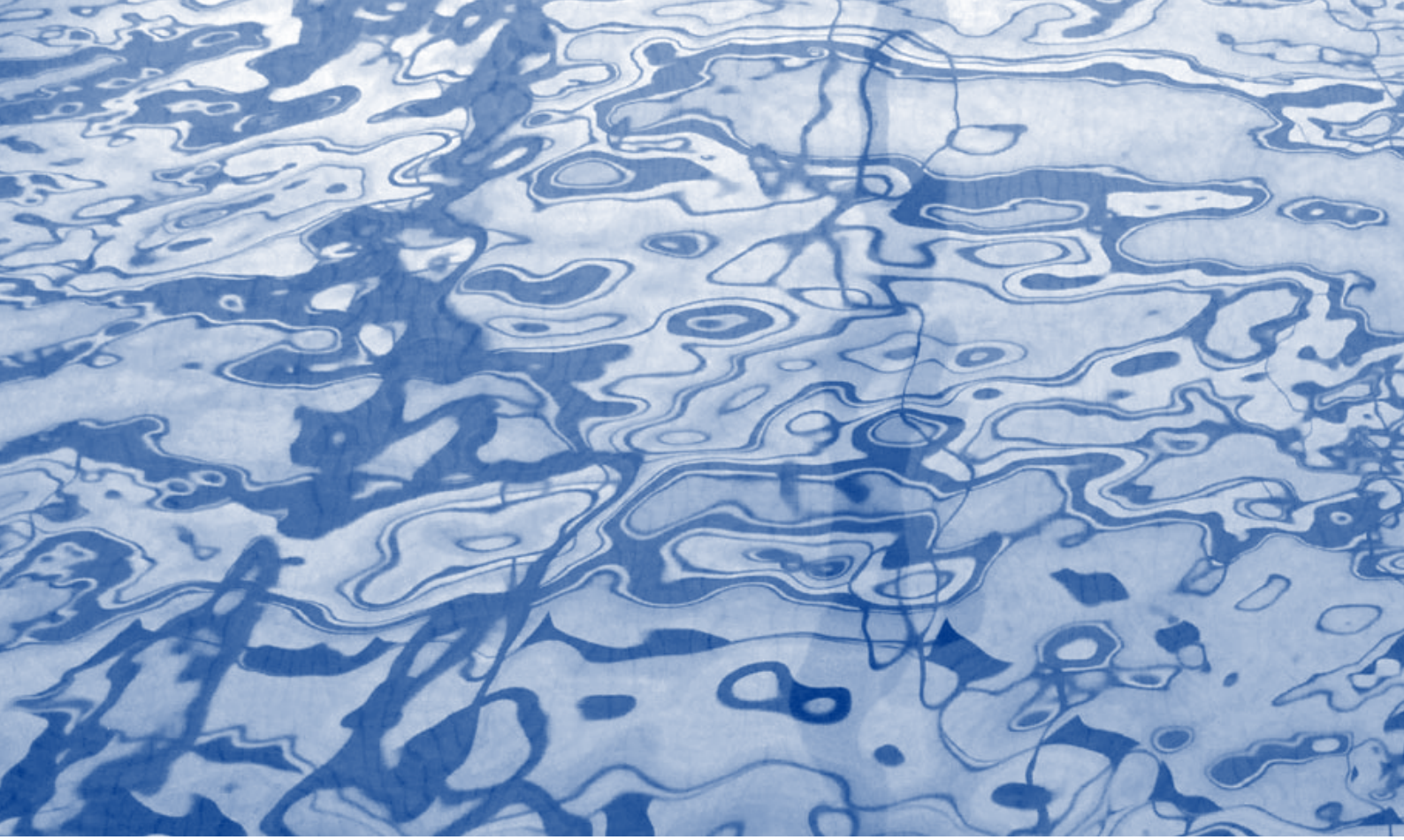
Allocated property rights in Abalone

Sustainability requires change to allocated property rights: the story of Abalone



Allocated property rights in Abalone

Sustainability requires change to allocated property rights: the story of Abalone

Jeremy Prince, Biospherics P/L, South Fremantle, Western Australia, biospherics@ozemail.com.au

Table of contents

Abstract	v
Introduction	1
Reforming abalone management	5
Territorial user rights fishery	7
Allocating territorial user rights for abalone	9
Conclusions	15
References	17

Abstract

Abalone fisheries in Australia and New Zealand are managed at scales of 100s of kilometers with zonal Legal Minimum Lengths (LML) and Individual Transferable Quotas (ITQ), for commercial divers, and short fishing seasons, trip and possession limits for the recreational sector. Abalone resources are comprised of many independent populations which vary widely in their size of maturity. Under focused fishing pressure local populations with larger sizes of maturity have relatively little of their breeding stock protected by a zonal LML. Populations with a large size of maturity relative to the zonal LML are prone to local extinction. A gardening approach to abalone management would allow cultivators to learn optimal shell sizes and harvest rates for individual reefs while allowing government agencies to withdraw into the role of regulator and advisor.

