



Research

Using Private Rights to Manage Natural Resources: Is Stewardship Linked to Ownership?

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ABSTRACT. There is increasing interest in privatizing natural resource systems to promote sustainability and conservation goals. Though economic theory suggests owners of private property rights have an incentive to act as resource stewards, few studies have tested this empirically. This paper asks whether private rights-owners were more conservative with respect to their management opinions than nonrights-owners in five Australian abalone (*Haliotis* spp.) fisheries. Multiple regression analyses were used to link opinions to demographic, economic, and attitudinal variables. In contrast to standard economic assumptions, nonrights-owners suggested more conservative catch limits than did rights-owners, confirming qualitative observations of behavior in management workshops. Differing views about the condition of the resource and differing levels of experience contributed to these results. The first of its kind, this study directly demonstrates that private rights do not necessarily promote the greatest level of stewardship. This has substantial implications for how natural resources are governed globally, but also warns against applying simplistic behavioral assumptions to complex social-ecological systems.

Key Words: *Australia, comanagement, fisheries, individual transferable quota, property rights, stewardship, sustainable behavior*

INTRODUCTION

Resource economists have long argued that privatization of natural resources, such as forests, fisheries, and rangelands, promotes economic efficiency (Gordon 1954, Chueng 1970, Johnson 1972). More recently, private rights have been advocated explicitly as a means of improving environmental goals (Gibson et al. 2002, Fujita and Bonzon 2005, Helson et al. 2010). The conventional wisdom is that, by internalizing the costs of resource use, ownership creates an incentive for stewardship (Grafton et al. 2006). In fisheries, for example, this proposed link has been used to argue that privatized catch shares will, and do, improve sustainability (Costello et al. 2008).

However, the link between private rights and stewardship behavior is based largely on assumption. Because privatizing natural resources has far-reaching and long-term conservation and social implications (Bromley 2005, Sumaila 2010), there is a clear need to demonstrate empirically whether, and to what extent, that link actually exists. Our aim in the present study is to examine relationships between private property rights, in the form of individual transferable quota (ITQ), and resource stewardship. The data come from five, high-valued (ABARE-BRS 2010) abalone (*Haliotis* spp.) fisheries in southeast Australia.

These fisheries are of particular interest because industry groups have, to varying degrees, adopted conservative self-management practices in addition to those stipulated by government managers (Gilmour et al. 2011). In this they provide cases of resource users voluntarily practicing stewardship behavior and resource management. Of greater

significance, however, is the fact that in these fisheries, individuals who do not themselves own rights, i.e., divers contracted to harvest abalone, have had a substantial role in developing and implementing the self-management practices. This suggests that previously reported correlations between environmental benefits and private property (e.g., Costello et al. 2008) may not be a direct, or simple, consequence of privatization.

In this paper we ask if there is a difference between the management preferences of quota owners, who hold private rights, and contract divers, who do not. We consider preferences for conservative management practices, such as reduced levels of allowable catch, to reflect the willingness of individuals to incur short-term costs in the interests of long-term resource sustainability, which, for the purposes of this paper, we take to be stewardship. Where differences are detected, we explore factors that may explain those differences.

We consider some theoretical and practical issues relevant to the role of private rights in natural resource management. We describe the research context and methods. The latter entailed a survey of stakeholders designed to reveal preferences for different management strategies. In the results, we explore how these preferences varied between categories of stakeholders. Finally, we discuss the incentives experienced by different groups and direct attention to factors that may influence stewardship behavior, including some that are seldom considered in more conventional models of rational behavior.

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PRIVATE RIGHTS AND STEWARDSHIP: THEORY AND PRACTICE

The basis for private rights in natural resource systems is closely tied to concepts articulated by Hardin in *The Tragedy of the Commons* (1968). The tragedy Hardin describes is the individual incentive to overuse resources that are held “in common”: open access resources to which everyone has rights (Berkes et al. 1989). Economists argue that, as an alternative to government control, the problem of overuse may be solved by granting private rights to resources, thereby internalizing the costs of harvesting and promoting efficient, long-term resource use (Gordon 1954, Johnson 1972, Grafton 1996). In practice, private rights have been granted to individuals using natural resources as diverse as rangelands, forests, and aquifers (Acheson 2006a). In fisheries, perhaps the most fully formed private rights are ITQs (Grafton et al. 2006). Owners of these quota rights are entitled to a share of a total allowable catch (TAC), i.e., a tradable share, issued in perpetuity.

