

# **ADVERSE IMPACTS OF INDIVIDUAL QUOTA SYSTEMS ON CONSERVATION AND FISH HARVEST PRODUCTIVITY**

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**ADVERSE IMPACTS OF INDIVIDUAL QUOTA SYSTEMS ON**

# CONSERVATION AND FISH HARVEST PRODUCTIVITY

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## Introduction

Promoters of individual transferable quota (ITQ) management regimes have often held out the prospect that such regimes generally will offer superior performance over alternative fisheries management systems. Anthony Scott, an eminent spokesman for this view, affirmed in 1986: "I have become convinced that quotas are what most fisheries should have" (Scott 1986). Indeed, over the past two decades, the claim of ITQ superiority appears to have achieved the status of "conventional wisdom." Thus Arnason (1995) observes that "... there has now emerged a fair consensus among fishery economists that this [ITQ] management system offers the most promising general approach to managing ocean fisheries." I am among the minority that is not party to the consensus, even though I continue to acknowledge the usefulness of ITQs in certain instances. My purpose in this paper is to challenge the notion of ITQ superiority in an important area of particular current interest, namely that of resource conservation. My *a priori* arguments will focus on innate characteristics of ITQ regimes that appear likely to lead to generally sub-optimal performance in respect of biological conservation and/or the related efficient sustainable use of fish stocks as expressed in harvest productivity.

The ITQ regime characteristics considered in this paper are for the greater part common also to individual non-transferable quota (INTQ) management systems. While the academic debate in this paper will be conducted primarily with reference to the more prominent ITQ-related literature, the conclusions will be largely applicable to individual quota (IQ) regimes in general. The analysis of the transferability feature of ITQ regimes is beyond the scope of this paper. This leaves out of consideration questions of distribution and equity (Copes 1997a), in which ITQ regimes are widely considered to perform unfavorably, and rationalization of labor and capital inputs (Moloney and Pearse 1979) in which ITQs are generally recognized to perform rather well. The efficiency considerations in this paper, then, are specifically concerned with the utilization of fish resource inputs.

The base case for ITQ superiority is a theoretical one. Arnason (1995) argues that "... by appealing to standard economic efficiency theorems, we may be justified in asserting that the ITQ system must generate economically optimal results. In fact it is easy to show, within the framework of standard analytical fisheries models that the ITQ system is in fact optimal in this sense." By juxtaposing such externality-free theoretical perfection of ITQs with the known deficiencies in the externality-scarred practical experience of alternative management systems (or non-managed open access conditions), an easy sense of ITQ superiority may be generated. But we need to compare like with like. With a judicious choice of explicit or implicit simplifying assumptions some other management systems may also be specified so as to achieve theoretical perfection. It is simple enough, for instance, to specify a theoretical limited-entry licensing regime that matches the theoretical ITQ regime in generating economically optimal results in the light of standard economic efficiency theorems.

What really should count is a comparison of ITQ and alternative management systems as they function in a real world environment, "with warts and all," and thus all open to observation of their negative externalities that prejudice the results in any real test of efficiency. It is easy to show how selected features of ITQs may avoid certain diseconomies of other systems. But what needs to be recognized also is that ITQ systems are particularly vulnerable to *Peer's Law* that "the solution to the problem becomes the problem" (Copes 1995). The ITQ approach concentrates on removing stock externalities observable in many fisheries, unmindful of new production externalities it may be bringing in through the back door (Boyce 1992). This poses the question of how often an ITQ cure may be worse than the management disease it is designed to alleviate. To give substance to that question, this paper will explore various external diseconomies to which ITQs are peculiarly prone in respect of the interlocking features of biological conservation and efficient stock utilization.

### **Support for management and conflict of interest**

There is a general question regarding the effectiveness of alternative management regimes that needs to be considered. The most fundamental problem of externalities in the exploitation of the fishery resource relates to its common-pool nature, with no particular part of the resource being exclusive to any one participant in the fishery. This is as much a feature of IQ fisheries as it is of other collectively managed or open access fisheries. It sets up a basic conflict of interest for each fishery participant when contemplating an action that will enhance the value of the participant's individual catch at the expense of good fishing practices required in the collective interest of all participants. By the nature of the problem, individual participants commonly are inclined towards action that puts their self-interest above the collective interest. This is so for the simple reason that they generally reap a relatively large exclusive benefit for their self-interested action (e.g., high-grading in an ITQ fishery) while being exposed to only a small part of the collective cost of such action (i.e., the additional stock mortality represented by the discarded fish) which is shared with all other participants.