Optimizing abalone production necessitates changing the nature of existing property rights from an allocation of zonal catch (ITQ), into a right to harvest a defined area; Territorial User Rights Fishery (TURF). Among the institutional impediments to this reform are the complex allocation issues involved. The first concerns the mechanism by which agencies and stakeholders could agree to change existing commercial allocations into an equitably proportional allocation of the harvestable area. Two proposed mechanisms illustrate the essential elements required; equity, transparency and independence from outside influence. The second issue concerns allocation between the commercial sector, recreational and traditional harvesters, and non-extractive users. The current systems generally avoid explicitly allocating shares between these sectors TURF management necessitates making this allocation explicit.

Introduction

Gulland (1969) stressed that at the basis of all fishery assessment models was the assumption that the unit of stock being fished had a level of homogeneity and mixing such that it comprised a uniform population that it could respond uniformly to fishing and management. There is a growing realisation that many marine resources are not large uniform resources amenable to regional assessment and management strategies (Hilborn *et al.* 2005). Instead many resources are composed of a mosaic of relatively independent and variable sub-stocks that effectively comprise micro-fisheries within the boundaries of existing scales of assessment and management (Prince 2005). With broad scale regional management fishing pressure is applied differentially across component micro-stocks, being focussed on the most attractive areas according to a sliding scale of preferences evaluated primarily on the basis of proximity, accessibility, safety and profitability. The most attractive abalone beds during any period are sequentially fished into localized recruitment collapses and even localized extinction causing an escalating long-term loss of overall productivity. Hilborn *et al.* (2005) go so far as to claim that currently unrecognised and inappropriate spatial structure is one of the principal reasons that fisheries assessment and management unexpectedly fail.

One of the challenges facing fisheries assessment and management in the 21st century is to reduce the scale at which management and assessment processes are implemented reducing them to the sub-regional and local scales of the component micro-stocks of many resources. So that the basic assumption of 'functional units of stock', as described originally by Gulland (1969), becomes at least vaguely valid.

This paper uses the Australian abalone (*Haliotis*) fishery as a case study of the allocation issues this change raises.

Regional management of abalone in Australia and New Zealand

Abalone are valuable herbivorous molluscs found on shallow coastal reefs around many of the world's coastlines. They are highly prized by Asian markets as a 'truffle of prosperity', but despite large investments in aquaculture, sea ranching and wild stock management global annual production has declined from around 29,000t in 1969 to below 10,000t today (Prince 2004). In spite of the billions spent since the 1950s on reseeding, aquaculture, and wild stock management there have been no well-documented accounts of the broad scale recovery of lost abalone productivity (Prince 2004). Only devastating evidence of how they can be virtually eliminated through large regions of their former distribution along the North American Pacific, Atlantic European and Eastern Australian coastlines. Since the collapse of large resources along the Californian and Mexican west coast, and with the continuing long slow decline of the Japanese resource, Australia's fishery producing about 5,000t per annum is approximately 50%, while New Zealand with around 1000t per annum is abut 10% of global production.

Without fully understanding the actual causes, but mindful of the spectacular stock declines observed in Mexico and California during the middle of the 20th century, and the slower long term decline being observed in Japan, the abalone fisheries of Australian and New Zealand have been managed rigorously and pro-actively, although regionally, since the 1960s. Legal minimum lengths (LML) were generally introduced during the 1960s, limited entry and transferable licenses for divers during the late 1960s and early 1970s, and individual transferable quotas (ITQ) and cautious regional total allowable catches (TACs) in the mid-1980s (Prince & Shepherd 1992). This pro-active and generally cautious management has undoubtedly done much to preserve these resources and to date has prevented the spectacular collapses observed in along the Pacific coasts of Canada, USA and Mexico, or the long slow decline observed in the Japanese resource.

