concept that will be discussed in more detail in Chapter 4. These licences can also be tradable, which means that the value of the licence can reflect changes in expected earnings within the fishery.

ii. Limiting Capacity per Vessel

While limited entry seems to be the principle means of limiting access to a fishery, it must not be used as a stand-alone solution. This is because of the rational incentive to increase the efficiency of a licensed unit. Each vessel can impact on a fishery in a variety of ways, i.e. its capacity (or catching power) is not constant, but rather various according to its dimensions, its physical capacity and the gear that it uses. Thus in any effort limitation scheme, restrictions may also need to be placed on the key components of effort. According to Iudicello *et al* (1999:75) the most common approaches are: (a) limiting the dimensions of a vessel, and (b) limiting the amount of gear utilised.

Another measure used to control the fishing capacity on a vessel is the imposition of individual effort quotas. These limit the number of effort units that a given vessel or licence holder can use (Gréboval & Munro, 1999). Examples of individual effort units are limits on the number of traps or the issuing of fishing permits. The effectiveness of these measures on effort however depends on whether they can properly be linked to effort. Input substitution can also result if these input controls are not correctly specified (Catanzano *et al*, 2000).

iii. Limiting Fishing Time and Location

Time limitations are usually expressed as restrictions on the number of days at sea. A season restriction (or closed season) is one way of reducing the duration of fishing time and thus effort. A closed season is usually justified for biological

[51] Canada introduced limited entry systems in the Pacific Abalone fishery in 1977, the Atlantic Inshore fishery in 1980 and the Pacific Sable fishery in 1981, however, in all of these, prevention of effort expansion reportedly failed (Eggert, 1999).

reasons. This is because it can be imposed during the critical stage in the life cycle of a specific resource, i.e. during its spawning period. If a closed season is however instituted alone, it will not regulate access to a fishery. The problem of overcapitalisation will thus still exist (Crutchfield, 1956). These adverse effects can result as fishermen fish intensely during the open season. The incentives that govern a fisherman's behaviour will thus still present (Cunningham & Gréboval, 2001).

A limitation on the location of fishing can take the form of a closed area. Closed areas may be used to protect the stock at particular locations in a similar fashion to closed seasons. A good example, from an ecological viewpoint, of a closed area is a marine protected area[52] (Anderson, 2000b). The impact of closed areas however depends on how effort re-allocates itself outside of the closed area and whether the closed area increases the stock size. In the latter case, the effect on capacity is likely to be similar to a closed season. Given the importance of location, a major traditional management measure is that of territorial allocations (Charles, 2001). These are sometimes referred to as *territorial use rights in fishing* (TURFs) and will be discussed further in Chapter 4.

3.5.3 Output (Catch) Controls

While input controls focus on limiting various components of fishing effort, output controls focus on limiting what is taken from a fish stock, i.e. limiting catches. They are thus direct control measures (Anderson, 1986) that stipulate the maximum amount of fish that can be caught in a fishery during a given time, widely known as *total allowable catch* (TAC). Portions of a TAC can also be assigned to various individuals (individual quotas) or user groups (community quotas) of a fishery. Output controls essentially rely on the ability to monitor total catch effectively.

[52] A MPA is a true example of an ecological based management tool as there is no focus on an individual species, but instead there is emphasis on limiting human activity throughout a designated area (Charles, 2001).

i. Total Allowable Catch (TAC)

By far the most widely used output control is to regulate the total harvest of a given fish stock through a TAC, i.e. the quantity of biomass that is permitted to be caught (Anderson, 1986 and Cunningham *et al*, 1985). The TAC is thus a general measure that is determined for each species based on scientists' advice (biological grounds). This amount is usually determined on the basis of stock assessment models[53]. Although a TAC does seem to reduce catch, there are some problems associated with its implementation. Conrad (1999) argues that the appropriate harvest is usually ill defined, because it is almost impossible to successfully calculate a given fish population (Everhart & Young, 1980). Ill-defined quotas can also create strong disinvestment incentives for profit-maximising firms (Segerson & Dales, 1993). In addition, limiting the supply of fish, without limiting entry into a fishery, effectively results in a regulated open access situation (Homans & Wilen, 1997 and Cructhfield, 1956) where the race-for-fish can continue[54]. A TAC can also be subdivided into quotas for specific participants or fishery sectors[55].

ii. Individual Quotas (IQs) and Community Quotas

Individual quotas (IQs) are quantitative output rights defining the amount each fisher can catch as a percentage of a TAC within a certain time period (Charles, 2001:98). A community quota is not all that different from an IQ[56], the only difference being that the quota share is allocated to a community (thus resulting in an institutional form known as community-based management). A possible problem associated with quota shares is how to allocate them. This has important ramifications for political considerations (such as equitable policies), and for

[53] Stock assessment models attempt to measure the abundance, or change in abundance, of a given stock or population of fish.
[54] This was exactly the case in the marine fisheries of the United States, where "an incentive to fish faster and harder to get as large a share of the total allowable catch" developed (Darcy & Matlock, 2000)
[55] As is the case in the European Union (Charles, 2001), where a set TAC is subdivided among countries.
[56] Individual quotas can, however, can either be non-transferable (INTQ) or transferable (ITQ). There are a number of implications associated with each type, however the issue of transferability will be discussed in more detail in Chapter 4.

economic considerations of efficiency. This is because monitoring IQs can be expensive as the incentive to dump, discard and high-grade fish exists.

3.5.4 Technical Measures

Technical controls are typically oriented towards meeting biological or conservation goals. They attempt to limit effort applied to a fishery by limiting the technical ability of fishers. The general purpose is thus to deliberately reduce the catching efficiency of fishers (reducing the effectiveness of technical inputs), usually increasing the cost of fishing. Such restrictions protect stocks from the use of new technologies that might increase the cost-effectiveness of fishing. These restrictions are thus not technically optimal. A positive consequence, however, is that restrictions on certain technologies can reduce capital stuffing. Probably the most prominent type of technical measure is gear restrictions. Gear restrictions are limitations on gear attributes, such as minimum mesh size or a minimum hook size for fishing lines. Gear restrictions however suffer from considerable enforcement problems. If enforcement is lacking then fishermen tend to systematically overcome these controls through input substitution (Eggert, 1999)[57].

3.5.6 Incentive-based measures

One good example of an incentive-based measure that can be used to reduce fishing effort is taxes (Turvey, 1964 and Anderson, 1986). The idea of optimal taxes (or landing fees) can be traced back to the introduction of the concept to economics, as a general device for correcting negative externalities, as used by Pigou (thus these charges where later referred to as Pigovian taxes)[58]. Landings taxes can be charged per unit of fish catch or fishing effort applied. This type of regulation can, theoretically, be set at a level that induces the desired behaviour from fishermen thus leading to an efficient solution. According to Turvey (1964), a tax can be used to limit effort, and the rent, once in the hands of government, can be redistributed or used to subsidise fishermen in the closed season (or those that have been displaced through reductions in effort).

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[57] An example of this behaviour was seen in the Maryland oyster fishery where motors on dredging vessels where prohibited thus leading to a commercial sailing fleet in the 1990s (Eggert, 1999).

[58] Pigou argued that the divergence between private returns/cost and social returns/costs could necessitate the use of subsidies/taxes to achieve optimal allocation of resources. This thus provided a case for government intervention.

Turvey (1964:73), however, goes on to state that to reach *optimum optimorum* a tax is necessary but not sufficient. Fishermen are nevertheless always unanimously against landing taxes, and taxes have thus never gained the status as a viable practical approach to fisheries management (Charles, 2001 and Eggert, 1999).

In line with incentive-based management measures has been the developed of *rights-based fisheries management* (Guyader & Thěbaud, 2001; Shotton, 2000 and Townsend, 1998). This method of management makes use of property rights to design systems that create incentives to alter the behaviour of fishermen. These systems depend on the characteristics that the property rights exhibit. It is however best to leave any further discussion of property rights, and their use within fishery systems, for Chapter 4, which is the main focus of that chapter.

3.5.7 Conclusion

Various types of fisheries management measures exist. These can broadly be divided into input, output and incentive-based controls. It however evident that although these measures do have some successes, they are usually still subject to adverse effects. These mainly include the race-for-fish and overcapitalisation, largely through input substitution and over-investment. To help alleviate these unpleasant effects, it is important that an assortment of fisheries management controls be used together.

3.6 A PORTFOILIO OF FISHERIES MANAGEMENT MEASURES

It is clear from section 3.5 that traditional fisheries management, all over the world, has come up with a battery of different management tools in a bid to halt the decline in marine stocks. Although these various controls do have their successes, in most cases if they are used independently, they can suffer from unpleasant side effects (Greiner *et al*, 2000). For example a licence limitation scheme used alone reduces the number of participants within a fishery, but the fishery can still suffer from overcapitalisation through input substitution. It is thus important to use a range of controls, or a portfolio of managements measures, as Charles (2001) calls it. Charles (2001) advises that a portfolio of management measures can be used achieve various policy objectives. This seems to make sense since most measures are not mutually independent; there are some that overlap in terms of their objectives. These objectives can range from the need to maintain a stock (e.g. restricting effort to maximise harvest at MSY), to the need to maximise economic rents (e.g. at MEY).

Most fisheries management measures however strive for the maintenance of productive fish populations. In these cases measures have to account for the biological characteristics of fish populations. In additional they may also have to account for variability of ecosystems. Because of such complicating factors, it is not unusual for disputes to emerge among scientists and fishermen over stock abundance, even when fishery scientists are confident in their stock assessments (Preikshot, 1998). Economic objectives, however, may not rest solely on efficiency criteria; a possible objective may require the minimisation of unemployment, thus increasing of effort beyond MEY. The same may be required where equity considerations are important; efficiency of utilisation thus becomes a secondary objective (Preikshot, 1998). Ultimately though it is the policy objective that determines the role that fisheries tools will play. Greiner *et al* (2000:34-35) states that management instruments can be evaluated according to the following criteria: (i) effectiveness, (ii) efficiency, (iii) innovation, (iv) equity, and (v) political acceptability.

Effectiveness relates to whether an instrument is "technically suitable for achieving a specified goal and whether it will deliver a desired target even when knowledge about likely responses is uncertain" (Greiner *et al*, 2000:34). *Efficiency* relates to two aspects. Firstly, does the instrument promote productive efficiency in the industry? The second aspect relates to "economic efficiency in a collective sense" (Greiner *et al*, 2000:34-35), as to whether marginal benefits are equated to marginal costs in resource allocations. *Innovation* looks at whether instruments provide ongoing improvements with regards to resource use. *Equity* relates the distributional effects of instrument within and among generations – an issue relevant to South Africa. Lastly, *political acceptability* is usually linked to the "compatibility of a new instrument [to] existing institutions and acceptance by all members of parliament" (Greiner *et al*, 2000:35).

Effectively designed management programmes thus attempt to encompass the above criterion. However, any single instrument may not be able to satisfy all these criteria simultaneously and appropriate combinations may be required. Tradeoffs, in terms of the criteria, do sometimes also exist (i.e. between efficiency and equity). The compatibility and feasibility of measures is thus important. Poorly designed management programmes are not only a waste of public and private sector resources, but create perverse incentives that can lead to further increases in effort (Holland, 2000b). The use of incentive-reducing tools is thus important. Keeping this in mind, it is important to note that the instruments of fisheries management are merely institutional mechanisms that have been developed or adopted by governments, and other authorities, in an attempt to influence the behaviour of those who use natural resources (Greiner *et al*, 2000). The evolution of these institutions are inextricably linked to the development of property rights (Pejovich, 2001). Property rights and the social and economic system within which they occur can thus eliminate the adverse incentives that create excess capacity (Holland, 2000b and Townsend, 1998). The development of rights-based systems is thus the next step in the development of effective management tools.

3.7 CONCLUSION

Excess capacity is a severe and costly problem that has led to both overfishing and reduction in the net benefits (through the dissipation of resource rents) derived from fishery resources (FAO, 2003). However it appears to merely be an underlying symptom that results from the failure of management systems (Holland, 2000b). The Gordon-Schaefer bioeconomic model, which essentially states that an open access resource will be overutilised, outlines this failure. Fishermen thus have a rational incentive to increase investment within a fishery as they attempt to extract additional rents from that resource (Gordon, 1954). If the resource is free for all to utilise, then due to its common-pool nature, fishermen have to catch as much as they can before others do so. This is because common-pool resources have a *subtractability* characteristic. The Gordon-Schaefer model states that both economic overfishing (effort greater than MEY) and biological overfishing (effort greater than MSY) will occur until bioeconomic equilibrium is reached. To help deal with this problem fisheries authorities have developed tools that can be used as control measures. However, for these measures to be successful a portfolio of controls is needed (Charles, 2001). This because individual measures can still suffer from adverse effects. This idea will be further extended in Chapter 4, as these measures are used to determine a use rights system.

CHAPTER 4

PROPERTY RIGHTS AND FISHERY SYSTEMS

4.1 INTRODUCTION

It is apparent from Chapter 3 that most fisheries are in a state of crisis. This is mainly due to problems of overcapitalisation resulting in excess capacity resulting in increased fishing effort over time. These issues (overcapitalisation and excess capacity) are however normally associated with the problem of *open access*. In fact Cunningham & Gréboval (2001) argue that the fundamental origin of excess capacity is due to the free or open nature of a resource. Van Santen (1996) states that fish, in an economic sense, are a free good. There are no nominal costs associated with their growth in the sea. When these fish are caught, they are transformed, through the production process, into resources that attain economic value. This value is reflected by consumer's willingness to pay for fish. According to Hannesson (1998), fishermen are therefore encouraged to increase capacity to harvest additional fish, but there is no appropriate incentive to manage the resource. The free nature of a resource is however defined by the property rights regime structure that it occurs in. According to Pejovich (2001a) as pressures on the environment increases, property right regimes change ultimately to protect the economic interests of fishers (and also to protect the environment).

The evolution of property rights regimes however depends on the structure of property rights introduced into different environments. Here property rights refer to "the socially sanctioned and protected entitlements of individuals and governments to use, to change the form and substance of, to benefit from, and to alienate ownership of these rights to assets, including natural resources" (Barzel, 1989 in Edwards, 2000: 3). If these property rights are not clearly defined and enforceable, *market failure* can occur. Poorly defined property rights can thus be seen as one of the main reasons for conflict within fisheries throughout the world (FAO, 2000a; Ward, 2000; Hara, 1999; Pearse, 1994; Tisdell & Roy, 1997; Hanna *et al*, 1996; Ostrom, 1990; Berkes, 1989 and Bromley & Cernea, 1989). This chapter thus explores the various forms of *rights* and *rights structures* that occur within a fishery system. These rights can either occur 'naturally' or can be introduced (Charles, 2001). Rights can also occur in various forms (also within the range of property regimes) and contain various characteristics. All of these factors have implications for the establishment of an effective fisheries management system.

4.2 PROPERTY RIGHTS REGIMES

4.2.1 Introduction

The concept of property rights, within natural resource systems, is made useful by identifying the various regimes or institutional frameworks within which they fall. The objective is to find an adequate means of defining property for sustainable resource use, especially in terms of their application to fishery resources. In specifying these various contexts, focus will primarily be on the definitions instituted by Bromley & Cernea (1989) in their discussion document *The Management of Common Property Natural Resources: Some conceptual and operational fallacies*. For most purposes Bromley & Cernea (1989:11) state that it is sufficient to consider four possible property regimes. These are open access *(res nullius)*, private property, state property *(res publica)*, and common property *(res communes)*. Berkes (1989), Ostrom (1990) and Tisdell & Roy (1997) agreed with these and also stated that reality can sometimes consist of a mixture of these idealised types. Bromley & Cernea (1989:5) describe a resource regime as "a structure of rights and duties characterising the relationship of individuals to one another with respect to that particular resource." This can refer to the relationship between individuals and/or a group and/or a corporate entity.

4.2.2 Open Access

An open access situation will occur when there is no property (Davidse *et al*, 1999), therefore meaning that no property rights exist in such a scenario. Pearse (1994:11) gives an example of open access when making reference to the high seas (the ocean space outside a nation's jurisdiction). He states that because no property exists, that neither individuals nor governments have any claims. Anyone can thus exploit these resources. The fish thus belong only to those who take possession of them by catching them. If property and the management arrangements that go along with them are not defined, then the "institutional vacuum of open access ensures that use rates will eventually deplete the asset," (Bromley & Cernea, 1989:20). This is exactly the type of situation that can result, as described by Gordon (1954) in Chapter 3, if a fishery is totally unregulated – fishing effort moves beyond MSY. A *pure open access* regime can result from the breakdown of the authority systems in other property regimes as will be described later. Institutional failure will thus lead to an open access regime.

Homans & Wilen (1997), however, also make reference to a *regulated open access* situation. This will occur if the output of a fishery (e.g. catch) is regulated, but the inputs (e.g. the fleet) are not. Homans & Wilen (1997:1) state that most of the world's important fisheries probably operate under these conditions. In such a case, the fish stocks may not necessarily collapse (as described by Clark, 1990), but fishing fleets may overcapitalise as they are driven by the *race-for-fish.* In both a regulated and pure open access regime some form of entry limitation will thus be beneficial.

4.2.3 State Property

According to Bromley & Cernea (1989:11), in the state property regime, ownership and control over the use of the resource rests in the hands of the State. Individuals are allowed to use the resource however this is governed by the State. Hara (1999) agrees with this when he states that ownership is held by the state on behalf of its citizens, but government exclusively holds the rights until access rules and levels of exploitation are determined.

The need to regulate and manage marine resources, due to their overexploitation, lead to the emergence of *Economic Exclusive Zones* (EEZs) during the 1970s and 1980s (IDGEC, 2000). These gave states sovereign rights over natural resources located in a zone stretching 200 nautical miles (320 kilometres) seawards, as measured from their coastal baselines. This effectively brought more than a third of the world's oceans (IDGEC, 2000), formally within an open access regime, under the jurisdiction of coastal states, thus causing an institutional change into a state property regime. The logic of converting away from an open access regime into a state property regime is that this institutional context allows the government to determine the rules, regulations, distribution and restrictions on the use of these natural assets (Bromley & Cernea, 1989:11). The state can thus directly control the resource through government institutions or lease the right to such a resource out for a specified time period. The members who receive these rights do not have ownership of the resource, but merely use of it.

4.2.4 Private Property

"Private property is the legally and socially sanctioned ability to exclude others", (Bromley & Cernea, 1989:12). Private property thus has an exclusionary aspect. With the help of the state's power, an excess population can be excluded from a resource and effectively resist unwanted intrusions. This thus means that private property regimes appear stable and adaptive because they have social and legal endorsement. A distinction can also be made between private property held by individuals and that held by corporate entities or corporations. In both cases economic and legal rights must be such that the good in question displays private good characteristics of rival consumption and excludability (Cullis & Jones, 1992:60-63). It is only when these two characteristics exist that private property right regimes will be efficient, that is, all costs and benefits will be internalised. However because most fisheries exhibit the characteristic of non-excludability (due to their common-pool nature), exclusive use rights need to be set up and enforced by the state. This thus means that a monopoly right to the use of the resource will exist (Mather, 2004). In this case there is essentially a single owner in the fishery and effort should revert to MEY.

4.2.5 Common Property

The use of the term 'common property' is a very controversial one. The term was first used by Gordon (1954). In so doing he provided the principles for the development of subsequent theories in renewable resources. Gordon (1954) argued that if left unregulated, resources held in common would be overexploited. Hardin (1968) however also made use of the term in his paper entitled *The Tragedy of the Commons*. Hardin envisioned a situation in which too many users placed too much livestock to graze on *common* (communal) land eventually leading to its depletion. Hardin's (1968:162) sentiments can be encapsulated by the following statement: "Ruin is the destination toward which all men rush, each pursing his own best interest in a society that believes in freedom of the commons".

Since Hardin's (1968) use of the term was popularised in the journal *Science*, it is continually viewed as being the same as an open access situation that has come to symbolise the degradation of the environment expected whenever many individuals use a scarce resource in common (Ostrom, 1990). Jensen (2000b) and Pearse (1994) see this as a 'common property' problem. The rationale behind this concept implies that if people act in a self-interested manner when harvesting shared natural resources, then the inevitable outcome results in the depletion of the resource.

Bromley & Cernea (1989:7) however contend that Hardin's use of the term in his metaphor was socially simplistic and historically false. They further argue that among the property regimes, common property carried a false affliction of resource degradation that should be attributed to open access, which means the resource is not owned by anyone. McCay (1996) agrees with this and contends that the confusion resulted from the semantic use of the term. Development communities realised that in order to be successful in stopping the degradation of natural resources that the very nature of property and their authority systems had to be redefined to prevent the current misunderstanding.

A common property regime is thus not the free-for-all of open access. A common property regime in effect represents private property for a group (others being excluded from its use). This means that a user group and their rights to use a resource is limited and defined (Holland, 2000a). However, the individuals of the group have rights and obligations in situations of common property. As Davidse *et al* (1999:538) put it, "there are balances to be maintained between the group... [among the group members], as well as in terms of individual behaviour in using and maintaining the resource". According to Jensen (2000b), this is because of the inherent *subtractability* characteristic present in the use of the resource (i.e. the use of the resource by any one user detracts from the welfare of others).

The difference between a private property regime and a common property regime is not to be found in nature of the rights and obligations so much, but rather in the number to which inclusion and exclusion applies (Bromley & Cernea, 1989). Common property and private property therefore both have the characteristic of exclusion of non-owners. A private property regime is however usually seen as being more efficient than a common property regime (Scott, 1955 and Hannesson, 1998). This is because even in a well-organised common property regime there is still a need for consensus among "co-owners". Exclusion of potential users can thus be challenging, as it has to be dealt with by the definable group (Charles, 2001)[1]. This form of interaction needed to reach consensus thus incurs transactions costs (Demsetz, 1964). Bromley & Cernea (1989:15) contend that these costs may not be seen as tedious to everyone as members of a common property resource group have a common interest coupled with a certain amount of interaction between members.

4.2.6 Property Regime Transformers

Institutional arrangements can be used to transform a property regime from one form to another (Mather, 2004). In a fishery these property regime transformers are used as tools to reduce the costs of stock failure (i.e. the fishery collapsing due to overexploitation). Open access regimes were transformed into state property regimes through the use of EEZs as an international institutional arrangement[2]. A state property regime can further more be transformed into a common property regime or private property regime depending on the number of users (Holland, 2000a). Within these regimes, however, property is not ownership of a physical object, but rather a right to a stream of benefits that materialises once those with a duty respect the conditions that protect such a stream (e.g. the government or users).

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[1] Hannesson (1998) argues that as the number of agents ("co-owners") increase, effective solutions become less and less likely. Apart from greater transactions costs, the larger the number of participants, the greater the potential for a build-up in fishing effort. According to economic intuition, a rational and effective management system occurs with fewer vessels, less infrastructure, and lower total costs.

[2] According to Holland & Ginter (2000), although fisheries within an EEZ is state property, they are often *de facto* open access and *de jure* common property to the citizens of the state until access rights or regulations are imposed. Jensen (2000b) thus refers to these resources as "common-pool" resources due to the nature of their characteristics, as outlined in Chapter 2.

Bromley & Cernea (1989) argue that essential to any property regime is the authority structure that will ensure that the rights holders expectations are met (this is especially true for a private property regime, where the state and its coercive power ensure that there is no intrusion from non-owners). When this authority system breaks down in a common property or private property regime, then, for all practical purposes, it degenerates into an open access system. The resource is then subject to external threats. Bromley & Cernea (1989:18) outlines at least one other situation, within common property regimes, that could lead to such a breakdown. This relates to the fact that if there is a deterioration in compliance by co-owners (e.g. if the resource in question fluctuates seasonally then overuse may occur due to a lack of monitoring and compliance). According to Charles (2001), the formal or informal institutions that determine the rates of use thus do not function properly (or common property systems have not developed strong institutions to conserve resources to ensure sustainability).

Finally the rule-of-capture ensures that resources are transformed from the other property regimes to that of private property. That is when fish are captured, and provided that the individual has the right to harvest them, they are converted from a resource under a common property regime or state property regime or an open access regime into the realm of a private property regime (Mather, 2004 and Charles, 2001). Private property does however not mean that individuals have ownership of a resource. Individuals merely have *use rights* to a resource (Charles, 2001:288). This means that a right is merely being allocated, whether limited in time or granted in perpetuity, to harvest part of a yield of a fishery. In other words fishers may hold the right to potentially catch an amount of fish. As Bromley & Cernea (1989) emphasize, these rights can only be defined once the party with an interest has a protected right and the other has a duty. "Thus property rights give entitlements with regard to resource use and rules under which those entitlements hold" (Hara, 1999:4).

Various types of rights thus exist under various property regimes – with the regime acting as an institutional context that specifies the structure of rights and duties characterising the relationship of individuals to each other and/or a group. These different types of rights and the rules that specify them will be discussed in section 4.3. It is however important to note that as institutional structures are transformed from an open access situation to one of state property to common property to private property greater limitations are placed on access to, and use of, a resource – rights thus become more exclusive.

4.2.7 Conclusion

It can thus be seen that four broad property rights regimes exist. However, it is important to point out that property rights regimes, especially with regard to natural resource systems comprise of a "spectrum from open access to private property" (Hanna *et al*, 1996:4). This continuum is characterised by the structure of rights and duties that an individual or user group is entitled to within the different property regime types. However within an open access regime no duties exist. This situation will thus result in the overutilisation of an unregulated fishery (Gordon, 1954). The growing realisation thus is that part of the remedy to the fisheries problem is in designing appropriate access rights to manage fisheries. This will avert the common cause of 'too many fishers continually taking too many fish'. These rights can exist in any of the other property rights regimes, namely state property, common property and private property.

4.3 PROPERTY RIGHTS SYSTEMS

4.3.1 Introduction

Open access or unregulated fisheries are a major threat to sustainable marine resource use. The solution therefore seems to lie in limiting access through the allocation of use rights. The idea of use rights is by no means new. They have existed in various forms; in part defining property or quasi-property rights. In the context of fisheries, use rights determine who can gain access to a fishery and how much fishing activity can take place (Charles, 2000). The distribution and allocation of use rights is however established by collective-choice rights. It is thus important to explore the various types of rights that can exist, and see how these can be used in a response to better management fishery systems through the design of rights-based systems.

4.3.2 Types of Property Rights

Before identifying the various types rights that are present, it is important to distinguish between rights and rules. This is because the terms *rights* and *rules* are often used interchangeably with reference to their uses in natural resources. Rights, according to Ostrom (1990), refer to particular actions that are authorised. Rights define the uses that are legitimately viewed as exclusive and the duties or penalties for violating those rights (Pejovich, 2001a). Rules, however, define how rights are exercised. They are the "generally agree-upon and enforced prescriptions that require, forbid or permit specific actions for more than one individual" (Schlager & Ostrom, 1992:250). Thus for every right that an individual holds, rules exist that authorise particular actions in exercising that right. For example, a right provides the authority for a fisher to operate in a specific fishing ground. How the fisher exercises that right is however specified by the rules, which may stipulate the type of fishing gear to be used.

Referring to section 4.2, it is clear that an open access regime, by default, lacks effective rules for defining rights (Ostrom, 2002). This is because the rules that govern such a right are not enforceable – the resource is not contained within a state property regime or no individual has successfully laid claim to legitimate ownership. An open-access situation can hence also result from the ineffective exclusion of non-owners by the individual assigned formal rights of ownership. To possess a right implies that other individuals have a commensurate duty to observe that right (Schlager & Ostrom, 1992). And it is the rules that specify both these rights and duties. Rules are therefore important as they can create different incentives among users within various institutional frameworks.

Having outlined the differences between rights and rules, a distinction can now be made between the different types of rights that can exist. These types differentiate between "rights to control, regulate, supervise, ... and allocate property on the one hand, and rights to use and exploit economically property rights on the other" (Von Benda-Beckman, 1995: 314 in Charles, 2001). The latter group refer to *use rights* (Charles, 2000) or *operational-level* rights (Schlager & Ostrom, 1992). The former group refers to *collective-choice* rights, which allow authorities to devise operational-level rights (Schlager & Ostrom, 1992).

Although there is considerable diversity within use rights systems, they can generally be placed into two categories. According to Charles (2000:1) these are *access rights* and *withdrawal rights*. Access rights authorise entry into a fishery, or a specific fishing ground. Withdrawal rights involve the right to engage in a specific level of fishing effort or to take a specific catch. Withdrawal rights can thus be seen as rights to harvest a given stock. Each of these categories can occur at various organisational levels, i.e. rights held by individuals, by communities or regions. There are also various operational forms of use rights. These will however be discussed in more detail in section 4.3.3 below.

4.3.3 Forms of Use (Operational-level) Rights

According to Charles (2002) whenever a fishery is managed by restricting access, either to determine how much fishing activity (fishing effort) individual participants are allowed, or to determine how much catch each can take, those who receive such entitlements are said to hold use rights. Such use rights have been assigned by a relevant management authority (whether formal or informal), which holds collective-choice rights. Management measures can thus be seen as a (negative) restriction or a (positive) use right, with fisherman acquiring certain entitlements with restrictions (Pomeroy, 2002). Use rights are usually established to answer two questions (Charles, 2000:1): "*who can go fishing?*" and "*how much fishing can take place?*" The first question is answered through allocating an access right, and the second question through a withdrawal right.

Well-defined use rights are significant because they give clarity by providing some security over access to fishing areas, use of an allowable set of inputs, or harvest of a quantity of fish. If use rights are well established, fishers know who can or cannot access the fishery resource, how much fishing each is allowed to do, and how long these rights are applicable. The more complete the set of rights, the less exposed the fishers are to the actions of others, the less risks that the fishermen face, and the more stable are expectations concerning catch and management (Pomeroy, 2002). This therefore provides fishermen with an incentive for longer-term sustainability and thus a motivation to maximise economic benefits.

Although use rights occur in two categories, various operational forms of these rights exist as fisheries management tools. When the form of use right is based on restricting access, two common forms exist. Firstly, access can be limited through entry licenses (which have been discussed in Ch3, section 3.4.2). Secondly, rights can be allocated to engage in fishing in a certain geographical location; these are known as territorial use rights in fishing (TURFs). On the other hand, withdrawal rights can be in the form of an input right (effort control) or harvest right (output control). These are often expressed as a TAE or TAC set at either MSY or MEY. Both of these have been briefly discussed in Chapter 3 as fisheries management measures. Having identified the categories and forms of use rights, a framework can now illustrated.