In addition to claiming general superiority for ITQs as a management device, prominent supporters have asserted that they offer a particular advantage in promoting conservation. Thus Anderson (1994: 331) in public testimony before the U.S. House of Representatives Subcommittee on Fisheries Management stated: "There are two main benefits of ITQs. First, a quota based management system is better suited to achieve conservation on a consistent basis because it directly limits the amount of catch." As will be argued below, this is precisely the source of a major conservation problem with ITQs, because often they are bound to limit the catch at the wrong level.

Elaborating further in his testimony, Anderson (1994: 332) postulated that ITQs "support conservation by providing incentives for ITQ owners to recommend sustainable total quotas [read TACs]<sup>1</sup> and to support strict enforcement because the value of their ITQs depends upon the health of the stock." Similarly, Schmitt (1994) in testimony before the same Sub-Committee argued: "Fishermen would have a vested interest in protecting the fish and seeing their fisheries managed efficiently in order to maintain the value of their ITQ." Logically such general statements lend no credence to a claim for *superior* management in an ITQ system. One only has to substitute "limited entry license" for "ITQ" in the two statements to construct a parallel claim for the superiority of a limited entry licensing system. For that matter, even in an open access system, participants are wont to assert vehemently that they favour strongly enforced conservation measures and good management because of their abiding interest in the health of the resource upon which they depend

for a living.

The suggestion that because ITQ holders must protect their valuable ITQs they will have a superior incentive to promote conservation, in comparison with participants in fisheries under alternative regimes, is challengeable on several counts. In the first place, *a priori*, there is no good reason to accept that an ITQ will be a more valuable asset than, for instance, a transferable limited entry license in the same fishery under an alternative regime. Which management regime will be more likely to produce the higher valued stock access rights for its participants will vary from fishery to fishery depending on many factors, from which no generalized conclusion is warranted. Secondly, it must be understood that, logically, fishers will be motivated towards conservation as much or more by their *overall dependence* on, or interest in the fishery, than by the *absolute market value* of their fish-stock related assets, as the latter is but a component consideration of the former. Thus a poor subsistence fisher in an open access fishery may be desperately concerned with, and highly supportive of measures to conserve the stocks on which he is utterly dependent to feed his family. A well situated ITQ owner, on the other hand, may have other assets or interests that occupy his concerns much more than do his ITQ holdings. Moreover, as I will discuss below, ITQ owners with high discount rates (i.e., profit expectations) have a distinct financial incentive in the case of some stocks to press for unsustainably high quotas, even to the point of fishing the stocks to extinction.

Apart from the foregoing considerations regarding personal incentives for conservation, one may also observe collective pressures on fishery participants to conform to conservation practices, stemming from such forces as a prevailing resource-oriented culture, community cohesion, or group solidarity. Again, there is no overriding reason to claim that these pressures will harmonize more with ITQ management than with other systems in supporting conservation. It is true that the smaller number of participants characteristic of a rationalized ITQ fishery may facilitate group cohesion; but that would apply also to other rationalization systems, such as limited entry licensing. On the other hand, one may suspect that the ideology of privatization that infuses the ITQ system will render ITQ fisheries less sensitive to community-based environmental concerns that promote conservation, and may condition ITQ fishers to be less willing to subordinate their private advantage to the collective good of the fishery.

The foregoing paragraphs suggest that in a welter of considerations regarding the personal motivation of fishery participants towards resource conservation, there is no *prima facie* evidence of a generally more beneficial influence exerted by the ITQ (or any other) management system. Most importantly, however, all of the foregoing discussion on this topic has really been only peripheral to the central problem, which lies in the different direct impacts that various management regimes exert on fishery conservation. These direct impacts stem from (a) the specific procedural requirements of each separate regime and (b) the specific operational incentives of each separate regime that bear on the conduct of fishers while engaged in the harvesting process. As will be argued below, it is in these areas of direct impact that ITQ systems are uniquely vulnerable to a set of serious problems that leave limited room for superior performance with regard to resource conservation and productivity in resource utilization. Before launching into arguments on these matters, it will be useful first to review the current understanding of the requirements for fishery conservation.