Abalone fisheries ecology

A series of parallel and complementary studies funded by the Australian Government's Fisheries Research and Development Corporation (FRDC) and its antecedents during the 1980s and early 1990s provide a good basis for understanding the factors underlying the problematic nature of sustaining abalone fisheries. Prince (2004, 2005) reviews the factors that undermine orthodox regional management strategies. Adult movement and larval movements are generally limited to scales of 10s – 1,000s of metres, while abalone growth and size of maturity is highly variable over local and regional scales, being largely determined by food supply, water movement and temperature. Upon maturing abalone emerge from interstitial spaces within

the coastal reefs and join adult feeding and breeding aggregations. These aggregations are highly visible making it easy for divers to learn their location and effectively target them for collection. Where the size of maturity on a reef is around or greater than a regional legal minimum length (LML) the aggregated breeding stock is extremely prone to complete removal, as are successive juvenile year classes when they begin the maturation process and emerge from their cryptic habitat to reform adult aggregations.

The fisheries ecology of abalone has important implications for the management of abalone fisheries. They are not the single freely mixing "units" of stock assumed by most management and assessment models. Instead they are comprised of many (1,000s - 10,000s) relatively independent and variable self-recruiting units, or micro-stocks. In this situation a 'tragedy of scale' occurs and regional management fails to control exploitation pressure on component local stocks (Prince *et al.* 1998). Where regional LMLs fail to protect sufficient breeding stock individual reefs are vulnerable to localized recruitment overfishing. Reefs favored by divers because they are close to home ports, contain uniformly legal sizes abalone, are relatively sheltered or shallow become depleted while less favored reefs may remain relatively lightly exploited. Rehabilitation is not technically difficult, re-introducing, or re-building and protecting breeding stock restores local productivity, however, under current relatively open (local scale) access arrangements there is no guaranteed reward for such altruistic long term behavior. Despite 'world best practice' management a 'tragedy of the commons' still occurs at the scale of individual reefs (Hardin 1968) and the productivity of a valuable resource is being incrementally lost.

In Australian and New Zealand the serial loss of productive area is being increasingly observed and reported by active divers across all spatial scales (100 m – 100 km), and although the averaging effect of regional scale stock assessment largely hides the decline from official assessments TACs in most jurisdictions have been trending down for several years. The need for more spatially explicit management of abalone fisheries was identified more than a decade ago in reviews by Prince and Shepherd (1992) and McShane (1995). Until recently the response of management to this challenge has been to increasingly regionalize the existing centralized government driven management framework of the fishery, introducing a growing number of zonal size limits and catch limits. Challenging this trend is the escalating level of government resources required to reliably monitor and assess stock abundance, and to enforce catch levels and LMLs, across a proliferating number of zones within each region.

Reforming abalone management

The solution to the tyranny of scale is to engage the intelligent behaviour of the divers who relate to the resource at the fine scale appropriate to abalone ecology. Currently only their hunter-gatherer facilities are being utilized. Their capacity to be assessors and managers has largely been ignored. As a matter of course divers memorise the location of each aggregation, the size of the aggregation and the size and appearance of the abalone in each aggregation. This basic information routinely memorised by divers can be turned to positive use in the assessment and management process.

A recent initiative pioneered by the Victorian Western Abalone Divers' Association (WADA) since 2001, and now with FRDC support being extended to five regions across Victoria, South Australia and NSW seeks to train divers in the subtle changes in shell shape and appearance that occur as abalone mature. On this basis the divers are trained to observe whether their catch is comprised primarily of immature or fully fecund individuals, and assess the status of each reef. Using these assessments regional associations of divers and quota owners are brokering their own local arrangements for the managing their resources on a reef by reef basis. Using this approach the Victorian management agency is working with their industry associations to implement a range of voluntary and regulated finer scale arrangements which distribute TACs and vary LMLs across the component reefs of each zone. These voluntary arrangements are codified within memorandums of understandings (MOUs) which form a condition upon which each year's TAC is negotiated and agreed.

