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Synthesis

Individual transferable quota contribution to environmental stewardship: a theory in need of validation

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ABSTRACT. We explored the extent to which (1) individual transferable quotas (ITQs) may lead to changes in environmental stewardship and (2) environmental stewardship may in turn contribute to explain the success or otherwise of ITQs in meeting sustainability objectives. ITQs are an example of incentive-based fisheries management in which fishing rights can be privately owned and traded. ITQs are aimed at resolving the problems created by open-access fisheries. ITQs were proposed to promote economic efficiency, and there is growing empirical evidence that ITQs meet a number of economic and social fisheries management objectives. Even though improved stock status arises as a consequence of the total allowable catch levels implemented together with ITQs, the effect is difficult to separate from the improvement attributable to existing and new management changes. However, stock status improvements have also been attributed to increased environmental stewardship resulting from the allocation of individual fishing rights. We defined environmental stewardship as a set of normative values that private individuals may hold, and that entail perceived duties and obligations to carefully manage and use marine resources. We did not debate the success or otherwise of ITQs in meeting sustainability objectives but discussed the premise that this success may in part be a consequence of a change in fishers' environmental stewardship. In particular, because of the absence of empirical literature, we explored the theoretical effects of the introduction of ITQs in conjunction with comanagement on a change in environmental stewardship. Although psychological theory suggests that there may be a relationship, there is insufficient evidence to draw the conclusion that improved environmental outcomes are attributable to changes in stewardship ethics arising from the combined effect of allocating fishing rights and comanagement in ITQ-managed fisheries. Complexity added by the move to fewer and generally larger scale fishing operations, the concentration of ownership with processors and investors, the increasing numbers of lease fishers, and corporate membership on comanagement committees may all affect stewardship, and more research is needed to establish in which direction these effects are in fact playing out.

Key Words: *comanagement; environmental ethics; fisheries management; fishing rights; stewardship*

INTRODUCTION

Even though on a global scale exploitation rates for ocean fisheries have declined (Worm et al. 2009), it is estimated that about 30% of fish stocks still require rebuilding (FAO 2010). Moreover, small unassessed fisheries may be in worse condition than well-assessed fisheries at the global scale (Costello et al. 2012). To achieve further reductions in exploitation rates and thus improved sustainability outcomes, some researchers have promoted the use of incentive-based approaches to fisheries management (e.g., Hilborn et al. 2005, Branch et al. 2006, Hilborn 2007). These approaches recognize the importance of relying on economic incentives to influence the decisions of fishers (e.g., Grafton et al. 2006). Economists Gordon (1954) and Scott (1955) were early advocates of using the allocation of use rights as a means to limit access to the commons, and thus to avoid the development of excess capacity in fisheries, and create incentives to conserve fish stocks. Allocating individual fishing quotas (IFQs), also called catch shares or individual transferable quotas (ITQs), is one of a number of methods, with common property or communally owned use rights, also successful in achieving positive environmental outcomes for fisheries management (Quiggin 1988, Ostrom 2000, Agrawal 2001, Charles 2001, 2002, 2006, Ostrom and Hess 2008, Gelcich et al. 2010).

The way in which ITQs are implemented is thought to have a major bearing on their success (Charles 2009). A comanagement approach is generally implemented alongside the creation of a form of ownership through ITQs. The composition of stakeholder representation on comanagement committees and their level of involvement varies (McCay 1995) but generally includes fishers, quota owners, scientists, and government officials and sometimes conservation and processor representatives (Smith et al. 1999). Comanagement involves a spectrum of approaches from widened consultation with resource users through to the direct assumption of management functions by fishers (Caddy and Seijo 2005), in particular with respect to decisions about setting a total allowable catch (TAC).

Unlike property ownership in land-based systems such as agriculture, ITQs involve an access right to a shared resource, the value of which is determined by a collectively set TAC, which generally has to be agreed on by members of the comanagement committee. Similar to forestry on public land and oil and gas extraction, it is "typically true that those engaged in fishing do not own the resource *per se* – until those fish are actually caught" (Charles 2009:254). ITQs are a use right that can be compared to, for instance, owning an apartment in an apartment block, analogous to owning a fishing right in a fishery, where the apartment block itself is owned by another entity and managed collectively, i.e., the fish are owned by the people, whereas the fishery is comanaged by the fishing industry and state or country (Charles 2009).

