

*Research*

## Understanding the Consequences of Property Rights Mismatches: a Case Study of New Zealand's Marine Resources

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**ABSTRACT.** Within fisheries and natural resource management literature, there is considerable discussion about the key roles that property rights can play in building biologically and socially sustainable resource management regimes. A key point of agreement is that secure long-term property rights provide an incentive for resource users to manage the resource sustainably. However, property rights mismatches create ambiguity and conflict in resource use. Though the term mismatches is usually associated with problems in matching temporal and spatial resource characteristics with institutional characteristics, I expand it here to include problems that can arise when property rights are incompletely defined or incompletely distributed. Property rights mismatches are particularly likely to occur over marine resources, for which multiple types of resource and resource user can be engaged and managed under a variety of regulatory regimes. I used New Zealand's marine resources to examine the causes and consequences of these property rights mismatches. New Zealand is particularly interesting because its property-rights-based commercial fishing regime, in the form of individual transferable quotas, has attracted considerable positive attention. However, my review of the marine natural resource management regime from a broader property rights perspective highlights a series of problems caused by property rights mismatches, including competition for resources among commercial, customary, and recreational fishers; spatial conflict among many marine resource users; and conflicting incentives and objectives for the management of resources over time. The use of a property rights perspective also highlights some potential solutions such as the layering of institutional arrangements and the improvement of how property rights are defined to encourage long-term sustainability.

**Key Words:** *aquaculture; fisheries; indigenous rights; individual transferable quotas; institutional analysis; marine; marine protected areas; marine resources; natural resource management; property rights*

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### INTRODUCTION

The world's marine and fisheries resources are well-recognized, vital economic assets that face extensive overexploitation and ecological degradation (Pauly et al. 2003, Food and Agriculture Organization 2005). In response to this dilemma, the fisheries and natural resources management communities are developing new approaches to better manage marine resources. These approaches include individual transferable quotas (National Research Council 1998), marine reserves (Sobel and Dalgren 2004), ocean zoning (Crowder et al. 2006), territorial use rights in fisheries (Gonzalez 1996), collaboration (Weible et al. 2004), co-management (Wilson et al. 2003), regulation (Hennessey and Healey 2000), and community-based management (King 2000).

As yet, little effort has been made to understand the effects of the use of multiple resource management approaches simultaneously or in close proximity. Although these innovations are encouraging, they can also create problems, partly because each resource problem is examined and each approach is applied individually. As a result, the approach that is used to solve one resource problem such as access for aquaculture may create problems in other resource sectors such as commercial and recreational fisheries. This is especially problematic when the resources have multiple uses, e.g., aquaculture, commercial fishing, and recreational fishing, resulting in conflicting demands on coastal resources. A key issue, then, is how these inter-relationships can be understood, analyzed, and managed.

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Here, I use property rights as a theoretical basis from which to understand these potential conflicts. Property rights theory may be used to analyze how different management approaches characterize property rights and distribute pieces of the property rights bundle. Conflicts arise when property rights or institutional arrangements are incompletely defined or are distributed in ways that create mismatches (Young 2002, Cash et al. 2006, Crowder et al. 2006, Wilson 2006) between property rights arrangements. A mismatch can be defined as “a problem of fit involving human institutions that do not map coherently on the biogeophysical scale of the resource either in time or space... In these kind of mismatch problems, the authority or jurisdiction of the management institution is not coterminous with the problem” (Cash et al. 2006:4).

An example of a mismatch is how cod in the northwest Atlantic was managed as a single large unit, rather than a series of more localized stocks, resulting in an extended set of serial depletion (Crowder et al. 2006). Mismatches are usually defined as temporal and/or spatial mismatches (Wilson 2006). However, I extended the concept of a mismatch to apply to property rights (Yandle 2006a). When a variety of property rights arrangements are created to manage individual resources or sectors, the result may be the creation of incompletely defined property rights arrangements, causing conflicting expectations among resource users. In such cases, there are property rights mismatches.

I explore the roots of resource conflicts in property rights mismatches using the example of New Zealand’s marine resources. This is a particularly interesting case because of New Zealand’s long history of policy innovation, particularly in natural resource management. After briefly reviewing key concepts from the property rights literature, I present an overview of New Zealand marine resource management, including an inventory of competing interests involved in New Zealand coastal resources. This is followed by an analysis of these interests, their property rights characteristics, and their property rights bundles. Finally, some causes, consequences, and possible solutions to property rights mismatches are discussed.

## PROPERTY RIGHTS AS A THEORETICAL BASIS

The roles of property rights in natural resource governance regimes are examined in a long and well-regarded body of literature (e.g., Demsetz 1967, Pearse 1988, Libecap 1989, Hanna et al. 1996). In terms of natural resources, Hanna et al. (1996:1) explain property rights as follows: “the structure of rights to resources and the rules under which those rights are exercised are mechanisms people use to control their use of the environment and their behavior towards each other... Property-rights systems are part of society’s institutions: the norms and rules of the game, the humanly devised constraints that shape human interactions...”

For the purposes of this analysis, I highlight three key points about property rights. First, in the absence of a well-defined property rights regime, common pool resources such as fisheries will be overexploited (e.g., Gordon 1954, Scott 1955) in what is now referred to as the tragedy of the commons (Hardin 1968). Second, property rights regimes are created in two distinct ways: by users, who negotiate and create the institutional arrangement used to distribute and enforce property rights (Libecap 1989); and by the government, which transfers or delegates certain rights from the government to the resource users (Raymond 2003). Third, it is inappropriate to discuss “a property right” because property rights are not a single unit. Instead, property rights are better thought of as a “bundle” or grouping of discrete divisible rights that may then be shared or divided in different ways (Schlager and Ostrom 1992, Ostrom and Schlager 1996). Several different property rights bundles are discussed in the literature (e.g., Demsetz 1967, Scott 1988, Feder and Feeny 1991, Sharp 2004; see Raymond 2003 for a discussion).

These three key points, i.e., the importance, origins, and definition of property rights, and property-rights-based governance arrangements or regimes provide the theoretical grounding for my analysis. Like Pearse (1988) and Seabrooke and Pickering (1994), I use property rights as a theoretical basis from which to understand how mismatched property rights create difficulties in natural resource management. However, unlike these earlier efforts, I apply the concept of a separable bundle of property rights, in this case, Ostrom and Schlager’s (1996) bundle, to systematically examine how property rights are distributed.

Ostrom and Schlager (1996) describe property rights as a grouping of five operational-level rights: access, i.e., the right to enter an area; withdrawal, i.e., the right to extract a resource; management, i.e., the right to regulate use and make improvements; exclusion, i.e., the right to determine who has access and how access rights are transferred; and alienation, i.e., the right to sell or lease management and exclusion rights. Their property rights bundle provides a tool for understanding how different distributions of the property rights bundle affect individuals' incentives to manage a resource. It is therefore the most appropriate tool for use here.