While clearly a great step forward in the evolution of finer scale management within the abalone fishery the weakness of this approach is the difficulty of agreeing, orchestrating and enforcing complex codes of fine scale action amongst disparate groups of highly individualistic divers and quota owners. While the industry associations involved have already shown themselves capable of surprising levels of difficult decision making, doubt still remains as to whether groups of disparate quota owners and divers can act pro-actively

enough against individual short term interests to halt the serial recruitment declines being observed in some parts of their fisheries. The inevitable tendency of a few individuals to 'free-ride' on the efforts of the majority and to disregard voluntary reef based LML or catch restrictions, especially towards the end of a TAC season, makes the task of the association's executive officers in trying to co-ordinate the voluntary action particularly difficult. Beyond the impact on the resource of reefs most susceptible to over-fishing this 'free-riding' behavior undermines the integrity and purpose of the corporate group and puts into jeopardy its ability to make difficult decisions about future catch levels and LMLs, effectively slowing the process to the pace determine by the 'lowest common denominator' in each group.

Territorial user rights fishery

There is no lack of will power and financial resources wishing to invest in conservative long-term management and rebuilding of these resources. The current problem is that this will power, and any investment backing it, is placed in jeopardy by the, sometimes capricious and, unpredictable will of socially complex industry associations and management agencies. The trends being observed in these resources would be totally different if the management and ownership system were as simple as establishing a vineyard or plantation of timber.

As proposed by Prince *et al.* (1998) moving towards a basis territorial user rights (TURF) by which operators would own and trade the exclusive harvesting and management rights to their own defined areas of reefs would overcome most of the existing challenges being faced by management in this fishery. In particular the use of market processes and forces would allow owners and divers to arrange themselves individually, and corporately, into entities with relatively homogenous interests in, and commitment to, management of the resource. Thus 'free riding' divers and anti-conservative quota owners would find themselves impacting their own reefs, leaving more conscientious owners and divers to accept their own short term cut-backs in expectation of their own long term rewards.

While perhaps considered radical within the centralized government management context of most western fisheries there is considerable precedence for TURF style fisheries management (Prince 1998). Never-the-less a predictable range of issues are inevitably raised whenever changing the Australian or New Zealand abalone fisheries to a TURF based system of management is discussed. Most of the issues raised are simply expressions of the innate conservatism and fear of change felt by the existing quota owners, divers and managers who have historically fared very well under the status quo. Existing management agencies apparently fear loosing control over management, while quota owners have been happy with historic returns on their investment and apparently fear increasing the complexity and

responsibility involved with managing their investments, while many divers value being able to range widely over the fishery and do not wish to have their existing freedom of movement curtailed. It is my observation that since first mooting the change to TURF management in the early 1990s (Prince *et al.* 1998) the strength of these objections have greatly diminished. This appears to be due to increasing awareness of the rate at which serial depletion is now occurring across these fisheries; the importance being placed upon 'existing rights and freedoms' (Hardin 1968) seems to be waning in the light of a growing desire to ensure a sustainable future.

Another issue raised against the implementation of TURF management in the Australian abalone fishery is that of enforcement; how can private individuals and corporate groups hope to enforce their exclusive rights when government agencies are having such difficulty? Of course this is a substantive issue and it is not the intent here to delve extensively into this aspect of the issue. In the hope of summarily dealing with the issue of enforcing TURFs let it be noted that similar enforcement issues were faced in the terrestrial environment when grazing moved from free-ranging to enclosures but that law changes and legal support for private ownership largely overcame the issue over time – although some level of stock stealing does occur to the present day. Access to most abalone beds is only possible under certain weather conditions and local fishers are extremely adept at knowing when these occur. With access to modern remotely controlled surveillance technology and a law change which made geo-referenced video sufficient proof that an unauthorised person had broken the law by interfering with abalone in an area by molesting abalone. It would be hoped that resource thieves who might currently be threatened with apprehension once in one hundred times would be threatened with detection and prosecution on every occasion. Changing the enforcement dynamic in this way is probably the only way the existing and growing enforcement issues facing this fishery are ever going to be overcome. Supporting this contention is the fact that in North America where some beach clam fisheries are managed under TURF arrangements the management agencies claim that this form of management is made necessary by the impossibility of policing resource theft under any other form of management (Beattie *et al.* 1982, Bourne 1986).

Having summarily and somewhat over-simplistically dealt with the other issues raised by proposing moving towards TURF management of the abalone fishery let us move on to the issues of primary interest in this context.

Allocating territorial user rights for abalone

Reforming management of the abalone fishery into a TURF system raises the issue of how the existing variously defined shares of the abalone resource might be converted into the spatially explicit shares which would be necessary to introduce a TURF system of management. Most obviously a process is required for the commercial sector to converting their existing shares of zonal or statewide total allowable commercial catch (TACC) into explicitly spatial allocations. However allocations to traditional, recreational and non-extractive sectors will also need to be made explicitly, rather than implicitly or cryptically as they are currently.