### **The conservation imperative**

During the past decade pressure on many fish stocks around the world has reached crisis proportions. Severe depletion and outright collapse of commercially important stocks are becoming commonplace. Despite greatly increased fishing effort and the diversion of much of the harvesting capacity to exploitation of previously unutilized or under-utilized low-value stocks, total world catches have tended to level off since 1989. Environmental groups increasingly have turned their attention and their agitation to fisheries issues. Enlightened by the experiences of fishery failures and beset by pressure groups, responsible fisheries authorities in several countries are considering or making commitments to new concepts of *sustainable development* and the *precautionary approach to fisheries*, as put forward by the Food and Agriculture Organization of the United Nations (FAO 1994, 1995a).

Unfortunately, by its very nature the precautionary approach remains vaguely defined, or rather, described. The concept is understandable enough. In order to achieve relatively high sustainable fishery yields we need to restrict the pressure on fish stocks so as to reduce the risk of serious or irreversible damage to an acceptably low level. But how high is high, how low is low, and how do we measure either? The risks to fish stocks are so manifold and complex that one may doubt the possibility of calculating and aggregating them in a meaningful fashion, though some specific risk factors may yield to sophisticated estimation procedures (Walters and Pearse 1996). In any case, while risks to the stocks from fishing may be reduced, there is no apparent reason for believing they can ever be eliminated, given the unpredictability of so many natural circumstances that affect the stocks. It needs to be realized also that at some point in the process the cost of further risk reduction becomes insupportably high in terms of lost production from the fishery. In the end we are faced with having to decide judgementally what limitations need to be placed on fishing effort and harvesting practices to produce acceptably low levels of risks that are balanced with the need to draw continuing adequate benefits from the world's various fisheries. Despite the conceptual obstacles and inevitable imprecision, FAO has assembled and issued understandable guidelines for a precautionary approach (FAO 1995a) and a code of conduct for responsible fisheries (FAO 1995b) that may prove to be workable.

Implementing a precautionary approach in fisheries management requires a deliberate and ongoing process to decide when and by how much to reduce the effort or the catch in a country's various fisheries, or to close some of those fisheries entirely. Making the decisions will continue to be difficult. There are, however, additional important considerations that may be brought into play in safeguarding the health of exploited fish stocks. Significant among these is the choice of management system or management technique used in a fishery, as this may have considerable bearing on risk to the stocks. There are several features specific to ITQ (and other IQ) systems that raise the risk of damage to exploited fish stocks beyond the risks that apply to fishing activity generally, as will be described in the sections that follow.

### **The sources of IQ problems**

Among major industry sectors, the fishery undoubtedly provides the most obvious example of massive "market failure" on account of the many external diseconomies by which it is beset. Economists became interested in the unique problems of the fishery in earnest in the 1960s and since then ongoing attempts have been made to design and create management structures that internalize various externalities and thereby improve performance of the industry. A major problem in this process has been that many new fisheries management devices, while being successful in eliminating

some negative externalities, appear to have created new problems in the process. *Murphy's Law for Fisheries* has been in evidence: "If anything can go wrong with a new fisheries management scheme ... it will." ITQ management, which was designed to eliminate negative externalities that were created or left uncorrected in previous management attempts, has shown itself no less at fault in spawning new diseconomies. As *Peer's Law* points out, the solution to a problem may simply change the problem. Indeed, ITQs have proven to be particularly prone to the creation of new externalities and other inefficiencies with a pernicious potential.<sup>2</sup> Many of these, which could be readily foreseen (Copes 1986) were ignored in the rush to embrace the new ITQ conventional wisdom.

Among the negative externalities introduced by ITQ management, those that are particularly pertinent in respect of conservation and harvest productivity may be traced to two major source categories. As already intimated above, these are the innate management requirements of ITQ systems and adverse system-induced behavior among participants in IQ fisheries. Following is a list of what are perhaps the most important externalities in these two categories:

(A) *Management requirements:*

- (1) Relatively inflexible TACs
- (2) Near-irreversible system commitments
- (3) By-catch dumping or by-catch enlargement

(B) *System-induced behavior:*

- (1) Quota busting
- (2) High-grading
- (3) Price dumping
- (4) Ratcheting of quotas
- (5) Discount-driven stock depletion
- (6) Data fouling

The impact of these various externalities will be discussed in the succeeding sections. The source and incidence for each externality is traced in Figure 1.

### **ITQ management requirements and the precautionary approach**

From a basic conservation perspective probably the most important problem in an ITQ fishery is the need to set a periodically fixed TAC, which can then be divided into individual quotas which participants are allowed to use at any time of their choice during the set fishing season. To fulfil the efficiency purposes of the system, participants must be allowed to rationalize their operations, guided by their professional judgement as to when, where and how to fish within the set season, in order to meet the opportunities offered by free markets for manipulation of inputs and outputs in the most efficient manner. Credibility of the system depends critically on meeting the commitment that participants may take the full extent of their allocated quotas at times of their choosing.