In addition to Ostrom and Schlager's (1996) property rights bundle, three other characteristics of property rights are examined. These are not operational-level rights, which delineate the actions a property rights holder must, may, or cannot take with regard to a resource, but rather "property rights dimensions," which are used to assess the qualities of the property rights. These qualities are temporal, spatial (Wilson 2006), and quantitative (Terrebonne 1995). Temporal refers to the period of time for which the operational-level rights are guaranteed or the time until the rights regime is renegotiated. This is important because for rights holders to have the incentive to use a resource sustainably, they must be confident in the time period over which their rights to the resource will not be diminished (Scott 2000). Spatial refers to how well the property rights regime defines the locations where the operational-level rights may be exercised. Spatial quality is important because the "effective management of resources requires a close match between the spatial extent of the resource and the institutions used to manage the use of the resource" (Wilson 2006:5). Finally, quantitative describes how well the property rights regime defines how much of a resource may be extracted within a given period. This dimension is important because it defines how much of a resource rights holders may extract, providing restraints and incentives to counter the overexploitation of common-pool resources (National Research Council 1998), assuming that the limits are set correctly (Conable et al. 2000).

I use these property rights dimensions along with Ostrom and Schlager's (1996) property rights bundle to systematically examine how property rights and the property rights dimensions are distributed in New Zealand's marine resources governance regime. To provide a background, I next present an overview of New Zealand's marine resources, followed by a brief summary of the 12

primary resource interests and an analysis of their associated property rights regimes.

## **MARINE NATURAL RESOURCES IN NEW ZEALAND**

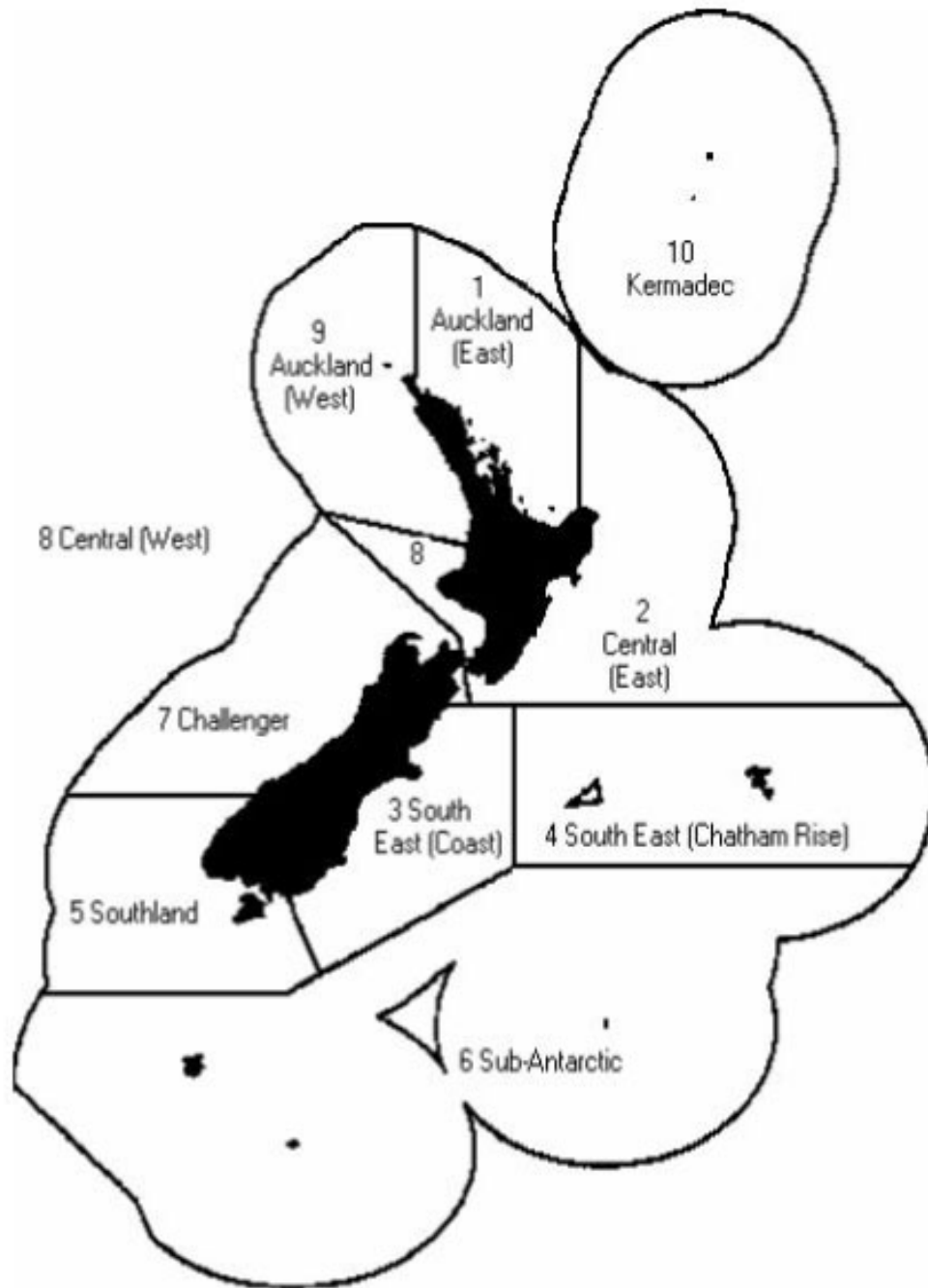
New Zealand is an important case in natural resource management because of its long-standing role in public policy innovation, both generally (Kettl 2000) and in natural resource management (Bühns and Barlett 1993). Many policies proposed in the research literature can be observed in practice in New Zealand. In the marine sector, this innovation is observed in the creation of marine protected areas (MPAs) and plans to implement a network of MPAs (Department of Conservation and Ministry of Fisheries 2005), as well as the early implementation of property-rights-based fisheries management in the form of individual transferable quotas (Batstone and Sharp 1999). New Zealand has also addressed indigenous peoples' (i.e., Maori) interests in natural resource management (Matunga 2000, Bess and Harte 2001).

New Zealand's marine areas provide a large, diverse, and economically significant set of resources. The 200-mile exclusive economic zone covers an area of 1.2 million square nautical miles, or 15 times New Zealand's land mass (Fig. 1). It is estimated that marine activities contribute \$NZ 3.3 billion to the nation's economy annually (Statistics New Zealand 2006).

## **EXAMINING NATURAL RESOURCES FROM A PROPERTY RIGHTS PERSPECTIVE**

Several distinct interests for the use of New Zealand's marine waters can be identified: government, commercial fishing, customary Maori fishing, recreational fishing, aquaculture, conservation, marine tourism, offshore resource extraction, and submarine cables and pipelines. Each of these interests has different property rights dimensions and property rights bundles. I next describe and analyze these interests together with their property rights dimensions and bundles (Table 1). In this analysis, each dimension and piece of the property rights bundle is treated as scaled, rather than as simply present or absent, because rights can be of varying strengths.