Clearly the standards expected by our modern society and applicable to all these processes must be those that:

- preserve the relative equity positions of all participants,
- ensure the processes are free from manipulation by vested interest groups and
- provides for transparency.

Re-allocating the TACC

When first confronted with the idea of converting the existing ITQ managed abalone fisheries to TURF management many people instinctively argue it is impossible because converting a mass based allocation into a spatial allocation one is impossible.

However as far back as 1992 the President of the British Columbian Abalone Harvesters Association, Mr Dan Pollock, devised a workable process which conserved the necessary public standards of equity, transparency and being beyond manipulation (Prince 1998). The proposed method involved: (1) Grid the available coastline using an appropriately fine scale (1km^2). (2) Each stakeholder assigns their own value (0-10) to each square, zero indicating no

value and ten indicating maximum value. (3) The total perceived value of each grid cell is determined by summing all assigned values. (4) The total perceived value of the fishery is estimated is determined by summing the totals of all grid cells. This value is then equated to the TACC. (5) A ballot is conducted which randomly selects grid cells for each quota owner such that the proportion of the perceived value of the fishery they receive is the same as the proportion of the TACC they owned. (6) Trading of spatial rights commences and resource owners begin trading spatial rights in order to configure their spatial allocation to suit their own needs.

Steps 1-4 of this process were trialled in 2001 Paua 5B Zone of the New Zealand fishery as part of a consultancy for the New Zealand Paua Management Company. The process was used in that setting purely as a means of studying the fine scale distribution of abalone beds around Stewart Island. But when processed and summarised the knowledge and information provided by six commercial divers mapped the distribution of catches in a way that was convincing to other divers with considerable experience around the island. So this use of diver knowledge to allocate catch to areas does appear to be robust.

In terms of practical implementation of this system it would probably be preferable to first perform the process in a workshop setting with the aim of sampling gaming the re-allocation process. This would allow the process to be trialled and developed if found necessary. It would also allow industry members to gain experience with the process and it is hoped some confidence being asked to commit large amounts of personal wealth to an untried process.

Where a reasonable time series of fine scale catch history data exists an alternative, but somewhat analogous process, might be applied which to streamline the process and avoid the appearance of 're-arranging' existing property rights. This alternative could also provide for a slower evolution towards TURF management, rather than the essentially 'big-bang' approach proposed by Dan Pollock. Under this system the average catch of each fine scale statistical cell over some agreed period of time would be used to quantify the relative proportion of the TACC comprised by each cell i.e. Statistical Cell A, B, C, D contribute 10%, 15%, 25% and 50% of the TACC respectively. Entitlement holders would then have their existing licence or quota unit split proportionally into shares of each cell i.e. 10%, 15%, 25%, 50% of their licence, or of each Quota Unit the hold, would be held in Cells A, B, C, D respectively.

In this system the statistical cells would effectively become units of TURF in which the resource owners would receive tradable shares. Under this system TURF management would evolve over time as individuals, corporate entities or co-operative groups moved in the market place to consolidate

their ownership in specific locations. Management agencies could initially foster a proliferation of sub-zonal local area management groups to provide reasonably democratic proportional representation to what would initially be relatively diverse groups of owners in each location. Management agencies could track the process of consolidation within each TURF unit and where coherent and sophisticated local ownership and management emerged they gradually relinquishing control.

Clearly if the aim is to promote individuals, corporate identities or small co-operative groups, taking responsibility for intelligently fine scale management of the resource using a larger number of smaller scale statistical cells will be preferable as the scale of the statistical cell used will eventually determine the scale of the smallest management unit, which in turn will influence to size and likely coherence of the entity which in time assumes responsibility for implementing fine scale management. Establishing such systems with a large number of smaller statistical cells may initial challenge the administrative capacity of existing management agencies because of the magnitude of trading that might ensue. Currently these agencies may be accustomed to handling the trade of a smaller volume of larger units being traded, however by 'grand-fathering' in initially small shares of units, and establishing new minimum holding regulations, this situation might be made temporary rather than permanent, and the process of consolidating the ownership of TURF units might be fostered.