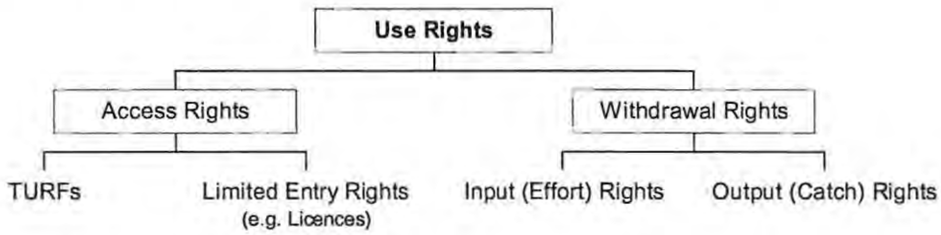

Figure 4.1: A Framework of Fishery Use Rights
Source: Charles (2000:2)

Figure 4.1 above shows the various forms of use rights that can exist. As can be seen, these can be expressed in terms of restrictions, where the primary choice is between an access restriction and a withdrawal restriction. According to Mather (2004), the form of rights developed by Charles (2000) is very useful, but does not take into account the fact that an access right can be limited by a withdrawal right and vice versa. In fact Mather (2004) goes so far as to say that experience in most of the world's fisheries follows the sequence of primary access rights later limited by withdrawal restrictions. For example, if an access right is granted in the form of a limited entry licence, but is subject to input controls (e.g. vessel size limits), then the withdrawal right, in terms of harvesting a fishing stock, acts as a further limiting restriction.

Although there are exceptions, generally the following results will hold true. Licences without withdrawal restrictions (rights over the allocation of fishing effort or allowable catch) give rise to capital stuffing as the incentive to race-for-fish still exists. Similarly, TAE forms without access restrictions give rise to these problems through input substitution. Another problem with individual input rights is the tendency of fishers to adjust for improvements in technology, thus improving fishing efficiency. All of these cases have been discussed in Chapter 3, section 3.4.

Mather (2004) goes on to define four levels of restrictions [expanding on the definitions instituted by Charles (2000) and Scott (2000a)] that can occur within a use rights framework. Within this framework, or decision tree as Mather (2004) terms it, the first two choices (1° and 2°) are identical to Charles' (2000) and the second two (3° and 4°) are in accordance with Scott's (2000a) observation. These can thus be illustrated in Figure 4.2 below.

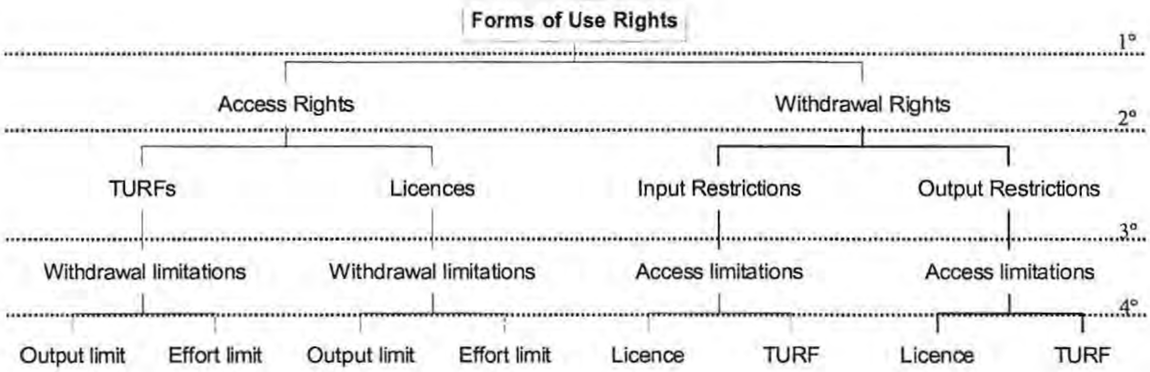

Figure 4.2: Decision Tree representing the Forms of Use Rights and their Limitations
Source: Mather (2004:121)

Figure 4.2 presents the form of rights (1° and 2°) with limitations (3° and 4°). According to Mather (2004) the first and second level can be either in the form of primary access rights instituted by imposing second level licences or TURFs, or through a primary withdrawal right with either output or input (effort) restrictions as a second level limitations. However four equivalencies are possible. For example, primary access rights in the form of a licence but limited by an output restriction is equivalent to a primary withdrawal right in the form of an output restriction but limited using licences. The other three (Mather, 2004:121) are: i) licences with input restrictions and effort restrictions with licences, ii) TURFs with output restrictions and an output restriction with TURFs, and iii) TURFs with input restrictions and effort restrictions with TURFs. These various forms can thus be used to regulate a fishery and enable the allocation of fishing rights. The most effective form will depend on the characteristics within a given fishery. For example, a fishery that has a large amount of variability will not be effectively managed through output limitations.

4.3.4 Collective-Choice Rights

Collective-choice rights can be divided into three categories. These consist of the following (Schlager & Ostrom, 1992:251): *management* rights, *exclusion* rights, and *alienation* rights. Management rights authorise stakeholders to participate in fishery management and governance. Exclusion rights allow the authority to determine who will access a fishery and the amount they can withdraw. Exclusion rights thus allocate use rights. Alienation rights authorise the transfer or sale of the other collective-choice rights. Both users and non-users can hold collective-choice rights, which is in contrast to use rights that are held only by fishers.

Collective-choice rights determine who will receive use rights and how these use rights will be structured at an operational level. They are thus part of the bundle of rights that fishery stakeholders can have. According to Charles (2001:283) the comprehensiveness of a given rights bundle depends on the extent to which a holder holds the five types of rights, namely access, withdrawal, management, exclusion and alienation. As mentioned, these five property rights are part of a bundle of rights, but can also occur independently of each other. As mentioned in section 4.3.2, it is possible to have access rights that are independent of withdrawal rights. The same holds for collective-choice rights (Schlager & Ostrom, 1992).

It is possible to have management rights without exclusion rights, and exclusion rights without alienation rights. In these cases individuals, or collectives, do not hold the full set of rights defined above. In fact in most fisheries worldwide, the fishers only hold use rights (access and withdrawal), which they can sometimes transfer. Fishers do not directly participate in making the collective-choice rules that devise their own operational-level participation. Management rights are probably the most functional collective-choice right, as they allow participation in operational level decision making. They also lie at the heart of co-management initiatives. Co-management systems have become increasingly popular within many fisheries management arrangements due to what many (Pinkerton, 2002; Charles, 2000; Abdullah *et al*, 1998; Feeny *et al*, 1996; and Nielsen, 1996) see as a response to the failure of top-down fishery management. Pinkerton (2002) argues that a co-management approach is the only way to mobilise enough resources to ensure an effective management system. A co-management system can however incur high transactions costs, which means that it is not always the most efficient approach (Abdullah *et al*, 1998).

An exclusion right is a collective-choice right that is also very important with regards to participation within a fishery. Holders of exclusive rights are mandated to allocate use rights that allow for participation. This can have important ramifications for the distribution of access rights within a fishery. Where equity considerations play an important part in fisheries policy, such as is the case in South Africa, holders of exclusion rights should account for political, social and economic circumstances. Lastly, alienation rights have important implications for the characteristic of ownership. According to Schlager & Ostrom (1992), an individual is not an owner unless he has the right to sell off all or part of his rights. In most case however, the state holds collective-choice rights and thus decides who will hold operational level use rights to access and harvest a fishery. In this sense the state thus 'owns' the resource and therefore has alienation rights.

4.3.5 Conclusion

Property rights can thus be used to manage natural resources. These rights are however informed by the rules that define how they will be exercised. Two broad categories of rights exist (Schlager & Ostrom, 1992); these are operational-level or use rights and collective-choice rights. Collective-choice rights are important as they determine the structure of fishery use rights system. However, at an operational level, which is where most fishers operate, use rights play a crucial role. It is thus important to outline how these rights can be effectively structured to meet the needs of a given fishery. This means that the characteristics that determine a "complete", for use of a better word, rights system need to be outlined. In this regard Scott (2000a), Arnason (2000) and Anderson (2000) provide some useful insights.

4.4 CHARACTERISTICS OF OPERATIONAL LEVEL RIGHTS

4.4.1 Introduction

Ward (2000:4) argues that if clearly defined and enforceable property rights for fish do not exist, due to what he refers to as a common property externality, the efficiency of the market becomes impaired (there is market failure)[3]. If this thinking is applied to fishery management then ill-defined rights can potentially lead to the collapse of the resource stock (Anderson, 2000). In this section, the structural characteristics or operational rules that define user rights are discussed. Scott (2000a: 5) lists five important characteristics of secure use rights; these are *exclusivity*, *duration* (of term), *security of title* and *transferability* (tradability). Arnason (2000:19-24) uses these characteristics to develop a quality measure of property rights, which he applies to the Icelandic, New Zealand and Norwegian fisheries. In addition to Scott's characteristics, Anderson (2000:28-29) adds the attribute of *eligibility of ownership* as well as two transferability options.

4.4.2 Eligibility of Ownership

Anderson (2000:28) poses the question "should any legal entity be allowed to own [a] right or should ownership be limited ... to specific groups or persons?" By defining an access right, authorities automatically designate a right to an individual or group.

[3] If property rights for fish existed, then owners of fish stocks could receive a higher unit price per unit of fish from the producer as the stock of fish declines. As prices rise, so do the costs to the producer. The producer will therefore move his capital and labour into other markets, where greater profits are available. This will continue until each market is equal. This means that as the abundance of fish stocks decline, fishermen produce less fish due to higher production costs, and inputs of production are moved to other markets where they receive greater returns. Market efficiency will thus be maintained.

Referring back to section 4.3.2 (see Figure 4.2), it can be seen that any form of use right that restricts access, either as a primary form or a secondary limitation, defines particular groups that may participate in the fishery (Mather, 2004). This right is defined through the collective-choice right of exclusion. And as mentioned, in countries where fisheries management policy has to account for equity concerns, authorises with exclusion rights need to be mindful of these considerations. Anderson (2000) suggests that restrictions on eligibility are sometimes necessary, but this can limit the flexibility of a rights-based management system.

4.4.3 Exclusivity and Security

Closely linked to Anderson's (2000) *eligibility of ownership* attribute, is the characteristic of exclusivity, as outlined by Scott (2000a). This characteristic refers to the ability of a property rights-holder to use and manage a resource without outside interference (Scott, 2000a:5). Most kinds of property rights have some exclusivity, but none are completely exclusive (Scott, 2000a and Arnason, 2000). A low level of exclusivity forces a fisherman, even with a licence, to compete with other fishermen for a share of the catch. In addition to the characteristic of exclusivity, security of title also plays an important role. Security refers to the ability of an owner to withstand challenges and maintain his property right (Arnason, 2000:19). This characteristic is valued because it saves the rights-holder from incurring the costs of protecting and enforcing his rights. Most current fisheries legislation arrangements, through the use of the courts, ensure the characteristic of security. A low level of security can also lead to a low level of exclusivity.

4.4.4 Term of Duration

The duration of term stipulates the length of time that a fishing right can be held by an individual. Arnason (2000) refers to this characteristic as permanence. If a right is awarded for a longer period of time, this gives some degree of assurance that the right will not be reallocated to someone else. The duration of a right is thus positively related to the security of a right (Mather, 2004). The longer the term for which a right is awarded the greater the possibility that fishers will use a resource in a more sustainable manner. This is because the right-holder is able to realise the pay-off of investments made in earlier years. If the duration of a right is short, and it is not necessarily renewable, then a right-holder is encouraged to exert more fishing effort to gain more profitable catches during that period (Scott, 2000a).

Another issue related to the duration of term, and linked to security, is the fact that fishing vessels (and fishing equipment) are specific assets that are co-specialised[4] with fishing rights. Individuals using fishing vessels can thus only earn rents when they have fishing rights that allow then to access a fishery. Thus with shorter-term rights, there is low security, and hence capital reinvestment in fishing vessels (and fishing equipment) might be slower than with longer-term rights.

4.4.5 Transferability

The final characteristic discussed is that of transferability. This refers to the ability of rights-holders to transfer the property right to someone else (Arnason, 2000). The characteristic of transferability is economically important, because it allows for the optimal allocation of a valuable resource. It allows the right-holder to make the best use of his time and capital while at the same time greatly increasing the flexibility of a rights-based system. The argument goes that if certain vessel owners do the most financially with their property right, then they can buy up rights from others thus the most efficient vessel owners remain in the fishery. Anderson (2000:28) however highlights the fact that making rights transferable may not always be appropriate because it allows for the possibility that certain individuals will be "obtaining wealth from a public resource". And if markets are subject to monopolistic tendencies there could be an accumulation of resource rents by certain individuals. He thus argues that if rights are transferable, then limitations on the types of trades are justified in some circumstances.

[4] A specific asset is an asset that is most valuable in one specific setting or relationship. When two specific assets are co-specialised, then they are most productive when used together. They thus lose most of their value if they are used independently (Milgrom & Roberts, 1992).

An important feature of transferability is that of *divisibility* (Scott, 2000a). This is the ability to subdivide a property right into smaller parts for the purposes of sale or transfer. According to Mather (2004), tradable fishing rights must be capable of divisibility if these are distributed in large asset sizes[5]. However, if rights are awarded in economically non-viable asset sizes, then the divisible units must be capable of consolidation. This will ensure economic and thus allocative efficiency but will not ensure distributional equity (Mather, 2004:125).

Also linked to the transferability characteristic is the issue of inheritable rights. Anderson (2000:25) highlights the fact that rights can be fully transferable by sale, lease or inheritance. The argument for the inheritability of property rights is often linked to the legal nature of ownership (Scott, 2000a). Ownership of most marine resources however rests in the hands of the state. Unless an individual has collective-choice alienation rights, the issue of inheritable property rights does not seem to hold. For this to happen there needs to be a transfer of resources from the public to private individuals. This might be efficiency enhancing but does not ensure an equitable distribution of resources.

4.4.6 Conclusion

Property rights within fisheries exist as a continuum in terms of their characteristics (Shotton, 2000). These characteristics provide a basis for designing effective use rights systems within fisheries. The strongest systems will be those in which the characteristics are least constrained (Scott, 2000a; Arnason, 2000 and Shotton, 2000). These characteristics, however, have implications for both economic efficiency and distributional equity within fisheries systems. In terms of these two concepts, a tradeoff usually exists, so efficiency may be sacrificed for equity purposes and vice versa.

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[5] A minimum asset unit can be defined as "...the smallest physical amount of the asset to which it is practicable to apply property rights, i.e., for which it is practicable to enforce exclusivity of use" (Dales, 1968:797 in Mather, 2004:125).

4.5 IMPLEMENTING OF PROPERTY RIGHTS SYSTEMS: SOME ISSUES TO CONSIDER

The preceding discussions have highlighted the assortment of property rights that can exist and the various types of characteristics that these rights can possess. This section deals with the fundamental issue of putting a use rights system into place. Edwards (2000) argues that a clear understanding is needed of how property rights assignments affect the way people manage and use the environment. However, because fisheries differ with regards to their circumstances, it is unlikely that any single use rights approach will produce optimal results. It is thus preferable to pursue a portfolio of rights – that is a combination that is most acceptable for a given context, that helps the fishery operate best, and to maximise benefits (Charles, 2000). To this end it is important to understand the structure and underlying nature of the fishery. For example, what are the relevant social, cultural or economic circumstances facing a fishery. These issues will be dealt with in more detail in Chapter 5 and 6 when discussing the South African squid fishery. For now though it is important to outline the underlying policy options within the design of a use rights system.

The task of implementing a use right system is made easier if there are clear policy directions laid out in advance, since such policies will provide guidance in terms of which fishery stakeholders are to receive priority in obtaining use rights. In South Africa, for example, the movement from a period of apartheid into one of democracy means that broadening the right to access is a matter of urgency (Cochrane & Payne, 1998). This highlights just one of the policy issues that can arise concerning the allocation and governance of the rights. Another key issue within the debate concerns the mechanisms by which the holding of rights is itself managed. This depends on the management institutional arrangement within which a fishery operates. These arrangements account for the social and economic incentives, and their interconnections, that can exist in the allocation and management of property rights systems (Pejovich, 2001a) [6]. After all, as McCay (1996:60) states, "we often forget, ...,

[6] This line of thought can be traced back to Gordon (1954) who argued that rent dissipation and overutilisation will occur in fishing grounds that are not exclusive (see Chapter 3).

that human beings do not exercise their rationality in a vacuum: that they do so within the context of institutions."

Three broad institutional orders exist (Edwards, 1994 and Hersoug & Holm, 2000): the state, the market and the community or co-operative. Traditionally fisheries management has been centred in the state arrangement. This has been characterised by "top-down centralist" fisheries management "interventions through spiralling regulations" (Lane & Stephenson, 2000:385). The state model corresponds to a centralised and bureaucratic style of management. According to Lane & Stephenson (2000) the performance of this management style has not been considered successful. Edwards (1994) also states that *government failure*[7] in fisheries can result from rent-seeking activities and/or the principle-agent problem[8]. The principle-agent problem is especially prevalent in situations with high transactions costs, e.g. a heterogeneous group of fishermen (Johnson & Libecap, 1982). Government can nevertheless affect the wealth of society by assigning property rights (through collect-choice rights) and should therefore have a supporting role in all decision-making processes.

A market-based approach uses market forces, with fishery participation and the allocation of catch and effort determined through the buying and selling of rights. The reliance on market forces has become a popular approach among many governments and international financial institutions, as it can be implemented relatively easily (Charles, 2001). According to economic theory this approach is more efficient as more-efficient stakeholders buy out less-efficient ones[9]. The implication is that if agents are freely allowed to trade rights, these will end up in the hands of those who value them the most, i.e. those who are most efficient at using them (Guyader & Thěbaud, 2001). Market-based measures, like ITQs (individual transferable quotas)[10], have thus gained increased support in many countries as they attempt to redress the

[7] Government failure or non-market failure refers to the inability of government stakeholders to produce, regulate, manage or monitor the production of goods and services efficiently (Edwards, 1994:257).

[8] The principle agent problem occurs when interests differ among principles (i.e. owners) and the agents for owners, who are only interested in personal gain (Milgrom & Roberts, 1992).

[9] However, in situations of inequality (e.g. in terms of income), individuals with greater access to financial capital can also buy out individuals that are worse off.

[10] The adoption if ITQs has led to the so-called "privatisation" of rights-based fishing, as they are able to generate efficiencies in resource use.

inefficiencies of state centred models (Hersoug & Holm, 2000). This approach nevertheless seems to have the same advantages and disadvantages of an open market mechanism. For example it may be a more cost-effective institutional structure, better able to deal with transactions costs (Coase, 1937 in Abdullah, Kuperan & Pomeroy, 1998), and increase the flexibility of operations, but it fails to achieve distributional equity without some form of intervention.

The third institutional arrangement is co-operative management, or better known as co-management (McCay, 1996). Fisheries co-management is defined as the arrangement where responsibility, for resource management, is shared by government and the relevant user groups (Hauk & Sowman, 2001 and Nielsen, 1996). By ensuring greater participation in regulatory decisions, greater legitimacy is brought to the process, which in turn enhances compliance (Jentoft *et al*, 1998). This type of management is thus a "bottom-up" approach and is more decentralised as responsibilities are delegated to user-groups (Jentoft *et al*, 1998:423). However, the devolution of authority away from fisheries administrators can be a difficult task. Firstly, administrators may be reluctant to relinquish power (Nielsen, 1996). Secondly, if user-groups do not have the capabilities to undertake greater responsibilities, fisheries management can be jeopardised. From an economic perspective, greater transactions cost can thus prevail as the number of decision-makers increases (Abdullah *et al*, 1998)[11].

The final issue affecting the development of a rights-based management system is that of distributional equity. Any form of access control, or alteration of an existing access control regime, entails a specific distribution of benefits advantaging some participants over others (Guyader & Thĕbaud, 2001:104). This can result in conflicts that can be a major obstacle to effective fisheries management. Thus regardless of what institutional arrangement a right-based system is operating in, it is widely accepted that distributional issues have a strong potential to affect management, especially when trying to resolve overcapitalisation problem as well (Guyader & Thĕbaud, 2001). At the national level, the distributional issues could theoretically be solved through the

[11] Abdullah, Kuperan & Pomeroy (1998:4-5) outline three major cost items: (i) information costs; (ii) collective fisheries decision-making costs; and (iii) collective operational costs.

intervention of a central authority, acting as the sole owner of resources placed under its sovereignty and/or jurisdiction. However, a lack of consultation with the relevant stakeholders to lead to further conflict in the implementation of any rights-based management system. In this regard it is likely that a co-management model is more useful as it emphasises distributional equity through the legitimacy of users. The issue however rests on who holds collective-choice rights.

4.6 CONCLUSION

A well-defined and appropriate system of use rights in a fishery produces many essential benefits, most importantly ensuring that fishing effort is proportionate with the productivity of the resource. This thus provides fishers and fishing communities with longer-term security that enables and encourages them to view the fishery resources as an asset to be conserved and treated responsibly (FAO, 2003). The type and allocation of these rights however is subject to much debate. Scott (2000a) argues that for a rights system to be effective, a 'complete' set of rights needs to exist. The structure of these rights depends on the characteristics that they possess. These characteristics can be altered to achieve various policy objectives, be that social, economic or political. The institutional environment within which these rights are allocated is also important, as this can affect the efficiency of a system. A state-centred, top-down approach is seen to be bureaucratic and inefficient. A market-based approach can achieve efficiency, but does not cater for distributional equity. A community or co-management system seems to be more effective with distributional issues, but can suffer from high transactions costs (Abdullah *et al*, 1998). These issues should thus be taken into consideration when dealing with the management and allocation of rights within the South African commercial jig fishery.

CHAPTER 5

THE SOUTH AFRICAN COMMERCIAL SQUID FISHERY: INSTITUTIONAL ORGANISATION AND EVOLUTION

5.1 INTRODUCTION

The purpose of this chapter is to place the South African fishing industry, and in particular the South African chokka squid fishery, into an institutional[1] and organisational framework. The South African fishing industry has undergone a typical process of evolution witnessed in most common-pool resources. That is, it has developed from an open access resource to one that is regulated through formal and informal institutions (Pejovich, 2001a and Ostrom, 1990). These institutions thus define rules of use and exchange with regards to resources. The more stable and credible these institutions become, the more benefits accrue to members of society. Before the formalisation of EEZs in the 1977, ocean resources along the coast of South Africa were essentially open access. After 1977 these resources fell under the jurisdiction of the South African government, converting an open access resource into a state property regime. This thus initiated a process of regulation, at varying degrees, within all of South Africa's fisheries.

The South Africa squid industry, however, due to its late development (commercialisation in 1983), was only affected by more formal regulations in the mid-1980s. In the late 1970s and early 1980s, this resource was a *de facto* open access resource, which resulted in increased fishing effort during its initial development (Augustyn, 1986). As the squid fishery developed it was increasingly affected by various government regulations that evolved to deal with increased fishing activities in the South African fishing industry. These regulations were the result of various

[1] Institutions can either be formal or informal, and their role is to enhance "cooperation and coordination among interacting individuals" (Pejovich, 2001a:xv). These institutions can thus be equated to rules, or bundles of rights, that govern interactions in society. Examples of informal rules include traditions, customs, moral values and religious beliefs. Formal institutions include constitutions, statues, common law and other government regulations. (Pejovich, 2001a).

commissions (i.e. the Diemont Commission) and laws (i.e. the Sea Fisheries Act of 1988 and the Marine Living Resources Act of 1998) that were formed to deal with sustainable marine resource use. This chapter discusses how these various institutional mechanisms helped to regulate and develop the squid industry into the mature fishery that it currently is. It also looks at how changes in society (i.e. the event of democracy in 1994) eventually led to changing management objectives for all of South Africa fisheries, especially with regards to issues of equitable redistribution. This effectively determined South Africa's "transformation" policies within the fishing industry.

5.2 INDUSTRY BACKGROUND

5.2.1 Introduction

Although there is evidence that the living marine resources of South Africa have been exploited for many centuries, larger scale commercial fishing only started at the turn of the 20^{th} century (RSA, 1997). Thereafter, effort escalated rapidly. The increase in fishing effort was largely due to increased demand, in the search for food, brought about during the Second World War (Payne & Crawford, 1989). This effort continued to increase, the net result being an increase in total landings from 71 000 tons to 422 480 tons between 1938 and 1958 (Stuttaford, 1995: 20). Due to advances in technology and increases in the exploitation of different types of species, commercial catch continued to increase throughout the 1960s and 1970s (however slowing considerably in the 1970s as more formal regulations were put in place).

5.2.2 The South African Fishing Industry: Pre 1977

South Africa has a coastline of some 3 000 km, extending from the border with Nambia in the west, to Mozambique in the east. The oceanographic situation of the coastline is such that it provides an ideal habitat for various living marine resources. The western coastal shelf is especially highly productive. This is due to the upwelling of the cold, nutrient-rich Benguela current thus making it comparable with other upwelling ecosystems around the world. The temperate, relatively shallow shelf (about a 100m deep) of the Agulhas bank also provides a good breeding area for many species of fish. The Agulhas current along the east coast is considerably less productive but has high species diversity, including both common and IndoPacific species (Paul, 2000b).

The South African coastline thus provides a good breeding ground for a variety of species, chokka squid being among these. The squid fishery however only gained commercial importance after 1983. Prior to this, all squid catches where trawled, mainly as by-catch of the popular hake and sole fisheries (Sauer, 1992). During the 1970s most of this by-catch was sold as bait. At this time a large number of squid catches were made by vessels from foreign fishing fleets. These consisted mainly of Japanese fishers, trying to meet the increasing demand for squid back home (Roel, 1998).

Although the squid fishery had not gained much importance prior to 1983, other South African fisheries had been in existence since the 1930s. At that stage commercial catch was dominated by the demersal (or trawl) fishery and the pelagic (or purse seine) fishery, and this trend has remained throughout the development of the South African fishing industry. According to Saville (1997), collectively these two fisheries accounted for roughly 90% of the reported annual catch up until 1996. As mentioned in Chapter 2, both these fisheries are TAC managed, as opposed to TAE managed (like the squid fishery). Of the two fisheries mentioned, the demersal fishery is the most valuable in terms of income generated, bringing in over R500 million per year (Paul, 2000b). The pelagic fishery however is the largest fishery in terms of volume landed. From 1958 landings increased from 194 000 tons to peak at 410 000 tons in 1962 (Mather *et al*, 2003b:151).

Catch in both the demersal and pelagic fisheries thus increased dramatically until the 1970s. In the demersal fishery, catches (by both South African and foreign vessels) peaked at over 300 000 tons (Mather *et al*, 2003b: 143), while those in pelagic were well over 400 000 tons. The dramatic increases in catches were mainly due to the fact that fishing activities in South Africa were unregulated. The resource for all purposes was thus an open access resource as described in Chapter 4 section 4.2. Until 1974 no individual limits existed for any companies exploiting these species. This inevitably resulted in the overutilisation of these species. This is exactly the outcome described by Gordon (1954) in Chapter 3. The pelagic fishery eventually collapsed by the late 1960s when catch fell from 410 000 tons in 1962 to 100 000 tons by 1967 (Mather *et al*, 2003b:151-152).

5.2.3 Legislative History: Pre 1977

The legislative history of the South African fishing industry deals with the development of laws and rules that have been put in place by the State, and various other stakeholders, to aid in the conservation and management of South Africa's living marine resources. The conservation of living marine resources in South Africa dates back to 1895 when the government of Cape Colony appointed a biologist to undertake fish surveys. This process was however terminated at the start of the Anglo-Boer war in 1899. Only to be resumed part time between 1918 and 1928 (Paul, 2000b).

Although most oceans were separated into "territorial waters" since the 17th century, resulting in the control of a narrow band of ocean by coastal states, it was not until 1930 that this was internationally recognised (Pearse, 1994). Most resources during this period were thus open access resources. During 1930, the Hague Conference resulted in the creation of a three nautical mile territorial waters zone for coastal states. This gave the fisheries authority the right to essentially manage small-scale fisheries and to exclude foreign vessels from exploiting these resources. Before South Africa gained its independence from Britain in 1934, the only fishing authority that had been established was the Sea Fisheries Research Institute (SFRI). In 1929, the Department of Mines and Industry created a Division of Sea Fisheries and the SFRI became its advisory body and remained so until 1998 (Mather, 2004).

After South Africa's independence from Britain, the first seemingly comprehensive legislation put into place, to protect marine resources, was the Sea Fisheries Act of 1940 (RSA, 1986a). Paul (2000b) however contends that although the act later established five marine reserves (that were very limited in area and scope), it was aimed more at the marketing aspect of sea fisheries than conservation. In 1944 the Fishing Industry Development Act was passed thus leading to the establishment of the

Fishing Development Corporation of South Africa Limited (Van Sittert, 2002). The objective of this Act was to promote and develop fishing through the provision of credit to individual fishermen. According to Van Sittert (2002:296) the 1940s reforms became the foundation on which the modern fishing industry was built, facilitating and financing the rise of the white monopolies, whose exclusive access later reforms (during the mid-1990s) would seek to redistribute.

In 1954, with the National Party in power, the Sea Fisheries Advisory Council (SFAC) became the new advisory body with regards to marine resource management. The SFRI still however provided biological and conversation advice (Mather, 2004). At the same time international debate around fisheries management and policy escalated. During the post-World War period, coastal states began to extend their jurisdiction over the ocean. The aim was to reduce outside pressure on marine resources and thus to secure more for themselves. These actions provided the momentum for the first and second United Nations Convention on the Law of the Sea (UNCLOS) conferences, held in 1958 and 1960 respectively (Kullenburg, 1999). These culminated in the extension of coastal territorial waters to 12 nautical miles from the shore. The National Party Government, in response to these proceedings, passed the Territorial Waters Act of 1963, which defined their territorial waters as 12 nautical miles from shore but also making provision for a 200 nautical mile fishing zone to protect larger vessels. The legitimacy of the South African government's 200 nautical mile fishing zone was however ignored by foreign fleets until 1977 (Mather, 2004).

The UNCLOS conferences in 1958 and 1960 did little to resolve the problem of creating a governance system for managing the ocean's resources (IDGEC, 2000). This led to UNCLOS III, starting in 1973. Consensus soon emerged that coastal states should be given "sovereign rights" over all natural resources located in a zone stretching 200 nautical miles (about 320 kilometers) seawards (Kullenburg, 1999). As mentioned in Chapter 4, these areas were called 'Economic Exclusive Zones' (EEZs), and they essentially converted a formally open access resource into a common property resource managed by the State. Coastal states now had the final say with regards to how resources were utilised within their EEZ. They also had jurisdiction over scientific activities and authority to devise laws to protect their marine environment. However, state authority within an EEZ is not unlimited; they still have a duty to ensure that the marine resources, within their EEZ, are not exploited to the point of extinction. When South Africa's EEZ was finally recognised in 1977, a year after the United States of America declared their EEZ, the reduced influence of foreign fleets led to a dramatic recovery of the hake and sardine stock in their waters (Paul, 2000b).