Individual transferable quota systems have often been successful in improving the economic efficiency of fisheries (Grafton 1996, Hannesson 1996). Increasingly, benefits in terms of stock sustainability are also being espoused (Fujita and Bonzon 2005, Costello et al. 2008, Chu 2009). This is suggested to be the result of the inherent incentive associated with ownership, the causal link inferred, but not tested, by authors such as Costello et al. (2008). However, reported cases of resource users with individual rights acting as stewards (Grafton et al. 2006), do not actually demonstrate that it is ownership as such that promoted stewardship. Indeed, there are many examples of stewardship in the absence of individual property rights (e.g., Berkes et al. 1989, Ostrom 1990, Agrawal 2001). This caveat is important in the context of acknowledged drawbacks of ITQ systems.

The problems with ITQs, in both theory and practice, have been well reviewed (Copes 1986, McCay 1995, Sumaila 2010). From an ecological perspective, the broader environmental impacts of fishing on bycatch and habitat remain external to owners (Gibbs 2010). Once implemented, private rights are also difficult to change (Bromley 2005). This can make it difficult for governments wishing to implement initiatives such as marine protected areas. From a social perspective, ITQs have also been criticized for creating inequities within fishing communities (Davidson 2010, Olson 2011) and as a “giveaway” of public resources (Bromley 2005:221). Moreover, although ITQs enable fishers to exit a fishery with “money in their pockets” for retirement or investment elsewhere, at the same time they create substantial financial barriers to new participants entering the fishery (McCay 1995:10, Phillips et al. 2002).

If the ownership features of ITQ systems, i.e., durability and transferability, are causally linked to sustainable harvesting this provides a strong argument in favor of ITQs (e.g., Costello

et al. 2008). Combined with other arguments, e.g., economic efficiency, the benefits of ITQs may outweigh the drawbacks summarized above. However, if it is not ownership per se that leads to stewardship, but rather some other combination of factors, the relative costs and benefits of ITQs may change, making alternative systems more desirable. Developing this more nuanced appreciation of the factors affecting stewardship is also critical in understanding sustainable behavior in social-ecological systems more generally (Dietz et al. 2003, Agrawal and Ostrom 2006, Levin 2006).

DESCRIPTION OF THE FISHERIES

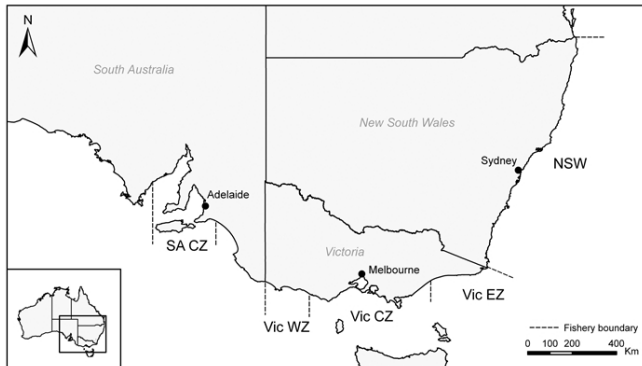
Abalone are highly valued marine gastropods found in shallow reef habitats around the world (Shepherd et al. 1992). Australia exports over 5000 tons of abalone per year and has some of the few wild fisheries that have not collapsed or suffered serious stock declines (Leiva and Castilla 2002). Divers collect abalone by hand, typically working from small (5-8 m), fast vessels manned by a single deckhand.

Abalone are relatively sedentary and, though they release eggs and sperm into the water column, the larvae usually travel relatively short distances (Prince 2005). For example, larvae of blacklip abalone (*Haliotis rubra*), the main commercial species in Australia, disperse only 10s to 100s of meters (McShane et al. 1988). The density and size of localized aggregations has a strong effect on recruitment strength (Prince et al. 1988, Dowling et al. 2004) and there is also substantial variation in growth rates and maximum sizes at this scale (Saunders et al. 2009). Thus, a length of coastline in the order of 10s of kilometers will contain numerous, essentially self-recruiting populations of abalone that grow and mature at different rates. This makes them vulnerable to recruitment overfishing and provides a strong rationale for size and catch limits at fine spatial scales (Prince 2005).

We collected data from five abalone fisheries in southeastern Australia: South Australian Central Zone (SACZ), Victorian Western, Central, and Eastern Zones (VicWZ, VicCZ, VicEZ), and New South Wales (NSW; Fig. 1). Each fishery is subject to state-implemented management rules concerning total allowable commercial catch (TACC) and minimum size limits. In each case, the TACC is allocated through ITQs. A limited number of access licenses in each fishery controls who can fish for abalone. Although license owners must own a minimum amount of quota, which varies between states, they can contract another person to work under that license.