**Fig. 1.** New Zealand's economic exclusion zone and quota management areas. Source: Ministry of Fisheries (2005:74).



**Table 1.** Summary and analysis of New Zealand marine resource interests and property rights arrangements.

Sector	Description	Property rights dimensions†			Property rights bundle‡				
		Temporal	Spatial	Quantitative	Access	Withdrawal	Management	Exclusion	Alienation
Commercial: ITQs§	Individual transferable quotas	Held in perpetuity (5)	Broad regions superseded by other interests (3)	% of TACC‡ (5)	Implicitly held by owner (2)	Well defined; held by owner (5)	Shared between government and owner (3)	Owner holds limited de-facto rights (3)	Owner holds very limited de-facto rights; government is primary holder (1)
Commercial: ACE¶	Annual catch entitlement	Valid for 1 yr (1)	Broad regions superseded by other interests (3)	Tonnes (5)	Implicitly held by owner (2)	Well defined; held by owner (5)	Not held by owner (1)	Not held by owner (0)	Held by government (0)
Customary Maori: <i>mātaihai</i>	<i>Tangata whenua</i> hold exclusive management rights for part of coast	Held in perpetuity (5)	Small areas corresponding to traditional boundaries (5)	Not explicitly defined (2)	Held by <i>tangata whenua</i> (5)	Held by <i>tangata whenua</i> (5)	Held by <i>tangata whenua</i> (5)	Held by <i>tangata whenua</i> (5)	Not defined; implicitly held by government, with varying perceptions of Maori rights (1)
Customary Maori: <i>taiāpure</i>	Iwi/hapu have great but not exclusive say in management; commercial fishing allowed	Held in perpetuity (5)	Small areas corresponding to traditional boundaries (5)	Not explicitly defined (2)	Held by general public (3)	Held by customary, recreational, and commercial fishers (2)	Shared between iwi/hapu and government (3)	Held by government (0)	Not defined; implicitly held by government, with varying perceptions of Maori rights (1)
Customary Maori: Kaimoana customary fishing	Individuals or groups receive permission to catch amounts beyond normal amateur catch for traditional celebrations	Held in perpetuity (5)	Small areas corresponding to traditional boundaries (5)	Well defined individually; poor collective definition (3)	Same as recreational fishers (3)	Rights enhanced over those held by recreational fishers (3)	Distribution of catch right held by <i>tangata whenua</i> ; most other rights held by government (2)	Held by government (0)	Held by government (0)
Recreational fishing	Strong social tradition; poorly enforced individual catch limits	Presumed held in perpetuity (3)	Not defined; implicitly anywhere that is not explicitly forbidden (2)	Individual limits; poorly defined collectively (2)	Implicitly held by recreational fishers (2)	Explicitly held by individual fishers; poorly defined collectively (3)	Held by government (0)	Held by government (0)	Held by government (0)
Aquaculture	Local councils define AMAs# and issue renewable resource consents	Valid for up to 35 years (4)	Well defined as a sector and for individual farms (5)	Poorly defined right to collect spat (2)	Held by permit holders (5)	Held by permit holder; often poorly defined (3)	Held by government (0)	Extremely limited; held by permit holder (1)	Held by government (0)

(con'd)

Conservation	Marine reserves	Held in perpetuity (5)	Well-defined small areas (5)	No-take zone, withdrawal set to zero (0)	Held by general public (1)	No withdrawal, thus held by government (0)	Held by government (0)	Held by government (0)	Held by government (0)
Marine tourism	Nonextractive recreational use of marine resources	Presumed held in perpetuity (3)	Implicit access to places not explicitly forbidden; some restrictions on tour operators (2)	Not applicable (0)	Held by general public (1)	Not applicable (0)	Held by government (0)	Held by government (0)	Held by government (0)
Offshore resource extraction	Natural gas drilling by extraction permit holders	Varies by permit (4)	Permits granted for specific areas (5)	Unlimited extraction allowed (5)	Held by permit holder (5)	Held by permit holder (5)	Shared by permit holder and government (3)	Held by permit holder (5)	Held by government (0)
Submarine cables and pipelines	Protected zone for submarine cables and pipelines	Presumed held in perpetuity (3)	Well-defined small areas, e.g., 4 m around cable (5)	Not applicable (0)	Held by general public (1)	Not applicable, but impinges on others' rights (0)	Shared by permit holder and government (3)	Held by permit holder (5)	Held by government (0)
Government	Holds rights in trust for public unless defined otherwise	Held in perpetuity unless delegated (5)	200-mile EEZ <sup>††</sup> unless delegated (5)	All unless delegated (5)	Held by government; often delegated (5)	Held by government; usually delegated to varying degrees (5)	Held by government; often significant portions shared (5)	Held by government; occasionally delegated (5)	Held by government (5)

†The quality of property rights dimensions was assessed on a scale of zero to five, indicated in parentheses.

‡The strength of property rights bundle elements was assessed on a scale of zero to five, indicated in parentheses.

§Individual transferable quotas.

¶Total allowable commercial catch.

¶Annual catch entitlements.

#Aquaculture management areas.

††Exclusive economic zone.

## Government

The first marine resources rights holder is the government, which is the default holder of all property rights in trust for the public. Through legislation, the government defines the rights of all other known interested parties and also has the ability to remove these rights through further legislation. Thus, in the absence of legislation defining otherwise, the government holds or has

control over the complete property rights bundle, i.e., access, withdrawal, management, exclusion, and alienation, within the 200-mile exclusive economic zone (EEZ) in perpetuity. In most cases, access and withdrawal rights are distributed to other interested parties. Management rights are often shared between private interests and the government, whereas exclusion rights are usually held by the government; an exception is the *mātaitai* (see *Examining natural resources: Customary Maori*

*fishing*). Alienation rights usually remain with the government. The exception to this are interests that hold weak alienation rights, either through the failure to create formal definition, e.g., *mātaïtai* and *taiāpure*, or by the development of a de-facto right over time, e.g., commercial individual transferable quotas (ITQs).

### Commercial fishing

The governance of New Zealand's commercial fishing is achieved through a co-management system under the property rights framework of the New Zealand Quota Management System (QMS; Yandle 2003, Yandle 2006b), with 96 of the 100 commercially significant species managed under the QMS (New Zealand Ministry of Fisheries, [link](#)). The objective of the QMS is to maintain sustainable levels of the targeted species, rather than ecosystem management. Additional input controls such as area closures and gear restrictions are used to address ecological issues (New Zealand Ministry of Fisheries, [link](#)). Individuals or companies own fishing rights called ITQs. Broadly, ITQs are the transferable (i.e., sellable) right held in perpetuity to catch a specific proportion of the volume of fish permitted for commercial purposes in a broadly defined geographic area. ITQs represent a proportional share of the total allowable commercial catch (TACC), which is set annually.