(A1) *Relatively inflexible TACs*

If in monitoring the state of the fish stocks during the season scientists become uneasy and conclude

that it would be safer to restrict harvests or to close the fishery entirely for the remainder of the season, their advice to that effect might well fall on deaf ears. Fishers who, using their economic judgement, had reserved a substantial part of their quota for the remainder of the season might well be furious if they would not be allowed to access their remaining quota. If the fishery were closed before individual quotas were filled, all participants would learn that it would be safer next time to race for the fish at the beginning of the season in order to make sure they would be able to fill their quotas. The high promise of rationalization through ITQs would then be seriously prejudiced. Thus managers will be inclined to take risks in order to avoid in-season reductions in the set TAC, even though this would be a requirement for a responsible precautionary approach in fishing.

Some compromises come to mind. For instance, breaking up the season into shorter fishing periods, with TACs and quotas set anew for each period, would give managers more frequent opportunities to make judgements on allowable harvest levels. But to the extent that precaution would be strengthened, the efficiency of the ITQ system would be weakened, as fishing decisions would be largely confined to shorter discrete periods that would seriously reduce the opportunities for efficient operational planning. At the short end, ITQs would be turned into "trip limits" with all the inefficiencies they imply. Alternatively, managers might retain the right to close the fishery in mid-season at their professional discretion, and allow fishers who had then not yet filled their quota to catch up when the fishery reopened. This would still contravene expectations and reduce anticipated benefits of the ITQ system in terms of harvest planning and cash-flow needs. Thereby trust in the system would be reduced, raising the likelihood of racing for the fish in subsequent periods.

The essential problem is that a fundamental requirement of ITQ management, on the one hand, and the critical needs of the precautionary approach, on the other, are basically incompatible. Pearse, otherwise a strong supporter of ITQ management, concedes a weakness in ITQ management on this account. In a co-authored paper (Walters and Pearse 1996) it is acknowledged that the shift to an ITQ fishery "calls for much more accurate and timely stock assessments." The authors continue: "The risk of stock collapse resulting from over-fishing, coupled with growing pressure for low-risk resource management policies, call for conservative quota setting in the face of uncertain stock information. Under existing assessment systems, quotas may need to be so conservative that foregone catches could wipe out the economic gains from quota management." The authors suggest that quota holders should have an incentive "to contribute to, and invest in, the gathering of information to improve stock assessments." What this ignores is that the problem is as much one of information timing as it is one of the amount and quality of information gathered. The pertinent problem with ITQ systems is that their TACs have to be set *in advance* of the season and cannot properly be altered during the season, regardless of the information that is gathered in-season. Alternative "real-time" management systems do not suffer this timing constraint in that they provide for continuous monitoring and allow fisheries managers to close or limit fishing according to changing stock conditions.

The Walters and Pearse (1996) analysis demonstrates that the need for ITQ systems to stick with pre-season stock information in setting TACs, exposes ITQ fisheries generally to a greater risk of stock damage or collapse than is present in well-managed fisheries that are not subject to this inflexible TAC constraint. A corollary of this is that ITQ fisheries, in order to meet equal standards of precaution, have to reduce their TACs to lower average yields than those that may be maintained in other management systems which are able to adjust TACs at shorter intervals or on a flexible real-time management basis. Other fisheries, such as those controlled by limited-entry licensing, at the same risk levels are able to work more closely to full sustainable harvest rates, by adjusting their

catch rates to these levels in-season. Put in other terms, ITQ fisheries have to accept either a higher incidence of stock damage with attendant reductions in subsequent catches, or permanent implementation of a lower rate of harvest productivity (i.e., size of the annual catch from a stock), or some intermediate combination of the two. The risk/catch trade-off in ITQ fisheries is therefore generally inferior across its full range to that achievable in relevant alternative management systems.

There would be little or no conservation problem for an ITQ fishery if it were on a fish stock that was sufficiently stable to allow a TAC to be set at the beginning of an annual season with full confidence that no in-season adjustment would ever be called for. Obviously, very few stocks can meet that condition. Given the normal uncertainties with respect to fish stock dynamics, what the precautionary approach essentially calls for is a simple flexible system, where an indicative TAC may be set at the beginning of the season, but where it is subject to possible or likely in-season adjustment. Managers would then have the authority to revise the TAC on the basis of scientific advice from in-season monitoring. Time and/or area closures on short notice would then be used to contain harvests at levels compatible with precautionary requirements. This is possible in limited entry fisheries in countries that have reasonably adequate management capabilities. Indeed, there are examples (e.g., salmon fisheries in Canada and the U.S.) of fisheries being managed, more or less rigorously, in this fashion. Fisheries conforming to this management mode may well have other problems that need attention in a different context, but the flexible TAC at least allows the precautionary approach to be used and the needs of biological conservation thereby to be served.