It is sometimes argued that individual quotas are in fact not a use "right" but rather a "privilege." From a legal perspective, in most current quota systems, such privileges indeed only stand subject to a set of regulations, including the level of TAC of which they are a proportion. However, individual quotas possess most if not

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all of the characteristics of property rights because they are generally durable, exclusive, and transferable and cannot be arbitrarily removed or diluted (Truelove 2000, FAO 2013). At least in the perception of quota traders, leaseholders, and quota owners, fishing rights are often perceived as de facto property rights (FAO 2013).

The allocation of IFQs is a vexed issue because they are often allocated on the basis of past fishing activity, and gifting may thus reward history (Armstrong and Sumaila 2001, Pascoe et al. 2013). Despite potential issues around allocation, ITQ management has been implemented for more than 3 decades in some fisheries, with an estimated 250 fisheries around the world that now have some form of ITQ management system (Costello et al. 2008, Chu 2009). ITQs are currently mostly applied in large-scale fisheries in industrialized countries with much less use in small-scale artisanal or subsistence fisheries. A growing amount of empirical evaluation of this type of management approach from an economic, social, cultural, and environmental perspective has been undertaken (Essington 2010, Sumaila 2010, Olson 2011, Emery et al. 2012, Thébaud et al. 2012).

With regard to the economic impacts of ITQ management, some studies show that ITQs can promote economic efficiency (Grafton et al. 1996, Hannesson 1996), the more profitable fishers remaining in the fishery operating at reduced costs and/or in some cases at an increased output value (e.g., McCay et al. 1995, Dewees 1998, Squires et al. 1998, Arnason 2005, Hamon et al. 2009). In some situations, the economic outcomes of ITQs are less well defined. For example, in multispecies fisheries (e.g., Costello and Deacon 2007), in situations of multiple or shared jurisdictions (e.g., Kulmala et al. 2013), in the absence of robust estimates of the resource stock abundance (e.g., Walters and Pearse 1996, Asche et al. 2007, Sumaila 2010), in the absence of sufficient monitoring and compliance (e.g., Hatcher et al. 2000, Parslow 2010), and potentially where a lack of cash flow leads to failure in the market for quota, ITQs may not achieve a high level of efficiency.

Empirical information on the social impacts of ITQs has grown over the past few decades. We label social impacts as those that affect the activity and well-being of a community, the individuals within it, and their families. Social impacts of ITQs have mainly focused on negative equity outcomes (Hannesson 1996, Guyader and Thébaud 2001, Olson 2011) including issues around the initial allocation process (Copes 1986, Matulich and Sever 1999, Macinko and Bromley 2002, 2004, Bromley 2009), the extension of corporate control at the expense of small-scale local interests (McCay et al. 1995, Pálsson and Helgason 1995, Davis 1996, Davis and Bailey 1996, Jentoft et al. 1998, Munk-Madsen 1998, Pálsson 1998, Pinkerton and Edwards 2009), and subsequent social stratification, changing social interaction, and gender relations (Gerrard 2008). There also appear to be trade-offs between improved economic efficiency and the nature and amount of employment in fisheries. Changing job structures lead, in some cases, to a fall in full-time equivalent jobs (Sumaila 2010, Olson 2011), mostly affecting crews (Stewart et al. 2006), whereas other research has shown that ITQs can also lead to an increase in the proportion of full-time jobs and a decrease in the proportion of part-time work (Batstone and Sharp 1999). Other effects of ITQs include both positive and negative changes in compliance and misreporting (Copes 1986, Bromley 2009), as well as improved fisher health and safety resulting from increased flexibility in allocating fishing time (Pinkerton and Edwards 2009).

A number of studies have also considered the impacts of ITQ management on the culture of particular indigenous communities. For instance, for the Maori in New Zealand (e.g., Day 2004, Yandle 2006), the Mi'kmaq in Canada (Charles 2006), and the Saami in Norway (Davis and Jentoft 2001), privatization of fisheries access rights was found to be at odds with cultural norms. In some indigenous communities, ITQs were thought to spell the end of a traditional way of life, leading to questions being raised regarding the usefulness of ITQ management in these small-scale fisheries (Sumaila 2010).