Because ITQs are proportional, once the TACC is set, they generate or spin off an annual catch entitlement (ACE) that represents the right to catch a specific tonnage of that species during that fishing year. This catching right may be bought or sold, but it expires at the end of the catching year (Statistics New Zealand 2007). Because ITQs and the ACE have such different property rights characteristics, each is examined independently. However, many ITQ share owners, which are either individuals or companies, will use the ACE generated by their ITQ, rather than sell the catching right. In such a case, their property rights and incentives are the stronger rights of an ITQ owner, not an ACE owner.

ITQ share owners' property rights dimensions are as follows. The temporal dimension is well defined, with ITQ share owners holding a perpetual right. Similarly, the quantitative dimension, while variable annually insofar as tonnage is concerned, is well defined as a percentage of each year's TACC. The spatial dimension is more complex. Although

broad quota management areas are defined (Fig. 1), these areas are not well matched to fishery conditions and are often superseded by other marine interests such as marine reserves.

Turning to the property rights bundle, ITQ share owners hold a right of access because a person must be able to enter an area to fish it. However, the right of access is limited because it is overridden by the rights of other interests such as *mātaïtai* and some aquaculture. ITQ share owners also hold a strong and well-defined withdrawal right, i.e., a percentage of the TACC. Limited management rights are exercised collectively and shared with the government. It can be argued that ITQ owners hold limited de facto exclusion rights because they can choose when and to whom they sell ITQs and the ACE. Alienation rights are primarily held by the government, with some limited de-facto alienation rights held by ITQ owners. This is because the sale of ITQs is legally the sale of formally granted access and withdrawal rights. Furthermore, management rights are shared between the government and ITQ owners. Whereas exclusion rights remain formally held by the government, ITQ owners do have limited de facto rights in this respect. Thus, with management and exclusion rights shared in practice, a limited de facto alienation right, i.e., the right to sell or lease management and exclusion rights, is held by ITQ owners.

The property rights characteristics of ACE owners are subtly different than those of ITQ share owners. Both classes of commercial rights holders share the same spatial dimensions. Catching rights continue to be well defined quantitatively, but are defined as a specific volume in tonnes. However, the temporal dimension is quite different, with the ACE expiring after a single year. Turning to the property rights bundle, the ACE represents an implicit access right and a well-defined withdrawal right. However, unlike ITQ share owners, ACE owners do not hold limited management or exclusion rights. Alienation rights continue to be held by the government. The implications of the differences between ITQ and ACE property rights are discussed later.

### Customary Maori fishing

The Maori peoples' historical, cultural, and economic ties to the oceans and fishing have been well discussed (Bess and Harte 2001). Furthermore, the Maori are recognized and codified by the Treaty

of Waitangi settlement and a variety of laws. Three different types of property rights regimes or governance arrangements exist: *mātaitai* reserves, *taiāpure*, and customary fishing rights. The characteristics of each regime are defined; however, each regime is administered at the level of the *tangata whenua*. Literally translated as “people of the land,” a *tangata whenua* can be understood as a legally recognized unit of Maori local governance that is defined based on historic ties to a specific geographic area.

According to the Ministry of Fisheries, *mātaitai* reserves are “areas where the *tangata whenua* manage all noncommercial fishing” (New Zealand Ministry of Fisheries, [link](#)). In a *mātaitai*, the *tangata whenua*, through a management committee, are able to make harvest rules independent of any other authority, and those rules are binding on all people harvesting from the *mātaitai*. In terms of property rights dimensions, the spatial dimension is well defined, conforming to *tangata whenua* boundaries. Temporally, these rights are held in perpetuity, and the *tangata whenua* maintains the right to define how much may be extracted from the area by any fishers, be they customary or recreational; commercial fishing is usually excluded from *mātaitai* reserves. The *mātaitai* reserves property rights bundle is also quite extensive. Access rights, management rights, and exclusion rights are all explicitly held by the *tangata whenua*. However, withdrawal rights, although explicitly recognized, are not well defined quantitatively or in proportion to the total allowable catch. Alienation rights are not explicitly allocated and could be assumed to be held by the government. However, the political and legal history surrounding the Treaty of Waitangi settlement creates enhanced ownership rights for customary Maori rights. Thus, there is the perception that some degree of alienation rights is held by the Maori, with primary rights ownership held by the government.

A *taiāpure* also applies to a specific geographic area: “estuarine or littoral coastal waters of special significance to the iwi/hapu for food gathering and/or spiritual and cultural reasons” (New Zealand Ministry of Fisheries, [link](#)). Within a *taiāpure*, the management committee, composed of members of the local Maori communities, is able to make management recommendations to the Ministry of Fisheries for regulations to manage the area, but the

Ministry is the ultimate decision maker. *Taiāpure* do not provide the iwi/hapu with superior access, but often result in regulations that exclude commercial fishing. An analysis of property rights dimensions shows that *taiāpure* provide similar property rights dimensions as *mātaitai*, with well-defined spatial rights that conform to customary boundaries. The rights are held in perpetuity, but the quantitative dimension is not well defined because catching limits are not explicitly defined. The *taiāpure* property rights bundle is subtly different than that of the *mātaitai*. Access rights are held by the general public, not just the iwi/hapu, and withdrawal rights exist for customary Maori fishers, recreational fishers, and sometimes commercial fishers. However, customary Maori fishers hold limited management rights, shared with the Ministry. Exclusion rights are specifically not granted for *taiāpure*, and alienation rights are similar to those of *mātaitai*.

Finally, there are Kaimoana customary fishing rights. Under these rights, Maori or non Maori individuals may request permission from recognized Maori leadership (*tangata kaitaki/tiaki*) to catch fish in excess of the normal recreational catch limit for customary purposes. From a spatial perspective, this right is limited to the *tangata whenua* traditional areas, but it does not exclude other interests from this geographic area. Rather, it provides enhanced customary catching rights within the area. Temporally, this property is held in perpetuity by the *tangata whenua*, but individuals must ask permission for each use. Property rights are also poorly defined quantitatively, with no aggregate rights assigned to each *tangata whenua*. Within the property rights bundle, access rights are congruent with those of recreational fishers. Enhanced withdrawal rights compared to those of recreational fishers are provided for individuals with Maori leadership, providing limiting details, e. g., amounts, locations, and dates, to the individuals who receive withdrawal rights. However, the withdrawal rights are poorly defined at the aggregate level, with unclear limits for each *tangata whenua* and total catch. The *tangata whenua* holds limited management rights to define individual catch limits, with primary management responsibility remaining with the government. The government holds exclusion and alienation rights.