Earlier in this paper it was pointed out that proponents of ITQs have claimed that in comparison with alternative management systems, "a quota based management system is better suited to achieve conservation on a consistent basis because it directly limits the amount of catch" (Anderson 1994). Ironically, as the foregoing analysis indicates, this feature of ITQs turns out to be probably their single largest liability in adhering to conservation-sensitive management. Under ITQs, the timing of TAC setting from data that necessarily will be out-of-date during the fishing season is fundamentally at odds with the precautionary approach.

(A2) *Near-irreversible system commitments*

In addition to the inflexible TAC question, there are at least two other notable problems with ITQ fishing that are related to the management requirements of the system. One concerns irreversibility of commitments in the system and the other has to do with the waste of by-catches. The first of these two problems provides further evidence of the difficulty of reconciling ITQ fishing with risk-averse strategies that the precautionary approach requires. When introducing a new management system, risk aversion suggests a need to experiment with that system without making commitments that will cause irreversible changes to occur that may turn out to be inordinately harmful to the biological, social, or economic structures of the fishery. If then, in the shorter or longer run, the new system that has been attempted proves inadequate and threatens to put the fishery at risk, the opportunity remains open to revert to a prior system of management, or try another one still that then appears to hold greater promise.

ITQs do not lend themselves easily to a risk-averse process of experimentation. The successful implementation of an ITQ system depends very much on embedding property rights to individual quotas in order to achieve the rationalization of effort on which the system's economic rewards are dependent. Among the experts it is widely recognized that in the experimental process with individual quotas there are strong forces that push for successive steps, starting with non-transferable short-term quotas, and progressing successively to longer term quotas, short-term rentable quotas and permanently tradeable ITQs. The dynamic of this progression is fed by arguments for the need to fully rationalize the fishery to prove and achieve ITQ benefits, and by the rent-seeking urge of quota holders who seek opportunities to make handsome windfall profits from cashing in, sooner or later, the fishing rights they likely obtained for free as initial participants in the quota fishery. Once the fishery has been fully committed to the ITQ system, with explicit or implied property rights vested in quota holders, it is very difficult to return to a condition in which the fish stocks resume the status of a public resource for which the state is able to set the conditions of exploitation and management. For reasons of equity it would likely require buy-back of the quotas that were initially distributed free, as a number of the current owners would have bought their quota on transfer and paid the full market price. It would be a fiscally stressful process that would likely be resented by taxpayers and therefore not readily undertaken by government. Cancellation of an ITQ system, no matter how imperfect it turned out to be, is not a very likely prospect.

(A3) *By-catch dumping or by-catch enlargement*

Most fisheries produce catches containing more than one species, even when they deliberately target on a single species. This complicates stock management and may be expected to create particular difficulties in an ITQ system (Copes 1986, Dewees 1989). To safeguard the stocks of all of the species in the catch, an ITQ system logically should set and enforce quotas for each within scientifically determined TACs. But it is impossible for any fishing vessel operator to determine the proportions of the species that will be brought up in the net, so that they will match the quotas held for various species. Inevitably, in the process of filling all of the quotas held, excess amounts of fish will be caught from species for which quota entitlements have already been exhausted or from species for which the operator does not have any quota.

All kinds of more or less cumbersome devices have been proposed and/or attempted to cope with the problem of matching species catches with species quotas, both at the individual operator's level and for the fishery as a whole. The results have been imperfect at the least and often decidedly unsatisfactory, as accumulated experience in New Zealand has already clearly shown (Dewees 1989, Sissenwine and Mace 1992, Duncan 1993). This paper is not the place for a review of the by-catch problem in detail. Suffice it to say that in multi-species fisheries ITQ systems inevitably will produce substantial catches in excess of quota for some species in the mix, leading to impairment of the management system with a variety of undesirable outcomes. Depending on design of regulations and success of enforcement, these surplus catches may be dumped (wasteful) or black-marketed (inequitable and illegal); or if the by-catches may be retained this may encourage operators "accidentally" to increase those by-catches and over-fish the stocks concerned. All of this plays havoc with proper biological management and puts the stocks at higher risk. Of course, alternative management systems may also face difficulties with multi-species fisheries. However, they are not constrained by any need to respect the right of operators to continue fishing until their individual quotas have been filled. Non-quota systems therefore have the flexibility of being able to act swiftly and close a fishery entirely, or set any other time or area restrictions needed to protect particular

stock components or the fishery as a whole.