The effectiveness of ITQs can also be evaluated against resource sustainability and broader ecological outcomes (Chapin et al. 2009, 2010). In a review of exploitation trends for all ITQ-managed fisheries, Costello et al. (2008) found that ITQ-managed fisheries were half as likely to collapse as those that were not managed in this way (Smith et al. 2009). Similarly, Branch (2009:39) found that "ITQs have largely positive effects on target species, but mixed or unknown effects on non-target fisheries and the overall ecosystem." Even though Costello et al. (2008) suggested that there is a relationship between target stocks improvement and ITQ management, we do not explicitly discuss the process by which these improvements arise. Essington (2010) failed to find systematic evidence of the broader ecological benefits of ITQs, a finding also supported by Melnychuk et al. (2012) and Essington et al. (2012). An explanation for the lack of environmental improvement under ITQs could be attributable to the fact that fish remain a common pool resource under ITQs and the "rush to fish" may not be entirely eliminated, for example with respect to areas or periods at which fish are particularly catchable. Higher initial catch rates and thus lower unit costs provide an incentive for individuals to catch extra because that person obtains the benefits but shares the costs among everyone (Copes and Charles 2004).

Measuring the success of ITQs in meeting stock sustainability objectives is not simple because the effect of allocating individual transferable catch shares cannot be easily separated from the effect of setting an appropriate TAC level (Bromley 2009, Garrity 2011). Moreover, ITQs tend to be implemented with other pre-existing or new management arrangements, such as input controls (Emery et al. 2012) and comanagement. Moreover, ITQs are not the only way by which better environmental outcomes can be achieved. Other pathways may involve legislative requirements, such as compulsory improvements to destructive and environmentally damaging equipment; extension and education campaigns, e.g., SeaNet (http://www.oceanwatch.org.au/seanet/); or creation of consumer-driven certification schemes such as the Marine Stewardship Council. In fact, it is acknowledged that relying on ITQ systems alone will in general not be sufficient to achieve the environmental objectives of ecosystem-based fisheries management (Gibbs and Thébaud 2012).

In addition to the previously mentioned factors that may be involved in determining the effects of ITQ on resource sustainability, a case is sometimes put forward that these systems can also lead to a change in environmental stewardship (Garrity 2011). Although there is a general lack of studies that provide empirical evidence for the relationship between environmental

stewardship and improved ecological outcomes resulting from the introduction of ITQs, and indeed a general lack of empirical data on stewardship in fisheries, it also seems that a theory of such relationships is also lacking, on which empirical investigations could be conducted.

We explore the extent to which environmental stewardship may contribute to explain the success or otherwise of ITQs in meeting sustainability objectives. As detailed subsequently, we define environmental stewardship as a set of normative values that private individuals may hold with respect to the marine environment and its uses, and that entails perceived duties and obligations with respect to the careful management of these uses.

DEFINING ENVIRONMENTAL STEWARDSHIP IN FISHERIES

Environmental stewardship has been defined as responsibly managing activities with due respect for the health of that environment by being the environment's caretaker or custodian (Department of Environment and Heritage 2005). In fisheries, it is useful to look at environmental stewardship in relation to two sets of actors: fishers "at sea" and fishing industry representatives in comanagement roles on decision-making committees and boards, i.e., "on land."

Examples of lack of "at sea" environmental stewardship include noncompliance and cheating through underreporting, but also discarding and high grading (Charles 2009, also Smith et al. 2009). At the comanagement level, environmental stewardship can be reflected in decisions about setting appropriate TACs, but also by industry participation in data collection and monitoring. Evidence for lack of environmental stewardship could include upward pressure on TACs exerted by the fishing industry contrary to scientific advice on sustainable levels.

Environmental stewardship is sometimes associated with the economic drivers that exist in ITQ systems, including an interest in maintaining or increasing the economic value of quota shares (Arnason 2005, Branch et al. 2006, Festa et al. 2008, Chu 2009, Essington 2010). By virtue of their economic interest, fishers "on the water" and those representing the industry at the comanagement level would be expected to look after fish stocks, including the natural ecosystem on which the fish depend, in the same way that they look after other assets they own. Even though we mainly focus ownership at the individual level, it also applies at the communal level where environmental stewardship can arise if the utility of communal cooperation in owning and looking after an asset exceeds the utility arising from individual interests (Davis et al. 1997, Charles 2009).

Environmental stewardship has also been explained from the perspective of noneconomic drivers. In this context, environmental stewardship is understood to arise from attitudes and deeper moral norms (Lam and Pauley 2010, Pitcher and Lam 2010). Environmental stewardship can be understood as "an ethical responsibility when short-run profit-seeking behaviour dictates practices contrary to long-term maintenance of [environmental] quality [of natural resources]" (Sauer et al. 2011:32). The concept thus relates first and foremost to the ethical dimensions of actions impinging on natural resources, at individual and collective levels. It carries a strong moral dimension, which may work in an opposite direction to personal interests. In this view, environmental stewardship is seen as a duty, a moral virtue, or a way to secure future benefits for others (Thompson 2011). In a detailed investigation of the stewardship concept applied to land use and conservation, Worrell and Appleby (2000) stress that this feeling of responsibility for the benefits of others may encompass the wider community and future generations, as well as the natural world itself. Environmental stewardship, thus understood, has been described as one of the key underpinnings of ecologically sustainable resource use (Sperling 1997).