## Recreational fishing

Within New Zealand, there are very strong cultural ties to recreational fishing. Indeed, the Ministry of Fisheries notes that “the basic legal right underpinning recreational fishing is ... [a] right to go fishing in the sea for personal use” (Ministry of Fisheries 2005:69). Recreational fishing is regulated by the Ministry of Fisheries, with individuals required to adhere to daily catch and size limits and method restrictions. There are, however, no licensing requirements, which would be viewed by activists as breaching the underlying right, and no reporting requirements. Legally, chartered fishing vessels are treated as providing taxi and advice services to recreational fishers and therefore hold the same property rights as recreational fishers. Thus, they are not required to purchase ITQs.

An analysis of recreational fishing shows that this sector holds a relatively weak formal set of property rights. Temporally, recreational rights are held in perpetuity, but in a quite abstract manner: The right to fish is recognized, but exactly what that entails is not well specified. There are no specifically defined spatial rights; it appears that recreational fishers may go anywhere where they are not specifically excluded. In addition, there is no aggregate quantitative right for this sector; instead, there are individual bag limits. Thus, recreational fishers hold implicit access rights, as well as withdrawal rights that are well defined individually, but poorly defined collectively. Although recreational fishers are consulted by the government, they do not hold management, exclusion, or alienation rights.

It is interesting that recreational fishers have traditionally rejected any effort to bring recreational fishing into a property-rights-based approach, even though it would provide them with a stronger bundle of property rights, preferring instead to protect their interests through the political process by relying on the huge number of voters who are recreational fishers. For example, in 1999, the Secretary of the New Zealand Recreational Fishing Council stated, “The council has for many years had a mandated policy of ‘no licensing, no quota, and crown to manage the fishery’” (Hetherington 2000:284).

## Aquaculture

Aquaculture is managed by a combination of regional councils (local government) and the Ministry of Fisheries (national government). The regional councils designate areas as Aquaculture Management Areas (AMAs) in which marine farms may be sited. Before a regional council designates an AMA, the Ministry of Fisheries must be persuaded that there will be no “undue adverse effect” on commercial, recreational, and customary fishing (Ministry for the Environment 2005; see also New Zealand Ministry for the Environment, [link](#)). This is important because, although the spatial rights of aquaculture supersede those of other interests such as commercial and recreational fishers once a marine farm is established, before designating an AMA, the local and national governments will work to ensure that the location will not have an undue adverse effect on other interests. Individual marine farms then receive permits to operate a marine farm within specific areas of the AMA. A permit is renewable and valid for up to 35 years under the Resource Management Act; however, the rights associated with marine farms that were created between 1992 and 2004 are not as well defined, so it is unclear whether the 35 years temporal rights apply to these marine farms as well.

An examination of the dimensions of aquaculture property rights indicates that they are well defined spatially and usually have a clear temporal definition, with property rights held for up to 35 years. The quantitative withdrawal dimension is not well defined; however, withdrawal occurs because spat (juveniles) are taken from the marine environment and seeded into aquaculture lines. Analysis of the property rights bundle indicates that aquaculture holds extremely well-defined access rights and poorly defined withdrawal rights. Permit holders have extensive management rights within their permitted areas. However, permit holders have quite limited exclusion rights because other interests, including commercial and recreational fishers, may enter an AMA, as long as they do not interfere with aquaculture activities. Alienation rights remain with the government.

## Marine reserves

Marine reserves are essentially “no take” areas in which no commercial, recreational, or customary fishing or any other removal or disturbance of

marine life or marine habitat may take place. From the property rights dimensions perspective, marine reserves are created in perpetuity and are extremely well defined spatially. The quantitative aspect is also well defined, but it is defined as a prohibition, i.e., no amount may be removed, rather than as a specific amount that may be removed. Thus, the quantitative right is held by the government. The property rights bundle is also well defined. Access rights are held by the general public; however, any withdrawal is prohibited, essentially meaning that these rights are held by the government. Similarly, management, exclusion, and alienation rights are held by the government through the Department of Conservation.

### **Marine tourism**

For the purposes of my analysis, marine tourism is the nonextractive recreational use of coastal and marine resources. Examples of marine tourism include beaches, scenic boat cruises, snorkeling, and whale and dolphin watching. Some activities such as whale watching are subject to specific regulations, but most marine tourism activities are only subject to general health and safety regulations. Thus, the property rights associated with this sector are roughly the equivalent of those of the general public. As a result, the analysis of the temporal property rights dimension suggests that, although not explicitly defined, these property rights may be assumed to be held in perpetuity. Similarly, the spatial dimension is implicit: Unless the public is specifically excluded from an area, it is assumed that the public is allowed to enter. However, the numbers of commercial access providers, e.g., whale-watching tour operators, are restricted by the Department of Conservation. The quantitative dimension does not exist because this activity is not extractive. Similarly, the property rights bundle is quite limited because of the nonextractive nature of the activity. Participants in marine tourism hold access rights to certain areas and do not require and thus do not hold withdrawal rights. Thus, the tourism interests hold access rights, but all other rights, i.e., withdrawal, management, exclusion, and alienation, are held by the government.

### **Offshore resource extraction**

In New Zealand, offshore resource extraction refers to natural gas drilling, e.g., the Maui Gas Fields. The exploration of other offshore mineral extraction is ongoing, but not presently commercially viable. Under New Zealand law, all offshore hydrocarbons and minerals are owned by the government, and permits are granted to allow drilling and resource extraction for a specific period of time.

Because the New Zealand government explicitly asserts full property rights for offshore hydrocarbon and mineral resources, the property rights associated with resource extraction are quite interesting to analyze. Clearly, in the absence of an extraction permit, the government holds all pieces of the property rights bundle and maintains a strong position on the dimensions, holding rights in perpetuity throughout the EEZ for all minerals found within the EEZ. However, when the government issues an exploration or extraction permit, the distribution of property rights changes. In terms of property rights dimensions, permit holders have property rights that have clear temporal limits and are also well defined spatially. However, there is no quantitative limit on extraction. The property rights bundle held by permit holders is not as limited as it may initially appear. Permit holders clearly have access and withdrawal rights. It can be argued that management authority is shared between the government and the permit holder because the government holds the right to regulate the permit holder, who has the right to make improvements. Similarly, exclusion rights are shared because permit holders determine who is allowed onto their drilling facilities, but the government determines how this right is transferred, as part of the permit. Finally, alienation rights are held by the government.

### **Submarine cables and pipelines**

Perhaps the least visible marine interest is submarine cables and pipelines. This infrastructure carries telecommunication signals, brings natural gas to the land, and transports electricity. There are 10 protected zones in which only extremely limited fishing activity, e.g., setting and lifting lobster pots, paua, or kina fishing, may take place, with anchor dropping and trawling specifically prohibited (Maritime New Zealand 1996). In essence, these protected zones create property rights for cable and

pipeline owners. The property rights dimensions are presumed to be in perpetuity because there are no sunset provisions in the law. Furthermore, they apply to very specifically defined spatial areas. As with marine tourism, because there is no extractive element to this activity, there is no quantitative dimension for these property rights.