The ITQ and licensing arrangements create four broad groups of fishing stakeholders: quota owners, who own quota, but do not currently dive; owner divers, who own quota and dive for that quota; contract divers, who are contracted by quota owners to dive and are usually paid on a per kilogram basis for the abalone they catch; and deckhands who maintain the boats and equipment when divers are in the water. Deckhands are often itinerant workers and are not considered further in this paper.

Fig. 1. Map showing the distribution of the abalone (*Haliotis* spp.) fisheries studied in southeastern Australia. SACZ = South Australian Central Zone, VicWZ = Victorian Western Zone, VicCZ = Victorian Central Zone, VicEZ = Victorian Eastern Zone, NSW = New South Wales.



All five fisheries have, to varying degrees, proactively adopted management measures over and above those stipulated by government. These include increasing size limits, implementing closed areas, petitioning government for quota decreases, and applying rules at finer spatial scales that better match the ecology of abalone (Gilmour et al. 2011). In adopting these measures, industry stakeholders have incurred direct material costs with the explicit goal of improving the long-term sustainability and productivity of the fishery. Contract divers have been an integral part of this process; both in terms of rule development and voluntary compliance.

METHODS

In July and August 2009, we interviewed, by telephone, stakeholders from each of the five abalone fisheries. Stakeholders were classed as contract divers, quota owners, or owner divers. We further distinguished contract divers as being, or not being, sons of quota owners on the assumption that sons might reasonably expect to inherit quota. Official lists of industry stakeholders and their contact details were publicly available only for the SACZ. For other cases, we compiled lists with the help of key informants and cross-checked these against available registries and license numbers. Of the 185 relevant individuals identified, 126 (68%) participated in the study.

We asked respondents about their views concerning optimal management rules and about a range of factors that might explain those views. Key questions were: (1) What do you think the TACC should be at the moment?; (2) Do you think size limits should be increased anywhere? (response categories: nowhere; a few reefs; many reefs; all reefs); and (3) Do you think size limits should be decreased anywhere? (same response categories).

It was assumed that lower TACCs, more extensive size limit increases, and less extensive size limit decreases entailed short-term costs for respondents while contributing to long-term resource resilience and sustainability. We assumed, therefore, that individuals who advocated these outcomes were inclined toward resource stewardship, in line with other stated-preference studies of environmental behavior (e.g., Marshall 2009, Cavalcanti et al. 2010, Sorice et al. 2011). Importantly, the TACC and size limits are reviewed and adjusted at least annually in all the fisheries. Thus, rather than being hypothetical abstractions (cf. Chouinard et al. 2008), the questions asked have real-world relevance. Moreover, the history of industry-led size-limit and TACC changes in these fisheries indicates that stated management preferences are more than just “cheap talk” (Farrell and Rabin 1996).

We hypothesized that individuals’ willingness to incur short-term costs would be influenced by several factors, or predictor variables (Table 1). Table 2 shows the questions we used to assess these variables. Hypotheses and questions were devised using literature on resource management, observations of management workshops, and semistructured interviews of 76 industry stakeholders.

Table 1. Predictor variables and hypothesized effects on the conservativeness of management opinions.

Variable	Hypothesized effect on management opinions	Direction of effect
Concern about resource condition	Those who consider stocks to be in poorer condition would be more likely to advocate measures to improve them (Poteete and Ostrom 2004)	+
Financial strain	Higher levels of financial strain would increase stakeholders’ discount rates, making long-term payoffs less attractive; resulting in less conservative management rules (Agrawal 2001)	-
Experience in industry/age	Older, more experienced stakeholders would be less conservative (Moon et al. 2002, Baticados 2004).	-
Income from fishery (%)	A high reliance on the fishery, assessed as a proportion of household income, could: promote a greater long-term vested interest (Agrawal 2001); or restrict an individual’s capacity to incur short-term costs (Gelcich et al. 2005).	±

We analyzed the data using SPSS version 17.0 (2006). Respondents’ judgments of the optimal TACC were standardized (difference between each response and the mean response in that fishery, divided by the standard deviation). This provided a measure (in standard deviations) of how much each respondent differed from the average opinion within each fishery, allowing us to pool results across fisheries. The ordinal nature of the size limit data meant that similar standardization was unnecessary for these variables.

Table 2. Survey questions used to measure predictor variables.

Variable	Question(s)	Response format (coding)
Concern about resource condition	I) Across the fishery, what condition would you say stocks are in, relative to what they could be? II) How many reefs or areas do you have concerns about in terms of their condition?	I) Very good (5); good (4); average (3); poor (2); very poor (1). II) None (1); a few (2,3); many (3,7); all (5) ^{†‡}
Financial strain	How would you rate your overall level of financial strain at the moment, on a scale of 1 to 5?	(1) indicates no strain, everything is fine; to (5), very strained and facing significant financial problems
Experience in industry	When did you begin diving and/or first purchase quota?	years
Age		years
Income from fishery (%)	What is the percentage of your household income that comes from the abalone industry?	%

[†]Four-point response scale coded onto a five-point scale so that the two questions could be combined.