We first set out to better understand how ITQ management approaches might inspire stewardship, considering theoretical predictions from the psychology of land ownership. We then assess whether the success or otherwise of ITQs could in part be a consequence of a change in fishers' environmental stewardship, created in ITQ-managed systems through the introduction of ownership of harvesting rights (Pierce et al. 2004). In doing so, we consider how a change in existing stewardship in a fishery may play out in practice given the diversity of individual views of the world and economic situations that may coexist among fishers. We suggest ways to improve predictions as regards the attitudinal changes that may be observed following the introduction of ITQs and the nature of empirical investigations that could be guided by the theoretical principles we have identified.

HOW ENVIRONMENTAL STEWARDSHIP ARISES AT THE INDIVIDUAL LEVEL

To allow analysis and measurement of change in environmental stewardship in fisheries occurring as a consequence of ITQ management, we need to consider how environmental stewardship arises and what the possible connection between property ownership and environmental stewardship may be. This question has been the focus of research in behavioral psychology, which explains why we care more about, i.e., "feel" more protective toward the things we own (Pierce et al. 2003, 2004, Avey et al. 2009). The behavior and decision making of a self-interested individual will reflect the higher values placed on goods owned by that individual, referred to as "the endowment effect" (Kahneman and Tversky 1979). The objects of ownership can in fact become so deeply rooted within people's self-identity that they can be viewed as an extension of the self (Belk 1988, Dittmar 1992, Cram and Paton 1993, Brown et al. 2005, Akerlof and Kranton 2010). Pierce et al. (2003:85) use the example of the debilitating effects of separating individuals, particularly children and the elderly, from their possessions to illustrate this effect. Ownership feelings and "self-identity" may be tied up with physical objects but also with facets of employment where a person strongly identifies with a particular profession (Pierce et al. 2004). Importantly, feelings of ownership are not limited to private goods but can apply to collective goods, for instance, to landscapes or entire ecosystems (e.g., Butler et al. 2011).

Even though the link between property ownership and stewardship has been identified in a variety of contexts, it is not fully understood and is the subject of ongoing research. For instance, psychologists who study organizational behavior strive to improve understanding of the "sense" of ownership and the "motivation" to protect and improve what is owned (Avey et al. 2009). Cognitive psychologists continue to investigate whether differences in mental representation, expertise, or education lead

to differences in property-related attitudes or behavior (Nash 2009, Nash and Stern 2010).

The link between property ownership and environmental stewardship can also be explored with the help of stewardship theory (Van Slyke 2007), which focuses on the nature of relations between individuals and the object of the relationship. It is built on the hypothesis that a person's core values form a foundation of consistent ethical values and goals leading to a set of moral norms and aspirations that influence individual decision making and behavior (Worrell and Appleby 2000, Van Slyke 2007). Stewardship theory considers the possibility that, over time, individuals can become stewards of a particular object or set of objects, and that this can develop based on trust, reciprocity, autonomy, discretion, responsibility, job satisfaction, stability and tenure, reputation enhancement, and alignment of objectives.

THE ROLE OF ATTITUDES, NORMS, AND BELIEFS ON BEHAVIOR

Stewardship theory helps us understand how environmental stewardship with respect to the marine environment is mediated and develops. Understanding these normative values, which include a person's attitudes and beliefs, can help predict their environmental behavior (Morrison 2005, Esty and Winston 2006). The "theory of planned behavior" provides a general framework for the relationship between attitudes, beliefs, intentions, and behavior (Azjen 1991, 2001). Resource management studies in agriculture and forestry, for example in the context of private land use, confirm that attitudes and personal beliefs play a role (Vanclay and Lawrence 1995, Yencken and Wilkinson 2001) in achieving environmental outcomes (Sperling 1997).