The above discussion shows that through the development of institutions, property rights regimes are converted away from open access to protect the environment and ultimately the long-term economic interests of fishers. This is exactly the argument raised in Chapter 4 and will be used to show how the South Africa chokka squid fishery, through a process of institutional evolution, has undergone a typical economic and institutional change of a common pool resource, as described by Pejovich (2001a). This also demonstrates how property use rights eventually evolved to aid in the management of the resource. These issues will be discussed in more detail in Chapter 6.

5.2.4 Development of the South African Commercial Squid Fishery

As mentioned earlier, during the 1970s squid was almost exclusively exploited by foreign fleets, of which the majority were trawlers from the Far East. Local fishermen only displayed significant interest in squid in the early 1980s. This led to the formation of the commercial squid fishery in 1983 (Augustyn, 1986), which until the 1990s was the only major commercial cephalopod fishery of importance in South Africa. The main squid species targeted was *Loligo vulgaris reynaudii*, whose distribution is mainly along the Agulhas Bank[2] and West Cost shelf of South Africa (Augustyn, 1989). Large concentrations of spawning squid occur in certain inshore areas along the southeast cost in such places as Plettenberg Bay, Jeffery's Bay, St Francis Bay and Algoa Bay (see Figure 5.1 below).

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[2] The Agulhas Bank extends from Cape Agulhas to East London, along the southeastern coast of South Africa (see Figure 5.1).

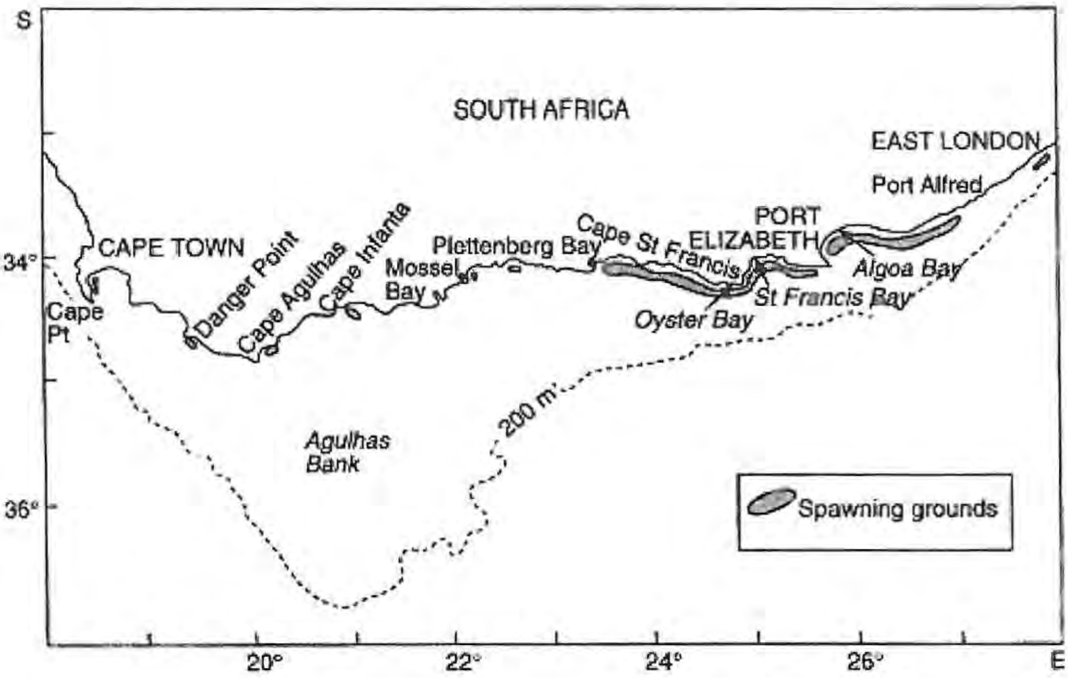

Figure 5.1: The main Fishing Areas associated with the Inshore Spawning Grounds of *Loligo vulgaris reynaudii* along the South African southeastern Coast

Source: Melo & Sauer (1999:308)

Interest, by local fishermen, in the commercial exploitation of squid was aroused in the early 1980s when calamari became a popular delicacy in Europe (Sauer, 1992). It was soon recognised that squid caught in South Africa was of high quality and thus opportunities for export became available. This fact, along with increased market prices internationally, highlighted the true value of the resource. Later, with the decline of the Rand in the mid 1980's, export opportunities became more lucrative (Augustyn, 1984). For example, in 1989 the wholesale value of jigged squid reached a record R108 million compared to R8 million for trawled squid in the late 1970's (Augustyn 1989).

With the squid fisheries becoming more profitable, more South African companies began to make requests, to government, for permission to fish squid commercially. At this stage very little was known about chokka squid, biologically or otherwise, and thus no formal fishing regulations existed (RSA, 1986a). The government therefore initiated research into the resource and used experimental licences for trawling, purse seine netting and mechanical jigging (Roberts, 2000). Squid was initially jigged using hand lines and Japanese squid jigs, but as the industry progressed so did the assortment of jig types[3] (Sauer, 1992). Between 1980 and 1982, in a joint inter-government venture, the Far Sea Fisheries Research Laboratory Japan Fishery Agency, performed biomass surveys on the south coast of South Africa. These surveys estimated the squid biomass to be between 35 000 to 40 000 tons in summer, decreasing to about 20 000 tons in winter (Augustyn, 1986). These figures were however subject to changes over time due to the huge resource fluctuations present in most squid species (Rodhouse, 2001). At this stage government stopped the trawl method, but still no real regulations existed. The squid fishery thus remained a *de facto* open access resource.

After the initial commercialisation of the squid industry, the years 1984-1986 saw a dramatic increase in effort. This period was described by some as the "gold rush" phase (Sauer, 1992 & Roberts, 2000). The escalation in effort was due to an increased awareness of the value of the resource and improvements in technology. A large number of vessels ranging from ski-boats to trawlers descended on the southeastern Cape to jig for squid[4]. This resulted in the frenzied exploitation of the resource, with many fishers converging on the coastline between Jeffrey's Bay and Oyster Bay to exploit the "white gold" (Schön, 2000:5). According to Roberts (2000) these vessels came from as far as Natal and even Namibia. This resulted in conflict between many of the participants, especially the local fishermen who felt that the resource should accrue mostly to them.

The influx of fishermen into areas that were predominantly used by holidaying families was also a major problem, especially with regard to inadequate housing for the fishing crews and the degradation of the local sea and land. Residents feared that property prices would fall with the development of a major fishery. This would adversely affect what was viewed as a tourist haven. Roberts (2000) states that many small operators from the region thus joined together to form associations like the South

[3] By 1983 the most viable method of catching chokka squid was using Japanese squid jigs, but many local jig varieties soon appeared on the market (Sauer, 1995a).
[4] For example in 1985, it was witnessed that in a small area between Cape St Francis and Port Elizabeth some 400 fishermen were in action (RSA, 1986a:56).

Cape Commercial Line Fishing Association (SCCLFA) and the St Francis Bay Squid Catchers Association. These organisations stressed that the increased effort, caused by the influx of outsiders, could not be sustained. They called for government to intervene and to introduce some form of regulation to protect the resource.

The increased effort witnessed during the years 1983 –1986 was largely due to the unregulated or open access nature of the resource. Although the resource fell within the EEZ of South Africa, making it a common property resource to the citizens of the State, and with no regulations in place it was *de facto* open access. And as mentioned open access resources usually suffer from overutilisation as fishing capacity increases. There is thus a need to move the resource away from an open access regime through some form of regulation. This was indeed the case with the South African commercial squid fishery.

5.2.5 Conclusion

It is evident that the South Africa fishing industry in general, and the squid fishery in particular, have both witnessed increased levels of effort within open access regimes. Most commercial fisheries worldwide witnessed a similar trend during the 1960s and 1970s. This eventually led to the formation of EEZs in an effort, internationally, to reduce fishing effort and bring about some form of control. Although EEZs did have limited success (IGDEC, 2000), they did not go far enough to resolve the problem. This is a fact observed both worldwide (Hannesson, 1998 and Gréboval, 2000) and within South Africa.

5.3 THE DIEMONT COMMISSION

5.3.1 Introduction

On the 7 June 1985, the Diemont Commission was tasked to inquire into and make recommendations on the allocation of quotas for the exploitation of living marine resources (RSA, 1986a). This meant that the Commission had to look into the management and institutional structures of all of South Africa's fisheries. The body was tasked to inquire about various issues, ranging from a quota allocation system (effectively a use rights systems), to ownership and participation issues. Those most pertinent to the squid industry are however highlighted.

5.3.2 The Diemont Commission of Inquiry: Overview

With the development of fisheries laws and regulations through the mid-1970s and with the adoption of the Law of the Sea Convention in 1982, international law recognised the need for exclusive control over coastal resources. EEZs gave coastal states, South Africa being among these, the sovereign right to explore, exploit, conserve, and manage the natural resources within their area. All foreign vessels within an EEZ were subject to the laws of the respective coastal states and it is that State's responsibility to maintain a sustainable yield and utilisation of their living marine resources.

Although the declaration formalising the EEZ, for South Africa, did aid in the recovery of the hake and sardine stocks, it did not nearly go far enough. This is because the creation of EEZs did not solve all problems related to ocean governance. For instance, although coastal states had *de jure* control in their EEZs, they still had to monitor their boundaries, which was a difficult and expensive undertaking. Many states did not have the domestic resources needed to manage their marine resources effectively (IDGEC, 2000), which led to monitoring and compliance problems. EZZs can thus be seen as a necessary but insufficient step towards the efficient management and sustainable utilitisation of fisheries (FAO, 2000). The effectiveness of EEZs are thus subject to much debate, however, the South African government clearly saw them as a necessary but inadequate step towards regulation.

In the period before 1982, the Minister responsible[5] granted quotas set as a means of regulating catch within the demersal and pelagic fisheries. This converted these fisheries from pure open access resources into regulated open access resources

[5] For the previous 30 years Sea Fisheries resided under the Ministries of Economic Affairs, Industries, Agriculture, and since 1983 under the Ministry of Environmental Affairs (and from the 1980s in alliance with the Department of Tourism, but in earlier years in alliance with other departments).

(Homans & Wilen, 1997). The quotas were set acting on the advice of officials stationed mainly in Pretoria. These officials were not solely dedicated to fisheries matters and dealt with problems on an *ad hoc* basis. This obvious inadequacy led to severe criticism of management authorities by successive commissions of enquiry, notably Du Plessis in 1971 and Treurnicht in 1980 (RSA, 1997). In 1982 the control post in Cape Town was upgraded to Chief Director and the local establishment was henceforth regarded as a component of the head office in Pretoria. On the 7 June 1985, the State President tasked the Diemont Commission with the duty to inquire into and to make recommendations concerning the exploitation of living marine resources within South Africa (RSA, 1986b). It was the duty of the Diemont Commission to provide fundamental guidelines for the effective management of these resources.

During 1986 the Diemont Commission gave considerable thought to many different matters. However, the issues that are perceived as being most pertinent, are those dealing with ownership and control, the right of participation, the type of right granted and the distribution of these rights. The first issue dealt with by the Commission related to the ownership and control of living marine resources. Regarding the ownership of the resource, it was established that according to Roman Dutch Law the sea is classified as *res extra commercium* (RSA, 1986a:1). This means that it cannot be subject to ownership. The sea and its resources are common to all inhabitants (i.e. it is *de facto* open access). Nonetheless, the formation of EEZs gave the State custodianship of all marine resources within their zone[6]. The State thus has a duty to control and regulate the exploitation of the resource "for the benefit of all people" (RSA, 1986a:3). According to the Commission the most widely accepted way of protecting the resource is through the imposition of a system of quotas and access rights (RSA, 1986a:2-3).

The second major issue of concern is whether participation should be based on past performance; should the fishery be closed to new participants or not? In this regard the

[6] On the high seas beyond the 200 mile zone the Republic can only exercise control over its own fishing boats and fishermen. Although a Code of Conduct was tabled at the 27th session of the FAO Conference in 1993, regarding international management measures on the high seas, this Code is to be applied on a voluntary basis and is not as yet binding (Garcia, Cochrane, Van Santen & Christy, 1999).

Commission seemed unclear (they seem to be both for and against). Issues of equity, capital investment and experience all played a role. The process of rights allocation therefore needed to be looked at in more detail. The Commission did however note that the annual task of distributing individual quotas places a heavy burden on the Minster subjecting him/her to political pressures, which are not strictly relevant to the advancement of the fishing industry. It was thus recommended that the task of distributing and redistributing quota shares should be taken out of the political arena (RSA, 1986a:4). It was also noted by the Commission that to grant initial participants exclusive rights, based on catch or processing performance, was flawed (RSA, 1986a:6).The plight of coastal communities dependent on the sea for their livelihood should be given an option to any increase in quota shares (RSA, 1986a:4).

The third issue that the Commission dealt with related to the type of right that should be allocated to participants wishing to engage in fishing activities. In this regard the Commission mainly focused on TAC measures that could be divided in individual quota shares (RSA, 1986a). The reason why the Commission predominantly focused on quota distribution system is because most of South Africa's major fisheries were managed by output controls at the time. Individual quota shares (along with vessel licences) thus represented use rights to participants in the fishing industry (Charles, 2000). The Diemont Commission also had a look at non-quota species, chokka squid being among these. With regards to squid, very little research existed on species, at the time the Commission was tasked. Fishers exploiting squid operated under a semi-commercial 'B' licence, but no real regulations existed (RSA, 1986a:56). The Commission thus recommended that further research be conducted and the imposition of a quota system may be justified (RSA, 1986a:56). Although expensive research has since been carried out in the squid fishery, the quota system never materialised.

In dealing with the allocation of rights (through individual quotas), the Commission also explored the term and tradability characteristics of these rights. The Commission opposed the practice of issuing rights on a year-by-year basis, and recommended that long-term rights be issued (RSA, 1986a:8). Their reasoning was that with large capital outlays, a long time was needed to recover the initial investment and secure a reasonable return to capital and this required a longer term than a single year. With regards to the tradability of rights, the Commission made the following recommendations (RSA, 1986a:9): i) a quota share must be held for a minimum period of three years before it can be traded, ii) a quota must be linked to a productive asset such as a fishing vessel or a processing factory, so that it does not become a paper quota, iii) the transferee must be a South African citizen, and iv) that person or legal persona, or otherwise, may accumulate no more than 30% of the TAC, and finally, v) the details of all allocations and transfers must be kept in a register. The transfer of rights (quotas) was thus subject to certain restrictions that attempted to prevent abuse of the characteristic.

The final pertinent issue that the Diemont Commission dealt with relates to the distribution of rights. This refers to paragraph (3)(h) of RSA (1986:ii), which deals with "the degree to which the different population groups ... should be allowed as entrepreneurs in the Industry." The Commission felt that there are "no bars against any population group [from] becoming entrepreneurs." However it was quite clear that most of the quota shares (withdrawal rights) where in the hands of majority white-owned corporations. It was felt that corporations should be allowed to prosper, so that they can be efficiently managed and provide the public with fish at reasonable prices (RSA, 1986a:84). This resulted in a monopsonistic market, where fishers (predominantly non-white) had to sell they catch at lower prices to large corporations. The Commission thus recommended an increased proportion of the TAC for the community and larger asset sizes for the fishers – a recommendation rejected by the Government (RSA, 1986b:26).

5.3.3 Intervention and Regulation

By the mid-1980s the number of participants fishing for squid had increased dramatically. This prompted calls, by the local fishing associations, to the Minister of Environmental Affairs for increased regulation. This occurred around the same time that the Diemont Commission was making recommendations about the management and regulation of the South African fishing industry in general. With regards to the squid fishery, the Commission felt that there was insufficient research within the industry and thus any measures introduced should be precautionary (RSA, 1986a). The primary goal was to ensure the protection of the resource from overexploitation, and secondly to protect the interests of the local fishing communities and residents. The Department of Environmental Affairs took the initiative, at the end of 1986, to promote orderly development around the resource (Sauer, 1992). Initial regulations imposed were aimed at protecting the interests of the 'small man' and were to ensure that big companies did not dominate the fishery. This was in line with the recommendations of the Diemont Commission.

The first control measures introduced included a closed season of six weeks from December to January, which were imposed during the peak squid spawning period. According to Sauer (1995a) these regulations did not apply to boats registered in the Agulhas Bank area. Trawlers that caught squid as by-catch were also not affected. This selective squid catching period effectively stopped many of the large vessels, from outside areas, from fishing for six weeks, but allowed local boats to continue their operations (Roel & Maharaj, 1999). This inevitably caused friction between the local and 'foreign' participants in the industry.

Soon after the initial regulations were put in place a squid licensing system was introduced. The allocation of licences was on the basis of historical performance up to 1985. In terms of the Diemont Commission, an Interim Quota Board (IQB) was appointed to oversee the allocation procedure in January 1987 (Augustyn *et al*, 1992). This control measure reduced the number of vessels participating in the squid fishery. After the allocation process was closed, a 3-year moratorium was placed on the sale and transfer of licences, and no person or company was allowed to monopolise more than 10% of the industry (Roberts, 2000). By early 1987, the industry had thus begun to enter into a stabilising phase. Most of the participants interested in short-term returns had now left the industry. However, total effort in the fishery still increased as smaller boat licence-holders merged to purchase larger deck boats (which could fish greater quantities and for longer periods). Roberts (2000) states that the estimated stock of squid had decreased from about 36 000 tons in 1981 to 11 500 tons in 1987, with by-catch in the trawl industry steadily decreasing. In 1988 the government voiced concern about the resource and the effort levels.

5.3.4 Conclusion

The main role of the Diemont Commission was to make recommendations about the allocation of quotas for South Africa' TAC fisheries. It did however play a useful role in initiating further research in the squid industry, which ultimately led to the imposition of regulations within the fishery. It also raised some very important issues relating to the rights allocation process in South Africa's fishing industry in general. These issues include the removal of political interference in the rights allocation process, the 'right of participation', which resulted in the removal of foreigners from the squid fishery, and the distribution of rights which largely limited the role of big companies in the industry (RSA, 1986a). Further recommendations also played a part, i.e. through the formation of the Interim Quota Board, which led to the development of a squid licensing system in 1987.

5.4 THE SEA FISHERIES ACT OF 1988

Based on the recommendations of the Diemont Commission, the Sea Fisheries Act of 1988 was introduced. The Sea Fisheries Act (12 of 1988) represented a marked change from previous legislation. Its main purpose was to provide for the conservation of the marine ecosystem. This entailed the orderly exploitation, utilisation, and protection of resources within the EEZ (Paul, 2000b). The managerial aspect of the act was a new and important feature of national policy for marine resources. It incorporated such ideals as sustainability through conservation and regulatory measures. According to Paul (2000b) the Act granted power of fisheries management (e.g., the determining of the optimal tonnage for each species, granting licenses for vessels and factories, specifying regulations for fishing gear, and establishing marine reserves) to the Minister of Environmental Affairs. The Act also led to the establishment, as recommended by the Diemont Commission, of a Sea Fisheries Advisory Committee (SFAC) that could advise the Minister when dealing with marine resource matters. The SFAC was assisted by the SFRI, which remained independent, and which was comprised of scientists and research officers from the various sectors of the industry. The most significant provision of the Act was the creation of a Quota Board whose primary function was the granting of rights for marine resource exploitation.

Although the Quota Board was only fully implemented in July 1990, an Interim Quota Board was in existence since 1987. It is this Board that handled the development of a squid licensing system. The Minister appointed and determined the number of members on the Board and the quorum[7], just as is the case with the SFAC. The Board's two main functions are: i) to recommend guidelines for the determination of quota shares, ii) to allocate quota shares within these guidelines (Mather, 2004). The Board may attach conditions to its quota allocations and no quota may be transferred without the Board's approval. The Board currently exerts control over access rights in all of South Africa's fisheries.

Within the squid industry, the Sea Fisheries Act of 1988, through the provision the SFAC, led to the establishment of industry representative bodies. The first body introduced was the South Cape Commercial Line Fishing Association (SCCLFA). The SCCLFA suggested to government that a squid management sub-committee liase between fishermen and SFAC to oversee renewal of squid licences. This can probably to seen as one of the first steps towards co-management initiatives in the chokka squid industry. By the end of 1988 SCCLFA was transformed into a new representative body known as the South African Squid and Line Industrial Association (SASLIA). This association's aim was to improve communication between all stakeholders. By 1990, SASLIA was again transformed into SASMIA (South African Squid Management and Industrial Association). This organisation consists of factory owners, vessel owners, fishermen and scientists and its objectives are to represent the squid industry as an industrial body that can make recommendations about the resource's management. SASMIA has since contributed a great deal to the management of the squid fishery and continues to do so. This has thus fostered a relationship of co-management within the industry.

[7] The chairman of the Board must meet certain requirements, mostly notably that of a legal background, and must have no interests in the fishing industry. The Act also stipulates that "a person in the employment of the State" may not serve on the Board (RSA, 1997). The appointment of politicians would also be contrary to the aims of the Board, which was "to remove quota allocation from the political arena" (RSA, 1986a:4).

To further limit any increase effort it became mandatory for all squid vessels to display their licence type in 1989. The moratorium on sales and transfer of licences also remained in place. However, in 1990, the licensing system was restructured to cater for the creation of system of permit control (this system will be discussed in more detail in Chapter 6). Permits stipulated the number of fishermen that were allowed to be on each vessel. It was thought that by limiting the number for fishermen on a vessel, authorities could thus regulate effort. This strategy was for the most part successful into the mid-1990s.

5.5 POLITICAL CHANGE AND THE FISHERIES POLICY DEVELOPMENT COMMITTEE

In April 1994 democratic elections were held for the first time in South Africa. This marked the end of white minority rule and the beginning of a new democratic dispensation. This meant that all laws and policies would now be under review to grant greater access, to economic resources, to all peoples of South Africa. In fact all sectors of society were to undergo a process of restructuring and redistribution where necessary (Hauk & Sowman, 2001). The South African fishing industry was no different in this regard. Poor subsistence fishermen (mostly non-white), previously denied access to marine resources, now had to be considered. The then Minister of Environmental Affairs and Tourism, Dawie de Villiers, initiated the process of developing a national marine fisheries policy on 27 October 1994 (Cochrane & Payne, 1998) under the auspices of the Fisheries Policy Development Committee (FPDC).

One of the first problems encountered with the establishment of the FPDC was that of membership. Previously, government officials dealt with most decisions, concerning South Africa's living marine resources, in Cape Town. However, various stakeholders, including the other coastal provinces (Eastern Cape, KwaZulu Natal and Northern Cape), conservation organisations, the formal and informal fishing community and organised labour, felt that they also needed to be represented (Cochrane & Payne, 1998). The issue of representation was finally agreed upon in 1995, giving greater access to these various sectors. This achievement in itself had been a major shift of fisheries policy, as 'grassroots' inputs had never been a feature of previous fisheries management or policy (Cochrane & Payne, 1998:88).

Apart from the initial problem relating to the dissatisfaction with central or top-down control, the other important issue that surfaced was that of granting access to people who had been denied access to the resources they felt they had a legitimate claim to. This frame of thought was embodied in the new democratic Constitution that was being developed at the time. To aid the FPDC in the above process, a Fishing Policy Development Working Committee (FPDWC) and Technical Subcommittees were created (RSA, 1997). It was the task of these committees to coordinate and integrate inputs from the range of relevant interest groups, institutional structures and individuals.

Taking into account the issues mentioned above, the main objective of the FPDC was to develop a new fisheries policy with the participation of all the sectors of the fishing industry. The FPDC thus identified the need to develop a mechanism that would ensure a fair allocation of rights and grant greater access to resources. An initial measure would be to restructure or completely dissolve the Quota Board. The previous system, of the Quota Board, was heavily weighted in favour of the large-scale commercial enterprises, and created "a privileged elite who alone benefited from the resource" (Paul, 2000b:15). The Board, initially established to remove quota decisions from the political arena, was in fact viewed by many as a complete failure (Mather, 2004 and Paul, 2000b). A long-term proposal by the FPDC included creating a system that would enable fishermen to purchase valuable long-term rights (i.e., long-term assets that are transferable, inheritable, and divisible). These rights could be obtained through a competitive bidding process, designed to ensure transparency and fairness (RSA, 1997).

The squid industry was in no way immune to the tides of change within a post-apartheid society. The FPDC asked various stakeholders for their input on how marine resources should be managed. This culminated in a White Paper on Marine Policy in 1997. However, the first draft submitted to the Minister, by the FPDC, did not address the broad factors of how access rights should be restructured or allocated within the squid fishery (Roel, 1998). At the end of 1997, a Task Group, consisting of members of the Directorate of Sea Fisheries (later replaced by Marine and Coastal Management in 1998) and the squid industry, was created to address issues of redistribution and equitable access (SASMIA, 2001 and Roel, 1998). A proportion of licences was to be removed from existing licence holders and were to be reallocated to fishermen from disadvantaged backgrounds. However, this process was not very successful, as will be elaborated on in Chapter 7. The years 1994 to 1998 can thus be seen as years of redirection and gradually changing of rules for the fishing industry as a whole, and the squid industry alike.

5.6 THE MARINE LIVING RESOURCES ACT (MLRA) OF 1998

5.6.1 Introduction

The formation of the Marine Living Resources Act of 1998 is a process that took four years, from 1994-1998. The Act was largely based on work done by the FPDC, which firstly led to the development of a Green Paper in 1996 and then a White Paper in 1997. These largely formed the basis for the MLRA (of 1998). The Act represented a marked change from past policy in that it attempted to encompass of holistic view of the South African fishing. This included issues of sustainable resource use, and the all-important issue of equitable redistribution. The Act currently remains the central policy prescription for all policy objectives in the South African fishing industry in general and thus the squid industry specifically.

5.6.2 Development of the MLRA of 1998

The process of formulating the Marine Living Resources Act (of 1998) took four years (1994-1998). The activities of those four years included the development of the FPDC, the establishment of forums for stakeholders to exchange ideas, and the publishing of papers to address various issues facing the exploitation of South Africa's living marine resources. Such papers included a Green Paper in 1996, a White Paper on Marine Policy in 1997, and a White Paper on Biodiversity in 1997. All of these, however, encompassed the work done by the FPDC, which provided the framework for the establishment of the Act through a bill introduced in March of 1998 (RSA, 1998).

All of this finally culminated in the Marine Living Resources Act of 1998. This Act was a significant departure from past legislation because it recognised that fisheries restructuring and management needed a comprehensive approach. The Act can basically be summarised in the following statement (RSA, 1998:2):

> To provide for the conservation of the marine ecosystem, the long-term sustainable utilisation of marine living resources and the orderly access to exploitation, utilisation and protection of certain marine living resources; and for these purposes to provide for the exercise of control over marine living resources in a fair and equitable manner to the benefit of all the citizens of South Africa; and to provide for matters connected therewith.

This statement reflects the three major objectives or cornerstones of the Act (RSA, 1998:section 2), which are the sustainable use of marine living resources (paragraphs a, b, c, e, f, g), stability and growth (paragraph d and h) and the need to "restructure the fishing industry to address historical imbalances and achieve equity within all branches of the fishing industry" (RSA, 1998: paragraph j).

With regards to the first objective, the responsibility of managing marine living resources ultimately rests with the Minister of Environmental Affairs and Tourism. The Minister determines the total allowable catch (TAC), the total applied effort (TAE), and the quota allocation to subsistence, recreational, commercial, and foreign sectors (RSA, 1998: section 14). And with regards to effort-controlled fisheries, the Minister determines who is given permits (e.g. for squid and linefish). It is also the Minister's duty to suspend any or all fishing activities if an emergency arises that may endanger the viability of stocks or species of marine living resources (RSA, 1998:section 16).

The Consultative Advisory Forum (CAF), an independent body composed of members from the various fishing sectors, was established to advise the Minister on matters regarding the management and development of fisheries. CAF effectively replaced the Sea Fisheries Advisory Committee and thus its duties are not fundamentally different.

Along with the establishment of CAF, in October 1998 the Sea Fisheries Chief Directorate was renamed Marine and Coastal Management (MCM)[8], a Chief Directorate of the Department of Environmental Affairs and Tourism (Stuttaford, 1999).

The second cornerstone of the MLRA deals with issue of growth and stability. The need for stability and growth can in part be related to the objective of achieving market stability. Market stability can be viewed both on the supply side (the fishing activities) and on the demand side (local and international markets). Although the supply side does depend on the variability of the resource, it also depends on the ability of fishers to catch fish (specifically the right of access and the ability to exploit the resource). The Act [RSA, 1998: section 18 (1)] states "no person shall undertake commercial fishing or ... operate a fish processing establishment unless a right to undertake or engage in such an activity ... has been granted to such a person by the Minister". The right of access, to a fishing ground, is specified in section 21(1) of the Act (RSA, 1998). However a quota (or harvest right) can only be activated through the issuing of a fishing vessel licence (RSA, 1998:section 13). Stability is supposed to be achieved through the market exchange of long-term quota shares, which are tradable and divisible (Mather, 2004).

The final cornerstone of the MRLA Act deals with issues of distributional equity. To help with this the Act (RSA, 1998: chapter 2 (part five)) created the Fisheries Transformation Council (FTC)[9], which was tasked with the function of restructuring the fishing industry to address historical inequities. The primary function of the Council is to "... facilitate fair and equitable access to ... rights" (RSA, 1998:section 30). The FTC is responsible for leasing rights to the "previously disadvantaged sectors of the industry and to small scale/medium sized enterprises" (RSA, 1998: section

[8] Marine and Coastal Management became the primary government authority responsible for the coastal zones in South Africa. In addition, the SFRI, along with non-fishing research and coastal management, was formally included into the structures of MCM. This meant that both management and research activities could now be co-ordinated through the same organisational structure. This organisational structure thus provides a framework that embraces the functions of management, research, control and enforcement, and development. All of these contribute to the sustainable utilisation of marine resources.
[9] The Fisheries Transformation Council's function is intended to only be temporary -- until previously disadvantaged companies and individuals are successfully able to compete.

31(2)). The Council is also responsible for deciding how much previously disadvantaged fishers must pay for their rights, taking into account their relative economic circumstances.