The property rights bundle is more difficult to assess because the protection zone is a prohibition on the activities of others, rather than allowing activity by cable and pipeline owners. Thus, access rights are held by the cable and pipeline owners, but they are also held by all other interested parties who care to enter the area, i.e., the general public. Because this is a nonextractive activity, the cable and pipeline owners hold no withdrawal rights, but by banning fishing and anchoring, the withdrawal rights of all fishing interests, i.e., commercial, customary, and recreational, are removed from these areas and are instead held, presumably, by the government. Management rights are held jointly by the cable and pipeline owners, who have maintenance responsibilities, and the government, which holds the right to regulate the cable and pipeline owners. Exclusion and alienation rights are held by the government.

## ANALYSIS

New Zealand's marine natural resources have a wide variety of uses and a variety of methods to manage these uses, which often occur in the same area or in very close proximity. I summarized the multiple interests and their regulatory regimes in New Zealand from a property rights perspective (Table 1). I then rated both the quality of the property rights dimensions and the strength of each property right in the property rights bundle, each on a scale from zero to five for each sector.

### Mismatches in property rights dimensions

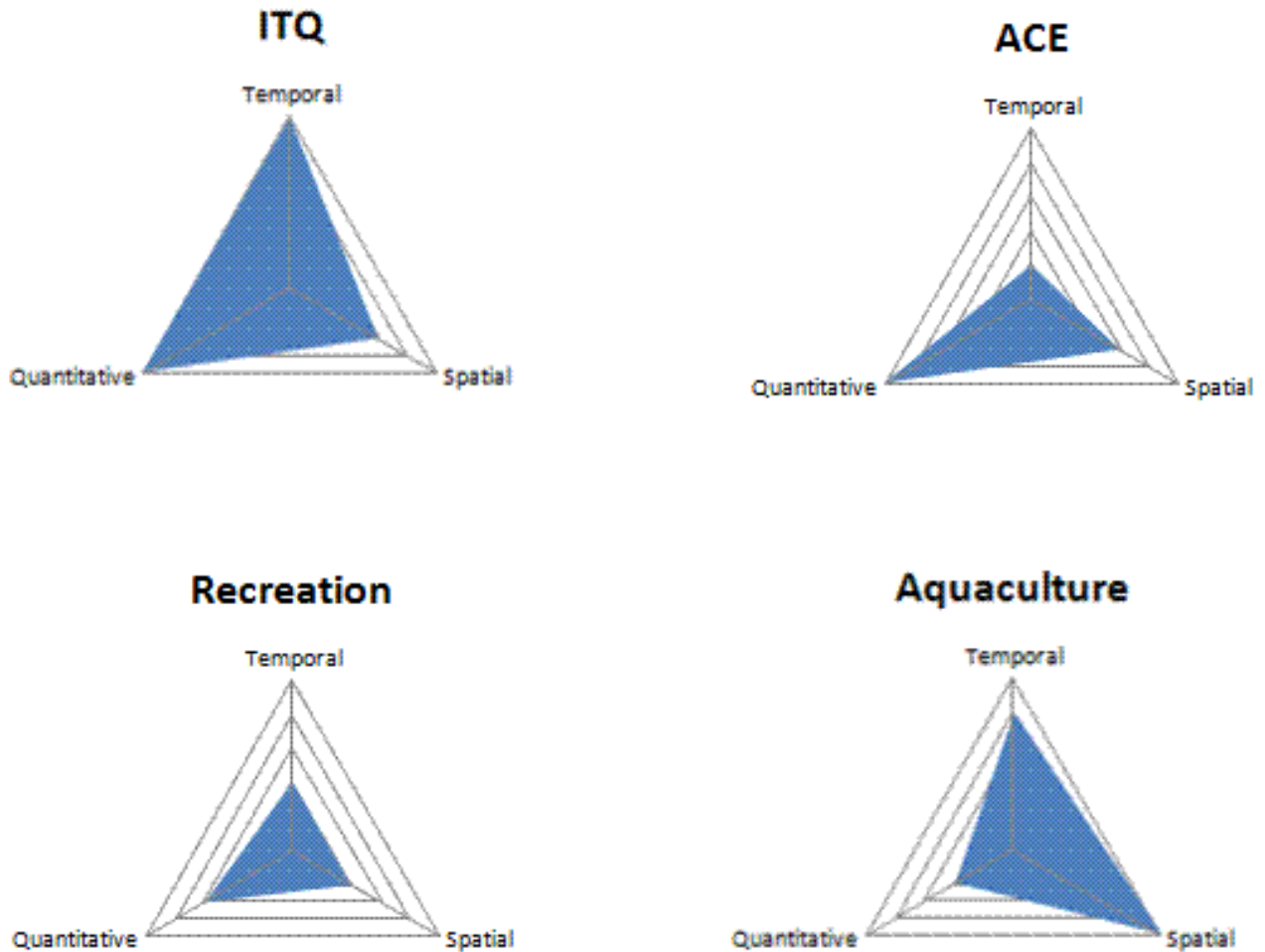
The analysis of property rights dimensions shows tremendous variation through all three dimensions. For the temporal dimension for example, although the property rights of most interests are held in perpetuity, those of others such as the annual catch entitlement (ACE) and aquaculture permits are valid for shorter periods of time, with the ACE valid for only 1 yr. This variation is important because there is considerable evidence that the greater a resource user's time horizon, the greater their incentive to

manage the resource sustainably or even rebuild the resource because they are more confident that they will receive the long-term benefit when the resource is rebuilt (e.g., Scott 1993, 2000). However, in the case of commercial fishing, the existence of individual transferable quotas (ITQs) and the ACE has created fishers with different time horizons and different incentives, with ITQ share owners having greater reason to participate in stock rebuilding efforts than ACE owners (Yandle 2006b). This is illustrated by comparing the quality of property rights dimensions for ITQs, ACE, recreational fishing, and aquaculture property rights holders using the property rights ratings from Table 1 (Fig. 2).

The spatial dimension also presents important mismatches, and these are perhaps the most visible because the demand for multiple activities to take place in the same space is very clear. The problem here is that most interests have a spatial component to their property rights, but often these rights overlap and come into conflict. For example, both commercial and recreational fishers have rights for quite broadly defined spatial areas, e.g., a quota management area. However, these rights are superseded by other marine interests such as aquaculture, *mātaitai*, marine reserves, and even resource extraction and submarine cables and pipelines. In the case of aquaculture, however, this conflict is clearly addressed in the requirement that undue adverse effects on the fishing sectors be considered. However, the cumulative effect of all of these smaller exclusive spatial property rights is a nibbling away at the broader spatial property rights for the commercial and recreational fishers, leading to weaker rights. This is particularly a concern for inshore commercial fishers who worry that their quantitative rights are undermined by their shrinking spatial rights. Essentially, as commercial fishers are left with fewer places in which to catch, greater pressure is placed on the stock in the remaining areas that are open, leading to increased costs as the catch per unit of effort decreases. Eventually, pressure to reduce their total allowable commercial catch (TACC) or quantitative rights will be forthcoming.