[‡]Cronbach's alpha = 0.74, indicating these questions provide a consistent measure of a single underlying concept (Peterson 1994).

We tested for differences between the management views of quota owners, contract divers, owner divers, and sons of owners (group factor) using two-way analysis of variance (ANOVA). "Fishery" was included as a second factor to check whether observed differences were consistent across fisheries. Opinions about size limits were analyzed for divers and quota owners from only the NSW, VicEZ, and VicCZ fisheries, because of a lack of responses from the other groups. In preference to nonparametric alternatives, we analyzed these ordinal data using ANOVA because of the greater power to detect potential differences between groups. ANOVA was also used to test for differences between the predictor variables of each group. We checked homogeneity of variances using Levene's test and, where this assumption was violated, used Welsh tests. Post hoc comparisons were done with Ryan's tests ($\alpha = 0.05$).

We used regression analyses to further understand stakeholders' management opinions and explain differences between groups. We compared three models, paying close attention to multicollinearity and residual normality. The most parsimonious "full model" was identified using Schwarz's BIC (Quinn and Keough 2002). We used hierarchical partitioning to identify the independent contribution of each predictor to the total variance explained by this model (Chevan and Sutherland 1991).

We then used decomposition analysis (Oaxaca 1973) to assess which factors contributed to differences between stakeholder groups. Adapted from the econometric literature, the

decomposition analysis involved running separate regression analyses for contract divers and quota owners. Owner divers and sons of owners were not included because there were too few cases. The assumption that regression slopes were not significantly different was tested using analysis of covariance. These slopes were used in Equation 1 to identify the relative contribution of each factor to the difference in the responses of divers and owners; $y^{owner} - y^{diver}$.

$$y^{owner} - y^{diver} = \sum(\beta_i^{owner} x_i^{owner} - \beta_i^{diver} x_i^{diver}) \quad (1)$$

where x_i is the relevant value of factor i . This established how much of the difference between owners and divers related to, for example, differences in the mean age of each group.

RESULTS

Opinions about optimal management

Standardized TACC judgments were significantly different between stakeholder groups ($F_{3,87} = 3.40, p = 0.021$; Fig. 2). Contract divers and owner divers suggested significantly lower TACCs than did quota owners (Fig. 2). Sons of owners suggested TACCs that were not significantly different to those reported by any of the other groups. The lack of an interaction between stakeholder group and fishery ($F_{15,87} = 1.22, p = 0.274$) indicated that this pattern of differences did not vary significantly between the fisheries.

Fig. 2. Standardized total allowable commercial catch (TACC) suggested by different stakeholder groups, pooled across fisheries. The standardized values provide a relative measure of what individuals considered the TACC should be, compared to the mean response for each fishery; positive values indicate responses higher than the mean; negative values indicate responses lower than the mean. Error bars equal ± 1 s.e.

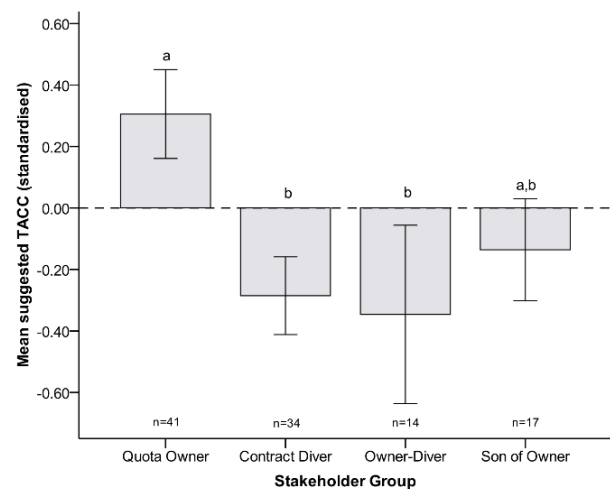


Table 3. Comparison of predictor variables hypothesized to influence stakeholders' opinions about the optimal total allowable commercial catch (TACC). Significant tests are highlighted in bold ($\alpha = 0.05$). Letters next to values indicate differences between groups of stakeholders; those that share the same letter are not significantly different from each other ($\alpha = 0.05$, post-hoc Ryan's test).