5.6.3 The Effect on the Squid Industry

With the development of the Marine Living Resources Act of 1998, the entire South African fishing industry began the process of restructuring in earnest. For the squid industry, the MLRA (Act 18 of 1998:section 8) meant that SASMIA was finally recognised as an industrial body in 1999. This formalised the co-management[10] structures within the fishery and thus allowed for greater participation by all stakeholders. Effective consultation with SASMIA however only initiated after the government failed at trying to go it only. This will be made evident when discussing the initial attempts at redistribution in Chapter 7.

Through this new institutional framework government recognised that redistribution can only be achieved by means of greater industry participation. This resulted in the formation of the South African Squid Fishing Task Group (SASFTG), which was tasked with the duty of compiling a 'rule book' defining management and access issues for the industry. The 'rule book' is a "binding agreement defining all aspects of the management of the fishery, including the process and procedure for allocating rights, transformation and means to achieve stability" (Mather *et al*, 2000:4). According to the SASFTG, policy reform in the squid fishery should focus on three concerns: achieving stability, viability and equitable "transformation[11]" (redistribution).

Stability relates to both the biological and economic concerns of the squid fishery. From a biological viewpoint, the resource needs to be managed on a basis that ensures

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[10] The type of co-management present in the commercial squid fishery still gave DEAT the majority of powers to manage the fishery; decisions were however made on a co-operative basis (Nielsen, 1996).

[11] "Transformation" within the context of fisheries, refers to the achievement of social and economic equity through the redistribution of fishing rights and the promotion of *historically disadvantaged individuals*. The objective is to have a normalised industry that reflects the demographics of the country and achieves equitable access to employment and income creation.

long-term sustainability. From an economic viewpoint, there is a need to reduce possible adverse effects on those directly and indirectly affected by changes in the management of the resource. This includes the reduction of business risk to the fluctuations of the resource (SASMIA, 2001). The concept of viability seems to refer specifically to the needs of business, ensuring that they are built on sound foundations in terms of assets, access to finance and the ability to be profitable (SASMIA, 2001:12). The last concern outlined by the SASFTG relates to 'transformation'. This is the granting of equitable access to groups that have previously been discriminated against under the apartheid regime. In economic terms this refers to redistribution, which according to the State should be achieved through the reallocation of access rights (RSA, 1998).

To aid in the equitable reallocation of rights, the Department of Environmental Affairs and Tourism decided to establish a Rights Verification Unit (DEAT, 2000). The RVU consisted of independently contracted individuals and companies, with the necessary experience and skills. In addition to the RVU, a Rights Allocation Unit (RAU) was also established. It is the job of the RVU, along with the CAF, to oversee the rights application process through the scanning of all applications, the creation of a comprehensive database and to further support the RAU. Within the squid industry the RAU dealt with the redistribution of access rights, the tenure of access rights and restitution (defined as an issue of internal redistribution and vessel ownership). All of these concerns were identified with the aim of achieving the objectives encompassed within the MLRA Act of 1998.

5.6.4 Conclusion

The MLRA of 1998 has become the foundation for all fisheries policies in South Africa to date. It has played, and continues to play, a vital role in this regard. The Act provided the guiding principles for redistribution issues within the squid industry. And through the formation of the Fisheries Transformation Council it has attempted to put those principles into practice. It also formalised co-management structures within the squid industry through its recognition of SASMIA. With regards to current redistribution issues, it has provided the institutional framework for the formation of various task groups and committees to aide in the 'transformation' process.

5.7 POST MLRA: 1998-2001

With the creation of the Rights Verification Unit and the Rights Allocation Unit in July 2001 (DEAT, 2003a), Marine and Coastal Management adopted a rights-based management system for the squid industry. Although this seemed to be a move in the right direction, the management system was ill defined and initial attempts at redistribution failed. According to Paul (2000b) the same elite circle of companies and individuals still dominated the industry. SASMIA (2001:6) also concluded that the years 1998 – 2000 were years of "turmoil and insecurity" largely caused by a "botched process of false restructuring". This process will however be elaborated on in Chapter 7.

At the beginning of the 1999/2000 fishing season the Minister sought to achieve a 20% redistribution of access rights and a 10% reduction in effort. However, rights that were allocated were not in viable units. This did not conform to the principle of "viability" as set out by the SASFTG and was one of the major problems associated with the initial restructuring process. The attempts at redistribution were also marked by conflict, lawsuits and discontent among almost most participants and stakeholders (Hersoug, 2002). The process had occurred without effective consultation or endorsement from SASMIA, the industry representative body.

In 2001, to further aid with the fishing rights allocation process within the squid industry, the Deputy Director-General[12] (DDG) of MCM, Mr Horst Kleinschmidt, established an Advisory Committee to assist with the assessment of applications by the Right Allocation Unit. The Advisory Committee consisted of legal and financial experts to ensure that applicants could not dispute futures allocations. This body, along with the Rights Verification and Rights Allocation Units, are currently still in place and their duties are centred around the rights allocation process for the 2002 to 2005

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[12] In terms of section 18 of the Marine Living Resources Act 18 of 1998, the Minister delegated his powers to the Deputy Director-General (RSA, 1998).

seasons. Their role in the redistribution process, specifically with regards to rights redistribution, will be dealt with further in Chapter 7.

5.8 CONCLUSION

The South African fishing industry, and the squid industry in particular, has undergone a process of institutional evolution. With the international recognition of EZZs in 1977, fisheries management authorities were able to impose more formalised regulations. However, initial management measures were largely through a central top-down approach based on advice from government scientists. This was the type of management approach adopted as the squid fishery developed through the 1980s. Various institutional structures gradually allowed for a change in the South Africa's fisheries management approach. The first major institutional arrangement that affected the squid was that of the Diemont Commission. This laid the policy groundwork for research and regulations within the industry.

As the squid industry developed it was further affected by the Sea Fisheries Act of 1988, which led to the creation of the Quota Board and thus a squid vessel licensing system and permit system. After 1994, a new political dispensation resulted in a change in policy objectives within South African society. These changes were also reflected in fishing industry, and culminated in the Marine Living Resources Act of 1998. This has become the foundation for all fisheries management objectives to date. Within the squid industry this brought about an era of redistribution and restructuring, through a reallocation of rights – a process that was supported by the creation of Rights Verification and Rights Allocation Unit (DEAT, 2001a).

CHAPTER 6

THE SOUTH AFRICAN COMMERCIAL SQUID FISHERY: STRUCTURE AND DYNAMICS

6.1 INTRODUCTION

This chapter attempts to structure the dynamics of the chokka squid fishery as based on historical and current trends. Firstly, the squid fleet dynamics are shown in order to establish how the change in vessel type could possibly affect the levels of catch and effort within the fishery. Next, focus is shifted to actual catch levels and effort levels. These levels thus highlight whether the current management measures within the fishery are in fact effective. These measures are based on effort limitation, through fisher permits, a closed season and gear restrictions. As Jackson (2002) will highlight, effort limitation seems to be the preferred method of regulation in most squid fisheries worldwide. This is because the resource is short-lived and subject to major fluctuations, a fact highlighted in Chapter 2. This obviously has seriously implications for the management of the resource. This fact is further constrained because of the redistribution policies that the South African government wants to pursue, an issue that will be dealt with in Chapter 7.

For now though, an attempt is made to underline the motivations behind Government's "transformation" policies. According to Hauk & Sowman (2001:174), the fisheries' sector is one example where the distribution of resources is heavily skewed in favour of White large-scale operators. An attempt is thus made to highlight the social and economic aspects of the fishery. These, along with data on the racial distribution, are then used to stress the need for redistribution within the squid fishery. In dealing with the social and economic aspects of the fishery extensive use is made of data collected for the *Economic and Sectoral Study (ESS)*.

6.2 BRIEF OVERVIEW

As mentioned in Chapter 5, the squid jigging industry started in 1983. Prior to this most squid catches resulted from trawling, largely by foreigners (Roel, 1998). From 1984, the industry developed quickly due to high demand and relatively good catches. The highest recorded catch was in 1989 when 9 800 tons was landed (Mather *et al*, 2003b). During that year the wholesale value of jigged squid reached a record R108 million (Augustyn 1989). In an attempt to regulate effort within the fishery, a closed season (currently imposed for four weeks) was introduced in 1988. This was soon followed by a licensing system, developed between 1986 and 1988, and a permit system introduced in 1990. The years 1989 – 1994 were years of consolidation and stability within the fishery.

In 1994, with the emergence of a democratic South Africa, a new Constitution was adopted. Through the Constitution and supporting legislation, the government aimed to promote equity to all areas of society. This was also reflected in the fishing industry as new policies were thus developed (as outlined in Chapter 5). These policies culminated in the development of the Marine Living Resources Act of 1998. By then, an average of 6000 tons of squid where caught per annum, generating foreign exchange of around R180 million and providing employment for about 2500 fishermen and 300 fish factory workers (SASMIA, 2001). The fishery thus provided an important livelihood for many individuals, but was still perceived to be controlled by one racial grouping (majority White-owned capital). Initial attempts to enforce an equitable redistribution in the industry however failed (Hersoug, 2002; SASMIA, 2001; Mather *et al*, 2000 and Paul, 2000b). The years 1998 – 2000 were thus marked by turmoil, insecurity and conflict.

From a resource management perspective, although the squid catches in the 1980's were relatively good; there was very little scientific information about the species. In fact, a direct biomass estimate of the South African squid resource had not been possible by 1999 (Roel & Maharaj, 1999). This situation, with regards to research, however changed in 1986, as research was encouraged based on the recommendations of the Diemont Commission. Although no direct estimate is possible, scientific research within the industry currently compares favourably with that elsewhere in the world

(Jackson, 2002 and Sauer *et al*, 2000). Research was initiated between 1980 and 1982, in a joint inter-government venture with the Japan Fishery Agency (Augustyn, 1986).

The need for research was largely fuelled by the concerns from initial participants about the status of the resource. This was especially pertinent during the "gold rush" phase of exploitation (Sauer, 1992), when effort increased dramatically and no real regulations existed within the industry. At that time, based on limited techniques, scientific indicators did show a gradual decline in the resource. However, this is very difficult to establish since the resource is subject to major fluctuations in catch that appear to result from varying environmental conditions (Schön, 2000). Recent studies (Roel & Butterworth, 2000) have however also stated that spawning biomass is falling and thus effort needs to be reduced.

Although reducing effort seems like a simple matter of reducing the number of individuals fishing, this is view is naïve. Firstly, the resource is subject to fluctuations making an accurate biomass estimate impossible. In addition to this the South Africa situation is further constrained by the need to 'transform' the industry in order to achieve equitable access for all members of society. This is further constrained by the possible adverse social and economic effects that prevail from failed redistribution attempts (or any restructuring for that matter). For any attempts, at reducing effort, to be successful an understanding of the structure and dynamics of the industry is needed.

6.3 SQUID FLEET STRUCTURE

The squid fishing fleet, like in most fisheries, is dynamic in its nature as gear on vessels can be changed, vessel conversions can occur and new vessels can enter the fishery (Roel, 1998). Data on vessels is however available from Marine and Coastal Management (formerly Sea Fisheries) as information about vessel length, date of construction and number of crew are a condition for registration. This information is available annually within the *Fishing Industry Handbook*, which was introduced in 1986.

In addition to this, further information can obtained from questionnaires complied to obtain more detailed information about squid activities. The first of these questionnaires was introduced in 1989 with the aim of gaining information about vessel specifications and other related data, such as crew and permits held. This was the first attempt, by authorities, to acquire a more comprehensive look at the squid fishery. A second questionnaire was thus issued for the 1995/1996 season with the aim of updating existing information because as technology changed, new vessels joined the fishery and some old ones were rebuilt. The process was again repeated for the 1999/2000 season. Whereas in the previous cases the information gathered was necessary to assess permit renewal for the following season, this questionnaire was needed to determine the current situation of the squid industry to aid with its restructuring. Based on the data obtained from these three sets of questionnaires, a distribution, based on vessel length can be determined.

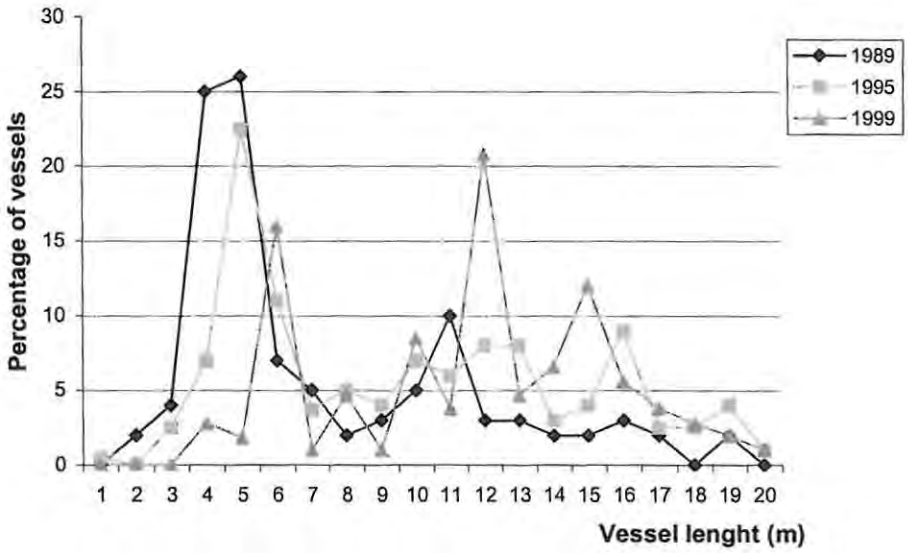

Figure 6.1: Trend distribution of Vessels according to Length for the years of 1989, 1995 and 1999

Source: Linefish database, MCM and Stuttaford (1995, 1999)

The distribution of vessels, by length, in Figure 6.1 is based on 72 responses from the 1989 squid questionnaires, 165 responses from 1995/1996 questionnaires and 106 responses from 1999/2000 questionnaires respectively. From Figure 6.1 it can be established that over a ten-year period the squid fleet has evolved to a situation where it is comprised of a greater percentage of larger vessels. This is one possible measure of an increase in capitalisation (in terms of a conventional definition of capital) and thus a potential increase in effort.

The higher number of smaller boats in 1989 can be due to the fact that by 1986 it was realised that large vessels were not suitable for squid fishing because they experienced difficulties with manoeuvrability and anchorage in fishing the concentrated inshore shoals of squid (Roel, 1998). Some of the large boats were thus converted to processing or freezer-type 'mother ships' (Roberts, 2000). These 'mother ships' (also known as factory boats) were used as storage vessels that freeze squid supplied by smaller boats. Many small, open deck ski boats thus surrounded these freezer vessels, jigging for squid. This meant that the small crafts could provide the freezer vessels with a constant supply of chokka, which significantly improved efficiency. However, as can be seen from Figure 6.1 there has been a gradual move from small ski boats to larger medium size vessels over time. The movement to more bigger freezer type vessels is largely due to market forces and improvements in technology. According to Roberts (2000), there has been increased pressure to produce a better quality product. This necessitated the installation of onboard blast freezers, only possible on larger vessels. Bigger vessels were also better equipped with advanced technologies like GPS, echo sounders and lights (Sauer, 1995a)[1].

The squid fleet is indeed dynamic. Changes in the structure of vessel types can be aided by ordering vessels into different categories. Boats can be classified into four basic categories according to vessel length and the number of crew allowed on each vessel. This classification of squid vessels can be seen in Table 6.1 below. The categories outlined are based on the classifications within the 'squid rule book', which was complied in conjunction with industry participants (DEAT, 2001b).

[1] According to Sauer (1995a), it was soon realised that chokka squid were attracted to lights aboard vessels. This meant that with more lights (open bulbs and spot lights), larger volumes of squid could be jigged at night.

Table 6.1: Classification of Squid Fishing Vessels according to Length and Crew

Vessel Category	Length	Number of Crew
Ski-boats	< 8m	± 7 fishers
Small vessels	8m to 13m	12 to 16 fishers
Medium vessels	>13m to 18m	14 to 20 fishers
Large vessels	>18m to 27m	18 to 30 fishers

Source: DEAT (2001b)

Table 6.1 thus classifies vessels into four basic categories. The first category consists of small ski-boats, which are non-freezer type vessels. The second category consists of small vessels that can either be deckboats, which use ice in the storage of catch, or small freezer type vessels. The last two categories consist of medium and large vessels respectively, the majority of which have freezing capabilities. Based on the categories highlighted, it would be useful to get an idea of the changes, in vessels, within each category. This is illustrated in Table 6.2 below (see Appendix I for mean data for the various categories).

Table 6.2: Percentage of Vessels within the various Categories (1993-2001)

	Fishing Season								
	1993	1994	1995	1996	1997	1998	1999	2000	2001
Ski-boats	40.2%	39.6%	38.6%	40.1%	36.8%	26.4%	25.2%	29.2%	24.8%
Small vessels	24.1%	24.7%	23.4%	21.3%	21.7%	24.3%	22.4%	25.1%	19.3%
Medium vessels	23.4%	23.3%	24.2%	26.0%	30.2%	34.0%	37.8%	32.9%	39.3%
Large vessels	12.2%	13.1%	12.8%	12.3%	11.2%	15.3%	14.7%	12.8%	16.6%

Source: Stuttaford (1993 - 2001)

Table 6.2 above shows the percentage of vessels within each category (based on the classification in Table 6.1). It is quite clear that the percentage of *ski-boats* has dramatically decreased over time. In fact between the 1993 season and the 2001 season, there has been a decrease 15.4-percentage points (subject to fluctuations over time) in these types of vessels. At the same time there has been an increase in *medium* and *large vessels*. Between 1993 and 2001, there has been an increase of 15.9 percentage points in medium vessel and an increase of 4.4 percentage points in large vessels. These figures thus support the views of Roberts (2000), Roel & Maharaj (1999) and Sauer (1995a), that bigger vessels can be better equipped with new technologies (such as blast freezers). The composition of *small vessels* has however not changed dramatically over time, as these boats are probably better at exploiting inshore concentrations of squid.

Vessel length and the number of crew are however not the only means of highlighting the change in fishing ability over time. Other measures such as the vessel's age, its gross registered tonnage (GRT) and the engine capacity of the vessel, measured in Kilowatts (Kwt), can also be used. Averaged values for these measures are shown in Table 6.3 below (see Appendix I).

Table 6.3: Characteristics of Fishing Fleet based on Averaged Values (1993 to 2002)

	Fishing Season									
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Average length	11	11	11	11	12	13	13	12	13	13
Average crew	12	12	12	13	13	14	15	15	16	16
Average age	19	13	13	13	11	12	12	14	14	15
Average GRT	40	42	43	46	44	45	48	44	48	47
Average Kwt	178	178	184	186	181	194	191	186	192	205

Source: Stuttaford (1993 - 2001), Spencer Jones (2002)

Most of the averaged values in Table 6.3 only show marginal increases over time. However, characteristics that are worth mentioning are the GRT and engine power (Kwt) of the fleet. Both of these displayed substantial changes over time. This is possibly an indication of the fact that larger vessels have been introduced into the fishery. These should be highlighted through a marked increase in fishing effort (as vessels can get to fishing grounds quicker), an issue that will be discussed in more detail in section 6.4.3.

All characteristics highlighted above show some form of increase. This can basically to attributed to increases in the vessel size and various other characteristics like engine size and power. The increases in vessel size (as measured through the categories in Table 6.2) can signify increased capitalisation in terms of the fleet. The increase in the other characteristics could also result from capitalisation, probably through input substitution.

6.4 CATCH AND EFFORT TRENDS

6.4 Introduction

The commercial jig fishery[2] has caught the majority of chokka squid within South African waters since the early 1980s. After initial exploitation trends continued to increase, regulation measures were instituted. Despite these measures being put in place, in the later half of the 1980s, there has been a steady increase in effort (Roberts, 2000). The increase in effort will be highlighted, both in terms of increased caches and as measured by the number of hours fished. Together with these increases, there has also been an expansion of fishing grounds to areas further offshore where more adult squid are found (Roel *et al*, 1998).

In the analysis, catch levels are based on data extracted from the Marine and Coastal Management (MCM) Linefish database. Compulsory submissions of daily chokka squid jig catch statistics are required of all licensed fishermen and fishing companies, and are thus captured in the database. In addition to this, data from the *Fishing Industry Handbook* is also used.

6.4.2 Historic Catch Trends

The South African squid fishery primarily targets spawning aggregations off the country's southeastern coast (Augustyn, 1989). Catch within the fishery is however subject to much variability (Roel, 1998 and Roberts, 1998). One of the major reasons for these fluctuations is the variability of environmental conditions (Schön, 2000 and Roberts, 1998). In addition to environmental conditions, other factors that play a role in variability, and thus catch, are the abundance of active spawning sites and the size of the spawning biomass (Roberts, 1998:267). The size of the spawning biomass, in part, depends on the level of effort exerted in the previous season. And because most squid species are short-lived (Jackson, 2002), a big catch in one year can reduce the recruitment for the next (O'Dor, 1998). In addition to annual fluctuations Roel (1998)

[2] The bottom trawl fishery, which targets Cape hake and Agulhas sole, also exploits squid as by-catch. However, squid caught as by-catch has continuously declined since the late 1980s. (Roel, Cochrane & Field, 2000).

also noted that chokka squid are subject to fluctuations within a given season. To view the variability in squid catch, it is useful to plot historic data, on both an annual and seasonal basis. Viewing time series data, on catch, gives a good indication of changes in catch over the medium to long term. Nevertheless this will smooth the trend generally witnessed on a season basis.

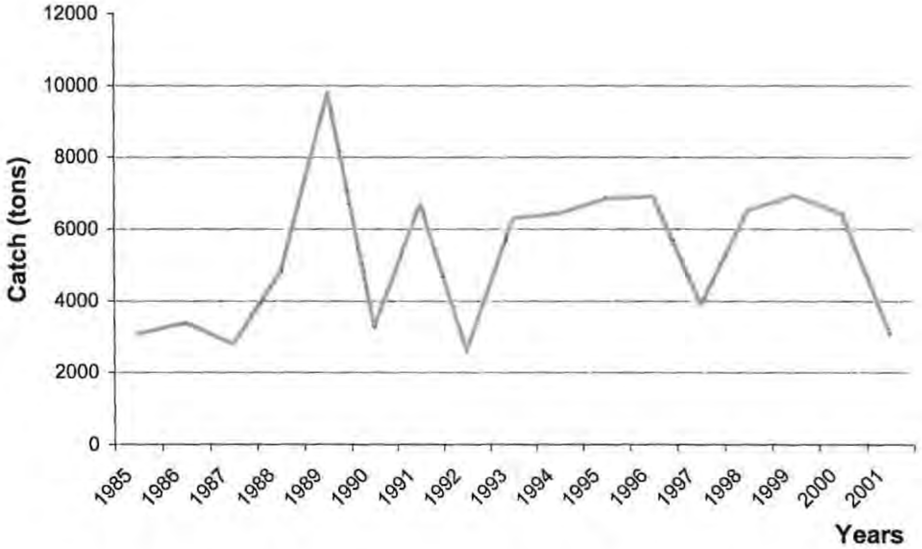

Figure 6.2: Annual Catch data for the Squid Jig Fishery (1985-2001)
Source: Linefish database, MCM (see Appendix II)

Figure 6.2 highlights the change in jig squid catch on an annual basis. It is quite clear that jig catch does suffer from fluctuations over this sixteen-year period. The highest recorded catch was in 1989, which was around 9 800 tons with a wholesale value of R108 million at the time. In recent years catch has however firstly stabilised (from 1998 to 2000), then begun to decline (in 2001). Possible reasons for the decline could be linked to increased effort (as stated in section 6.3) or a reduction in the number of participants due to redistribution attempts the industry, a factor that will be discussed further in Chapter 7.

Although the fishery does suffer from fluctuations in catch on an annual basis, there are fluctuations within a given seasons as well (Roberts, 2000 and Roel, 1998). It is thus possible to highlight this variability by plotting the monthly averages for the years 1995 – 2002.

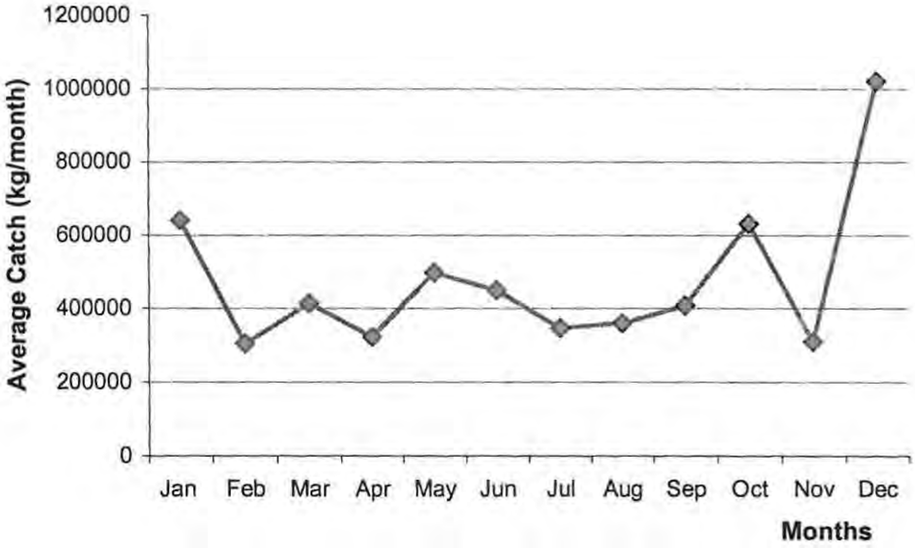

Figure 6.3: Average Monthly Squid Catch (1995 –2002)
Source: Roel (1998) and Linefish database, MCM

Figure 6.3 shows the average monthly squid catches for the years 1995 – 2002. As can be seen a seasonal trend exists. The lowest catches observed are between February and April. This is comparable with data collected by Roberts (2000), which highlights average monthly catches for the years 1989 to 1999. As with Roberts (2000), peak catch is also observed in December. The decrease in catch in November is due to the closed season imposed, currently for four weeks, during October-November, the peak spawning period for squid.

Variability within the chokka squid biomass is in part due to the abundance of spawning sites (Roberts, 1998). This means that catch within different areas is thus affected by the abundance of squid within those areas. It is therefore useful to view catch data from the main fishing areas to determine which of these are associated good or bad catch levels. These are highlighted in Table 6.4 below.

Table 6.4: Catch data associated with the main Fishing Areas of Squid as a Percentage of Total Catch obtained (1995 – 2002)

	Fishing Season							
Area	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Port Alfred	6%	4%	21%	9%	9%	6%	6%	11%
Algoa Bay	17%	15%	12%	17%	14%	16%	17%	16%
Port Elizabeth	25%	23%	22%	15%	17%	18%	12%	18%
Jeffery's Bay	21%	18%	12%	15%	22%	13%	3%	3%
Tsitiskamma	13%	15%	12%	15%	16%	17%	17%	21%
Plettenberg Bay	13%	20%	14%	18%	16%	16%	0.4%	0.3%
Elsewhere	6%	6%	8%	6%	7%	14%	44%	31%

Source: Linefish database, MCM (see Appendix III)

Table 6.4 highlights the fact that good squid catches, between 1995 and 2002, are associated with locations that have traditionally been viewed as the primary spawning grounds of squid, which are along the southeastern coast of South Africa (as displayed in Figure 5.1 of Chapter 5). The largest catches occur between Algoa Bay and Tsitiskama (on average more than 70%). Because the largest catches occur within these spawning grounds, changes in monthly squid catches, as shown in Figure 6.3, thus reflect the changing abundance of squid within spawning grounds for a given season. Based on this, apart from the closed season, the biggest concentrates of spawning squid occur in December. This is a view further supported by Augustyn (1990) and Augustyn *et al* (1994) who states that immigration to spawning grounds takes place in early summer.

6.4.3 Effort trends

Changes in effort over time can either be measured on an input or output basis. The traditional approach used by fisheries managers, focuses on output measures such as catch at MSY or MEY. Kirkley & Squires (1999), however argue that it is vital to include the input characteristics of a fishery as well. This is because any capacity-reduction programmes attempting to reduce output need to consider the inputs within that production process. However, where inputs are considered, fishing effort is usually viewed as a composite input[3] within a two-stage production process. This conforms to the traditional static equilibrium notion of effort (Anderson, 1986). Kirkley & Squires (1999) however argue that the input bundle should be disaggregated to some degree to distinguish between the stocks of short-run fixed, and quasi-fixed, inputs and their flow of services.

Measures of effort based exclusively on an output basis primarily look at changes in catch over time. To view this for the squid fishery, reference can be made to Figure 6.2 above. Figure 6.2 shows that the level of catch has fluctuated dramatically since 1985. As mentioned, the highest rate of exploitation, and one would thus assume fishing effort, was exerted in 1989. After this period, tighter regulations, in the form of a licensing system and then a permit system, were in introduced in 1990. This definitely seemed to reduce catch levels. However, as mentioned in section 6.4.2, catch depends on many different factors such environmental conditions and the existing biomass of the stock. These factors are however difficult to estimate. One factor, that can be determined, is the number of vessels participating within the fishery on an annual basis.

Table 6.5: Number of Vessels participating in the Squid Fishery (1994 – 2001)

	Fishing season							
	1994	1995	1996	1997	1998	1999	2000	2001
Number of vessels	275	273	277	258	235	147	243	145

Source: Stuttaford (1994-2001)

From Table 6.5 it is clear that the number of vessels, between the years 1994-1996, remained reasonably constant. Catch during this period seemed to remain fairly constant as well. However, after 1996, although the number of vessels remained fairly constant (a marginal decline) until 1999 there was a decrease in catch levels. In the years 1999 and 2001, there were was a decrease in vessel participation. This was probably due to redistribution attempts initiated by the State. Fluctuations in catch after 1998 however seemed to correlate to vessel participation. Although a relationship between catch and

[3] The idea of a composite input can be expressed by the following production function (as outlined by Kirkley & Squires (1999): $Y = f(K, L, E, M, X, T)$ where Y is output, K is capital, L is labour, E is energy, M is materials, X represents other inputs used and T is the state of technology.

the number of vessels seems evident during certain periods, it should be remembered that this relationship is affected by other factors. Firstly, catch is subject to factors such as weather conditions and biomass recruitment. Secondly, the number of participants on a vessel is a better measure of effort as they are more closely linked the level of fishing activity. Finally, the data does not take into account such factors like inaccurate declaration of catch levels, "over-crewing" of vessels and changes in vessel specifications. Measuring effort purely on an output basis is thus flawed.