Finally, mismatches also occur in the quantitative dimension, in which very few interests have well-defined property rights. For some such as marine tourism, the property rights do not involve extraction, so quantitative rights are not applicable. In offshore resource extraction, it appears that

**Fig. 2.** Comparison of property rights dimensions for individual transferable quotas (ITQs), annual catch entitlement (ACE), recreational fishers, and aquaculture.



quantitative extraction rights do not come into conflict because there is presently only one form of hydrocarbon extraction. For fishing, however, there is significant conflict over the rights to fish recognized for commercial, recreational, and customary Maori fishers, with only commercial fishers holding a well-defined quantitative property right. Moreover, given how the TACC is determined, commercial rights holders fear that their quantitative rights will become defined as the residual left after the estimates of all other users' requirements are deducted.

Some in the commercial sector would argue that as the only sector with quantified rights, they are the most obvious targets for cuts. The other sectors would argue that the commercial sector's position as the only party with quantified rights, as well as its organizational strength, put it at an advantage. However, it is worth recalling the previous efforts of the recreational sector to discourage the distribution of a stronger, quantified set of property rights to recreational interests. Partly as a result of this ongoing debate, the New Zealand government is now in the process of examining various options to address this shared fisheries issue (Ministry of

Fisheries 2006). Not surprisingly, the debate has been quite heated (e.g., Symmans 2006), and the result could be a considerable redistribution of property rights.

These mismatches in property rights dimensions among interests illustrate the conflicts that can be created when resource management problems are addressed individually, without fully addressing the effects of these regulatory decisions and the resulting property rights distributions on other interested parties. Though less dramatic, a similar pattern is observed in the examination of the property rights bundles associated with various marine interests.

### Mismatches in property rights bundles

Just as mismatches occur in the property rights dimensions, they also occur in the property rights bundles. These mismatches are more subtle, but are important because research has shown that at least access, withdrawal, and management rights are necessary if users are to have sufficient interest to manage a resource sustainably, although it is preferable for resource users to have exclusion rights as well (Schlager and Ostrom 1992). Thus, the literature suggests a link between the strength of property rights and the success of management. Furthermore, mismatches in property rights bundles lead to mismatched incentives to manage a resource sustainably. Overall, the strongest property rights bundle is held by the government as the default holder of all property rights, but many of these rights are distributed. Under New Zealand law, the government is also the entity that has the ultimate responsibility to manage marine resources sustainably. However, property rights bundle mismatches among the resource users are important in cases in which there are varying bundles of property rights and the holders are therefore affected by the variation in the incentives to manage a resource sustainably.

The first example of a mismatch is among commercial fishing interests. In addition to access and withdrawal rights, ITQ owners share management rights with the government. They also have limited de facto exclusion rights. Thus, ITQ owners have a strong property rights bundle and clear incentives to manage the resource for long-term sustainably. In contrast, ACE owners hold only access and withdrawal rights and thus have few

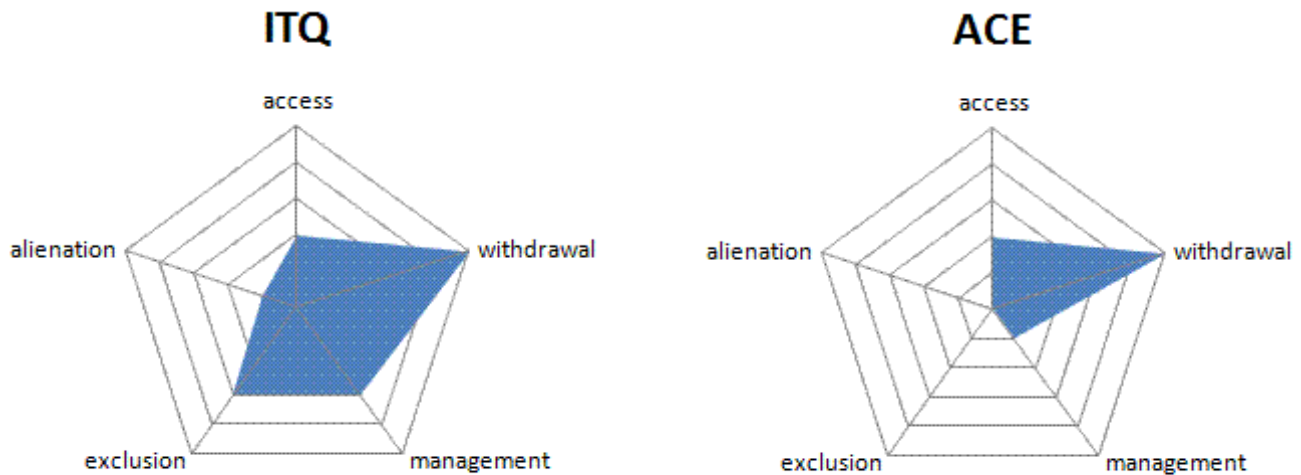
incentives to support long-term sustainability efforts. This dynamic is compounded by the temporal mismatch that limits the confidence that ACE owners will share in the long-term gain from rebuilding fish stocks. This is a significant concern because in many fisheries, ACE-reliant fishers do the majority of the actual fishing. This is illustrated by comparing the strength of individual property rights in the property rights bundles for ITQ and ACE rights holders using the property rights ratings from Table 1 (Fig. 3).

A similar property rights bundle mismatch is observed in comparing the three types of customary Maori fishing arrangement, i.e., *mātaitai* reserves, *taiāpure*, and Kaimoana customary fishing (Fig. 4). The strongest bundle of property rights is held under a *mātaitai* reserve, and the weakest is held under a Kaimoana arrangement. However, in this case, two of the three arrangements, i.e., *mātaitai* reserves and *taiāpure*, hold at least the threshold bundle of property rights, which is identified as a necessary incentive to manage a resource sustainably. With the extremely limited management rights held under Kaimoana arrangements, it is unclear whether the property rights bundle is strong enough to encourage sustainable management.

However, in this situation, there is further complexity because these institutional arrangements may be layered. For example, there may be a *mātaitai* with a *taiāpure*, and a customary permit could be valid for either area, as well as fishing grounds outside the *taiāpure*. Thus, in this case, it appears that the additional complexity and layering of institutional arrangements can provide, when functioning appropriately, a mechanism for subtly working out these property rights conflicts. This model could perhaps be adapted to other situations.