Variable	Mean (SD)				Test	p-value
	Owners	Divers	Owner divers	Sons		
Concern	5.1 (2.09)	5.4 (1.86)	6.0 (2.51)	5.7 (1.53)	$F_{3,98}=0.75$	0.523
Financial strain	3.2 (1.57) a	2.6 (1.29) a	4.3 (1.05) b	2.8 (1.40) a	$F_{3,118}=5.95$	0.001
Experience (y)	31.2 (11.94) a	14.4 (7.24) b	23.3 (9.37) a	10.5 (4.09) b	$F_{3,48.1}=43.37$	< 0.001
Age (y)	60.7 (8.01) a	42.5 (7.58) b	50.2 (8.01) c	33.4 (5.42) d	$F_{3,119}=77.79$	< 0.001
Income from fishery (%)	64.0 (37.05)	63.4 (27.92)	79.1 (25.40)	77.6 (26.21)	$F_{3,47.0}=2.22$	0.098

[†]Welsh test and post-hoc Games-Howell tests due to unequal variances

Quota owners and contract divers did not differ in their opinions concerning the extent to which size limits should be increased ($F_{1,56} = 0.64, p = 0.368$). Although opinions differed between fisheries ($F_{2,56} = 12.26, p < 0.001$), there was no interaction between fishery and stakeholder group ($F_{2,56} = 0.78, p = 0.378$).

There were no significant differences in opinions about size limit decreases, either between fisheries ($F_{2,58} = 1.08, p = 0.158$), or between quota owners and contract divers ($F_{2,58} = 0.17, p = 0.679$). Again, there was no interaction between fishery and stakeholder group ($F_{2,58} = 0.33, p = 0.717$).

Understanding differences in management opinions

Stakeholder groups differed with respect to age, experience, and level of financial strain (Table 3). Quota owners were the oldest and most experienced group, whereas sons of quota owners and other contract divers were the youngest and least experienced. Owner divers, though intermediate with respect to age and experience, reported significantly higher levels of financial strain than did any other group. Neither the proportion of respondents' income nor their expressed level of concern for the resource differed significantly between stakeholder groups (Table 3). There was a strong positive correlation between age and experience ($r = 0.80, n = 120, p < 0.001$), and a weaker correlation between age and financial strain ($r_s = 0.23, n = 119, p = 0.014$), but no correlation between other combinations of the predictor variables.

Regression analysis showed that concern for the resource and experience contributed significantly to opinions about the TACC (Table 4; Model I, Model II). Higher levels of concern correlated with lower TACCs, whereas higher levels of experience tended to be associated with higher TACCs. Because of strong collinearity between age and experience, we removed age from Model II. We also removed income percentage because it contributed little and there was no clear theoretical rationale for retaining it.

No stakeholder groups differed significantly from the reference group (quota owners) in either Model I or Model II.

Model III explores the effects of stakeholder group independent of experience, which was previously shown to differ significantly between the groups (Table 3). In this case, the negative partial regression slope indicates that when controlling for levels of concern and financial strain, contract divers reported significantly lower TACC estimates than quota owners. The negative regression slopes of owner divers and sons of owners both suggest similar trends, but were not significant.

Hierarchical partitioning of Model II showed that concern for the resource was the most important factor in predicting opinions about the TACC, accounting for over half the explained variance (i.e., 56% of r^2 Table 5). Stakeholder group and experience accounted for similar proportions of the remaining variance, while financial strain contributed only minimally.

Decomposition analysis shows that over half the gap between contract divers' and quota owners' suggested TACCs (Fig. 2) can be attributed to differing levels of experience in the two groups (Table 6). Less than 10% of the gap in TACC values can be attributed to differences in levels of concern. Importantly, this means that 38% of the difference between the TACCs suggested by divers and owners relates to other differences between the groups.

DISCUSSION

The results of this study show that stakeholders with property rights in these abalone fisheries are no more conservative in their opinions about management rules than those with no formal property rights. This is an important finding in that, at face value, it appears inconsistent with expectations derived from standard economic theory applied to natural resource management.

In the five abalone fisheries discussed here, contract divers, with no formal property rights, consistently suggested lower TACCs than quota owners. Their suggestions varied from mean estimates 20% below those of owners in the VicEZ to

Table 4. Comparison of selected regression models explaining respondents' suggested values for the total allowable commercial catch (TACC). Figures in bold highlight significant relationships ($\alpha = 0.05$). OD = owner diver.