According to Cunningham & Gréboval (2001), an increase in fishing effort is more generally associated with an increase in fishing capacity (an input measure). Excess fishing capacity, however, is largely a result of overcapitalisation. And as mentioned in Chapter 3, a major signal of overcapitalisation, is increased investment in the world's fishing fleets (World Bank, 1994). The result is an increase in the capacity of a vessel or fleet, as its ability to generate fishing effort per period of time increases. This can occur through improvements in the size of the vessel, its technical efficiency (i.e. through gear improvements or input substitution) and the potential time that a vessel can spend fishing (Gréboval & Munro, 1999). Measuring capacity on this basis is clearly an input measure. Excess capacity in this sense means that the capacity of a given fleet is higher than that required to ensure a target level of sustainable exploitation.

To determine the possible effect that the squid fleet has on fishing effort, reference in made to section 6.3 above. Firstly, it has been determined that the squid fleet has evolved from smaller ski-boats (less than 8m) to predominantly medium-size freezer type vessels (between 13m and 18m). According to Schön (2000) medium size vessels have recently proved most effective. This is because they are better equipped (i.e. better lighting for fishing at night, GPS systems, and fishing finding equipment) and with the expansion of fishing areas, these vessels are able to exploit deeper spawning grounds (Roberts, 2000 and Schön, 2000). There have also been changes in engine size and power (see Table 6.3). Although changes in engine size have been gradual, a definite upward trend exists. A possible reason for the gradual change is because vessel engines can probably be classed as a quasi-fixed capital input (it is cheaper and easier to change the vessel's power than it is to buy a new vessel or rebuild one).

A measure that encompasses both output and input factors, of fishing effort, is catch per unit effort (CPUE). Catch per unit effort is the most commonly and routinely used index of abundance in fishery studies (King, 1995 in Schön, 2000), and is often used as a proxy measure of squid abundance. CPUE is useful because it gives the amount of fish caught when an additional unit of effort is applied to a fishery. In terms of this thesis, CPUE calculations are based on annual records of catch and effort, expressed as the number of men on board a vessel multiplied by the hours spent at sea. This is consistent with the measures used in other studies of the squid fishery (namely, Roel & Butterworth, 2000; Schön, 2000 & Roel *et al*, 1998). Data on annual CPUE levels, between 1985 and 2001, is expressed in Figure 6.4.

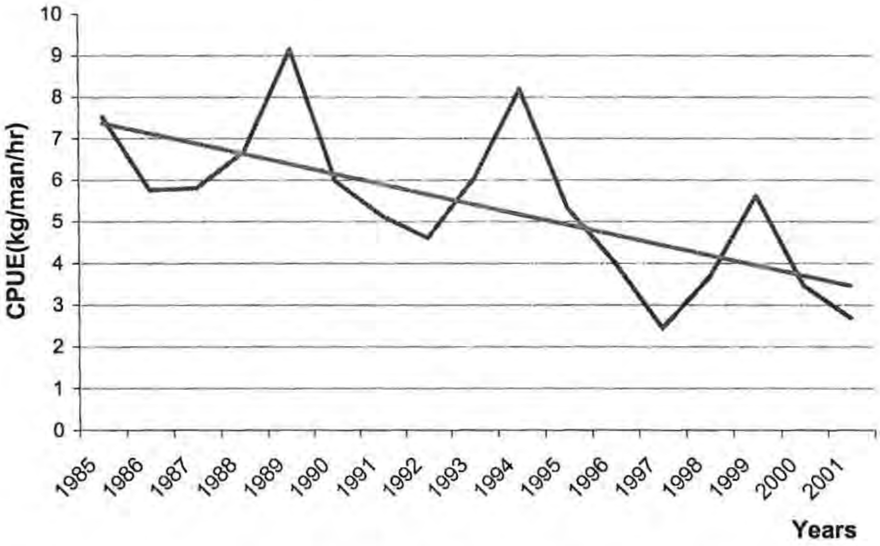

Figure 6.4: Annual CPUE trend of the Chokka Squid Jig Fishery (1985-2001)
Source: Linefish database, MCM (see Appendix II)

Figure 6.5 makes it quite clear that over a 16-year period, 1985-2001, CPUE has on average gradually declined, a view supported by Booth & Hecht (2000). Taking into account the catch fluctuations in Figure 6.2, it is clear that effort has steadily increased as the squid fishery has developed. To better highlight this fact, effort in terms of man-hours (men on board a vessel multiplied by time spent at sea) can be determined. Since squid are predominantly caught by hand using jigs, the men on board a vessel should be a reliable measure of fishing activity and thus fishing effort.

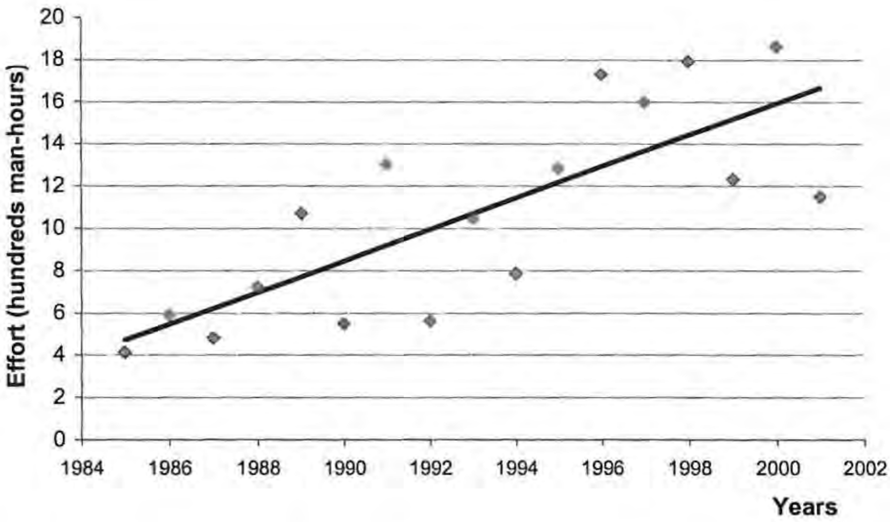

Figure 6.5: Annual Effort data for the Chokka Squid Jig Fishery (1985-2001)
Source: Linefish database, MCM

Figure 6.5 highlights the fact the effort has, on average, continuously increased over the years 1985 to 2001. Roel *et al* (1998) uses data over the period 1985-1996, to determine effort (in man-hours), which provides supporting evidence of the earlier trend displayed in Figure 6.5. Roel & Butterworth (2000) also conclude that effort has increased as the fishery has developed. This has meant that by the late 1990's the squid resource was "at a high risk of severe biomass reduction" (Roel & Butterworth, 2000:224). The squid resource is in fact currently considered to be fully utilised with no room for further expansion (DEAT, 2003a; Roel & Butterworth, 2000; Booth & Hecht, 2000; Paul, 2000b and Friedel, 2000). This means that, unless effort is reduced, "the stock is likely to be driven to low levels at which future recruitment will most likely be jeopardised" (Roel & Butterworth, 2000:224).

6.4.4 Conclusion

According to the data above, the chokka squid fishery has witnessed changes in both catch levels and effort levels over time. Firstly, in terms of catch, these levels have fluctuated throughout the industry's existence. There was however a dramatic increase in the late 1980s, decreasing into the 1990s, only stabilizing for brief periods (i.e. 1994-

1996). In terms of monthly fluctuations, on average the highest catch levels are recording in the summer months, close to the traditional spawning period (Roberts, 1998). Although catch has been variable, there has been a definite increase in effort over time (Roel & Butterworth, 2000). Figure 6.5 best displays this, where effort is measured in man-hours. This dramatic increase in effort has necessitated the imposition of controls to maintain stock levels.

6.5 MANAGEMENT AND REGULATION MEASURES

6.5.1 Introduction

The squid fishery is currently regulated through the setting of a TAE. This consists of limits to the number of fisher permits allocated to participants. In addition regulations on fishing gear and the imposition of a closed season are used. In order to gain comparative knowledge on fisheries management it is useful to look at other squid fisheries around the world. According to Pierce & Guerra (1994), the squid fishery in the Falkland is one of the best regulated in the world. On comparison with the chokka squid fishery, it is clear that management measures used are similar. Nevertheless it is still important to emphasize the effectiveness of this system. These controls can also be related to a property rights management system as described by Charles (2000). This aspect will thus also be highlighted.

6.5.2 Resource Management Measures: A Comparison

After its formation, the squid jig fishery developed quickly into the mid-1980s and it was soon realised that some form of regulations will be required to control effort. Initially the absence of high-quality information on stock levels threatened the implementation of control measures in the fishery. Scientific advice was, nevertheless, soon provided by the Sea Fisheries Research Institute (SFRI) and focussed primarily on controlling effort. Effort control seems to be the preferred method of regulation in most of the world's squid fisheries (Jackson, 2002).

Effort limitation in squid fisheries is the preferred method because of the inherent characteristics of the squid species (as outlined in Chapter 2). Basically all squid have short life spans and rapid continuous growth (Jackson & O'Dor, 2001). Policymakers and managers in different squid fisheries are thus faced with similar challenges. Furthermore, because of their short life spans, each season is essentially fishing a new generation of squid. According to Roel (1998), a key factor for management implications is the stock-recruitment relationship. Each year's spawning success is thus crucial to the fishery in the following year since a low reserve in year-classes can result poor stock recruitment (Brodziak & Rosenberg, 1993). The earlier in a given season the recruitment level is estimated the more effectively the stock can be managed – recruitment overfishing can thus be prevented. In addition to this, squid populations, due to their life history, can also face stock collapse due to natural conditions (Schön, 2000). And while a population collapse can occur naturally, recovery in the stock is aggravated by increased fishing pressure (O'Dor, 1998).

In order to provide a comparative example of management measures, reference is made to the squid fisheries in the Falklands Islands. These islands support two species of squid and a variety of fish species in their trawl and jig fisheries. Jackson (2002:5) states that the two most important fisheries are the squid fisheries, which are the myopsid, loliginid squid *Loligo gahi* fishery (a trawl fishery) and the oegopsid, ommastrephid squid *Illex argentinus* fishery[4] (a mainly jig fishery, further offshore). The *Illex argentinus* fishery started around the 1970s (Basson *et al*, 1996), while *Loligo gahi* fishery has been the subject of a major trawl fishery since the early 1980s (Agnew *et al*, 1998). These fisheries have been managed together, as part of a multi-species fishery along the Patagonian Shelf, for over 13 years and are the main source of government revenue in the Falklands (Jackson, 2002). The main management authority during this time has been the Falkland Island Government Fisheries Department (Jackson, 2002).

[4] This fishery is probably the most successfully regulated cephalopod fishery in the world resulting it being the most valuable fishery in the Falklands, both in terms of value and volume (Jackson, 2002).

The fishery is managed based on effort limitation, by limiting the number of licences issued and the duration of the fishing season. The fishing season is divided into two six-month periods. *Illex argentinus* is fished during February-June of the first season only (Jackson, 2002), while *Loligo gahi* is fished for 4 months in the first season and 3 months in the second season (Agnew *et al*, 1998). Specific features of the fishery for *Loligo gahi* have also been to restrict the area where the fishery can target this species. In terms of the issuing of licences, the status of the stocks is reviewed during the start of each season. This allows effort to be adjusted every six months (Jackson, 2002). Prior to the start of each season, when population abundance is unknown, fishing effort is based on a historic estimate (Basson *et al*, 1996). Effort limitation is seen as the most appropriate method for managing the limited resource of the Falklands. A TAC and quota system has been attempted, but would be difficult to maintain with conditions of stock variability[5]; catches of *Illex argentinus* have ranged from 64 000 tons to 266 000 tons (Jackson, 2002). In addition to this, it is important to realise that population size can only be determined once fishing has begun, it is thus impractical to use a TAC as a management tool (Basson *et al*, 1996). Mirman & Spulber (1985) also argue that if fisheries are faced with harvest uncertainty, then it is likely that optimal harvest limits will be exceeded[6].

Most squid fisheries around the world are managed through the use of input controls. These include, but are not limited to, the *Todarodes pacificus* fishery off the coast of Taiwan, the New Zealand arrow squid (*Nototodarus sloanii*) fishery, and the California market squid (*Loligo opalescens*) fishery (Jackson, 2002). Some squid fisheries are however managed through the use of a TAC. The fishery for *Loligo pealei* off the northeastern coats of North America is one of the few squid fisheries based on TAC rather than predominantly on effort control (Jackson, 2002). The TAC is based on calculations from pre-recruit surveys in combination with effort limitation. Thus in addition to catch limits, the fishery is still regulated by limited entry restrictions.

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[5] Danielsson (2002:29), in his paper dealing with the efficiency of catch vs. effort quotas, concludes that when the "variability in the growth of stock is great ..., management with effort quotas is superior to management with catch quotas."
[6] Pontecorva (2001) also contends that if there is supply-side uncertainty within fisheries, it is best to impose input restrictions that limit the fishery to a more efficient size.

From the above it is clear that most of the world's squid fisheries are managed through effort (TAE) limitation. The South Africa chokka squid fishery is no different. One of the first regulations introduced was a six-week closed season in 1988. During this period (1986-1988) a licensing system was also developed. This system however had limited effectiveness and was further enhanced by the introduction of a permit control system in 1990.

The squid jigging fishery is still currently regulated through the setting of a TAE level. The TAE is reviewed and set on an annual basis. It is set based on scientific research conducted by DEAT scientists and other research organisations, which together form a Scientific Working Group (Mather *et al*, 2003b). This research group attempts to determine the status of the stock and its relationship to current levels of TAE. The results of the research are then discussed and recommendations, about the new level of effort that can be sustained in future seasons, are made to Consultative Advisory Forum (CAF). Finally, based on this information, the Minister, or his representative, sets the new level of TAE.

The TAE is comprised of effort restrictions in the form of limits on the number of vessels (through a licensing system) and the number of men on board a vessel. The number of fishing permits allocated to a vessel determines the number of fishers on board that vessel. Permits thus determine the intensity of fishing on a vessel, and hence the viability of fishing endeavours. The fishery is still also regulated by means of a closed season (of variable length). Furthermore, it is forbidden to catch squid in the Tsitsikamma National Park, where intensive spawning has been observed in the past (Roel *et al*, 1998). The use of a closed season is very valuable from a biological viewpoint, because it can be imposed during the critical stage in the life cycle of a specific resource (see Chapter 3). Nevertheless, if it is instituted alone, a fishery can still suffer from overcapitalisation as the race-for-fish prevails. The development of a marine protected area, like the Tsitsikamma National Park, plays a similar role to closed season. However, from an ecological viewpoint it is perceived to be more effective (see Chapter 3, section 3.4.2).

In additional to the above regulations, restrictions on the type and power of lights used on a vessel have also been considered (Mather *et al,* 2003b). Vessels exploiting squid use lights to attract the resource to shallower depths, where they can be more effectively caught using handlines[7]. This is especially effective when fishing at night. Schön (2000:8) states that there has been a dramatic increase in the light power of vessels since the introduction of Korean-type hanging light bulbs in 1997. An earlier study by Sauer (1992) also outlines the role that lights play in exploiting squid stocks.

6.5.3 Use Rights System

Of all the regulations introduced in the squid jig fishery, the one that probably plays the most important role is the use rights system. This is because it determines who will access the fishery and thus determines the primary level of effort to be exerted. It also has important implications for the redistribution agenda of the new Government policies. For redistribution to occur the State will have to reallocate rights to individuals who were previously denied access. However before this issue can be addressed it is imperative that resource managers have an idea of the development of the rights system, its current effectiveness, and possible consequences of its restructuring.

Prior to 1984, access to chokka squid resource was not restricted in any way (Augustyn, 1986). Apart from covering their costs of fishing, individuals were "free" to exploit the resource. Although the resource fell within South Africa' s EEZ, it was a *de facto* open access resource. Initially, with the development of a commercial squid jig fishery between 1983-1978, the only requirement for participation was a valid "A" or "B" licence (SASMIA, 2001:6). An "A" licence was a commercial licence granted to all participants in the linefishery, whereas a "B" licence was a semi-commercial licence granted to respective participants within the South African fishing industry. They were thus not linked to a specific fishery or species. The lack of specificity with licences meant that a large number of participants could exploit a particular species, but maintaining control, over increasing effort, was very difficult. During the period of 1987, specific access rights were granted for the squid fishery with the inception of the new "C" licence, which still exists today. This effectively put an end to the "gold rush"

[7] According to Schön (2000), the effectiveness of handlines decreases at depths of greater than 60m.

phase (described in Chapter 5, section 5.2.4), and resulted in a reduction of the number of active boats from 560 to 235 by 1988 (Augustyn *et al*, 1992). In 1989, to further support control, it became mandatory for all squid vessels to display their licence type when fishing (Roberts 2000).

The development of fishing licences reduces the number of people that are allowed to enter a fishery – as did occur in the squid fishery in 1988 after the inception of a squid specific licence. According to Eggert (1999), a licence scheme is easy to implement and is thus a widespread regulation used in many fisheries worldwide. This was probably a factor that encouraged its introduction in the chokka squid fishery. Although a licence scheme is definitely a necessary step towards effective management, it does not prevent active participants from increasing their landings. This can occur through capital stuffing, which increases vessel's productivity. Within the squid fishery, even with the adoption of licence limitations in 1987, effort continued to increase. In fact, the highest catch levels in the fishery were recorded in 1989. Other forms of regulations are needed to further manage effort.

In 1990, in a bid to further enhance the squid management system, a permit control system was introduced. These permits stipulated the number of fishermen allowed on each vessel and depending on its type also restricted the area of operation (similar to a TURF). The imposition of a permit acted as a further input control, in conjunction with licences, to limit the fishing capacity of a vessel. It thus deals with the rational incentive to increase the efficiency of a licensed unit. When the TAE is set in the squid fishery, the total number of individuals participating in fishing activities is determined. Permits are then attached to these individuals and are subsequently allocated to participants fishing in the squid fishery (supposedly to rights holders with successful vessel licences). Three different categories of squid fishing permits emerged over the years. Firstly, there are unrestricted permits, which allow squid fishing in all South African waters, except the former Ciskei. Secondly, there is a restricted permit, which allows fishing in a designated area within South African waters. Lastly, there is a Ciskei permit, which allows squid fishing in the waters of the former Ciskei.

Charles (2000) would regard the system of licences and fishing permits, within the squid fishery, as *use rights* (as defined in Chapter 4). Use rights determine who can access a fishery and how much fishing activity can take place. These two functions mean that use rights are divided into two categories, access rights and withdrawal rights (see Figure 4.1 in Chapter 4). Access rights determine who can enter a fishery and withdrawal rights determine how much fishing activity can take place. Within the context of the chokka squid fishery, a vessel licence can be seen as an access right and a squid-fishing permit can be seen as a withdrawal right. Although access rights and withdrawal rights are the primary categories of use rights, they can act as limitations if used jointly (Mather, 2004). This refers to the fact that an access right can be limited by a withdrawal right and vice versa. In the squid fishery, before a vessel can participate within the fishery it needs to get a licence that will grant it access. However, no actual fishing can take place until fishing permits, in the form of withdrawal rights, are allocated to that vessel.

According to Mather (2004) use rights have four levels of restrictions. These restrictions have been outlined in the decision tree represented in Figure 4.2 in Chapter 4. The decision path applicable to the squid fishery is an access right, in the form of a licence, limited by a withdrawal right, in the form of an effort restriction (in this case a the number of permits on a vessel). The evolution of this decision path can thus be represented for the squid jig fishery.

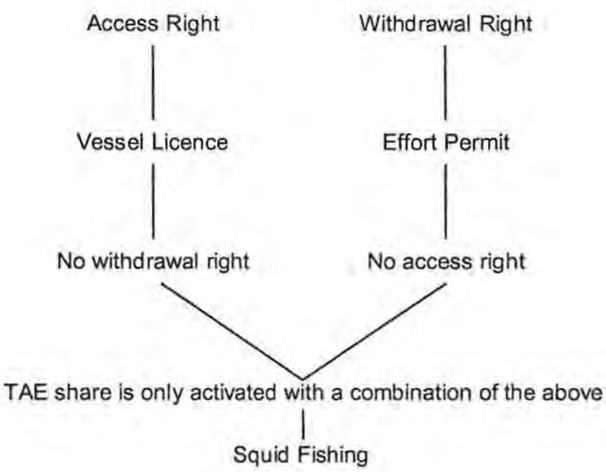

Figure 6.6: The Dual Form of Use Rights applied to the South African Commercial Squid Fishery

Source: Adapted from Mather (2004) and Charles (2002)

The system of use rights in the squid fishery thus appears to be a dual system determining access and withdrawal. However, in most literature surveyed the distinction does not appear be to expressly stated. For example in DEAT (2002), SASMIA (2001) and DEAT (2001a), reference is merely made to 'squid rights' or 'rights holders'. It does however seem to be implicitly stated in the application procedure that a dual system does in fact exist as vessel-licensed applicants are given preference. In addition, within the MLRA of 1998, the right of access, to a fishing ground, is specified in section 21(1) of the Act (RSA, 1998), which states that a harvest right (referred to as a quota) can only be activated through the issuing of a fishing vessel licence (RSA, 1998:section 13). Nowhere in the Act, however, does it stipulate that an individual needs to have access to a fishing vessel to be granted a harvesting right. This opens up a number of possibilities. At the one extreme, quota holders can transfer their right at a negotiated price to a vessel owner with access to the fishing grounds. This is called a 'paper quota'. At the other extreme, a vessel owner with access to the fishing grounds but no harvesting right leases a quota share, at a negotiated price, from the 'paper quota holder[8]'. Regulations thus do not stipulate a link between the right to withdraw and the right of access.

[8] DEAT (2002:4) defines a 'paper quota holder' as an applicant that applies "for a right with the intention of selling it or transferring it, i.e. it does not appear to be a *bone fide* applicant..."

Access rights are determined through a licence attached to a vessel. In terms of this, vessel participation can thus be equated to access rights (since no vessel is allowed to fish without a licence). Table 6.5 therefore represents an approximation of access rights. From this it can be seen that the number of access rights allocated has remained fairly constant between 1994 and 1998. Beyond 1998, vessel participation (and thus access rights) decreased in 1999 and 2001. The decreases are linked to initial rights redistribution attempts within the squid fishery and attempts to reduce effort. However, without comparable permit data (withdrawal rights) it is difficult to determine the true nature of rights allocated.

Nevertheless for an effective use rights system to prevail within the squid fishery, the operational characteristics of these rights also need to be defined, otherwise inherent problems will arise with any attempt at restructuring. The viability of a dual rights system is however also questionable as a long-term solution. Some of these problems, and their implications for the system, will be highlighted in Chapter 7 when discussing the first attempts at redistribution (between 1999 and 2001).

6.5.4 Conclusion

Most management measures for squid fisheries, worldwide, are based on effort limitation. This is largely due to the erratic nature of the resource, which makes accurate biomass estimates impossible. It is thus preferable to limit effort, which can be adjusted if necessary. The South African squid is no different in this regard. It is regulated through TAE primarily consisting of limitations on permits per participant. These permits represent a component of the use rights system. In theory this consists of a dual system of access and withdrawal rights. However, the lack of clear guidelines, in terms of vessel ownership, mean that permits can be allocated on an *ad hoc* basis. This system can result in a 'paper quotas' (referred as 'paper permits' in the squid fishery).

6.6 ECONOMIC AND SECTORAL STUDY: SOME KEY INDICATORS

6.6.1 Introduction

In the previous section, the structure of the chokka squid fishery has been outlined. Thus far it has however neglected to focus on the people behind the fishing activities, whose either directly involved or indirectly affected. According to DEAT (2003b), the squid fishery provides employment for approximately 2500 people, with thousands more indirectly affected. It is thus imperative to highlight any possible effects that restructuring can have on the livelihood of individuals. To provide a socio-economic baseline for the squid fishery reference is made to the Economic and Sectoral Study (ESS) Report. The EES is a sectoral study commissioned by DEAT in 2000 to provide baseline information for all South African commercial fisheries. Although the study is not yet complete, two draft reports have been presented to Marine and Coastal Management, the directorate of DEAT responsible for the management of all South African marine resources. According to the EES report, the study has completed 85% coverage of the squid jig fishery. To further aid analysis, data from the ESS is compared with data independently extracted from the questionnaire survey conducted by MCM, for the squid fishery, in the 1999/2000 season. Data from this survey consists of 106 responses.

6.6.2 Background and Methodology to the ESS

The Department of Environmental Affairs and Tourism commissioned the ESS in 2000. The need for such a study arose from the lack of basic information about the economics and socio-economics of the South African fishing industry. Under the leadership of Valli Moosa, the Minister at that stage, the Department saw it as a critical step towards achieving the new policy objectives outlined in the MLRA of 1998. Before any decision-making around rights allocations or industry restructuring could take place, realistic baseline information would be required.

The main objectives of the ESS was: i) to describe the South African commercial fishing industry as a micro-economy, ii) to provide baseline economic and socio-economic data, iii) to provide a measurable estimate of the level of "transformation" (redistribution), including the distribution of the wage bill to previously disadvantaged individuals (Mather *et al*, 2003a:2). Information obtained from these objectives would inform future rights allocation processes and establish a database that could be updated on an ongoing basis. Although the ESS seemed to have an economic bias, it also included a legal analysis and accounted for biological considerations. The legal analysis was aimed at examining the constitutional compatibility of the policy and management systems with respect to fisheries.

Data used in the ESS was complied from questionnaires tailored for each fishing sector in South Africa. In additional to this, representative data was obtained from various companies and individuals with in-depth knowledge of specific fishing operations. Data was further supplemented with historic data available in the MCM databases, however Mather *et al* (2003a) argue that this data was of little value as databases were poorly maintained. Datasheets complied for the chokka squid fishery, and summarised in the ESS and represent 160 rights holders.

6.6.3 Ownership Distribution

This section deals with the ownership distribution of companies exploiting squid and that of the squid fleet, according to race. It also looks at the racial distribution of rights holders, as specified by the ESS. The ownership distribution of the squid fishery is vital for determining the division of capital assets among racial groups. Most capital assets in fisheries (i.e. fishing vessels) are co-specialised (see section 4.4.4 in Chapter 4), which means that even if rights are reallocated to *historically disadvantaged individuals* (HDIs), they will not be able to make use of them without a vessel. Taking into account the cost of vessels[9], and the fact that the majority of HDIs fall within lower income brackets, it is unlikely that they will be able to afford a vessel. Allocating fishing permits to these individuals can thus create adverse incentives, as will be highlighted in Chapter 7.

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[9] Mather *et al* (2003: 111) estimates that a medium sized vessel currently has an approximate market value of R1.4 million and a replacement value of about R4 million.

To begin, the ownership distribution of the chokka squid fleet will be outlined. This distribution will be based on race, where formerly repressed individuals (i.e. Blacks, Coloureds and Indians) will be classed as historically disadvantaged individuals (HDIs) and these will be compared with the White racial grouping. This system of classification is consistent with that of the ESS and is thus used to ensure comparisons with independently complied data.

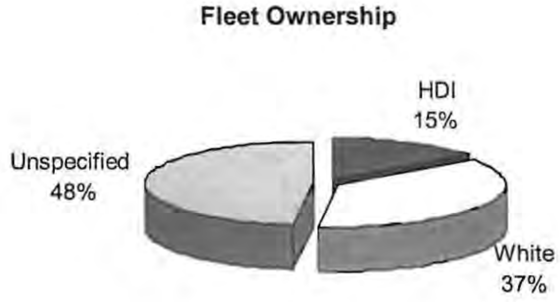

Figure 6.7: Percentage of Fleet Ownership in the Chokka Squid Fishery in 2000
Source: Mather *et al* (2003b: 206)

According to Figure 6.7, about 15% of vessels were HDI-owned and 37% were White-owned. However, a rather large portion of vessel ownership seems to be Unspecified (about 48%). Although vessel ownership seems to be in favour of Whites, the large unspecified component ultimately makes comparisons indeterminate. In the hope of getting a better resultant distribution, data from the 1999/2000 squid questionnaire was independently extracted and also used. Instead of using the seemly narrow categories of the ESS, categories were determined through majority ownership, where majority is 50% or greater for a given racial category. About 26% of all vessels were sole-owned in 2000 (DEAT, 2003b). The results are displayed in Figure 6.8 below.

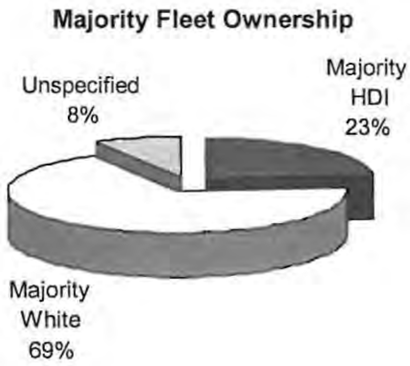

Figure 6.8: Percentage of Majority Ownership in the Chokka Squid Fishery in 2000
Source: Squid questionnaires for the 1999/2000 seasons

Using majority ownership as a measure seems to give a better indication of the breakdown in fleet ownership among racial groupings. According to Figure 6.8, about 69% of vessel ownership rests in majority White hands. These results thus reflect the sentiment that the majority of assets, within the fishing industry, rest in the hands of Whites (Friedel, 2000).

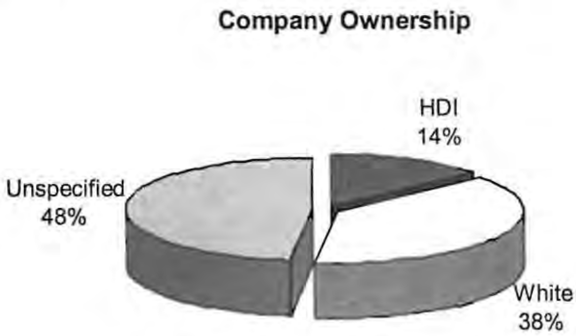

Figure 6.9: Percentage of Company Ownership in the Chokka Squid Fishery in 2000
Source: Mather *et al* (2003b: 206)

In terms of company ownership, the level of White ownership is a lot higher (38% as opposed to 14% for HDIs). However, yet again there is a large unspecified portion of ownership. It is thus again useful to compare these results with data extracted from the squid questionnaires. However, majority ownership will be used as a comparison.