The final interest within the fishing sector is recreational fishing. This interest is unusual because, unlike commercial and customary Maori fishers, recreational fishers have not sought strong and well-defined property rights. The result is apparent in the limited property rights bundle that is formally held by recreational fishers. Their property rights bundle is limited to access and withdrawal rights defined at the individual, not collective, level. The remaining rights are held by the government, and the recreational sector has the expectation that the government will manage the fisheries sustainably, with attention paid to the interests of recreational fishers. This leaves little

**Fig. 3.** Comparison of property rights bundles for commercial fishing: individual transferable quotas (ITQs) and annual catch entitlement (ACE).



incentive for recreational fishers to participate in management, especially when the conflicts observed between the other two fishing sectors, i. e., commercial and customary Maori, are noted; conflicts which could have been predicted by examining property rights arrangements. Thus, a difficult question is how to resolve the problem of mismatched property rights when one of the parties is not interested in acquiring a stronger property rights bundle.

Outside of fishing, two distinct patterns of property rights bundles emerge. Licensed activities such as aquaculture and offshore resource extraction hold very strong but localized property rights bundles with access, withdrawal, shared management, and alienation rights. Thus, for the period that the permit holder's permit is valid, the strong property rights bundle gives the incentive to manage the resource sustainably. In contrast, other interests such as conservation and marine tourism seem only to require and hold the quite small formal property rights bundle of access rights of the general public, with all other rights maintained by the government. The lack of withdrawal rights is understandable because they are inapplicable in both cases. However, it is interesting to note that it appears that neither conservation interests nor marine tourism

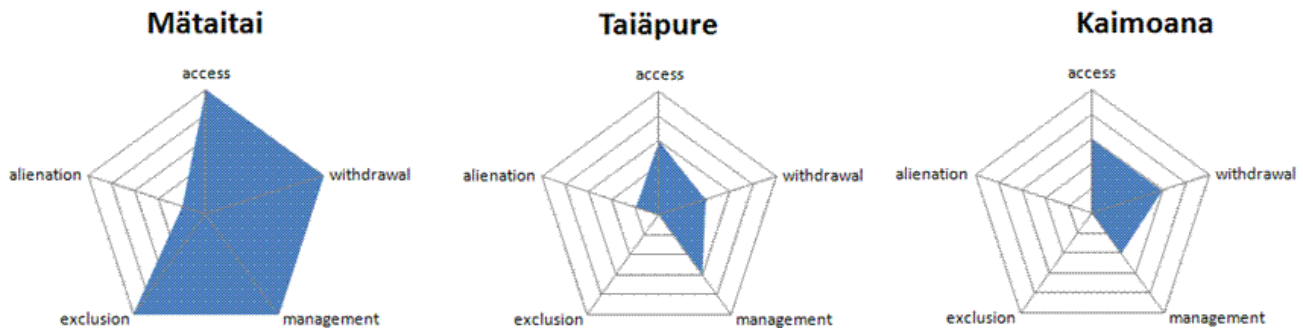
interests, especially commercial tour operators, have sought any direct form of management property rights. Instead, like recreational fishers, both interests appear to be content to assert any management interests through the political process.

## CONCLUSION

Traditionally, each resource or policy problem has been addressed individually, leading to complex and potentially conflict-laden arrangements such as those described here. To understand the roots of and possible solutions to such conflicts, there needs to be rigorous and complete analysis of all interests when developing or revising a management regime. As illustrated here, property rights provide a clear theoretical basis for performing such an analysis. Property rights evaluation is a useful tool because it allows comparisons across diverse sectors. It also allows different types of findings from the analysis of both property rights dimensions and property rights bundles, thus allowing a comprehensive analysis of the resource management problem.

The analysis of property rights dimensions offers insights into the multiple origins of conflict. For example, the differing temporal qualities of

**Fig. 4.** Comparison of property rights bundles for customary Maori fishing: *mätaitai*, *taiäpure*, and Kaimoana.



individual transferable quotas (ITQs) and the annual catch entitlement (ACE) appear to have created a commercial fishery in which two key components have distinctly different time horizons and goals for fishery management. Another example is the spatial dimension, in which poorly defined or overlapping spatial boundaries such as those among customary Maori fishing, aquaculture, marine reserves, and commercial fishing create political or physical competition for access to marine resources, as well as frustration within the commercial fishing community, which perceives that its broad, but not exclusive, spatial rights are eaten away by the smaller but more exclusively defined spatial rights of interests such as marine reserves, customary Maori fishing, and aquaculture.

The property rights bundle can be used to analyze the parties' incentives to manage or partake in managing the resource sustainably. This is perhaps most apparent when considering the difference between commercial ITQ and ACE property rights bundles. It is also apparent in the various types of customary Maori fishing rights regimes and in comparing the recreational and commercial fishing rights bundles.

Although it is interesting to identify property rights mismatches as the possible roots of resource conflict, this approach would be more useful if it could also identify potential solutions for policy makers. Fortunately, by providing insights into where and why property rights mismatches occur or may occur, possible solutions can also be

identified. However, it is important to remember that there are usually no simple, universal solutions (Degnbol et al. 2006, Wilson 2006) and each case requires its own analysis.

From a property rights perspective, the answer is not simply to expand all interested parties' property rights bundles to include strong management rights or to give all interests identical property rights bundles and dimensions. Rather, scholars and policy analysts must seek the best ways to match management regimes and property rights arrangements to the conditions across interested sectors based on the insights provided by the analysis of property rights decisions and bundles. For example, expanding the temporal dimension of commercial ACE, e.g., to allow the ACE to span multiple years, would better align ITQ and ACE holders' incentives to manage the stock sustainably. Within the Maori fisheries, the institutional layering that appears to occur with *mätaitai*, *taiäpure*, and Kaimoana customary fishing could be encouraged and applied more systematically where appropriate and even expanded to encourage additional institutional layers or participation in governance among sectors.

However, as illustrated by the preference of recreational fishers to engage in politically based debate, property rights will not always provide a universal tool for negotiation. Nonetheless, a property-rights-based analysis could suggest that better defined withdrawal rights and the encouragement of recreational fishers' political

participation in management could be productive ways to enhance the recreational fishers' property rights bundle, with the long-term goals of more appropriately enhancing their property rights bundle and engaging them in long-term fisheries management. Indeed, it appears that this may be one of the government's goals in the ongoing "Shared Fisheries" negotiations (Ministry of Fisheries 2006).

A final key point regarding property rights analysis is that historically, property rights arrangements have not been static. This is illustrated by the evolution of the property rights associated with ITQs over time (Bess and Harte 2001, Yandle 2003) and by the development of commercial customary Maori fishing rights over the past two decades (Bess and Harte 2001). Over time, property rights arrangements can and should change to best reflect the current and desired situation concerning the natural resources. Thus, the analysis of management regimes and property rights arrangements should be an ongoing process. Property rights can be successfully used to identify and analyze property rights mismatches that lead to conflicts in resource management, as well as potential solutions. By examining property rights in this manner, the theoretical tools of property rights and institutional analysis can be used to gain policy-relevant insights into natural resource management.

Responses to this article can be read online at:  
<http://www.ecologyandsociety.org/vol12/iss2/art27/responses/>

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