Factor	Model I			Model II			Model III		
	β	s.e.	<i>p</i>	β	s.e.	<i>p</i>	β	s.e.	<i>p</i>
Concern	-0.21	0.05	< 0.001	-0.21	0.47	< 0.001	-0.18	0.05	0.001
Group									
- Diver	-0.18	0.31	0.563	-0.09	0.28	0.754	-0.52	0.22	0.022
- OD	-0.27	0.33	0.413	-0.17	0.31	0.584	-0.45	0.28	0.234
- Son	0.01	0.41	0.981	0.18	0.34	0.598	-0.33	0.29	0.125
Fin. strain	-0.04	0.07	0.611	-0.05	0.07	0.478	-0.05	0.07	0.582
Experience	0.03	0.01	0.042	0.02	0.01	0.019			
Income %	0.00	0.00	0.467						
Age	-0.01	0.02	0.535						
Model sig.	$F_{8,79}=3.80$			$F_{6,81}=4.95$			$F_{5,82}=4.54$		
r^2	0.28		0.001	0.27		< 0.001	0.22		0.001
Adj r^2	0.21			0.21			0.17		
Schwarz (BIC)	-1.3			-9.0			-7.5		

3% below those of owners in the VicCZ. Interestingly, the opinions of owner divers were more varied than those of contract divers, but, on average, were more conservative than those of owners who did not dive. With respect to size limits, there was no significant difference between contract divers and quota owners.

Table 5. Hierarchical partitioning of the variables in Model II, showing the independent and joint contributions of each variable to the explained variance in total allowable commercial catch (TACC) estimates (r^2).

Factor	Independent contribution to r^2 of Model II	Joint contribution to r^2 of Model II	Total	Independent / r^2 (%)
Concern	0.151	0.005	0.156	56.3
Group	0.051	0.042	0.093	19.1
Financial stress	0.002	0.000	0.002	0.0
Experience	0.064	0.017	0.081	23.8

It should be noted that though measured differences between stakeholder groups are based on self-reported beliefs, the results are supported by independent empirical observations. Contract divers do take part in self-management activities and they do vote for size limit increases and quota decreases, which impose tangible costs. As one diver noted, "We used to sit around and agree to a two mil size increase—it's all very easy at a meeting, but, on the bottom, that might take 50 kilos an hour off your catch rate ... but, at the end of the day the resource is the resource and that's what we've got to look after." Respondents' opinions with respect to the TACC are, therefore, likely to be a meaningful indicator of sentiments and behaviors displayed in actual management contexts (cf. Portney 1994).

Table 6. Decomposition analysis of the difference between values suggested for the total allowable commercial catch (TACC) by divers and owners. Note that "other" represents that portion of the difference that is unaccounted for by the model, i.e., unaccounted for by these variables. The mean difference is 0.52 (based on modeled estimates).

Factor	Contribution to difference in standardized TACC estimates (0.52)	% contribution to difference in standardized TACC estimates
Concern	0.05	9.5
Experience	0.27	52.2
Other	0.20	38.2

The unexpected finding that divers suggested lower TACCs than did owners, despite owners having, at least theoretically, a greater vested interest in the long-term sustainability of the fishery (Grafton et al. 2006), calls for explanation. Of the variables examined, respondents' opinions about the TACC were best predicted by their expressed concerns about the resource condition (Table 5). This supports conclusions from other resource systems, such as forests (Tucker 1999, Gibson et al. 2002), where it has been suggested that it is resource-users' "perceptions of the condition of a resource – not the 'actual' condition" that are important (Poteete and Ostrom 2004:228). However, divers' and owners' perceptions of resource condition did not differ substantially (Table 3), meaning this factor explained less than 10% of the difference in their opinions about the TACC (Table 6).

Levels of financial strain also appeared to be unimportant. They did not differ significantly between divers and owners (Table 3) and contributed little to the explained variance in the suggested TACC (Table 5). This is despite the fact that

many industry members suggested that “others” were being influenced by debt-servicing obligations and other financial problems. We suspect that, in addition to the measure of strain being relatively imprecise, the relationship was obscured by two groups of individuals with contrasting values.

The first group included individuals who, even when not under financial pressure, advocated high levels of fishing pressure, and hence a high TACC, to maximize the flow of income. These individuals appear to have inherently high discount rates and/or a strong belief in the resilience of the resource to fishing pressure. Several interviewees outside this group characterized these income-maximizers as “greedy.”

The second group appeared to have stronger “altruistic” values and, despite high levels of stress, still supported relatively low TACCs. For example, one owner in this group, who was subsequently forced to sell out of the industry, noted the “... conflict between my hip pocket and my heart ... and at the end of the day, I decided in favor of the resource.” Although we would expect different values exist to varying degrees among all stakeholders (Jentoft and Davis 1993, Gelcich et al. 2005), other authors warn that broad changes to management institutions can lead to system-wide shifts in attitudes and values. In particular, Jentoft et al. (1998) and Schreiber (2001) caution that implementing private rights, with their focus on economic efficiency, may shift attitudes and values in ways that encourage more individualistic, income-maximizing behavior.