Under this process it might also be envisaged that in some TURF units the process of consolidation may not proceed. This might be expected to occur in areas where prospective TURF owners lack confidence in their ability to control the resource; remote areas, or areas that are heavily impacted by recreational or illegal fisheries. In this setting it maybe that a form of financial risk management would be for a wide group of owners to retain small shares of these areas, rather than for a smaller group to attempt to consolidate ownership and accept the risk of loosing control of the production and management of the area. Such areas would provide some opportunity for those current owners and divers who do not wish to actively join the evolution of the fishery but wish to remain operating under the existing form of the fishery, although probably within a declining proportion of the fishery. In these areas management processes might remain much as they are at the current time with disparate groups struggling with decision making and engaging in difficult and at times confusing negotiations with management agencies. In the long term areas that remain outside TURF management can be expected to suffer the impact of serial depletion of component abalone beds and so slowly decline in productivity. Where this occurs it might be come attractive enough in the long run for an entity to accept the risk of lack of control, and buy up the harvesting rights cheaply with the aim of long term rebuilding of stocks.

Re-allocating shares to the non-commercial sectors

Across the abalone fisheries of Australia and New Zealand there is currently a considerable degree of re-allocation occurring between the commercial and non-commercial sectors of the abalone fishery. These re-allocations are occurring incrementally and by stealth. None of the acceptable standards of equity, transparency and independence from special interest groups are being observed.

Across the board the number of recreational fishers is growing rapidly. Controls on daily catches and possession limits are in place in all jurisdictions, but the number of days that can be dived is only controlled in suburban Western Australia and Victoria. To date no jurisdiction has contemplated how the absolute number of recreational divers can be managed and until this is done the recreational fishery effectively remains open access and its share of the resource beyond control.

In Australia the claims process of the traditional sector has not advanced far enough to say much with any certainty. However, under the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 the New Zealand Ministry of Fisheries has enacted the Kaimoana Customary Fishing Regulations which provide for local tengata whenua claiming specific areas for their management under maitaitai reserves which generally excludes commercial fishing. The criteria for granting these claims pertain largely to demonstrating traditional ties and usage of areas, and are not particularly specific with regard to sustainability and equity. They should be consistent with sustainable use principles and should not 'unreasonably prevent person with a commercial interest in a species from taking their quota or annual catch entitlement within the quota management area'. Specifically there are no compensatory mechanisms in place when a TACC needs to be reduced to compensate for lost areas of productivity.

In all jurisdictions across Australia and New Zealand there are also processes underway to declare marine protected areas (MPAs) which will, or have already, alienated productive abalone beds from the TACC. Only in the jurisdiction of the Australian Commonwealth Government has a policy decision been made that the commercial sector should be compensated for losses incurred by this process. Recently in the Victorian jurisdiction the abalone sector was specifically and uniquely excluded from the process set up to compensate for the losses experienced by commercial fishers. Instead it was claimed that a generic compensation was being offered to the Victorian abalone industry through research grants aimed at locating previously undiscovered beds (which was unsuccessful) and through increased expenditure on enforcement which is meant to preserve the level of the TACC by taking indefinable catch share away from the indefinable illegal sector.

Thus across the jurisdictions of Australia and New Zealand the commercial share of the abalone resource represented by the TACC is being steadily eroded by processes that remain opaque, inequitable and heavily driven by special interest groups.

In terms of the evolution of TURF management and its future operation the issue of MPAs and traditional users are most easily and satisfactorily dealt with. Both these sectors have compatibly spatially explicit claims on the resource. Where these are pre-existing the allocation of TURF has already occurred. In the future where further claims for MPAs or traditional areas arise it would occur in the context of an explicit claim for the TURF of another defined owner. As with the expropriation of terrestrial property it would be explicit that the equity position of defined individuals was being adversely effected by the public desire for more MPAs and traditional areas, and that consequently the public purse should be used to compensate the individuals who are having their property taken. This would be in contrast to the current situation where because zonal TACCs are not spatially explicit a 'polite fiction' can be maintained by the political process that the alienation of productive commercial abalone beds by establishing MPAs and traditional areas, does not constitute the re-allocation of wealth from individuals in the commercial fishing sector, to individuals with interests in the traditional or the non-consumptive sector.