Among other things, research in this domain has focused on describing and explaining attitudes and personal beliefs toward environmental issues (e.g., Vanclay and Lawrence 1995, Yencken and Wilkinson 2001). Some "types" of environmental attitudes have been shown to be predictive of environmental stewardship behavior (e.g., Jones and Dunlap 1992) with extremes ranging from "eco-centric" attitudes at one end of the spectrum to utilitarian attitudes at the other (e.g., Dunlap and van Liere 1978, Reeve 2001). Eco-centric attitudes reflect the belief that nature has a value of its own and deserves protection independently of any economic service it may provide, and these conservation-centered attitudes are often predictive of proenvironmental behavior and stewardship in empirical research (Drake et al. 1999, Luzar and Diagne 1999, Klosowski et al. 2001, Stevens et al. 2002, Söderqvist 2003, Tosakana et al. 2010). Moreover, these individuals are more likely to join incentive schemes that promote conservation outcomes (e.g., van Putten et al. 2011).

The gradations that occur on the continuum between the two "extremes" in environmental attitude are complex. Generally, individuals are multifaceted, leading to a number of different attitude types including those with multiobjective attitudes. The study of environmental attitudes is widespread in the agriculture and forestry domains (Vogel 1996, Luzar and Diagne 1999) where the attitudes of land managers have been characterized using different typologies (van Putten et al. 2011, Hujala et al. 2013). In general, both proenvironmental and antienvironmental attitudes are found to occur in these communities (e.g., Dunlap and van Liere 1978, Corbett 2002). Environmental attitude characterization has not been carried out in a fisheries context.

Previously, we focused on a person's attitudes and beliefs, i.e., their normative values, to understand environmental stewardship as expressed in that person's behavior (Gelcich et al. 2008). In the agricultural literature and empirical studies carried out mainly in the United States, Europe, and Australia, indicators, or empirical proxies, for drivers in the theoretical framework or model of stewardship have been studied. For example, lower age, higher educational attainment, female gender (e.g., Lynne et al. 1988, Jones and Dunlap 1992, Wilson 1997), higher income levels (e.g., Earle et al. 1979, Vanclay 1986, 1992), larger acreage, and higher capital ownership (Prokopy et al. 2008) were predictive of higher stewardship behavior. Higher levels of farm debt, higher dependence on farming for an income, being an absentee landlord or corporate owner, and being a leaseholder (Timmons 1980, Lee and Stewart 1983, Tosakana et al. 2010) were predictive of lower stewardship behavior (e.g., Gasson and Potter 1988, Force and Bills 1989, Loftus and Kraft 2003). Even though the reported results apply to many different agricultural "contexts," they cannot be generalized to apply to all agricultural situations, and there is no absolute uniformity in either the predictive accuracy of the variables or in the direction of the effects that have been analyzed to date. In summary, there are a number of empirical proxies and drivers of environmental stewardship at the individual level: observable variables, i.e., proxies, such as demographic and social characteristics of the individuals, their economic and financial situation, and the institutional set of rules that determines the ownership they hold of the environmental asset under consideration; and not easily observable variables, i.e., drivers, such as individual psychological factors, which include both self-interested motivations and personal values including moral norms and environmental ethics.

HOW ENVIRONMENTAL STEWARDSHIP ARISES AT THE COLLECTIVE LEVEL

Stewardship theory shows that individuals can become stewards of the goods they own. Of particular interest to our analysis is whether stewardship can also develop for collectively owned goods, leading individuals to place greater value on cooperation than defection and other expressions of self-serving behavior. Research in this domain has argued that this could result from the steward's perception "that the utility gained from contractually aligned behaviour is higher than the utility that can be gained through individualistic, self-serving behaviours" (Davis et al. 1997:25). An alternative interpretation is that personal norms such as moral values cause a shift in the utility associated with a particular course of action, depending on the individual's moral views regarding this action (Hatcher et al. 2000). Where such normative values are shared by others, and collective goals overlap, it is shown that there is an increased likelihood of that person acting in the interests of achieving collectively shared objectives (Van Slyke 2007, Mills and Keast 2010). The likelihood of collective objectives will be greatest where self-interest and normative values align and are shared within a group. Where this is not the case, the opposite may result (Bowles 2004).

Research on long-term sustainability and stewardship outcomes at a collective level in a common property context shows that this is mediated by several variables such as access to adequate information, information sharing, and engagement (Ostrom 1992, Van Vugt 2009), which all depend on the existence of some form of cooperation between the stakeholders who can impact on the common resources (Lindroos 2004, Levin 2006, Haynie et al. 2009,

Ramirez-Sanchez and Pinkerton 2009, Gilmour et al. 2011). Trust has an important influence on the acceptance by individuals of the costs borne in the interest of resource sustainability (Caddy and Seijo 2005, Van Vugt 2009, de Vos and van Tatenhove 2011). Environmental, agricultural, and forestry research has provided empirical evidence that environmental stewardship is predicated on this common understanding, trust, and cooperation (Vanclay 1992, Karp 1993, Curtis and De Lacy 1996, Cocklin et al. 2006). The relationship between the different variables and stewardship behavior is complex because of negative and positive feedback between the variables and because of possible nonlinear responses.