### **Detrimental system-induced behavior**

As already observed, the installation of an ITQ system leaves a fishery open to the possible introduction of new external diseconomies. Indeed, with *a priori* reasoning, several such externalities were identified in advance of the introduction of contemporary ITQ systems and have formed the basis of challenges to ITQ policies (Copes 1986). Particularly noticeable among the externalities are several that may be traced to fisher behaviour in response to incentives introduced by the ITQ system. Following are comments on prominent examples of such behavior that is obviously detrimental to conservation:

#### *(B1) Quota busting*

An obvious weakness of the ITQ system is the need to prevent fishers from taking more than their allowed quota of a species. Particularly in small-boat fisheries, where there may be hundreds or thousands of vessels out on the water fishing legally with valid quotas, it may be well nigh impossible to spot transgressions and prevent fishers so inclined from taking catches in excess of quota, especially if there are many landing sites and many channels through which they may dispose of the fish. Most of the world's fish catch is taken in geographically dispersed small-boat fisheries, where the cost of any effective attempt at enforcement might well be prohibitive. There is a great deal of anecdotal evidence of serious levels of quota busting in many fisheries, though it is virtually impossible to secure meaningful estimates of illegal catches. Successful quota busting leads to an excessive draw-down of stocks and brings the management system into disrepute. It encourages previously law-abiding fishers to join the transgressors in their illegal activities for fear of being put at a disadvantage. This can only further imperil stock protection efforts.

#### *(B2) High-grading*

To obtain the greatest net value from a species quota, a fisher naturally will want to fill the quota with fish of that species that fetches the highest price per pound. This provides an incentive to discard fish that has a lower value per unit weight (high-grading), because it is of a non-preferred size or of lesser quality for one reason or another.<sup>3</sup> It is recognized that high-grading takes place in many ITQ fisheries, on a smaller or larger scale, and that it represents an unjustifiable waste of fish (e.g., Copes 1992, Dewees 1989).

A possible measure to discourage high-grading would be to issue quotas in value terms, rather than in physical quantity terms (Copes 1986, Turner 1996, Willmann 1996), so that fishers would not face a reduction in total revenue by retaining lower-value fish and would not dump fish for the sake of higher-value catches later. But there are serious problems with this alternative, including the cost and complexity of administering it in the face of ever-changing prices over time and among buyers, with opportunities for cheating on reported values through trade collusion. A value-based quota system might also threaten the quality of fish landed by capping harvester revenues and thus removing the incentive that quantity-restricted harvesters have to increase revenues through value-added improvements to their catch. For these various reasons the prospects for successful value-based quotas appear tenuous.

*(B3) Price dumping*

In many fisheries port prices for fish vary considerably from day to day (or within a day), according to the vagaries of local supply and demand conditions. In a quota fishery it is possible for a fisher returning with a catch to hear on the radio that the port price has dropped drastically. It is known that under these circumstances some fishers will dump their catch so that it will not count against quota, in the hope and expectation that prices will be much better on a subsequent occasion.<sup>4</sup> Obviously, this practice damages stocks. The incentive to dump does not hold in a non-quota fishery, where landing the catch will not reduce opportunities for future catches at higher prices.

*(B4) Ratcheting of quotas*

The precarious nature of the fishery inclines fishers, on the whole, to have notably short time horizons and high discount rates. To paraphrase a well-worn saying: "A fish in the hand is worth ten in the water." Thus, the surety of an immediate catch weighs heavily in relation to speculation on a better catch in the future. Consequently, fishers may be inclined to press for increases in TACs (and thus in ITQs), and to resist reductions, unless they are persuaded of an imminent danger of stock collapse. For political and other reasons fisheries managers and politicians are often sensitive to pressure from fishers. At times, against biological advice, they will give in to such pressure and increase permissible catches, or fail to lower them when needed, as has happened in Canada's Atlantic Coast fisheries (Crosbie and Stevens). Thus one may observe a tendency for quotas to be ratcheted upwards when stocks are stable or growing, but often a failure for them to drop when stocks are declining (Duncan 1993). This, of course, is contrary to the requirements of the precautionary approach. It is true that upward ratcheting of TACs may also occur for the same reasons in non-IQ fisheries. However, as argued above, other systems typically are better able to react quickly to evidence of declining stocks with swift closures, so that IQ fisheries may be expected to be more at risk from upward ratcheting.