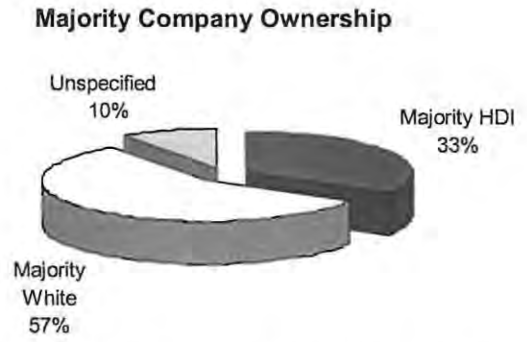

Figure 6.10: Percentage of Majority Company Ownership in the Chokka Squid Fishery in 2000

Source: Squid questionnaires for the 1999/2000 seasons

Percentage of majority ownership gives a slightly better result. About 33% of HDIs are majority owners of companies that exploit squid. Ownership, as will be shown in Chapter 7, plays an important part in the "transformation" agenda of government. This is because one of the major barriers to gaining access to the commercial fisheries was access to capital and equipment (Hauk & Sowman, 2001). For equitable participation to be a reality, HDIs need to have a meaningful stake in the ownership of fishing companies. Without such an involvement there can be no real redistribution of wealth.

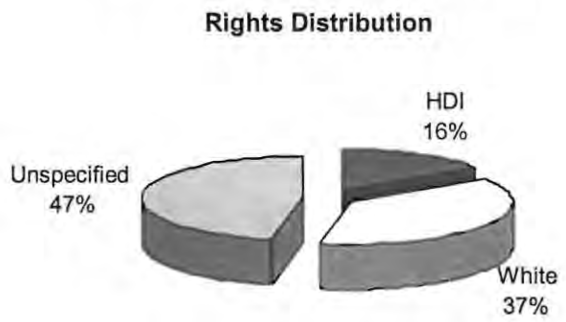

Figure 6.11: Percentage of Fishing Rights, by Racial Group, in the Chokka Squid Fishery in 2000

Source: Mather *et al* (2003)

It is still unclear whether the right distribution, as specified by the ESS, relates to vessel licences or squid fisher permits. However, based on the supposed rights allocation process, these should refer to the distribution of permits among participants. It should however be evident that the majority of rights rest in the hands of the White racial grouping as vessel owners are usually given preference in the rights allocation process and these are predominantly white-owned. This view is confirmed by DEAT (2002:24) who states that 30% of rights holders, as measured through the TAE, are HDI participants. In all categories shown above, White "control" is apparent. Van Sittert (2002:1) in fact argues that "the gross inequalities in the fisheries are the product of capitalism," in the form of White monopoly capital.

6.6.4 Employment, Income and Skills Levels

On average about 6000 tons of squid are caught per annum, providing employment for about 2000 fishermen and 500 shore-based factory workers (SASMIA, 2001). Considering families, it is estimated that as many as 25 000 people are directly dependent on the performance of the fishery (DEAT, 2003b). The chokka squid fishery thus supports a large number of people, but is of particularly important in the Eastern Cape province. This is because the main squid fishing grounds are located on the southern Eastern Cape coastline, which means that a number of processing activities also occur in this region. As can been seen in Figure 6.12, the percentage of fishery employment is the largest in the Eastern Cape, which is about 82%.

Figure 6.12:Percentage of Employment, per Region, provided by the Chokka Squid Fishing Industry in 2000

Source: Mather *et al* (2003b: 210)

The percentage of employment provided by the chokka squid fishery is extremely significant for the Eastern Cape as it has one of the highest levels of unemployment in

South Africa. According to the ESS the level of unemployment, in terms of its conventional measure[10], stands at 34% in the Eastern Cape, with HDIs making up about 43% of that figure and 24% being unspecified. Determining the actual division of employment within the chokka squid fishery is thus vital. The ESS received employment data for 87.5% of the vessels active in the commercial squid fishing industry in 2000, and 12 squid processing facilities (Mather *et al*, 2003b). From this sample, Figure 6.13 was constructed.

Figure 6.13: Percentage of Employment, by Racial Grouping, in the Chokka Squid Fishery in 2000

Source: Mather *et al* (2003b: 207)

According to Figure 6.13, of the total number of people employed in the squid fishery, about 91% of these were HDIs. It is useful to establish the breakdown of employment figures among the various sectors of the squid fishing industry. This provides an indication of the importance that the various sectors have. Essentially the fishery can be divided into three sectors, which include the primary sector, the secondary sector and the tertiary sector (Mather *et al*, 2003). The primary sector deals with harvesting activities and their support services. The secondary sector deals with processing. Lastly, the tertiary sector encompasses marketing and management services. In terms of the available data (for the 1999/2000 season), the secondary and tertiary sectors are not always distinguishable and have thus been lumped together.

[10] Conventional unemployment refers to people actively searching for work, but who have not found employment.

Table 6.6: Total Sector Employment for the Chokka Squid Fishery in 2000

	Full-time		Part-time		Total
Fishery Sectors	**HDI**	**White**	**HDI**	**White**	**Total**
Primary Sector	224	51	1629	134	2058
Secondary & Tertiary Sector	593	70	100	19	782

Source: Squid questionnaires for the 1999/2000 seasons

Based on employment alone, it would be assumed that HDIs, which make up a large percentage of the employment, would be better off in terms of earnings as well. If reference is made to income data from the ESS, approximately 80% of employment income earned goes to HDIs. Although this seems like a large proportion, the distribution of average income, and capital assets (as stated in section 6.6.3) is still skewed in favour of the White racial group. In order to get a better perspective, data on income and skills levels thus needs to be included as well. These not only indicate the level of importance that the fishery has on individuals, but also give an indication of the degree of "social transformation" (Mather *et al*, 2003a:89). This refers to the degree to which the fishery has integrated the historically repressed racial groupings. In doing so a separation will be made between the primary sector, vessels only, and the primary sector, including on-shore support activities. This is because the market generally fails in the primary sector with regards to harvesting (Mather *et al*, 2003a:89-90). Thereafter the secondary and tertiary sectors, together, can be examined.

Table 6.7: Primary Sector (Vessels only) Employment number and Income (in '000 Rands), by Race and Skills group, for the Chokka Squid Fishery

	Professional		Skilled		Semi-skilled		Unskilled	
	HDI	**White**	**HDI**	**White**	**HDI**	**White**	**HDI**	**White**
Employment Income	9	9	5,679	14,466	49,974	1,071	960	0
% of Total Income	0.01%	0.01%	7.9%	20%	69.3%	1.2%	1.3%	0.0%
Employment Numbers	3	1	103	143	1672	39	95	0

Source: Linefish database, MCM

From Table 6.7 it is clear that the largest percentage of employment income goes to HDIs. In terms of total employment income, roughly 78.5% (or R 56.6 million) is earned by HDIs through harvesting activities on squid vessels. A large portion of this is however mainly earned by *semi-skilled* labour (69.3%), who on average earn around R30 000 per annum. White individuals earn more in the *skilled* category (approximately 20% of total income) with an average income of R101 160 compared to an average income of R55 130 for HDIs in the same category. It should however be noted that employment figures include both full-time and part-time employment. Nevertheless, there is still a lack of absorption of HDIs into the *skilled* category, which can probably be related to the fact that skills take time to acquire or that non-discriminatory work practices are still in the process of being implemented. Including shore-based support activities into the primary sector supports this view.

Table 6.8: Primary Sector (including On-shore support) Employment and Income (in '000 Rands), by Race and Skills group, for the Chokka Squid Fishery in 2000

	Professional		Skilled		Middle services		Semi-skilled		Unskilled	
	HDI	White	HDI	White	HDI	White	HDI	White	HDI	White
Income	540	2298	5316	12888	120	378	47382	1110	1326	0
% Total Income	0.8%	3.2%	7.5%	18%	0.8%	0.5%	66%	1.6%	1.9%	0.0%
Employment	5	24	103	143	4	6	1672	41	48	0

Source: Mather *et al* (2003a: 100)

When looking at the primary sector, including on-shore support activities, an additional skill's category arises. The *middle services* skill category includes customer service clerks and other salesperson related activities. These skills are thus not present in harvesting which focuses primarily on fishing activities. Comparing Table's 6.7 and 6.8, it can yet again be seen that White individuals makeup a bigger portion of the *professional* and *skilled* categories. A comparison of the HDI and White racial groups in these two categories combined, suggests that HDI's on average earn R55 771 per annum while White's on average earn R94 913 per annum. Whites within the *professional* and *skilled* categories combined, thus on average earn 26% more than HDIs.

Table 6.9: Secondary and Tertiary Sector represented in terms of Total and Average Employment Income (in '000 Rands), by Race and Skills group, for the Chokka Squid Fishery in 2000

	Professional		Skilled		Middle services		Semi-skilled		Unskilled	
	HDI	White	HDI	White	HDI	White	HDI	White	HDI	White
Income	180	126	36	36	18	0	1080	144	444	0
% Total Income	8.7%	6.1%	1.7%	1.7%	0.9%	0.0%	52.3%	7%	22%	0.0%
Average Income	25.7	63	36	36	18	0	16	20.6	15.9	0

Source: Mather *et al* (2003b: 102-103)

Data from the secondary and tertiary sectors, merely confirms the trend witnessed in the primary sector (vessels and on-shore support activities). Although employment figures in absolute terms are lower, suggesting that the core business of the squid fishery is linked to harvesting activities, the trend with regards to average income earned is still in favour of the White racial group. Again the highest discrepancy in average income earned is within the *professional* skill category. If any equitable redistribution is to occur within the chokka squid fishery this is definitely an issue that needs to be addressed. This issue, and others associated with equitable redistribution, will be dealt with in greater detail in Chapter 7.

6.6.5 Conclusion

Although the ESS does not provide a 100% sample of the squid fishery, and in some case there are large amounts of unspecified data, it does provide a "picture" of the chokka squid fishery in terms of economic and socio-economic data. This is important as none of this data previously existed for the fishing industry. Using this data in conjunction with independently extracted data, gives valuable indicators of the social and economic factors. This also sets a baseline from which to determine a redistribution agenda (Chapter 7). Firstly, with reference to ownership within the fishery, assets (capital and fishing assets) are skewed in favour of the White racial grouping. Secondly, in terms of employment, income and skills, in relative terms these are again in favour of Whites. Although absolute figures for employment and income do favour HDIs, but these are largely due to larger numbers in lower skills categories. All in all it is clear that any redistribution attempts must account for all the above factors.

6.7 CONCLUSION

The squid industry as an industry has a developed and changed a great deal since its inception. This is evident from the dynamic nature of the fishing fleet used to harvest chokka squid. In terms of the composition of the fleet, there has been a gradual movement towards larger vessels that a better equipped with new technologies. According to most fisheries' authorities this should result in an increase in the level of effort exerted on the squid resource (Gréboval & Munro, 1999). However because of the erratic nature of most squid resources (Jackson & O'Dor, 2001), it would be difficult to determine increased effort levels from catch alone. It is thus useful to use CPUE as a proxy for stock abundance. From this one can determine the level of effort for given levels of catch. Effort data (in terms of man-hours) reveals a distinctly upward trend as the fishery has developed. In fact the fishery is currently fully utilised with no further room for expansion (Roel & Butterworth, 2000). This means that the management measures used control the resource need to be reviewed.

The fishery is managed through effort limitations, the preferred method for most squid fisheries worldwide (Jackson, 2002). The main component of effort control can be translated in a dual use rights system. This system, although largely successful, is nevertheless unclearly specified. This obviously has implications for resource management and the redistribution agenda, as will be highlighted in Chapter 7. Another issue that partly informs the redistribution agenda of government is the ownership structure of the fishery (in terms of vessels, companies and rights). Linked to these are the employment and income opportunities afforded to historically disadvantaged individuals. It is clear that in terms of most of these factors, resources are skewed in favour of the White racial grouping (Hauk & Sowman, 2001 and Hersoug & Holm, 2000). This thus creates a motivation for equitable redistribution within the fishery.

CHAPTER 7

REDISTRIBUTION WITHIN THE SOUTH AFRICAN COMMERCIAL SQUID FISHERY

7.1 INTRODUCTION

All marine resources within a country's EEZ are public property controlled by the State. All inhabitants of a country are allowed access to these resources until access is regulated by the State; they hence become common property resources. It is therefore the duty of the State to ensure equitable access and participation in terms of the exploitation of these resources. This is the fundamental premise enshrined in the Constitution[1] of a democratic South Africa. This is a fact that holds for all sectors of South African society, and the chokka squid industry is no different in this regard. To achieve the principles set out in the Constitution, the State adopted a strategy of "transformation" (equitable redistribution). Initially, with the shedding of the infamous apartheid regime, expectations for a rapid "transformation" were high. However the demographics of pre-1998 participants in the squid industry, in terms access and participation, did not reflect those of society (Mather *et al*, 2003). With regards to ownership, access rights and employment income earned, resources were skewed in favour of the White racial group (see Chapter 6). Government thus adopted of strategy of reallocating fisher rights in the squid industry with the hope of allowing greater access of HDIs. This process however was subject to some major problems, as will be outlined in section 7.3. In order to deal with some of these problems, proposals are made to change both government procedures and the rights-based system to be implemented. These issues are taken up in the latter half of the chapter.

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[1] Equitable access to natural resources, access to information, involvement of the public in decisions and management were key principles embraced in the Constitution Act 108 of 1996 as well as many of the new policies and legislation relevant to natural resource management (Hauk & Sowman, 2001:175)

7.2 THE "TRANSFORMATION" AGENDA

7.2.1 Introduction

In terms of Government policy, all sectors of society need to reflect the demographics of society. If this is to hold true for the squid industry, then in terms of access rights, then at least 65% of rights need to be reallocated to HDIs according to the ESS. However, based on the preliminary strategy outlined by Marine and Coastal Management, a more modest reallocation, between 40% and 60%, is required (Mather, 2003). However, equitable redistribution should not be based on the reallocation of fisher rights alone. In terms of the MLRA of 1998, redistribution should ensure meaningful participation, by HDIs, within squid industry. This thus relates to both social and economic normalisation, with regards to race. A sound definition of "transformation" (referred to as an equitable redistribution in the context of this thesis) thus needs to be established, so that various measures can be determined as benchmark against this. The EES report provides some useful indicators in this regard.

7.2.2 Defining Redistribution

The MLRA of 1998 can be used to distinguish between three types of redistribution (Mather *et al*, 2003a:145): (i) social "transformation"[2], (ii) structural "transformation"[3] and (iii) economic "transformation"[4]. Social transformation refers to changes is the social well being of individuals in terms of employment opportunities, skills development and access to income (and within a broader context the creation of wealth). Structural transformation refers to changes in the composition of business within the industry, specifically as to whether it is better suited for bigger companies or small, micro and medium enterprises (SMMEs). Both types of "transformation" play a vital part in the restructuring of the industry.

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[2] Section 2 (j) of the Marine Living Resources Act of 1998
[3] Structural transformation is viewed as a sub-objective of economic transformation, specifically encouraging small, micro and medium enterprises.
[4] Section 2 (d) of the Marine Living Resources Act of 1998

Within the context of the MLRA of 1998, economic "transformation" refers to achieving economic growth, capacity building and employment creation. However, from a purely economic perspective, "economic transformation" refers to the transformation of inputs (e.g. from labour intensive techniques to capital intensive techniques, or vice versa) in the production process with the objective of achieving economic efficiency. Although the attainment of economic efficiency is indeed a valuable long-term objective of the fishery, it largely does not serve the purposes of equity and thus the objectives of redistribution. However, if the concept of economic transformation is amended to reflect the "economic objective" (Arnason, 2000) outlined in Chapter 2, then society should allocate scarce resources with the aim the maximising social welfare. This thus encompasses both equity and efficiency criteria, with the former playing a more immediate role within the context of the squid fishery.

In terms of the three types of "transformation" mentioned, social transformation probably most closely reflects the redistribution attempts of the State. This is because it not only deals with such issues as employment equity and access to income, but also looks at issues around racial and gender equality. Improvements in economic welfare however, are reflected in issues of employment and income creation, as well as other social enhancements. Economic issues should thus not be excluded. Although the different aspects of redistribution can be treated separately, they should not occur exclusively from each other. Within the context of the fishing industry, the process of redistribution can occur in different sectors, i.e. the primary sector vs. the secondary or tertiary sectors. Redistribution attempts within the sectors may thus progress at different levels. For example, the priority within the squid industry, and most South African fishing industries for that matter, seems to be linked to the redistribution of access rights. Although, this has repercussions for all sectors, the major effect will be witnessed in the primary sector, as this is where most harvesting activities occur. Nevertheless to be able to gauge that process of redistribution, the process needs to be measured against some baseline or criteria.

7.2.3 Strong vs. Weak Redistribution

Mather (2004:195) makes reference to a distinction between a *strong redistribution* and a *weak redistribution*. A strong redistribution includes the redistribution of resource rent (through permit rights), fishing capital (vessels and access rights), as well as the transfer of skills and creation of employment opportunities. This thus encompasses most of the objectives laid out under social "transformation" in terms of the MLRA (section 2, j) of 1998. A weak redistribution however only includes the transfer of resource rents through the reallocation of permit rights. Since initial redistribution attempts (see section 7.3 below) seemed only to include the reallocation of permit rights, the important question thus is; *Can a weak redistribution have strong redistribution consequences?* Based on initial results the answer seems to be *no*.

Redistribution measures or indicators are thus vital as they allow policymakers, and other authority figures, to track redistribution attempts. Since social "transformation" seems to be the accepted equivalent of strong redistribution, it is worthwhile to highlight the components of this measure as defined by the ESS. In terms of measuring social redistribution, Mather *et al* (2003:151) provide three areas that affected. These relate to: (i) human skills, employment and income, (ii) access rights and (iii) ownership. In terms of all these areas, data from Chapter 6 shows that the White racial grouping is favoured (apart from absolute figures like total employment and total income earned). It is important to however note that permit rights are not included in the above measures. These rights can however be classed under capital ownership, if they are issued on a long-term basis.

7.2.4 Redistribution Options

Having highlighted the various indicators of redistribution it is important to outline the functional options that firms and new entrants face. A number of options exist, however for practical purposes only a few important ones will be outlined. It should be borne in mind that any attempt at redistribution needs to ensure that a more equitable and fair distribution of power and wealth be achieved without destroying the economic basis of the industry. Existing participants and new entrants thus need each other to survive. That is, the new entrants will tend to capture and retain more of the permits, and the established interests have the expertise and the infrastructure to exploit the squid stock. Redistribution options thus need to reflect this.

Option1: Internal transformation

Companies in the squid industry can internally "transform" by transferring, or selling at market value, a minimum predetermined proportion of their shareholding to individuals from previously disadvantaged groups. In many instances this is a very favourable option. Existing companies can select the method and membership for internal redistribution; for example, they may seek partnerships with specifically identified individuals or with new entrant companies. These individuals can thus include the HDI employees of a given firm, who gain shares through "employee share option plans" (Van Sittert, 2002: 2). Companies can thus negotiate payment, for example, in the form of deferred profits. This option does, however, have some drawbacks. Certain potentially important new entrants may become excluded, but this remains the case with all options.

Option 2: Joint ventures

Existing companies may establish joint ventures with permit holding new entrants. The exact relationship of these joint ventures must be carefully established if this option is to be adopted. This option can however lead to opportunism by established interests (through price setting) and by new entrants (through a "paper market", as described in section 7.3.3) and should be very carefully considered before it could be classed as an equity criterion. This is however the dominant form of institutional coalitions at the moment (DEAT, 2003b).

Option 3: Buy-outs

Existing companies can negotiate buy-outs with new entrants and potential new entrants. This option is very similar to internal transformation, but ownership rests entirely with individuals from previously disadvantaged groups. Issues of access to capital however limit this option, especially if this option is applied to potential entrants who are currently fishers.

Option 4: New entrants establish new companies

This may not provide a smooth and rapid transformation path. The practice of awarding sub-economic licensing packages and the subsequent establishment of a 'paper' permit market and the lack of human skills, retards the ability for new entrants to establish new companies (all these issues are discussed below in section 7.3). In addition to the above, this option will result in the closing down of existing fishing companies and the squeezing out of others. This means that existing skills and valuable expertise will not be utilised, and business viability is challenged. It does however provide a realistic option for "transformation", but should not be considered as the only option (Mather, 2003).

Option 5: Release of a certain proportion of permits to new entrants

This option allows individuals or companies to release a further stipulated proportion of their effort permits (harvesting rights) to new entrants. If they so wish, established interests can in this way retain autonomy, but only at the expense of losing a proportion of their resource rights. This method of redistribution is in essence the current way of implementing policy, except that there is no voluntary action by squid fishing businesses (DEAT, 2003a).

The selection of options above depends to a large extent on the nature of the right to be granted and the specific fishery in question. The nature of rights depends on the operational-level characteristics that structure them. Rights can be short term or long term fisher licences or permits; that are transferable or non-transferable. The adoption of a given option also depends on the ease with which its implementation is perceived to be. Given the constraints facing both government (i.e. lack of capacity and a need to a quick redistribution) and potential new entrants (i.e. lack of financial capital and experience), options 2 and 5 seemed the most appropriate. However as will be made clear, no reforms can be implemented without problems of their own.

7.2.5 Conclusion

For the purposes of this thesis, redistribution is defined as social "transformation" that incorporates various economic aspects. This is encompassed through the term *strong redistribution*, which deals with all equity criteria, i.e. fishing rights, employment, income and ownership. There are however many redistribution options available for government reforms. The one that seems to cause the least disruption (especially to existing participants) is redistribution through the reallocation of fisher rights. This is the option adopted when government attempted its initial redistribution attempts. These will now be discussed in more detail below.

7.3 INITIAL ATTEMPTS AT REDISTRIBUTION

7.3.1 Introduction

As mentioned, in Chapter 5, the South African fishing industry has undergone, and is still in, a process of redistribution and restructuring. After political normalisation in 1994, South Africa began its journey into the era of democracy. The institutions of the apartheid government and other sectors of society had to undergo a process of "transformation". The process of developing a national marine fisheries policy began on the 27 October 1994 under the auspices of the Fisheries Policy Development Committee (Cochrane & Payne, 1998) and finally culminated in the Marine Living Resources Act of 1998. The MLRA of 1998 has since provided the guiding principles for all policy shaping the process of redistribution within the South African fishery industry, and in dealing with the utilisation of all marine resources within its jurisdiction. The Act is essentially rests on three pillars: equity, sustainable resource use and industrial stability (Mather *et al*, 2000).

Equitable "transformation" implies that there should not just be a short-term redistribution of income (from resource rents), but there also needs to be a redistribution of wealth (i.e. capital assets). This will ensure equitable participation that has the potential to be sustainable and long term. Sustainable utilisation of the resource implies that there should be organised exploitation of the resource enforced legally through the new legislation. Industrial stability needs to be ensured to minimise business risk and guarantee viable business operations. The MLRA seeks to ensure all of these.

7.3.2 Initial Redistribution: 1998 - 2000

The implementation of the MLRA in the squid industry (during the 1998/1999 season), and its transition, has proved problematic. The new era started with delays by government in issuing new licences and permits. This prevented vessels from going to sea and cost the industry dearly. This is because there were no sound economic policies and/or strategies in place for "transforming" the fishing industry. Capacity was also lacking within the Chief Directorate: Marine and Coastal Management, and a top down style of implementation was adopted (Mather *et al*, 2000 and Friedel, 2000). Reforms focussed exclusively on fisher rights and effort control. This attempt at redistribution can best be referred to as a "command and control attempt at redistribution" (Mather *et al*, 2000:2), a view is also supported by Hersoug & Holm (2000).

To begin, at the start of the redistribution process, during 1999, it was deemed undesirable to increase effort in the squid fishery, and according to DEAT a 10% reduction in effort was required (Mather, 1999). When looking at catch and effort data from Chapter 6 (section 6.4.2 and 6.4.3), this position was understandable as both catch and fishing effort were on the increase in 1998. The reduction in effort was to be achieved by reducing the number of fisher permits on each vessel by an average of 30% (Mather *et al*, 2000). Along with the reduction in effort, a 20% redistribution of fishing rights[5] was sought by the Minister of Environmental Affairs and Tourism. All in all, a 30% across-the-board decline in TAE was enforced on the industry[6] (Mather, 2003).

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[5] It is unclear whether these referred to access rights in the form of vessel licences or withdrawal rights in the form of permits; however, it is implicitly assumed that it is the latter.

[6] In addition, reductions in non-fishing crew placed stress on the ability to ensure safety on vessels at sea and to monitor specialised equipment. This has led to certain estimates that the total reduction in effort was actually around 40% (Mather, 2003 and SASMIA, 2001).

According SASMIA (2001), most "new" rights were reallocated to historically disadvantaged entities. However, these rights were allocated in sub-economic TAE units that were mostly short-term (one year) fishing permits. In terms of the operational characteristics (Scott, 2000a and Mather, 2004), these rights were allocated in *economically non-viable assets sizes* (see Chapter 4, section 4.4). They were also short term in duration, which meant that they were negatively related to the *security* characteristic. All these factors meant that these rights were incomplete and would be subject to adverse incentives, as will be highlighted below.

The sub-economic units meant that some rights-holders ended up with less than a full vessel crew. The immediate result, of the attempted redistribution process, was socio-economic disruption in the form of crew lay-offs and under crewed vessels, which were unable to operate on a profitable basis. Roberts (2000) states that fishing vessels were no longer viable as they were only left with about 70% of their original crews in operation. In addition to endangering the viability of new entrants, he states that reductions in crew also placed strain on the ability to ensure vessel safety at sea. The reduction in effort together with the uncertainty in policy implementation resulted in turmoil and insecurity within the squid industry. This situation forced both the existing participants and the new entrants to react in adverse ways.

Firstly, existing participants could either buy or lease fishing permits from the new entrants (who were predominantly HDIs). This seemed like a feasible option to both groups as most new incumbents did not have access to sufficient capital[7] (Hauk & Sowman, 2001) and therefore could not acquire or gain access to a fishing vessel. This effectively denied them access rights to participate in the fishery and in effect classed new entrants as "paper permit[8]" holders (to be discussed below in section 7.2.3). New entrants also lacked the necessary human capital (e.g. skills and experience), which further hindered their successful participation. If reference is made to section 6.6.4 in Chapter 6, it is clear that existing HDIs participating the in squid industry before the

[7] The permits could not be used as collateral as they were not long term and were not strictly transferable. Financial institutions would therefore not recognise them as "assets".
[8] A "paper permit" is a permit that is leased or sold back to industry participants, and thus it does not fulfil the aims for which it was issued (e.g. to ensure a reallocation of rights within the squid fishing industry).

redistribution process, consisted predominantly of semi-skilled and unskilled labour (i.e. more than 70% of HDIs fell into these two categories in the primary sector), who may have had the necessary fishing skills, but lacked business acumen.

Secondly, because of the uncertainty, and the possible reduction in future profits, there were strong incentives to cheat (especially because the existing chaos in the industry made effective policing difficult). Some vessels simply went to sea with a full crew and risked legal action by the state (Mather *et al*, 2000). This placed strain on the fully exploited chokka squid stock through what Roberts (2000) effectively states was a 30% increase in effort. Self-policing also in effect becomes a myth, because if one fisherman cheats this establishes incentives for all too cheat, with everyone attempting to maximise their present value from the stock (Scott, 1955).

7.3.3 The "Paper Permit" Market

The motivation behind the restructuring of the squid industry and subsequent redistribution of rights was to allow equitable access, to the resource, for all racial groups. However, the false process of "redistribution" through new rights allocations was based on inappropriate and ill-conceived criteria. This resulted in damage to both the well being of the industry (due to increased effort) and new incumbents. According to Mather *et al* (2000:2), the process of selecting new rights holders was "deeply flawed", as there had been no controls in place to determine whether, or not, new entrants had previous experience within the squid fishery. This, along with the lack of other seemly relevant criteria, meant that almost anyone could apply for fishing rights. This highlights that fact that no clear guidelines existed in terms of the dual rights system mentioned in Chapter 6. Although section 21 of the MLRA of 1998 did imply a dual system existed (RSA, 1998), this was not enforced through implementation policies. This links to the *eligibility of ownership* characteristic, which essentially specifies that rules need to exist to determine the right of participation (Anderson, 2000a).

The lack of proper verification procedures (in terms of selecting participants) and the subsequent allocation of sub-economic units of short-term permits to new entrants opened the fishery up to adverse selection (pre-contractual opportunism) and moral hazard problems (post-contractual opportunism)[9]. Firstly, with regards to the lack of allocation procedures, certain individuals could apply for fishing rights, with no intention to engage in fishing activities, knowing that once they were allocated rights they could sell these off at a profit. This is an example of adverse selection. Secondly, in terms of sub-economic allocations, on average new entrants were issued with five permits; this is too small to operate a workable boat especially considering that an average ski boat needs about seven men to ensure a viable operation, and in addition these vessels were not considered economically viable to qualify for finance anyway (Mather *et al*, 2000). This meant that new permit holders were unable to establish viable enterprises and created a strong incentive to lease or sell permits to established firms, as they were unable to access financial capital effectively. This type of behaviour led to moral hazard problems. The presence of both adverse selection and moral hazard, in the permit allocation process, led to a trade in "paper permits" as new rights holders could not viably participate in fishing activities.

7.3.4 Consequences of Initial Redistribution

The flawed process of redistribution, through attempted effort reductions and rights reallocations, disrupted the squid industry immensely. Firstly, problems of racial tension arose between new entrants and established participants. This is to be expected in any event as rights are taken from one group and given to another (Hersoug & Holm, 2000). In addition to this, some existing participants were forced into partnerships (i.e. joint ventures) with new entrants from disadvantaged groups, which could add to the tension (Mather *et al*, 2000). New entrants could not establish independent enterprises and were forced into joint ventures with existing participants who more often-than-not wanted to pursue their own established interests. Meaningful participation by new permit holders was thus not achieved.

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[9] Adverse selection refers the kind of pre-contractual opportunism that arises when one party to a bargain (contract) has private information, before the contract is concluded, that can benefit him/her. Moral hazard, however, refers to self-interested misbehaviour by individuals who have private information about their actions after a contract has been concluded (Milgrom & Roberts, 1992). Both of these are present when asymmetric information exists.

Secondly, there was a resultant increase in fishing effort, which threatened the sustainability of an already fully utilised resource (Roberts, 2000). Vessels that were under-crewed were forced to "cheat", by employing more fishers than allocated permits. This resulted in an increase in effort as any expectation of self-policing fell away. Thirdly, industrial instability resulted from policy uncertainty and a botched rights reallocation process. The buying back of "paper permits" also increased the costs of existing participants. As Mather *et al* (2000:2) stated, the "redistribution process could be viewed as a revenue tax on established companies".

Fourthly, the restructuring process resulted in much conflict and litigation, as companies challenged Government's policies in court (Hersoug, 2002). From an economic viewpoint, this resulted in further waste as resources were reallocated to unnecessary processes. Lastly, from a socio-economic perspective, the well being of many fishermen and their families were affected due to crew layoffs. According to Mather (1999), a 10% reduction in effort leads to approximately 240 fishers losing their livelihoods, which directly affects about a 1000 people through family ties.