Although we have no evidence to suggest the different stakeholder groups here were any more altruistic or individualistic than each other, the level of experience of respondents was clearly linked to the conservativeness of their management preferences. More experienced stakeholders suggested higher TACCs and, because owners were on average more experienced than divers (Table 3), this factor explained over half the gap between their opinions about the TACC (Table 6).

There may be several reasons why more experienced stakeholders tended to suggest higher TACCs. In other contexts, younger individuals have been shown to have more proenvironmental attitudes and values (e.g. Moon et al. 2002). Alternatively, older, more experienced individuals may have less time to recoup any “investment” in the resource, resulting in shorter term decision making. Time in the fishery may also promote beliefs about resource resilience. Many quota owners, the majority of whom were ex-divers, recalled confidently how stocks would “bounce back” after heavy fishing. One recollected that “you’d clear out an area, come back in a few weeks, and they’d all be back ... they’re amazing.” Though such observations can be misleading, i.e., the result of abalone reaggregating to favored areas after fishing (Officer et al. 2001), repeated experiences of this sort would be likely to reinforce beliefs in the resilience of stocks to fishing pressure.

Nevertheless, irrespective of why greater experience leads people to suggest higher TACCs, this does not account for all of the difference between owners and divers.

Beyond the effects of differing levels of concern and experience, almost 40% of the gap between the TACCs suggested by owners and divers was unexplained by the variables explored here (Table 6). We suggest this difference may be, at least in part, related to incentives that vary systematically between the two groups, such as the incentives surrounding the capital value of quota and the costs of fishing.

One of the key differences between divers and owners was that divers usually bore the costs of fishing, i.e., boat costs, fuel, deckhand, etc. Eighty-three percent of divers were liable for these costs while receiving a fixed amount per kilogram of catch. Their income was, therefore, a function of both the quantity of catch and how efficiently it was caught. By contrast, the income of quota owners was directly proportional to catch quantity only. Divers and owners, therefore, experienced quite different incentives with respect to the costs and benefits of fishing.

Standard fishery economic theory notes that as catch levels go up, stocks become less abundant and fishers’ catch-per-unit-effort declines (Grafton et al. 2007, Hannesson 2007). Bioeconomic modeling of the VicWZ fishery, for example, indicates that increasing the TACC by 10% (255 tons to 280 tons) would require 26% more fishing effort (Sanders and Beissen 1996). For quota owners, this would be a 10% increase in net profit. For divers, however, the 10% gross increase in revenue would be offset by the proportionally greater effort required. Although the exact nature of this offset depends on exploitation levels and the various fixed and variable costs of fishing, the point is that divers have less of an incentive to increase quotas. Evidence of this was apparent in management workshops in the VicCZ, where several divers indicated reluctance to increase quota on several reefs. As one contract diver noted, “to a small business operator ... to go to some of those areas and fish them, it’s just unviable.”

The incentives facing the two groups may also differ because of the capital value of quota itself. The capital value of quota units is, theoretically, set by the market, based on the expected flow of benefits from the resource (Grafton 1996). This lies at the crux of the stewardship argument for private rights, that rights owners have an incentive to maximize the value of those rights by ensuring sustainable long-term yields. However, this also means that owners looking to exit the fishery in the short-term have an incentive to view the value of their quota, and therefore the condition of the resource, in a positive light. As the TACC sends a strong price signal in this respect, such individuals have an incentive to support a relatively higher TACC, regardless of long-term consequences.

Another difference concerns the fact that investment in the fishery is much higher for quota owners than for contract

divers. In interviews, industry members indicated that a boat and other equipment for diving entails an investment in the order of US\$100,000-\$200,000. By contrast, the average quota holding of an owner is valued at several million dollars, though the actual value varies between fisheries. With fewer sunk costs, divers have greater workplace mobility, flexibility to supplement their income needs from elsewhere, and, therefore, greater capacity to incur short-term costs, such as quota reductions. Gelcich et al. (2005) makes similar observations about the effects of off-sector employment on the attitudes of Chilean fishers. This dynamic may be particularly important in the context of declining quotas and quota values. As noted by one quota owner, “The worst case scenario [for divers] is they sell their boat and go and get a job. Like I said, I’ve had four million dollars [~US\$4,300,000] worth of quota that I can’t sell at the moment.” Such declines may not only inhibit or prevent rationalization within the fishery (McCay 1995), but also increase the discount rates of owners who face both diminishing asset values and income streams.