*(B5) Discount-driven stock depletion*

The promotion of ITQs as a form of "privatization" of the fishery is often coupled with the notion that ITQ-managed fish resources should be recognized as private property. The impossibility, in most cases, of sequestering wild fish assemblages into units that are owned and managed independently by private individuals or companies, has led to pressure instead for associations of ITQ holders to take over more and more of the management authority for the stocks in their fishery, to the advantage of their members. This development is supported by the argument that quota holders have a direct interest in the profitability of the fishery and for that reason will manage it most efficiently and therefore sustainably.

On closer investigation the argument fails, as the pursuit of high profit levels is often the enemy of sustainable fishing. Corporations and investors of ample means have demonstrated considerable interest in the acquisition of large holdings of quotas in a number of fisheries, often in a speculative mode. They commonly have high private discount rates, reflected in expectations of high profit levels. Economic calculations demonstrate clearly that in some fisheries (particularly for long-lived, slow-growing species, for which maximum sustainable catches are a very small part of the total biomass) the higher target profit levels can be satisfied--and can only be satisfied--with a rapid fishing-up of the biomass to the point of stock collapse or extinction (Clark 1985). The large profits

thus secured may then be used partly to write off the quota investment in the fished-up stocks, leaving the rest of the high profits to be invested in quotas for alternative fish stocks, where the scenario may be repeated, or for investments outside the fishing industry. Elements of this analysis may be traced in the experience of the ITQ-managed orange roughy fishery of New Zealand. The offshore fishery for this long-lived species (reportedly with individual fish reaching ages well in excess of 100 years) has been pursued by larger fishing companies which have successfully pressured the government into allowing them unsustainably high annual quotas, resulting in high immediate profits, but serious depletion of the stocks.

While the pursuit of large profits may motivate quota investors with high private discount rates to deplete some fish stocks, the general interest of the public is expressed in much lower social discount rates, compatible with sustainable use of renewable resources. Divorced from individual profit considerations, the public has an interest in sustaining bio-diversity in a healthy natural environment for current and future generations. This speaks for continuing public ownership of marine resources and public control of their management.

#### (B6) *Data fouling*

As indicated in the preceding paragraphs, ITQ systems induce a number of behavioral responses in fishers that are quite inimical to good fisheries management and conservation. Often these have a secondary effect of "data fouling" that adds further to ITQ management problems and puts greater strains on conservation. Quota busting and poaching are illegal and operators engaging in these practices undoubtedly will fail to report them. Officially recorded catches therefore will understate real catches and the real drain they impose on fish stocks. Discarding of fish through high-grading and price dumping may or may not be illegal, but it is as a rule not reported and thereby represents an unrecorded and largely unknown drain on fish stocks. All of these problem practices have the effect of "fouling" the data used by scientists to calculate the TACs that need to be prescribed to ensure that fisheries remain sustainable at high catch levels.

Unfortunately, scientists have sometimes assumed that what they do not know concerning drains on a stock, does not exist. By either ignoring or underestimating unreported and discarded catches, they are liable to assume higher stock densities than actually exist and consequently recommend catch levels that are not sustainable. In any case, with "fouled" data they will not be in a position to calculate TACs with an appropriate degree of accuracy, with adverse consequences for fisheries management. Data fouling, for instance, has been notoriously high in European Community national quota fisheries, which has been of great concern to the scientists responsible for their management (Gulland 1985, Copes 1986). Consider also Canada's experience. Individual quota systems were introduced in the country's Atlantic fisheries in 1976 and were rapidly expanded after 1982, soon extending to the larger part of the catch. There has been a great deal of anecdotal information regarding quota busting, high-grading, by-catch waste and consequent data fouling, much of it acknowledged by fisheries officials. In 1992, after a decade of extensive use of individual quotas, Canada's Atlantic Coast for the first time ever experienced a massive and multiple collapse of cod and other groundfish stocks, leading to an extended moratorium in the fisheries concerned. Almost a decade later there are still but modest signs of stock recovery.