Re-allocating the existing rights of the recreational sector raises more complex issues because the current recreational is currently unlimited and spatially undefined. In the interest of long term sustainability and the evolution of TURF management both these difficult issues should be addressed by explicitly defining areas for recreational abalone fishers distinct from areas of commercial TURF. This would explicitly cap the recreational share of the resource, and provide for security of tenure for commercial TURF owners, while leaving the issue of how recreational abalone fisheries can be sustainably managed, essentially unresolved. In this regard it can be argued that defining and separating recreational and commercial abalone fisheries might usefully shorten the recreational sector's learning curve with regard to their role in the decline of certain abalone beds. Without the ability to continue moving away from depleted areas this sector might be forced to confront their own need to sustainably manage the beds they rely on and be encouraged to form local management committees. It can however be anticipated that existing recreational lobbies will vigorously defend their existing right to take abalone where ever they can still be found, but as with the commercial sector, this opinion can be expected to soften over time as the impact of serial depletion continues to erode the relative value of this existing right.

In fact it would be possible to introduce TURF management to the commercial sector without explicitly addressing the issue of the recreational sector. Under this scenario it could be envisaged that the political process

of a jurisdiction may decide that the recreational sector is too politically troublesome to attempt to restrict their existing right to range freely, while an enlightened commercial sector pushes for change regardless. In this scenario it can be expected that the impact of recreational pressure will be taken into account through the market for TURF and that abalone beds subject to extensive or damaging recreational pressure (or for that matter similar illegal pressure) will be devalued proportionally. Returning to the discussion above, under the more evolutionary approach to developing TURF management, it can be envisaged that areas where illegal and recreational pressure remains uncontrolled may well remain with more diffuse ownership arrangements as a risk management strategy by owners of TURF units. This may provide medium term mechanisms by which the commercial sector can move on to confronting the majority of their sustainability issues but in the longest term exploitation levels the recreational sector will also need to be controlled sustainably.

Conclusions

Developing an appropriate scale of management for the abalone fishery will require enlisting and motivating the intelligent action of individual divers as they select abalone to harvest. An evolutionary process is needed in the fishery to change divers from hunters to gardeners. This will require changing the current ITQ management into a system of tradable exclusive harvesting rights raising a range of allocation and re-allocation issues. None of these allocations issues are insoluble and as the resource continues decline the will to find solutions is bound to increase.

References

Bourne, N. 1986. Bivalve fisheries: Their exploitation and management with particular reference to the Northeast Pacific Region. Pp. 2-13. In: Jamieson, G.S. & Bourne, N. (eds.) *North Pacific workshop on stock assessment and management of invertebrates.* Canadian Special Publication of Fisheries and Aquatic Sciences 92. 568 pp.

Gulland, J.A. 1969. *Manual of methods for fish stock assessment. Part 1. Fish population analysis.* FAO Manual of Fisheries Science 4: 1–54. FAO. Rome.

Hardin, G. 1968. The tragedy of the commons. *Science* 162: 1243-1248.

Hilborn, R. Orensanz, (Lobo), J.M., Parma, A.M. 2005. Institutions, incentives and the future of fisheries. *Philo. Trans. Roy. Soc. B.*, 360: 47–57.

McShane, P.E. 1995. Recruitment variation in abalone: its importance to fisheries management. *Mar. Freshw. Res.* 46: 555–570.

Prince, J.D. 2004. The decline of global abalone (Genus *Haliotis*) production in the late twentieth century: is there a future? Pp. 427-443. In: Leber, K.M., Kitada, S. Blankenship, H.L. & Svasand, T. (eds.) *Stock enhancement and sea ranching: Developments, pitfalls & opportunities.* Blackwells Publishing Ltd.

Prince, J.D. 2005. Combating the tyranny of scale for haliotids: Micro-management for micro-stocks. *Bull. Mar. Sci.* 72: 557–577.

Prince, J.D. & Shepherd S.A. 1992. Australian fisheries for abalone and their management. Pp. 407-426. In: Shepherd, S.A., Tegner, M.J. & Guzmán del Próo, S.A. (eds.) *Abalone of the world: Biology, fisheries and culture*. Fishing News Books: Blackwell Scientific Publications, Cambridge.

Prince, J.D., Walters, C., Ruiz-Avila, R.J. & Sluczanowski, P. 1998. Territorial user's rights in the Australian abalone fishery. Pp. 367-375. In: Jamieson, G.S. & Campbell, A. (eds.). *Proceedings of the North Pacific symposium on invertebrate stock assessment and management*. Canadian Special Publication of Fisheries and Aquatic Sciences 125.