7.3.5 Conclusion

The initial redistribution process was an ill-conceived attempt to "transform" the chokka squid industry. Firstly, the right-based system that was to be implemented was ill defined, with incomplete rights being reallocated to new entrants. In addition to this the rights allocation procedure was also flawed. All of these factors led to problems of adverse selection and moral hazard. These problems were reflected through the formation of a "paper permit" market. Both existing and new entrants within the squid industry were thus severely damaged. In addition, the families of fishermen were also directly affected.

7.4 PROPOSED REFORMS SUBSEQUENT TO THE INITIAL REDISTRIBUTION

7.4.1 Introduction

The command and control attempt at "transformation", within the squid fishery, had some distressing consequences for resource management, the equitable reallocation of rights and the fishermen concerned. In order to deal with this, an incentive based redistribution is proposed by Mather *et al* (2000). This new arrangement recommends that the rights based management system be altered to reflect a more complete property rights scheme. This can be achieved through the use of the operational-level rules specified by Scott (2000a), Anderson (2000) and Arnason (2000). To further reduce adverse incentives; a new rights allocation procedure is also highlighted. This process attempts to introduce more guidelines to prevent any possible misbehaviour on the part of rights applicants.

7.4.1 Incentive Based Redistribution

The initial redistribution process can be referred to as a command and control attempt at redistribution. One implicit problem associated with this type of coercive action is that it undermines any future redistribution attempts by Government, because stakeholders concerned become sceptical about Government's ability to deliver. In an effort to remedy some of the problems associated with these initial attempts, Mather *et al* (2000:2) proposed an incentive based approach to "transformation" within the squid industry. This approach primarily sets out to deal with the adverse effects of the paper permit market, but also offers some useful insights into other social issues (such as the redistribution of ownership and wealth).

With regards to the paper permit market, two of the major reasons that resulted in its formation were the lack of verification procedures in dealing with new entrants and the ill defined rights to be reallocated. Firstly, in dealing with the rights application procedure, it was suggested that a unit be set-up to specifically deal the verification of all squid applicants. These applicants will be checked to establish whether they have any past involvement in the squid industry and whether this involvement is legitimate (DEAT, 2003a). Guidelines describing this process and its requirements must also be made available to all concerned. Any applications that are found to be deficient will be eliminated from the process[10] (SASMIA, 2001). This thus acts as a disincentive to those applicants attempting to exploit the process for personal gain.

In dealing with the problems around the allocations of incomplete rights, it was suggested that the structure and term of rights be altered (Mather *et al*, 2000). The initial reallocation of rights to HDIs, in the 1999/2000 season, where in the form of short-term fisher permits (a form of withdrawal right). The tenure of the rights, namely being short-term, meant that it was difficult for entrants to use these rights as collateral to gain finance[11] (i.e. to buy or lease a vessel). Because of their duration, financial institutions, refused to recognise these rights as an asset. Longer-term rights will thus be required to avert this problem[12]. Long-term rights also aid with the compliance problems faced in the fishery. This sets up the necessary incentives for the squid industry to police itself; participants have a strong incentive to look after their long-term interests by protecting the stock of squid (Mather, 2003). Stability is thus also achieved. In order to gain long-term economic efficiency, permits should also be *transferable* in the sense that those who are most efficient will inevitably be the ones who operate in the industry; the inefficient operators drop out by selling their rights to the more efficient ones (Arnason, 2000). Anderson (2000) however highlights the fact rules may need to be set up to initially limit transferability if equity criteria are pursued.

Long-term transferable rights clearly have benefits for both new entrants and for the lasting sustainability of the resource (as is reflected by the *exclusivity* and *security* characteristics); they can however act as a hindrance to the achievement of equity in

[10] Eliminated applicants will be informed and will be allowed to re-submit within a limited time frame upon the payment of an additional application fee. This is merely to avoid litigation with regards to technical omissions.
[11] The need for finance arose due a deficiency in capital funds. This because people of African, Asian and mixed origin were to a large extent excluded from accessing capital during the era of the apartheid government. This can also be seen as a direct result of the lack of development and promotion of these groups, who were suppressed under the apartheid regime.
[12] Both the White Paper of 1997 and the MLRA of 1998 prescribed a system of long-term rights.

the short term. Although economic efficiency is desirable outcome in the long term, it is in direct opposition to the objectives of equity. Currently, the majority of economic power rests in the hands of the established companies; they are thus more likely to succeed in the event of uncertainty. Any failure by new entrants can thus result in fishing rights being re-concentrated in the hands of established firms. In the short term, economic efficiency thus needs to be scarified until equity is achieved. According to Mather *et al* (2000), longer-term rights can also be used as an additional incentive tool to realise equity objectives. Government can use the allocation of long-term rights as an incentive for vessel owners who activity pursue redistribution attempts, and a removal of these rights as a disincentive for "bad behaviour" (Mather *et al*, 2000:3).

In addition to a change in the duration of rights, the system of permit rights needs to be changed. A system of attaching permits to vessels is proposed (Mather *et al*, 2000). The vessel thus becomes the effort unit within the squid fishery, with gear restrictions and the closed season being used as additional measures to limit effort. A vessel licence should thus be allocated that reflects the number of men that can viably operate it. This means that the vessel should be sufficiently crewed to ensure that it is has the potential to operate profitably. The number of men, on a vessel, should also be reflected in terms of its safety certificate[13]. This thus ensures that there is no sub-allocation of permits that could possibly compromise safety on a vessel. Effort within the fishery is still determined on a scientific basis, however the vessel acts as the unit of effort. This thus ensures that no sub-economic permit allocations occur and thus eradicates any moral hazard effects – the paper permit market is thus eliminated. This will also improve compliance measures, as vessel owners should not have an incentive to over-crew vessels, and even if they do it is easier to monitor vessels than it is individual fishers.

The use of vessel licences as a means to determine effort and as a means of granting access to a fishery should however be longer-term objective. This is because fisheries managers need time to adjust to the new unit of effort in terms of setting a TAE. In the

[13] Should the vessel's Safety Certificate reflect a manning level that is less than its complement of permits, the manning of that vessel shall remain at that level until its viability is determined (SASMIA, 2001).

medium term the dual use rights system should still prevail until the necessary adjustments are made. This system should however be properly designed, in that it should account for the operational-level rules described above. Because of this is a transitional solution rights should be issued on a medium-term basis. This improves the exclusivity and security of these rights, but allows for the issue of longer-term rights as well. Limitations on transferability should remain in place until an equitable redistribution is achieved. This approach allows DEAT the opportunity to establish effective criteria for their redistribution strategy. After all redistribution cannot be achieved overnight and should thus be a gradual process. This also reduces instability caused by a rushed approach. The granting of vessel licences, as the ultimate goal, as is nevertheless preferable from a redistribution perspective as this system eliminates the adverse effects mentioned above.

7.4.2 A New Rights Application Procedure: 2001-2002

The Department of Environmental Affairs and Tourism has to an extent heeded the advice offered to them by implementing changes in their rights allocation process. Firstly, in terms of the application procedure, a Rights Verification Unit was established in 2001 (see Chapter 5, section 5.6.3). It is the job of the RVU to oversee the rights application process through the scanning of applications and the creation of a database[14]. In addition to the RVU, a Rights Allocation Unit was also established. The RAU is an independent body appointed to assist with the official apportionment of the TAE and thus determines effort units. The duties of the RAU were to be supported by the information collected by the RVU. As part of Government's structures, the Deputy Director-General[15] of MCM also appointed an Advisory Committee[16] to assist with the assessment of applications in accordance with his instructions (DEAT, 2003a). Upon completing their assessments of all application forms, the Advisory Committee presented their findings to the DDG for consideration. The DDG considers all applications, based on both information from the Advisory Committee and the RAU,

[14] The RVU database contains information about the data submitted by applicants in terms of vessel, company and personal information. This information is complied to help determine the degree of paper permit risk (DEAT, 2003a).
[15] Mr Horst Kleinschmidt
[16] This Committee consisted of financial and legal professionals.

but still has the ultimate say on the units of TAE to be allocated to each successful applicant.

In terms of the duties of the Advisory Committee, the DDG outlines the underlying purpose and principles with reference to assessment criteria. These assessment criteria were based on six broad objectives determined by DEAT. These are (DEAT, 2003a:6): (i) the need to transform the squid fishery, (ii) the need for stability within the industry, (iii) the determination of past performance in terms of harvesting and marketing, (iv) a commitment to new entrants, (v) the need for local economic development and lastly, (vi) the reduction of paper permit risk. These objectives clearly have areas that overlap, and some lead on from others. It is thus useful to outline how these objectives helped to inform the rights application procedure for the 2001/2002 season.

At the end of 2001, 164 applications were received from candidates wishing to acquire squid fishing rights for the 2002 season (DEAT, 2003a). Of these 127 were rights holders[17] from the previous season (potential new entrants thus made up 22.6% of applicants). The Advisory Committee, in terms of the objectives set out in the above paragraph, evaluated all applications received[18]. The evaluation procedure for 2001 rights holders can thus be described. Firstly, these applicants were evaluated in terms of their "degree of transformation" (DEAT, 2003a:9). This criterion objective looked at the percentage of HDI participation in terms of the degree of ownership, the percentage of management (skills levels) and future "transformation" plans[19]. Applicants who display a higher "degree of transformation" receive a higher weighting in terms of the assessment process.

The second object evaluated deals with past performance and involvement in the fishery (DEAT, 2003a:10-11). The determination of past performance is significant because it distinguishes the level of experience that candidates possess. Greater levels

[17] Six applicants, from the 2001 rights holders, were however disqualified for issues ranging from improper lodging to not meeting essential requirements.

[18] These objectives are assigned a series of weightings that help determine a score for applicants. Applicants who have met these objectives favourably will thus have a higher score and thus be allocated fishing rights.

[19] No points were awarded if applicants failed to provide sufficient details in respect of its transformation plan.

of experience ensure that potential rights holders are more likely to succeed, thus enhancing stability within the industry (an aim of the MLRA). Involvement in the fishery can be linked to harvesting, marketing or processing activities. With respect to harvesting, access to (or investment in) a vessel, greatly improves an applicant's chance of obtaining a right. This will in fact have to become an essential requirement if an effective vessel licensing system is adopted. This also reduces the risk of potential paper permit applicants, which leads into objective (vi). All the above objectives inform this last objective, which aims to reduce the risk of paper permit holders. If a candidate has scored well in all previously evaluated objectives, it means that they have some form of meaningful participation in, and commitment to, the industry; their paper permit risk should thus be low.

Of the 37 applications received from potential new entrants, 7 were found to be improperly lodged or defective, and 1 did not meet the essential requirements (as determined by the Rights Verification Unit). All defective applications were thus rejected. In addition to the criteria discussed above, potential new entrants were also evaluated in terms of their "degree of business acumen" and legislative compliance (DEAT, 2003a:12). Both these criteria, along with those mentioned previously, attempt to establish whether new entrants will be able maintain viable operates within the squid industry. As to how the Advisory Committee is able to establish the degree of financial capability of entrants is however still debateable. A new rights allocation procedure will thus be a great improvement. This process is outlined in Figure 7.1 below.

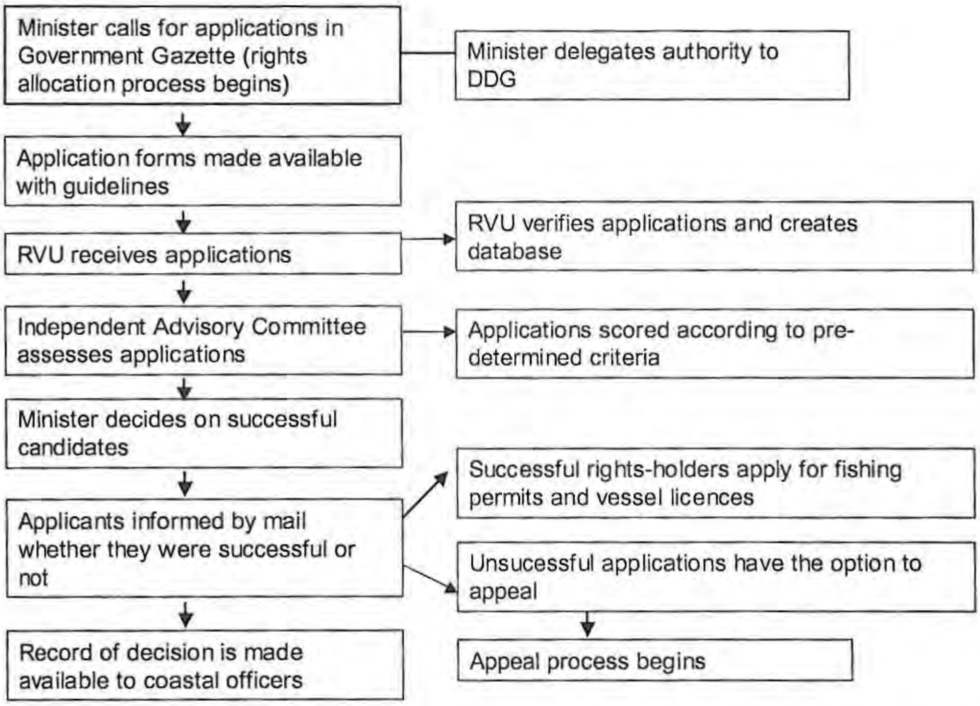

Figure 7.1: The New Fishing Rights Application process for the Squid Industry as outlined by the Department of Environmental Affairs and Tourism

Source: Adapted from DEAT (2002)

7.4.3 A New Rights Allocation System

Previously, a permit right was granted to successful candidates to use a specified number of fishers on board a vessel to catch squid. However, with the reallocation of rights to new entrants (mostly as short-term, sub-economic units), the system suffered from adverse incentives that, among other things, resulted in a paper permit market. It was thus suggested (see Mather *et al*, 2000) that vessels be used as the unit of effort and that permits be attached to vessels in accordance with their capacity. In the long-term vessel licences will thus determine access rights, which can be redistributed. It was also suggested that the duration of rights be extended once equity considerations have been taken into account. The obvious advantages of these changes have been highlighted in section 7.4.1. In their rights allocation process for 2001/2002, DEAT decided to implement these suggestions with the hope of improving the redistribution process.

In the 2000/2001 fishing season, 145 vessels participated in the squid fishery (Stuttaford, 2001). These vessels predominantly consisted of medium to large boats ranging between 13m and 25m. The TAE at the time was determined to be a maximum of two thousand three hundred and eighty-six (2386) fishers aboard various vessels (DEAT, 2003a). Because of overcapacity within the squid industry (see Chapter 6), and the limited nature of the resource, the Minister decided to keep the same TAE level for the 2002 season. In line with the procedure described in section 7.4.2, fishing rights were allocated to successful applicants. Applicants were awarded the right to use a number of "sites" on a specified vessel to catch squid. Vessels were divided in accordance with the vessel categories (as displayed in Table 6.1 of Chapter 6) specified in the squid rulebook (DEAT, 2001b). Each vessel category specified the maximum carrying capacity for vessels within that category. Rights were thus allocated in accordance with a vessel's category as sites on that vessel. In addition to this, vessels are required to obtain a valid safety certificate (issued by the South African Maritime Safety Authority, SAMSA) placing vessels into the proposed categories[20] (DEAT, 2003b).

The new approach adopted by DEAT significantly reduced the risk of a paper permit market from developing. It also improves DEAT's ability to enforce compliance measures, as vessels are easier to monitor than are individuals. In terms of increases in effort, this however means that the number of vessels will have to be reduced to limit fishing effort. It is as yet not clear whether DEAT will be willing to do this as a reduction in vessels means that fishers will be without jobs. Nevertheless within the framework of use rights explained by Charles (2000) in Chapter 4, a dual form of use rights will effectively be applied to the squid fishery as a medium term goal. This dual form uses a combination of access and withdrawal rights (see Figure 6.6 in Chapter 6) to determine harvesting within the fishery. DEAT has currently decided to grant rights to one hundred and six (106) of the 2001 rights-holder applicants and fourteen (14) new entrants. The TAE was set at 2266 persons with 120 permits set aside for appeals (DEAT, 2003a).

[20] If a right holder is allocated a different number of persons than specified by the SAMSA certificate, the right holder will be given three months to have the safety certificate altered to ensure that the maximum number of persons permitted is equal to persons allocated.

In terms of the duration of rights, it was decided in 2001 that all fishing sectors, with the exception of abalone, will be granted four-year commercial fishing rights. These medium-term rights will be replaced with long-term rights in 2005 (DEAT, 2003c:2). These longer-term rights should be based solely on vessel licences as opposed to permit rights. The initial allocation of medium term rights will help stabilise the squid fishery. It also means that it is easier for new entrants to access capital as these rights should act as collateral due to their duration of term. Longer-term rights should also increase the sustainability of the fishery as participants now have an incentive to conserve the squid stock.

7.4.4 Conclusion

To combat the problem associated with the initial redistribution of rights an incentive-based strategy has partially been adopted. This system can be enhanced by using the operational-level characteristics of property rights to define a more complete rights system, as defined by Scott (2000a). However, because not all problems related to the structure of rights, the application procedure for the allocation of rights had to be adjusted as well. A new procedure better describes the criteria needed by candidates in applying to fisher rights. In terms of the rights system, it is suggested that a vessel licensing system be adopted with fisher permits attached to vessels. This reduces the incentive to over-crew a vessel as well as the allocation of sub-economic units of effort.

7.5 INSTITUTIONAL ISSUES

As mentioned in Chapter 4, reforms in most fishery policies worldwide are centred in one of three broad institutional orders (Hersoug & Holm, 2000). These are state control, community and the market. The state, however, is often characterised by a hierarchical order, hindered by a bureaucratic structure and one-dimensional relationships. Policy within South Africa has thus far been determined and managed within a state institutional structure. This seemed to be the approach initially adopted by government authorities when attempting reforms within the squid fishery. The first attempt at "transformation" was implemented and controlled by the State, without much participation from user-groups concerned (Mather *et al*, 2000). This fact was partly to blame for the initial failed attempt at redistribution. There were, however, other problems associated with the state centred attempt at redistribution.

Friedel (2000) states that there was a lack of political will on the part of government to implement the necessary redistribution strategies. This can be linked to the ideas of a strong vs. a weak redistribution mentioned in section 7.2.3 above. In terms of these concepts it seems that Government rather attempted to pursue a weak redistribution strategy in order to move the process along hastily. However, it is still debateable whether redistribution strategies based solely on the reallocation of access rights will have the desired effect. In terms of the redistribution options available (section 7.2.4), options 1, 3 and 4 seem like those that are most likely to achieve a strong redistribution. This is because there is not only a transfer of fisher rights, but also transfers in capital ownership. However, redistribution attempts thus far have primarily been based on option 5, and to a lesser extent option 2. The reason why a weak redistribution was probably also preferred is because it seemed like an easier option for a government that lacked capacity to realise multiple objectives (Friedel, 2000 and Hersoug & Holm, 2000). However, significant structural and policy changes have currently been proposed, as outlined by DEAT (2003a).

As a possible alternative to the state-centred approach to redistribution, a market-based approach has been proposed in many fisheries worldwide, largely through ITQ systems (Scott, 2000c). Within a market-based approach strategic decisions about who will participant in a fishery and who is to receive allocations of catch or effort are determined through the buying and selling of rights in the market place (Charles, 2001). However, in South Africa, where access to capital and information is highly skewed in favour of the rich white population, it seems unlikely that the market principle will work in favour of the previously disadvantaged groups (Hersoug & Holm, 2000). The MLRA of 1998 has however incorporated some desirable aspects of market-based principles into its objectives. In terms of fishing rights, the Act makes provision for long-term tradable rights (RSA, 1998). These aspects are indeed desirable for the long-term interests in the squid fishery, but owners should be prevented from transferring rights until the redistribution period is over to ensure equity.

The state-centred approach seems to suffer from issues related to government failure, in terms of implementation, while the market-based approach seems to fail in terms of equity objectives. The final management approach is that of co-management. Broadly speaking, co-management covers a variety of partnership arrangements between government, resource users and other stakeholders in which responsibilities and decision-making powers are shared in order to manage a resource (Hauk & Sowman, 2001: 174). This approach seems relevant to the squid industry, which already has an established industrial body, in the form of SASMIA, to represent it. Although SASMIA has been around since 1990, Hauk & Sowman (2001) argue that co-management arrangements are still in their infancy in South Africa. SASMIA did however gain prominence after 1998, when the MLRA made provision for the formal recognition of industrial bodies. Government however failed to effectively consult SASMIA before the initial attempt at redistribution of fisher rights (Mather *et al*, 2000). The results of this process quite clearly indicate that the government, by itself, cannot develop and implement reforms to fisheries property rights systems alone – the direct involvement of the rights holders is essential (Craig, 2000). This means that collective-choice rights (as defined in Chapter 4) need exist for user groups as well. The extent to which these rights are devolved to user groups or rights holders, however depends on the power sharing arrangements and management responsibilities present.

7. 6 CONCLUSION

From Chapter 6 it was clear that squid industry needed to undergo a process of redistribution. The final goal of this "transformation" is a normal society where the distinct between race, based on economic and socio-economic characteristics, are not distinguishable. In terms of a *strong redistribution* this means that fishing rights, employment, income and ownership criteria should reflect the racial demographics of South Africa (Mather, 2004). Initial attempts at redistribution were however primarily based on the redistribution of fisher rights. And because of inherent problems in both government structures and the structure of the rights system, attempted redistribution of rights resulted in adverse consequences. One of these was the development of a "paper permit" market (Mather *et al*, 2000). To deal with these problems, there was a change in the rights allocation procedure as well as the adoption of a new incentive based rights redistribution process. This meant that the operational-level characteristics of rights needed to be altered (i.e. the allocation of long-term rights to begin). However, it was further suggested that government adopt co-management approach is terms of any future reforms within the squid industry. This will reduce the ineffectiveness of policies, which have resulted from the enormous gap that currently exists between policy objectives and implementation (Hauk & Sowman, 2001: 176).

CHAPTER 8

CONCLUSION AND POLICY RECOMMENDATIONS

8.1 INTRODUCTION

This chapter outlines the conclusion reached with regards to the effective management of and equity redistribution in the chokka squid resource off the coast of South Africa. The conclusion is thus informed through the discussion in previous chapters. To begin, the central concern for most economists is the optimal utilisation, management and allocation of scarce resource with the objective of maximising social welfare. Within the framework of neoclassical economics, economists have tended focus primarily on the efficiency gains from resource allocations. However, with the evolution of economics as a discipline, it has also been recognised that the distribution of resources can have important implications for progress (Cructhfield, 1956). The notion of equitable resource allocation is however by no means a new one. This belief, in fact, has its roots in social philosophy through theories of social contract prescribed by Locke and Rawls (Arnason, 2000). These ideas are also at the heart of classical economic thought and are now again reflected in the fields of resource and development economics. This thesis has thus described such views as the achievement of a "social objective".

When dealing with resource allocation, classical economists tended to focus primarily on non-renewable resource use. However non-renewable resource use has serious implications for long-term sustainable economic growth and development. The prominence of renewable resource use has thus gained increased importance. As long as these resources are harvested at a rate that do not exceed their natural regeneration rate, their continued availability seems guaranteed. Investment in renewable natural capital, as stated in Chapter 2, is thus of vital importance.

The above principles have been used to analyse redistribution initiatives in the South Africa squid industry. These principles are broadly enshrined in the Marine Living Resources Act of 1998, whose policy prescription is the sustainable utilisation of resource while granting trying to address inequalities of the past. Based on this objective, Chapter 8 concludes on the discussions from previous chapters in terms of defining a strategy for the squid industry. The final part of the chapter makes recommendations on this.

8.2 THE NEED FOR MANAGEMENT MEASURES

The South African chokka squid fishery is a common-pool resource that is subject to commercial exploitation (Cochrane & Payne, 1998). As a common-pool resource it has the public good characteristic of non-excludability (Cullis & Jones, 1992). This means that it is very difficult to exclude "non-owners" of the resource from its use. The resource however also suffers from the characteristic of subtractability (Jensen, 2000b). This means that if one individual uses the resources, there is less available for others to use. These two inherent characteristics mean that participants will usually attempt to exploit as much of a resource, in the quickest time possible, to maximise present value. The chokka squid fishery is however also a renewable resource. This means that if the resource is utilised within sustainable levels (i.e. at levels below its natural renewal rate), it can regenerate (Conrad, 1999). Individuals and communities can thus enjoy long-term benefits from such a resource (e.g. through the accumulation of resource rents or for subsistence purposes).

Nevertheless, if the resource is open for all to use it is more than likely that it will be unduly overexploited (Gordon, 1954). This will result in the dissipation of resource rents as the resource is depleted. This is the so-called Class I common property problem outlined by Munro & Scott (1985:631). The main prescription to dealing with this problem is to move the resource away from an open access regime through some for of regulation. At an international this process has gradually evolved to result in the establishment of EEZs. These converted open access resources into a state property regime, which is effectively common property to the citizens of a given nation. The South African squid fishery, due to inshore nature, thus falls within the South African EEZ. It is thus a common-pool resource governed by the state, exploited by the citizens of the country (the presence of foreign participants decreased as the fishery developed). Although resources fall within a country's EEZ, they are still *de facto* open access if no regulation limiting access is possible. Even if output controls are established, a situation of regulated open access still prevails (Homans & Wilen, 1997). Fishing capacity (through bigger fleets and better technologies) can thus still build-up within a fishery, a situation similar to the Class II common property problem outlined by Munro & Scott (1985:631). Various management measures therefore have to be used together to effectively regulate any given fishery.

Throughout its development the chokka squid fishery has suffered from problems similar to the one described above. Firstly, when the fishery was formalised in 1983, it was for all purposes an open access resource to the public. This is because no regulations existed and squid were only transformed into private property once they had actually been caught. The resource was thus subject to the rule-of-capture. Effort within the fishery therefore continued to increase, as its perceived commercial value improved – as witnessed by the "gold rush" phase between 1984-86. Even when licensing and permit control systems were adopted, apart from initial reductions, effort continued to increase throughout the 1990s. Increases in effort can largely be attributed to the presence of larger vessels and improved technology, such as more powerful lights (Roberts, 2000 and Sauer, 1995a). This thus highlights the fact that failure to abide by *a priori* input constraints in the form of a TAE may, in the extreme case, result in the entire fishery collapsing. Although the squid fishery has not as yet collapsed, the resource is currently fully utilised (Roel & Butterworth, 2000).

In addition to the usual problems of capacity and effort management, fisheries authorities are further hindered by the biological characteristics of squid. Squid species are generally short-lived species that as subject to much variability in stock abundance (Rodhouse, 2001 and Roel, 1998). This adds a degree of uncertainty in the management of these stocks, as accurate biomass estimates can as yet not be determined. Effort limitations are thus the preferred method of control. These measures can also be adjusted, within a given fishing season, if effort is perceived to be too great. The chokka squid fishery is therefore also controlled by effort (input) limitations, in the form of a TAE. The primary unit of TAE are fisher permits allocated as fishers on board a vessel. These are supported by a closed season imposed during the peak spawning period of squid, usually in the months of October and November.

These measures worked relatively well until reforms, outlining the need for equitable redistribution, were initiated in the industry.

8.3 EQUITABLE REDISTRIBUTION

In line with the rest of South Africa, the squid industry has had to undergo a process of redistribution. The need for redistribution arose from the need to grant greater access to formally disadvantaged individuals. These individuals, because of the apartheid regime, had been denied access, or where effectively excluded (e.g. due to a lack of capital), from participating in the South African fishing industry. As Van Sittert (2002) states, the fishing industry was controlled by White-owned monopoly capital. Although the squid fishery was not entirely dominated by big business, access and participation still favoured the White racial grouping. This is evident when viewing the racial distribution of capital assets (i.e. vessels, companies and rights) outlined in Chapter 6.

Other factors to consider, in terms of the distribution of resources, relate to employment[1] and income opportunities. With regards to employment, the majority of individuals employed are within the HDI grouping. In absolute terms this bodes well for the fishery as it provides a valuable source of employment in a region (the Eastern Cape) where it is sorely needed. However, the majority of HDI employment is at the lower skills levels. In fact about 94% of HDI employment in the primary sector either consists of semi-skilled or unskilled labour. This situation thus reflects the lack of HDI absorption into the professional and skilled categories. This also means that on average, within most skills categories, HDIs earn less. This is especially prevalent in the primary sector (including on-shore support), where Whites within the professional and skilled categories, combined, on average earn 26% more than HDIs. All of these factors indicate that redistribution needs to encompass both social and economic factors. It is for this reason that a *strong redistribution* should be the preferred objective of "transformation".

[1] With regards to employment it is also important to note that the type of employment offered in the fishing industry, of South Africa, is largely of a part time (or commission based) nature. This does thus not guarantee a permanent source of income.

A strong redistribution includes the redistribution of resource rents (through permit rights), fishing capital (vessels and access rights), as well as the transfer of skills and creation of employment opportunities. From Chapter 7 it is however clear that initial attempts at redistribution were not based on a strong redistribution. Because the State attempted to hastily proceed with redistribution policies, it was thought that the easiest way would be to merely redistribute fishing rights (harvesting rights). It was felt that by allowing HDIs greater access, other areas that needed redistribution would follow automatically. This process was however ill conceived, and can probably best be described as institutional failure. Firstly, it was not possible for the market to reallocate individual rights, and thus government intervention was necessary (Hersoug & Holm, 2000). Secondly, when government did intervene, by reallocating rights, this process failed as well (Mather *et al*, 2000). Both institutional structures thus failed to achieve the desired outcome. The result was that the squid industry was forced into a state of turmoil as, among other things, a "paper permit" market formed.

8.4 THE USE RIGHTS SYSTEM

One of the reasons for the disruption and turmoil in the squid fishery, after the initial redistribution attempt, was an "incomplete" property rights system. This was one of the factors that led to the formation of the "paper permit" market. As outlined in Chapter 6, the squid fishery is implicitly managed by a dual use rights system. This means that the fishery uses a combination of access and withdrawal rights together to determine fishing activities. Access rights are determined through the issuing of vessel licences, which in essence grant the holder entry into the fishery. Withdrawal rights are determined by the granting of fisher permits, which give the holder the right to harvest squid. These two forms of use rights should thus act as limitations on each other and fishing activities can only commence once a participant has both forms. This dual system has been outlined in Figure 6.6 of Chapter 6.