Beyond financial incentives, contract divers and quota owners also differ because of the nonpecuniary, physical costs of diving. Industry members often said that one of the key attractions of abalone diving was “lifestyle,” which they characterized in terms of flexibility, independence, and a job that was enjoyable. One diver noted that “It doesn’t even really pay its way anymore. It’s just an enjoyment thing.” This enjoyment, however, is closely tied to weather, physical exertion, and the pressure of “getting your catch.” As another diver said, “You enjoy the calm days. But the winter time, dirty water and rough weather, which you have to dive, which if you didn’t dive, you wouldn’t get your quota, I don’t enjoy those.” Although higher quotas mean more potential income, they also mean that divers are under greater pressure to fish in suboptimal conditions, when the work is less efficient, less enjoyable, and more dangerous, disincentives that do not apply to quota owners.

Nonfinancial drivers of behavior have been indicated in a range of other fisheries (Gatewood and McCay 1990, Durrenberger 1997, Salas and Gaertner 2004, Smith and Wilen 2005) and resource systems (Chouinard et al. 2008, DeCaro and Stokes 2008, Steg and Vlek 2009). The problem is that they are rarely considered in economic assessments of resource use, which typically assume profit-maximizing behavior (e.g., Huppert 2005, BenDor et al. 2009) and often ignore key motivations and behaviors that contribute to the sustainability of fisheries (Salas and Gaertner 2004, Branch et al. 2006). As shown here, this is particularly important when incentives differ systematically between stakeholder groups.

Indeed, one of the key findings of the current study is the differing incentives experienced by those who fish and those who, although they own quota, do not themselves fish. This

is illustrated by the opinions of owner divers who, like contract divers, were more conservative in their opinions about the TACC than nondiving owners. Other authors warn that separating ownership from the practice of fishing removes the incentives for those who fish, but lack ownership rights, to be resource stewards (Lynham et al. 2009). Our results suggest that the opposite may sometimes be the case. The material and physical costs associated with the act of resource extraction create important incentives for sustainable behavior, incentives that appear to be more important in encouraging stewardship behavior than private property rights alone.

CONCLUSION

This study does not question the potential benefits of defining clear and limited access rights to natural resources. Indeed, in line with previous work in these fisheries (Gilmour et al. 2011) and other natural resources (Berkes et al. 1989, Ostrom 1990, Acheson 2006b, Townsend et al. 2008), the limited and well-defined nature of the resource using groups is likely to have been critical in enabling cooperation and stewardship. Rather, we cast doubt on the inferred, often taken for granted link between private ownership, in the form of ITQs, and stewardship. This is the first study to directly test the veracity of this assumption.

Our data show that nonrights-owners actually propose more conservative catch levels than do rights-owners. This indicates that private rights are less important than commonly suggested, or may even entail a range of disincentives to sustainability. These are important caveats given recent, high profile reports heralding private rights as the solution to overfishing (Costello et al. 2008, Heal and Schlenker 2008). The social and environmental drawbacks to such rights (Sumaila 2010) suggest that alternative arrangements, perhaps grounded in communal (Wingard 2000) or limited-tenure systems (Bromley 2005, Costello and Kaffine 2008), should be considered in more detail.

Our results also emphasize the complexity of resource users’ behavior. Financial incentives may be important, but are not necessarily straightforward; the differing incentives facing active resource harvesters, versus resource owners not involved in harvesting, warrants further attention in this regard. Nonfinancial incentives, such as the “drudgery” of work (Durrenberger 1997:162), are important too. Moreover, the very nature of incentives is shaped by an interaction between subjective perceptions, such as those of resource condition, and underlying attitudes and values (Gelcich et al. 2005, Sorice et al. 2011). The problem is that, despite their importance, the effects of these nonstructural factors are poorly understood, particularly in comparison to simplified models of profit-maximizing behavior.

This problem reflects broader issues in conservation and natural resource policy, i.e., the use and extension of simple behavioral models to complex systems (McCay and Jentoft

1998). “Good story lines are easily applied to many situations with the risk of misrepresenting the more complex and shifting social, cultural, and ecological relationships and processes at stake” (McCay and Jentoft 1998:23). The fallacy, perhaps, is that while having a vested interest in a resource may encourage sustainable behavior, this does not mean that those with the greatest vested interest will necessarily favor the most sustainable management options. As Caddy and Seijo (2005:72) suggest, “enlightened self-interest” alone is not enough and should be seen in the context of broader incentives and ethical considerations. The complex and often nonlinear characteristics of these social-ecological systems calls for more holistic and integrated research across disciplines to better understand the underlying mechanisms and processes. This is critical for implementing policies that address the related ecological, economic, and social dimensions of these systems.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/vol17/iss3/art1/responses/>

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