#### **Conclusion**

This paper has explored a significant number of faults that are generated by unique characteristics of

ITQ systems and that impair the ability of such systems to engage in the risk-averse management strategies that are appropriate to the precautionary approach in fisheries management. The effects of these faults have been identified in working ITQ systems, though the full cost of their consequences still needs to be established from empirical research. The evidence of these faults in ITQ systems is firm and voluminous in relation to the sparse information and challengeable claims that ITQs would offer superior incentives for conservation. This suggests a *prima facie* case that ITQ systems in fact tend to be inferior to some alternative systems in their ability to conserve fish stocks (Copes 1997b).

Walters and Pearse (1996) have suggested that ITQ systems could make up for one of their major shortcomings, namely that of having to provide greater safety margins in setting TACs. This would be done by spending more resources on the generation of stock data which would help to produce more reliable TAC estimates. There is no evidence, however, that this could compensate for the inability to apply the information in a timely manner. Alternative management systems would have the option of gathering the same information at the same cost and using it to better advantage in adjusting their flexible TACs in a more timely manner. In addition it needs to be considered that ITQ systems already tend to suffer from an inferior data base because they are uniquely and inordinately vulnerable to data fouling. Therefore, no matter how high their expenditures on data generation, ITQ systems could not expect to achieve the levels of risk limitation that flexible-TAC systems could reach at the same or lower cost. In an effort to meet appropriate standards of risk limitation, ITQ systems would face prospects both of having to use (inflexible) TACs that were lower than the (flexible) TACs of alternative systems and spending more resources on cleaning up data fouling and generating superior data, with trade-offs between these two tactics. Both the higher costs and the lower catches signify a lower harvest efficiency relative to some alternative management systems.

The case for ITQ systems is often made by contrasting some of the more favorable anticipated or achieved results in specific ITQ fisheries with some of the most depressing results in fisheries characterized by open access, grossly excessive capacity and/or severe over-fishing. The conventional foil is the former Alaskan "derby" fishery for halibut where the annual catch was taken in a single opening that eventually shrank to a few days only. To justify an ITQ fishery the real comparison that needs to be made is with a well-managed limited-entry system with effective provision for capacity controls.

If the *prima facie* evidence of risk of inferior performance by ITQ systems in respect of conservation is confirmed by convincing empirical investigations, this does not necessarily make a case for abandoning all ITQ regimes. There is recognition that ITQs are particularly effective in some other facets of fisheries management, most importantly in rationalizing capital and labor inputs, though there are also additional negatives, especially in respect of equity in the distribution of benefits (Copes 1997a). Given great variations in the natural, economic, social and political circumstances of diverse fisheries, as well as in the objectives they are expected to meet, one may expect the relative advantages and disadvantages of using ITQs to be weighted quite differently from one fishery to another. On balance, ITQs may well be justified in some fisheries, where the risk of adverse conservation and social impacts is low and the benefits of ITQ rationalization are high, but not in other fisheries where this is not the case. However, considering the long-run importance of adhering to a strongly precautionary approach, it behooves all parties interested in the welfare of fisheries to subject further proposals for the introduction of ITQ systems to thorough investigation, with an impact assessment requirement to show their ability, in respect of the fisheries concerned, to measure up to adequate precautionary standards of conservation, without sacrificing competitive levels of

harvest productivity.

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## Notes

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1. In the fisheries management literature the terms "total quota" and "global quota" have crept in as synonyms for the correct and perfectly descriptive term "total allowable catch" (or "TAC"). This has

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created unnecessary confusion as to whether an unspecified quota is total or partial. It has also turned any fishery with a TAC into a "quota" fishery, thus blurring the important distinction between fisheries that do and those that do not have individual quotas. In any case, the (Concise Oxford) dictionary defines a *quota* as "the share that an individual or company is ... entitled to receive from a total." Thus reference to total or global quotas constitutes a contradiction in terms. I plead that the offending terms be expunged from the literature.

2. It is debatable whether all of the categories of inefficiencies enumerated in this section should be classified as externalities, i.e., uncompensated costs imposed by some persons or agencies on others. Undoubtedly, the categories listed under *system-induced behavior* would qualify as negative externalities. However, one might argue that those listed under *management requirements* are simply inherent characteristics of a system that may represent inefficiencies but should not be labelled as externalities. In this paper, using a broad concept, they are considered externalities; for they do result in uncompensated costs to fishers collectively, relative to alternative systems.
3. High-grading pertains to the dumping of fish that has a value in excess of the social cost of landing it and should be distinguished from the discarding of trash fish that is not worth the (social or private) cost of landing it.
4. This is reputed to have happened, for instance, in the British Columbia ITQ fishery for sablefish.