Although the dual system seems to hold in theory (Charles, 2000), it is not explicitly stated in the rights granting procedure for the squid industry. Section 21 of the MLRA of 1998 however states that a harvesting right can only be activated through the issuing of a fishing vessel licence (RSA, 1998). In the initial reallocation of permit rights, DEAT did not however strictly adhere to this. Permit rights where allocated to new entrants regardless of whether they owned a vessel or were holders of vessel licences. This probably seemed like the reasonable thing do given the fact that some new entrants, who did not have access to capital, could not afford fishing vessels. The process however opened the system up to problems of adverse selection and moral hazard, which effectively resulted in a "paper permit" market. The problem of adverse selection, which is the opportunistic behaviour from an individual who transfers their right at a negotiated price to vessel owner, was however also due to the lack of clear rights application procedures.

Directly related to the moral hazard problem, was the ill-defined structure of permit rights allocated to new entrants. Firstly, rights were issued in economically non-viable asset sizes. This meant that rights were not of any operational value, as they could not be used to run a viable fishing operation. Secondly, these rights were issued on a short-term basis (i.e. one year), which meant they lacked security. This meant that financial institutions could not use then as collateral. As a medium-term (or transitional period) solution to deal with these problems, and those mentioned above, it is suggested that permit rights be attached to a vessel (according to the vessel's operational category, as defined in Table 6.1 of Chapter 6). This will ensure that no sub-economic permit rights are allocated. These rights must however be structured according to the operational characteristics illustrated in Figure 8.1 below.

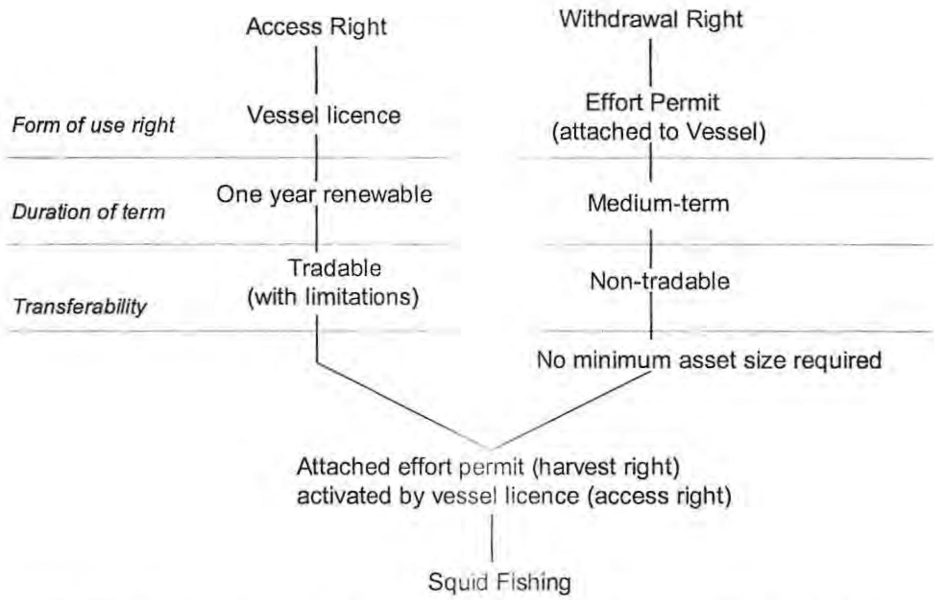

Figure 8.1: The Dual Use Right System including Operational Characteristics
Source: Adapted from Figure 6.6 in Chapter 6

Figure 8.1 outlines the dual use rights system that incorporates the operational-level rules. Effort permits (harvest rights) are thus attached to vessels (which determine access). With regards to the duration of term, medium-term rights should be issued to improve the security of the right; longer-term right should only be issued once an equitable redistribution is achieved. These will be in the form of a vessel licence that grants both access and withdrawal rights. The aspect of tradability also needs restrictions. World experience illustrates that tradable rights will concentrate in the hands of efficient fishers and with long term rights these will thus be entrenched in the hands of a few. The issuing of medium-term rights (a term of four years) is thus a positive move by DEAT, but it is still doubtful whether inequity can be wiped out during this term.

As a long-term solution vessels should be used as the primary unit of effort. The right of participation is therefore solely determined by the issuing of vessel licences. This means that no sub-economic rights can be issued. The dual rights system will therefore not exist. A medium term solution however provides fisheries management authorities with the opportunity to adjust to this new unit of effort limitation. The new rights issued to entrants should be long term in nature, as this will improve security aspects of the system. Users have an incentive to invest in the resource, as it will serve their long-term interests. Compliance is therefore improved and the sustainability of the resource is guaranteed. Long-term rights should also be transferable, as this improves the efficiency of the system.

8.5 INSTITUTIONAL ARRANGEMENTS

Fisheries management within South Africa has historically been governed by the State. All enforcement and major research initiatives have been controlled through bureaucratic government structures that have sort exclusion rather than inclusion in their policies (Van Sittert, 2003). This top-down approach is what determined initial redistribution attempts within the squid industry (Mather *et al*, 2000). Although an established industrial body did exist at the time, policies were implemented without much consultation. Inevitably this led to distrust, confusion and conflict within the industry as government pursued its "command-and-control" attempt at redistribution. This fact was made clear in the aftermath of the redistribution process. As mentioned in Chapter 7, there was conflict between new and existing participants as well as litigation against Government as companies challenged its policies.

The first approach of reallocating rights could almost be viewed as a passive approach at redistribution – hence the perceptions of a weak redistribution. This is because DEAT merely allocated rights and left the racial distribution of capital and fishing skills to the market. A possible reason for this approach can be linked to what Friedel (2000) states was a lack of political will on the part of government to implement the necessary redistribution strategies. A lack of capacity, other than in the scientific research fields, can also be related to this approach. The problem of adverse selection can be attributed to this fact. Because of the lack of capacity and expertise, application procedures were ill conceived, this led to opportunistic behaviour through the selling be "paper permits". The state –centred approach therefore highlights fact government failure was evident in certain aspects of the redistribution process.

Given the fact that government failure was present, proposals for a market-based approach had been prescribed as an alternative since the White Paper on Marine was drawn up in 1997 (RSA, 1997). Hersoug & Holm (2000) however argue that given the highly skewed nature of capital and information, it is unlikely that this approach will work. If one considers the fact that government intervention was originally necessitated because of market failure in the finance sectors, then this argument seems to hold ground. However, as will be highlighted below, aspects of the market approach can be efficiency enhancing and should therefore not be totally discarded.

8.6 RECOMMENDATIONS

In terms of the rights-based management system it is recommended that an incentive-based rights system be implemented within the squid industry as a medium-term solution. This system should be based on permit rights (withdrawal rights) that are attached to vessels, which in turn determine the right of access (as illustrated by Figure 8.1). This use right system should be tailored to ensure that the operational-level rules result in a 'complete' set of rights. The system should also be clearly defined, so that appropriate and enforceable rules outline responsibilities for all users. This is because property rights are created by rules that govern them (Jensen, 2000a). However, as a long-term solution vessels should be used as the primary unit of effort control, obviously using gear restrictions and a closed season as secondary effort controls. Vessel licences will therefore determine the right of access and the right to harvest squid. This simplifies the conditions for the 'right of participation' while reducing the adverse effects of the old system. Rights should also be issued on a longer-term basis, as this encourages investment in the maintenance of natural capital stocks (Scott, 2000a). Making the rights transferable improves the flexibility and efficiency of the system (Anderson, 2000a). These are both desirable in the long term.

In terms of the management structures, the roles of Government should be clearly defined. These should be linked to the core functions of enforcing compliance and distributing access rights. However, due to the government failure highlighted above, it is also suggested that a co-management approach be adopted in the squid industry. This approach seems likely within the industry, as an established industrial body in the form of SASMIA already exists. There is thus a need to separate the roles of the government as sustainability manager from the roles of rights holders (through

SASMIA) as fisheries managers. Giving greater autonomy to users will therefore mean that collective-choice rights will have to be devolved down to fishers. Since DEAT's core function is still to allocate rights, alienation rights should remain with them. Nevertheless participants should still be consulted if rights allocation procedures are to be changed. In terms of collective-choice rights, it is thus most appropriate to grant users management rights. A co-management approach will therefore reduce the "top-down" state-centred approach traditionally utilised in South Africa's fisheries management. As Craig (2000) states, successful property rights management can only be achieved through a "bottom up" approach. This is because co-management gives resource users a sense of ''ownership'' over a resource (Hauk & Sowman, 2001: 178), which fosters a culture of sustainable utilisation.

Lastly, in terms of the functions of the market, incentives need to be created to allow financial institutions the opportunity for providing finance to potential HDI entrants. The issuing of long-term rights would be an example of this. Another way in which the market can aid redistribution initiatives is through the selling of shares within established fishing companies. This is in line with the view of internal transformation programmes; where new entrants or employees gain participation by buy shares in existing companies. After all for the squid industry to remain viable, the expertise and specialised knowledge of existing participants will be invaluable. The industry must maintain some of these skills if it is to remain economically viable.

All of the above recommendations are tailored to achieve a strong redistribution. This means that, along with fishing rights, there will also be a long-term transfer of wealth to new entrants. In line with this perspective, existing firms should be encouraged to "transform" internally by providing opportunities for HDIs to improve their skills and thus gain greater access to income and management positions. A possible disincentive, for existing firms, if this approach is not adopted could be the withdrawal of long-term rights. All the policy options mentioned above illustrate that redistribution attempts require a multi-faceted approach that no one institutional mechanism can achieve alone.

8.7 CONCLUSION

This thesis thus proposes that a strong redistribution approach be adopted as opposed to the passive weak approach initially instituted. This requires a strategic approach that deals with multiple objectives. To accomplish this it is therefore recommended that a co-management approach be adopted – as this attempts to involve all stakeholders. As far as the role of government goes, it should maintain the role of allocating rights, however these should be based on access rights in the form of vessel licences. The role of the market and existing firms should also not be sidelined. These can both be used as valuable mechanisms that enhance the achievement of redistribution attempts. This thesis thus provides some options for redistribution plans within the squid fishery; the implementation of these plans in however beyond the scope of this study.

Appendix I

Fleet Characteristics of the South African commercial Squid Fishery

Category	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Ski-boats										
Avg Length	7.0	7.0	7.0	7.0	7.0	6.8	6.9	6.9	7.0	7.0
Avg GRT	-	-	-	-	-	-	-	-	-	-
Avg Age	23.0	8.1	8.3	8.6	8.1	8.8	11.0	11.9	13.2	13.5
Avg Kwt	122.4	118.4	119.3	120.3	121.5	110.8	99.8	103.3	100.0	88.5
Avg Crew	7.1	7.1	7.0	6.8	6.9	6.5	6.9	6.9	7.2	7.0
Small Vessels										
Avg Length	9.8	10.1	10.2	10.4	10.4	10.8	10.9	10.9	11.1	11.0
Avg GRT	9.0	9.2	10.1	11.1	11.5	13.2	17.4	13.7	18.3	18.0
Avg Age	16.5	16.5	17.2	16.0	14.5	14.7	9.6	15.5	12.9	15.0
Avg Kwt	139.3	13.1	135.6	128.2	132.4	130.5	131.6	139.1	183.9	190.8
Avg Crew	10.3	10.8	10.8	11.3	11.2	11.9	12.6	13.7	12.6	12.3
Medium Vessels										
Avg Length	15.0	15.0	15.0	15.3	15.2	15.4	15.2	15.3	15.3	15.4
Avg GRT	33.3	33.1	34.0	39.6	39.8	41.6	41.4	41.7	42.4	42.0
Avg Age	13.4	12.7	11.9	13.6	11.3	10.4	10.0	11.9	11.7	12.1
Avg Kwt	207.6	218.4	227.6	219.8	205.1	228.4	215.1	220.3	208.9	216.3
Avg Crew	16.2	16.8	17.4	18.5	18.9	19.1	19.6	19.7	20	20.4
Large Vessels										
Avg Length	19.8	20.1	20.1	20.3	20.0	20.0	19.6	20	20.2	20.4
Avg GRT	72.8	76.2	75.7	75.3	74.0	74.2	77.4	75.2	75.7	77.2
Avg Age	22.4	22	22.9	21.9	18.6	20.2	20.4	21.5	22.5	23.8
Avg Kwt	249.4	256.8	259.8	260	235.6	239.2	244.1	243.8	231.7	238.5
Avg Crew	20.1	20.4	21	21.4	23.6	22.8	24.3	24.3	25.3	25.4
Total Vessels										
Avg Length	11.1	11.3	11.3	11.4	11.5	12.6	12.7	12.2	12.9	13.3
Avg GRT	40	41.5	42.8	46	43.7	44.5	48.3	43.6	48	47.4
Avg Age	19	12.8	12.8	12.9	11.4	12.4	11.7	13.9	14	15
Avg Kwt	178	178	184	185.7	181	194.1	190.6	186.4	192.2	205.4
Avg Crew	12	11.9	12.1	12.5	13.2	14.4	15.3	14.7	15.7	16.2

Appendix II

Catch (in tons) per period for the Squid Jig Fishery: 1985-2002

Year	Catches
1985	3100
1986	3400
1987	2796
1988	4826
1989	9791.7
1990	3282
1991	6700
1992	2588
1993	6308
1994	6441
1995	6850
1996	6900
1997	3891
1998	6526
1999	6933
2000	6424.6
2001	3076
2002	4229

Annual Jig standardised CPUE data (kg/man/hr) for the Squid Fishery: 1985-2001

Year	Jan-Mar	Apr-Dec	Total
1985	2.152	5.376	7.528
1986	2.93	2.825	5.755
1987	2.324	3.484	5.808
1988	3.075	3.597	6.672
1989	4.283	4.863	9.146
1990	3.527	2.453	5.98
1991	1.738	3.396	5.134
1992	2.459	2.149	4.608
1993	2.375	3.658	6.033
1994	5.382	2.808	8.19
1995	2.979	2.363	5.342
1996	2.104	1.889	3.993
1997	1.213	1.221	2.434
1998	1.593	2.049	3.642
1999	3.055	2.576	5.631
2000	1.49	1.963	3.453
2001	1.277	1.397	2.674

Appendix III

Monthly catch per Area for the Squid Fishery: 1995-2002

Monthly Catch (in kgs) per area for the Squid Fishery: 1995

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere								737	250	17205			18192
East London				59	1860	2145		4086	37548	86219		729	132646
Port Alfred	21343	825	674	250	496	578	156	38354	82072	154229	11685	80827	391489
Algoa Bay	121105	62066	58185	17205	17075	160218	69265	62832	86482	265227	26931	223645	1170236
Port Elizabeth	305262	61314	53964	83836	179201	88837	99852	69254	118212	251975	123612	293293	1728612
Jefferys Bay	244871	56420	88217	92563	239909	195937	167844	74994	85111	93588	40478	74268	1454200
Seal Bay	22380	19999	24473	9587	24006	3665	27127	3712	6159	4065	8508	45874	199555
Tsitiskamma	115620	78496	58709	70313	85838	31785	28126	59261	67015	51796	81668	132592	861219
Plettenberg Bay	149700	78142	71107	28383	66706	8243	11342	17593	56959	82699	141920	158917	871711
Mossel Bay						66	332	95					493
Still Bay	877	10871		254		20763	1380	210	60	311	94		34820
Hermanus	427					3089					2260		5776
False Bay	246	349	8			10	5		7	45	104	51	825
Total	**981831**	**368482**	**355337**	**302450**	**615091**	**515336**	**405429**	**331128**	**539875**	**1007359**	**437260**	**1010196**	**6869774**

Monthly Catch (in kgs) per area for the Squid Fishery: 1996

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere	20			4				363	127				514
East London					16136	6783	2303	17118	26328	20396		261	89325
Port Alfred	75765	4408	949	7269	6015	9855	6994	5410	4550	6282	56228	119747	303472
Algoa Bay	106381	27161	23980	22243	241131	208750	37385	57366	72826	39005	57771	173102	1067101
Port Elizabeth	198177	179527	121144	111284	267910	80854	64294	127681	126376	95600	96100	140622	1609569
Jefferys Bay	65896	62527	140286	117228	161975	79574	78551	140044	142232	86843	120737	92832	1288725
Seal Bay	39257	16635	30837	11552	21317	5569	9235	17215	10470	4338	15760	12064	194249
Tsitiskamma	99248	57505	194878	128257	55170	30279	17145	102953	35460	76297	85345	150109	1032646
Plettenberg Bay	149049	74250	187811	203201	39461	21174	12521	28958	70121	98487	214592	304178	1403803
Mossel Bay			2599	226		1820	5016	805		307		5229	16002
Still Bay	292	192	1361		25381	13389	14400	9819	1360	11135	10	1045	78384
Hermanus	6	32	313		786	493	5442	400	57	15099	422	186	23236
False Bay	3	9				29	60	11		49		22	183
Total	**734094**	**422246**	**704158**	**601264**	**835282**	**458569**	**253346**	**508143**	**489907**	**453838**	**646965**	**999397**	**7107209**

Monthly Catch (in kgs) per area for the Squid Fishery: 1997

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere				265					100	69			434
East London	160	185	125	25		30	655	754	1147	21186	1590	66419	92276
Port Alfred	29473	6920	1585	16146	2992	6405	1970	3813	12178	163622	80127	478680	803911
Algoa Bay	77184	12090	12531	15533	17404	55732	26522	23586	23907	61307	62931	71182	459909
Port Elizabeth	136653	21053	38489	18902	6163	25713	31469	91897	110179	195167	29186	149655	854526
Jefferys Bay	29855	4332	17897	27041	23583	10451	24284	94734	72940	91276	14339	63939	474671
Seal Bay	4651	196	4807	422	91	650	4388	8517	7861	13390		13352	58325
Tsitiskamma	44970	12927	70801	62058	1672	2596	21388	16756	96164	31624	19943	69365	450264
Plettenberg Bay	77975	7688	153106	50152	2130	3605	16129	8641	30808	28969	8609	155514	543326
Mossel Bay	3892		17					150				185	4244
Still Bay	2180	37478	15657	3906			1859	907	13813	5704	537	991	83032
Hermanus	2573	34154	9929	2281	95		1546	4945	6233			1878	63634
False Bay	138	236		6	114	59	51		557	67	69	972	2269
Total	**409704**	**137259**	**324944**	**196737**	**54244**	**105241**	**130261**	**254700**	**375887**	**612381**	**217331**	**1072132**	**3890821**

Monthly Catch (in kgs) per area for the Squid Fishery: 1998

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere	6					35							41
East London				70		10	2931	235	1001	5435	96	49	9827
Port Alfred	35962	3220	4952	2778	1062	3060	14061	17988	3825	79020	1162	441885	608975
Algoa Bay	13516	5319	8244	11962	15711	58822	65286	194865	67783	100667	26139	531066	1099380
Port Elizabeth	89157	45766	191636	62251	69172	65629	51584	107525	80693	82338	3100	161260	1010111
Jefferys Bay	42005	22542	137644	43826	96734	106843	61835	117476	85980	116277	4525	130175	965862
Seal Bay	3999	10883	26814	7769	23981	14754	7855	12526	5170	8974		33207	155932
Tsitiskamma	80298	54249	159916	66480	182887	135871	69559	42903	41744	150768	2500	277677	1264852
Plettenberg Bay	144126	106026	187467	82816	50347	146927	51814	33594	34933	133659	4900	197838	1174447
Mossel Bay					202	244		22322		2082	330	16000	41180
Still Bay	8010	28789	13445	10037	906	7858	11381	17266	17263	30135	36	1195	146321
Hermanus	4342	7664	1760			7305	1493	5310	7040	10715	6		45635
False Bay	384	237	342	57	281	517	37	632	397	233	36	109	3262
Total	**421805**	**284695**	**732220**	**288046**	**441283**	**547875**	**337836**	**572642**	**345829**	**720303**	**42830**	**1790461**	**6525825**

Monthly Catch (in kgs) per area for the Squid Fishery: 1999

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere							300				15		315
East London						20865	41521	5300	80	108	65	8041	75980
Port Alfred	103750	3496	12798	4767	15783	60851	10502	3962	3891	6659	63737	367711	657907
Algoa Bay	165192	23047	17432	23120	70205	308035	179224	53399	13740	10758	18291	72511	954954
Port Elizabeth	150718	51962	72781	59902	178966	139671	107896	92071	60925	58231	42844	133491	1149458
Jefferys Bay	172994	90843	94577	112560	383121	199799	138739	103850	75955	32755	8873	79650	1493716
Seal Bay	35212	33939	5953	10536	33858	14780	8614	8546	8973	6453		26035	192899
Tsitiskamma	189489	88296	118912	78380	180334	125340	80573	28848	36973	56875	1954	96764	1082738
Plettenberg Bay	126360	60645	166606	140285	277091	74068	19822	15383	17753	47219		136133	1081365
Mossel Bay	48	70	362	50		5051			8239	31712			45532
Still Bay	39976	16430	17346	3741	4570	154	2643		10961	26480	146	12657	135104
Hermanus	1127		3543		537	105	1272	305	20715	8741	1752	21123	59220
False Bay	346	210	155	45	329	467	118	290	53	542	447	356	3358
Total	**985212**	**368938**	**510465**	**433386**	**1144794**	**949186**	**591224**	**311954**	**258258**	**286533**	**138124**	**954472**	**6932546**

Monthly Catch (in kgs) per area for the Squid Fishery: 2000

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere			25	69	2831	1100				44	5959	1300	11328
East London		6069		3241	3499	11206	45049	86212	26699	28365	7463	210518	428321
Port Alfred	23299	3839	1795	4742	12427	6871	11607	33700	82040	127538	32096	59131	399085
Algoa Bay	31690	22518	20893	42128	79949	201961	154188	111278	107488	122953	57570	56167	1008783
Port Elizabeth	104272	78600	33592	73811	65122	126962	83884	42963	158679	93825	164013	156802	1182525
Jefferys Bay	55439	74680	28567	38530	74520	103296	135540	64277	60223	66311	27758	105128	834269
Seal Bay	14794	7494	7878	24754	18161	16585	11058	25385	22454	10156	2278	28138	189135
Tsitiskamma	96827	146028	95088	87843	110839	73293	65414	53321	80976	133702	11112	142113	1096556
Plettenberg Bay	57044	104312	65041	50903	114241	87863	77018	47949	70867	134898	41240	165239	1016615
Mossel Bay	1367	410		2270	3914	558		8087		20			16626
Still Bay	1798	6803	4363	14363	1012	5366	180	14494	7607		9511	12249	77746
Hermanus	5125	11466	6489	7968	12385	13968	25416	36525	22122	4057	5355	12901	163777
False Bay	500	15		12	30	28	72	25		34	7	199	922
Total	**392155**	**462234**	**263731**	**350634**	**498930**	**649057**	**609426**	**524216**	**639155**	**721903**	**364362**	**949885**	**6425688**

Monthly Catch (in kgs) per area for the Squid Fishery: 2001

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere	88480	70			1649		6526	8416	2969	330	10216	10940	129596
East London	208129	5233			1772	893	24028	3772	1257	4024	73388	90457	412953
Port Alfred	37169	3827	3134	6678	15671	20200	22422	13458	8292	12642	16148	33772	193413
Algoa Bay	32389	17639	5224	6194	14317	17772	6935	9113	37019	74288	98123	191344	510357
Port Elizabeth	27228	5685	29869	63094	38240	42668	11334	11312	27611	20425	15168	72390	365024
Jefferys Bay	10254	3857	3795	10116	10633	4552	2750	2865	7136	10565	18287	20886	105696
Seal Bay	41350	14375	15520	36840	58277	32073	11694	7236	42808	72113	54003	234689	620978
Tsitiskamma	30803	13612	5523	21430	19090	28864	19945	4403	78749	82700	42872	185389	533380
Plettenberg Bay		4278	39				2993		350	4314			11974
Mossel Bay	6371	6410	3258	1021				5604	6452	17353		27521	73990
Still Bay	11454	12814	18368	3808		480		4293	1160	10070		1533	63980
Hermanus	164			6910	11				830	2075	18120	26663	54773
False Bay				38		30				15		212	295
Total	**493791**	**87800**	**84730**	**156129**	**159660**	**147532**	**108627**	**70472**	**214633**	**310914**	**346325**	**895796**	**3076409**

Monthly Catch (in kgs) per area for the Squid Fishery: 2002

	Months												
Area	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Elsewhere				1149		3175		6837	664			2359	14184
East London	6965		1979	1830	1137	1404	711	5823	14348	4924	8032	147278	194431
Port Alfred	37675	30571	23284	29020	25608	24129	30232	35213	134621	125739	11089	25316	532497
Algoa Bay	126722	33694	42386	21013	18976	26606	61271	33622	62460	229930	9157	73631	739468
Port Elizabeth	118528	32777	26869	45889	14797	35384	88149	92700	49175	140399	129055	85277	858999
Jefferys Bay	31881	13431	29546	8136	6385	7010	9309	4675	4949	8419	1115	5471	130327
Seal Bay	198113	103286	147743	76715	92464	60823	52965	46671	70722	163749	20549	78358	1112158
Tsitiskamma	161761	75201	45080	48599	49367	35265	82031	74441	34823	239747	86943	64695	997953
Plettenberg Bay					863		505	250			1200	10300	13118
Mossel Bay	3090	5395	5963	3167	334	7768	1225	100	4597	1227		550	33416
Still Bay	14140	5696	3694	8363	898	12936	2088	655	6569	14130			69169
Hermanus	2965	1601		1823	2538	146	115		240	2470		130	12028
False Bay	4048		7450	390	2113	304	2608	270	564	212	3114		21073
Total	**705888**	**301652**	**333994**	**246094**	**215480**	**214950**	**331209**	**301257**	**383732**	**930946**	**270254**	**493365**	**4728821**

Appendix IV

Total Employment per Sector for the Squid Fishery (1999/2000 season)

	Full time		Part time	
Squid Industry Sectors	**Black**	**White**	**Black**	**White**
Vessel Employment	244	51	1629	134
Factory Employment	554	22	87	0
Company Employment	39	48	13	19
Total Employment	837	121	1729	153

Appendix V

Employment numbers, per Company, by skill and race for the Squid Fishery (1999/2000 season)

SQUID	Professional/Managerial				Skilled				Middle services				Semi-skilled				Unskilled			
	Full time		Part time		Full time		Part time		Full time		Part time		Full time		Part time		Full time		Part time	
Employment NUMBER per Company	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
TOTAL	39	48	13	19	39	81	11	7	44	18	6	6	48	10	9	1	177	3	88	3
Andrews LA																				
Barnard TI																				
Bertie-Roberts																				
Biz Afrika 32 (Pty) Ltd	0	1			0												2	0		
Blackbeard																				
Breedt																				
Brigitte Trust																				
C & K Fisheries C.C.																				
Calamari Fishing (Pty) Ltd			0	4			2	1			1	0			2	0			10	0
Caylash Fishing Trust																				
Christina Fishing CC	0	1			0												1	0		
Christy T																				
Coetzer P																				
Comach (Pty) Ltd																				
Computer Visserye CC			2	0															1	0
Davel L																				
De Bruin C																	2	0		
De Castro Fishing CC																				

DMA Fishing Enterprises (Pty) Ltd			0	4							2	0			2	0			8	2
Dodeka Fishing CC																				
Ensemnle Trading 203 (Pty) Ltd																				
Evervest Thirty Two (Pty) Ltd			0	1							0	1							1	0
Fairwinds Fishing (Pty) Ltd																				
Faulkner																				
Gerrard RW																				
GGA Fishing Enterprises CC																				
Goldstone Commercial Fishing CC																			2	0
Gradwell MJ			0	2			0	1											2	0
Groenewald Familietrust																				
Hendricks S																				
Hess AJ																				
Heuwllkor Agtien (Pty) Ltd																				
Highland Fisheries CC																				
Hill, P/D.																				
Homan J																				
Hooke, R.T.																				
Irvin & Johnson Ltd	33	27			33	79	1	0	22	4	3	2					103	2		
J & J Investment Trust																				
Jurassic Fishing Industries (Pty) Ltd			2	2							0	1			1	0			1	0
Kendal Trust																				
Knobel																				
Knysna Fishing Co (Pty) Ltd																				
Komicx Prod. & Knysna Fishing																				

Komicx Products (Pty) Ltd	3	4			3	0	3	0					1	0					37	0
La-Landi Vissery BK	0	1			0															
Lawley Business Partners																				
LM Fisheries (Pty) Ltd															2	0				
Lusitania Fishing Co. (Pty) Ltd																				
Marais																				
Marine Dream Trust																				
Mast Fishing (Pty) Ltd																				
Mihenon Fishing (Pty) Ltd							0	1							2	1				
Montidan Fisheries (Pty) Ltd																				
Muller IP																				
Natasja Vis BK																				
Ocean View & Masiphumelele Fishing			0	1															2	0
Offshore Fishing Co (Pty) Ltd																				
Paarman Fisheries CC																				
Peregrine Trust							1	1											4	0
Perils N																				
Peter Platt Enterprises CC																				
Peterson																				
Pioneer Fishing (Pty) Ltd																				
Premier Fishing SA (Pty) Ltd						1														
Prima Seevisserye EDMS BPK			8	0			4	0											8	0
R C L Fishing CC	0	1			0	1			0	1							1	0		
Raka Trust																				
Ristgans Visserye CC																				

Robberg Sea Freeze (Pty) Ltd																				
Ruacana Investments CC																				
Rupestris Investments CC																				
SA Commercial Fishermans Corp.						0													5	1
Sabalaza Fishing CC																				
Sagittarius Fisheries CC																				
Sangoma Fishing																				
Shehasta Trust																				
Smith																				
Smith, D.C.																				
Smith, E.W.																				
Solitaire Fishing Trust			0	1			0	1											2	0
Squid Packers (Pty) Ltd			1	1							0	1								
St Francis Sea Products CC			0	1							0	1							1	0
Stander																				
Starfish Trust																				
T T M Fishing																				
Talhado ishing Ent (Pty) Ltd			0	1			0	1											3	0
Tamarin Fishing CC																				
The Piscean Trust																				
Total Inventions One CC																				
Trade Off 65 (Pty) Ltd																				
Trade Up-Front 156 (Pty) Ltd																				
Trevors Commercial Fishing CC																				
Tucker JD	0	2			0												1	0		

Ulandi Trust																				
Umsobomvu Fishing (Pty) Ltd																				
Van Bouen, T.T.																				
Van Ginkel A J																				
Van Ginkel M							0	1												
Van Niekerk Fisheries CC																				
Viking Fishing Co (Pty) Ltd	3	11			3	0			22	13			47	10			67	1		
Viljoen																				
Vorster																				
West Point Fishing Corp.																				
Western Star Enterprises Fishing			0	1															1	0
Zingara Trust																				

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