EVIDENCE OF CHANGE IN ENVIRONMENTAL STEWARDSHIP

Considering the factors by which environmental stewardship may arise, and insights into the theoretical basis for the connection between collective and private property ownership and environmental stewardship, we find that there is an apparent lack of empirical literature that provides insight into, and evidence of, the theoretical relationship between the implementation of ITQs and changes in environmental stewardship of fishers at sea and fishing industry members of comanagement committees. Even though several articles mention the possible influence of environmental stewardship in fisheries (Branch et al. 2006, Chu 2009), there is no evidence available to indicate that this environmental stewardship has changed as a consequence of fisheries management changes. In light of the absence of baseline information on both the extent and nature of environmental stewardship prior to ITQ introduction, Costello et al. (2008) acknowledged that there is no conclusive evidence that under ITQ management quota owners change their interest in the long-term sustainability of fish stocks.

There is also limited empirically based information that improves our ability to predict changes in environmental stewardship in fisheries, for instance on the basis of information on attitudes and attitudinal change. Aside from studies that investigate the environmental consequences of bycatch in ITQ-managed fisheries and attitudes with respect to various other fisheries issues, such as work conditions, safety, and fisheries management (Hanna and Smith 1993, Glain et al. 2001, Fuchs 2003, Strand 2004, Richardson et al. 2005, Tzanatos et al. 2006), there are few studies that empirically investigated actual changes in attitudes toward the environment in fisheries (Hanna and Smith 1993). In relation to specific environmental attitudes held by fishers, there is currently surprisingly little information, and as far as we were able to determine, there has been no study in which postmanagement changes in environmental attitudes were measured that could shed light on stewardship changes as a result of moving to a TAC and ITQs.

Even though there is an absence of empirical evidence, this does not of course imply evidence for an absence of environmental stewardship. However, several theoretically based suppositions provide the impetus for future investigation of the empirical presence or absence of ITQ-driven change in environmental stewardship. Ideally, stewardship and associated behavioral changes would be measured against a baseline stewardship status prior to the introduction of any new management instrument. Baseline environmental stewardship status could be established through, for instance, attitudinal surveys. Because attitudinal heterogeneity characterizes fishers and fisher communities with respect to work conditions, safety, and fisheries management (Jentoft and Davis 1993, Gelcich et al. 2005), we consider it unlikely that an environmental stewardship ethic would be completely absent among fishers and in fishing communities prior to management changes, most communities being characterized by heterogeneity in this regard (Vanclay and Lawrence 1995). It may be that regulated open-access fisheries that existed before ITQs did not translate into effective stewardship behavior, evidenced by past levels of overexploitation, even though similar levels of environmental stewardship ethics may have been present in at least parts of the fishing communities prior to the introduction of ITQs.

The lack of attitudinal information is mirrored by the notably few fisheries examples of empirically gathered demographic and social information (e.g., Hanna and Smith 1993, Richardson et al. 2005). However, research in agriculture shows that, for example, owner characteristics, gender, education, and age can be used as explanatory variables to predict attitudes and thus stewardship, even though this type of information cannot predict changes in attitudes. We hypothesize that a reason for the lack of this simple type of data may be that, unlike logbook information on catch, catch composition, fishing location, gear, and other infrastructure details, information about the fishers themselves is not often analyzed by fisheries management authorities. Even if this type of demographic information is analyzed by an authority, it may not be combined with logbook information to allow, for instance, econometric analyses where fishing behavior is analyzed as a function of these variables. Therefore, even if researchers were to assume that the same predictors for stewardship apply to fishers and landowners, ignoring the fact that no universal empirical model applies to the latter, there is inadequate available information in many fisheries to carry out an analysis to "predict" environmental attitudes and consequently stewardship ethics. A low-cost solution in the short term may be to analyze various information sources and databases currently held by different fisheries management authorities, such as owner characteristics, gender, and education, to establish a proxy stewardship baseline, with a focus on collecting attitudinal data in the future, and undertake studies to establish the true predictive variables for fishers.

POTENTIAL INFLUENCE OF QUOTA OWNERSHIP PATTERNS ON ENVIRONMENTAL STEWARDSHIP

The lack of empirical evidence of existing environmental stewardship, as well as the lack of data for predictive variables, makes it especially difficult to predict changes to environmental stewardship with current changes in fisheries dynamics under the ITQ management system. The property ownership and distributional characteristics within fisheries with management systems that theoretically inspire stewardship behavior may no longer be the same as when ITQs were first implemented. In other words, changes in fishers' stewardship may in fact be complicated by changes in patterns of quota ownership in some fisheries. Vertical integration that has in some cases accompanied ITQ management has led to quota shares increasingly being owned by processors and investors (Dewees 1989, Olson 2011).

Quota ownership change and concentration has thus also led to a growth in the number of fishers who depend on lease quota to go fishing. From an economic perspective, lease fishers may face

high upfront capital investment costs and be under higher financial stress (e.g., Pinkerton and Edwards 2009, van Putten and Gardner 2010). As for lease farmers (e.g., Gasson and Potter 1988, Force and Bills 1989), lease fishers may be forced to place greater weight on short-term financial returns and may not be in a position to support long-term conservation. In addition, lease fishers may feel less sympathetic toward long-term resource sustainability because of lack of ownership. Theoretically, at least, lease quota fishers' lack of ownership of access rights, combined with economic pressure, may thus result in less information sharing, trust, cooperation, and ultimately stewardship. However, this may be counterbalanced by the fact that lease fishers are always active fishers and may have a strong interest in the long-term continuation of their activity and their jobs, which is part of their self-identity. Studies suggest that the strong attachment of fishers to their jobs is particularly pertinent in mediating stewardship (Pollnac and Poggie 1988, Binkley 1995, Pollnac et al. 2001). However, although active lease fishers are concerned for their future livelihoods and may still be inclined toward stewardship on this account, it is unknown if they are less inclined than when they were regular fishers in a non-ITQ fishery. Indeed, it may be true that ITQs can result in fishers feeling less attachment to their profession because it becomes less a way of life and more an impersonal business, thus also affecting their environmental stewardship. How these opposing forces balance out in practice is currently unknown, and determination of motivational drivers and behavioral change for various stakeholder groups may be an important area of future research focus.

POTENTIAL EFFECT OF COMANAGEMENT ARRANGEMENTS ON ENVIRONMENTAL STEWARDSHIP

Even though the phenomena of "slipper skippers" and quota leasing could reduce stewardship among at-sea fishers, there may be incentives for the quota owners to be stewards at the higher level of tactical or strategic management. The issue of environmental stewardship at a collective strategic management level is of particular interest from a fisheries perspective because comanagement and collective resource ownership arrangements are increasingly used to manage fisheries (e.g., Mazur 2010). In some fisheries, comanagement committees composed of various stakeholder representatives, scientists, and government officials might be considered analogous to company boards in that they determine business paths and futures. From the management literature, we know that shared values and stewardship behavior of management and decision-making boards can explain long-term business success (Donaldson and Davis 1991, Davis et al. 1997). With respect to fisheries, the philosophical alignment of comanagement committee members could theoretically result in collective decisions that achieve environmental objectives. Environmental stewardship may also be the result of a common decision-making process in which breaking from agreed positions would have social repercussions (Fuchs 2003), for instance in the form of social pressure placed on the stakeholders who break away.

Although acknowledging that comanagement arrangements have the potential to enhance environmental stewardship, there is currently no research evidence to confirm this (Fuchs 2003), though again this does not mean it is absent. We speculate that comanagement arrangements could in some respects also have a negative effect on environmental stewardship.

We indicated that trust and cooperation are central requirements for collective stewardship. Gilmour et al. (2011), however, found no strong relationship between trust, the capacity for cooperation, and attitudes to resource management in fisheries but instead found that perceptions of "resource conditions" were a key determinant of collective resource stewardship. Garrity (2010) found that the information-sharing precondition for stewardship is currently not met by comanaged ITQ systems. It could be argued that, rather than information sharing being a precondition for stewardship, in fact, stewardship has to be present prior to information sharing occurring. People may more readily share information if they perceive this as being in the interest of resource preservation (Curtis and McConnell 2004) and if they hold resource preservation as an important goal to pursue. Once stewardship is present, it may therefore, in the longer term, be self-reinforcing through increased information sharing. Comanagement systems may in fact provide an incentive to give inaccurate information because of perceived competition between participants (Parslow 2010). If competition persists under comanaged ITQs, information sharing may not arise naturally, i.e., there are complex and interacting factors at play.

Another aspect that may blur the direct link between the enabling factors of comanagement and enhanced stewardship is the potentially different views and levels of influence of representatives on comanagement committees (Fuchs 2003). Empirical evidence suggests that sustainable resource outcomes and stewardship development have been adversely affected by the significantly divergent views and varying political influence of representatives in such committees (Fuchs 2003). For instance, where stakeholder representatives comprise large industrial fishing operations or fish-processing firms that may also control much of the supply of lease quota, unbalanced negotiation outcomes disadvantaging small-scale or lease fishers may result (Leal et al. 2010). The implications for stewardship are again complex and depend on whether large corporate owners are likely to display relatively greater or lower propensity for stewardship. For instance, having a small number of large industrial fishing operations involved in comanagement committees could facilitate development of shared understanding, information, and trust. Such players, when they can be assimilated to individual people, may also be in a better position to take the longer view. Nonetheless, the stewardship ethics of the individual people representing large industrial fishing operations, when these involve collectives structured into profit-driven companies, are largely unknown but may have potentially significant implications on the sustainability outcomes of ITQ-managed fisheries (Leal et al. 2010).

Increasing membership of investors, who do not actively fish, on decision-making committees may further complicate the prediction of stewardship outcomes (e.g., Shertzer and Prager 2007). Fishers have been found to have strong attachments to their jobs (Pollnac and Poggie 1988, 2006, 2008, Binkley 1995, Pollnac et al. 2001), which is pertinent in mediating stewardship. The extent to which the stewardship ethics of quota owners at the collective comanagement level is driven by their attachment to profession is unknown. From other resource studies, we learn, for

instance, that absentee landowners, who are similar in some respects to investors in fishery quotas, have a preference for current income and have in some cases reduced stewardship incentives (Timmons 1980, Lee and Stewart 1983, Tosakana et al. 2010). However, quota owners who have made a conscious decision of long-term investment in a fishery may strongly support choices that maintain its sustainability. We are also aware of instances where large corporate players exhibit strong stewardship ethics. An example is Austral Fisheries (http://www.australfisheries.com.au), one of the largest fishing companies in Australia, which has actively sought and secured Marine Stewardship Council certification for all the fisheries in which it engages.

CONCLUSION

There is a severe lack of baseline information on the presence or distribution of individual and corporate environmental values and attitudes in fisheries. This makes it difficult if not impossible to associate changes in resource outcomes under ITQ management with changes in stewardship ethics. Despite claims, based mainly on the psychology of ownership and property, that stewardship ethics could be enhanced by ITQs, there is little empirical information to support this. Although psychological theory suggests that there may be such a relationship, the lack of empirical information precludes any conclusion that improved environmental outcomes are attributable to changes in stewardship arising from changes in access rights associated with ITQ management in fisheries. Similarly, even though theory suggests that features of the comanagement approach (Beddington et al. 2007, Hilborn 2007) in ITQ fisheries could enhance the development of stewardship, there is only a smattering of empirical evidence that supports the existence of such an effect.

We recognize the potentially important role of management decision processes in fostering a stewardship ethic, and preliminary review of the changes in these decision processes associated with the introduction of ITQs shows that some of these changes may be favorable, and others unfavorable. In a similar vein, the move to fewer and generally larger scale fishing operations, the concentration of ownership with processors and investors, increasing numbers of lease fishers, and corporate membership on comanagement committees may all affect stewardship (Morecroft 1983, Gibbs 2009). However, more research is needed to establish more definitive effects, which can play out in both directions. In other words, the complicated link between both changes in patterns of quota ownership and changing stakeholder representation on comanagement committees and changes in stewardship needs to be empirically explored.

It would seem that collection of attitudinal information, given the continuing move to ITQs as a general approach to fisheries management, and also with respect to other management systems like marine protected areas, particularly for high-value species, is a logical step. In particular, it would seem important to collect baseline information against which, at some stage in the future, the actual effects, perceptions, and environmental attitudes under changed management arrangements can be compared.

In general, research needs to focus on how stewardship can be measured and how it changes with new management approaches (e.g., Reeve 2001, 2002, Gilmour et al. 2011). Collection of suitable revealed and stated preference data with respect to environmental norms, attitudes, motivations, and stewardship behavior is a prerequisite to developing knowledge on how stewardship can be enhanced. Consideration also needs to be given to how comanagement arrangements either enhance or impede attitudes toward the environment. After all, the interplay between ITQs, stewardship, and environmental outcomes goes beyond just fishers out at sea and extends to representatives on comanagement committees that help to determine resource management outcomes (e.g., Yandle 2006).

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