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The Commons becoming Uncommon: Integration or disintegration in the protection of aquatic biodiversity

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ABSTRACT

This paper highlights some of the notable features of the aquatic biodiversity of New Zealand which give rise to the particular values and vulnerabilities of certain species, community types and ecosystems. It summarises existing national biodiversity management objectives for aquatic ecosystems, including those in legislation.

The paper outlines existing and changing property rights and responsibilities for aquatic biodiversity, while acknowledging that these are challenged by both Treaty claimants and land owners. An explanation is provided for the statutory frameworks and agency management roles for freshwater biodiversity. Some of the planning tools and other methods for promoting more integrated management are identified.

It discusses some of the unresolved issues and other challenges in management of aquatic biodiversity across administrative and/or ecological boundaries. These include the difficulties associated with controlling land-use activities to safeguard downstream aquatic habitat quality. A trend towards unbundling common heritage property rights and responsibilities has a goal of facilitating more focused and efficient utilisation of resources, but it also brings the risks of dis-integration to the planning and management of aquatic biodiversity.

A suite of principles to guide future strategic planning for the management of aquatic biodiversity is put forward for discussion.

1. INTRODUCTION AND DEFINITIONS

This paper discussses institutional management of aquatic biodiversity. There have been many different definitions and categorisations of biological diversity (or biodiversity) since its introduction to the conservation literature in 1980.

These usually include species diversity (or species richness at different scales), genetic diversity (or the diversity within species) and ecosystem diversity (or the diversity of ecosystem and community types). A seminal contributor to this thinking, Elliot Norse, also recognises two other kinds of biological diversity; the diversity of higher taxonomic groups and the diversity of functional groups (Norse 1993).

From a management perspective, it is more important to define what is meant by the *conservation* of biodiversity. A useful framework was presented in 1993 to the joint symposium of the New Zealand Ecological Society and the Systematics Association of New Zealand by Allen Rodrigo of Auckland University. He considered that biodiversity conservation meant preventing loss of biological *information*, from any of three mutually exclusive categories of information, namely:

- *Properties or Components*: equivalent to inter-species and intra-species genetic diversity.
- *Patterns*: equivalent to the interactions between components which yield biological pattern.
- *Processes*: ecological system dynamics and resultant ecosystem structure.

The following discussion takes into account these three categories of biodiversity conservation.

2. SOME NOTABLE FEATURES OF NEW ZEALAND AQUATIC BIODIVERSITY

A variety of unique communities have evolved, such as:

- Wormfields of chemosynthesising pogonophoran beardworms and their mutualistic microbial flora at the hydrothermal vents at the Calypso Pinnacle in the Bay of Plenty (Tarasov 1990; Kamenev et al.1993)
- The foodchain of the Kaikoura Canyon supporting notable populations of sperm whales and giant squid
- The microbially mediated sinter, travertine and stromatolite deposits of the Champagne Pool and other geothermal pools (Jones et al. 1997; Skinner & Banfield 1997) which are simpler in structure but equivalent in formation and function to coral reefs. These are extreme ecosystems, often topped by a single species of brine fly (Winterbourn 1969).

Some elements of New Zealand's indigenous aquatic biota are highly distinctive and some are quite specialised. For example:

- Most freshwater fish species are diadromous, needing to migrate between marine and freshwater habitats. This is an adaptation to the instability of our young rivers.
- The endemic blue duck is one of only four specially adapted torrent ducks on the planet. It has poor powers of dispersal, and cannot adjust to impounded or otherwise modified steepland rivers

Some orders are poorly represented, such as:

- The freshwater fish fauna is sparse with less than 40 species (cf. Lake Malawi with over 900)
- Amphibians are limited (e.g. Hochstetters frog) and aquatic reptiles are limited to visiting coral snakes and turtles
- Many ecological niches are unfilled, such as specialised herbivorous and planktivorous freshwater fish species

These features of our aquatic ecosystems and species are highly vulnerable to:

- Alien invasion, especially by aquatic plants, molluscs, fish species, and terrestrial predators of groundnesting waterbirds. Few lowland freshwater ecosystems are still dominated by indigenous species.
- Genetic dilution through hybridisation with newly established and closely related species (e.g. pied stilt dominance over black stilt, and mallard duck over grey duck, etc.)
- Habitat loss and degradation, including the impacts of landuse change (e.g. wetland drainage, eutrophication, river channelisation, riparian vegetation removal, bottom trawling and shellfish dredging, etc.)
- Direct and indirect impacts of harvesting, including the trophic cascade effects of major changes in the top predator abundance and size (e.g. reduction of large size classes in coastal fish stocks contributed to widespread 'blooms' in biscuit urchins and paddle crabs.)

In summary, our aquatic biodiversity is unique and characterises New Zealand as much as the better known terrestrial icons such as kiwi and karst country. Both individual species and whole ecosystems are valuable to science and society. For example, some of the species of thermophilic microbes in our geothermal ecosystems are providing high temperature enzymes for genetic engineering. Ecosystem valuation methods have been developed for New Zealand by Massey University scientists (Patterson & Cole in press) and current calculations indicate that freshwater and marine areas provide by far the most valuable ecosystem services (e.g. estuarine ecosystem products and services are valued at $34,000 per hectare each year).

As outlined, many elements of the aquatic biodiversity of New Zealand are vulnerable to invasion, interbreeding, overharvest and habitat loss. The degree of loss and damage in the past has been major. This has been highlighted in the recent report on 'The State of New Zealand's Environment' (Taylor & Smith 1997). These trends appear to be continuing or even increasing for some ecosystem types, especially seamount communities (Nelson & Gordon 1997), and for some aquatic species, such as brown teal, the decline appears unstoppable on the mainland. Without effective new initiatives we face further irreversible losses of species, communities and ecosystem processes, as discussed in 'A draft strategy for New Zealand's biodiversity' (Anon. 1998).

The range and pervasiveness of these threats is such that there is a need for responsive management to assign clear responsibilities and set measurable objectives for the conservation and sustainable use of aquatic biodiversity. Necessary steps are to review and, if necessary, revise the property interests in

aquatic resources in order to clarify those responsibilities, define the rights and identify the actual incentives that the system provides.

3. AQUATIC BIODIVERSITY PROPERTY RIGHTS AND RESPONSIBILITIES

Four main types of property interests are formally recognised in (aquatic) natural resources in New Zealand (Department of Justice 1994). These are:

- *Ownership interest*: this is derived from the vesting of exclusive possession or control of primary uses of the resource, has both rights and responsibilities, and can be public or private.
- *Regulatory interest*: this is derived from the vesting of managerial powers and responsibilities for making decisions for a common good, and is usually public or collective in nature.
- *Use interest*: this 'usufruct' refers to specified use rights and responsibilities which have been granted or recognised by the owner or manager.
- *Value interest*: this acknowledges a spiritual or cultural value held in the resource, regardless of other current uses or controls .

Any effective system of management needs to recognise each of these types of property interest, and the relationship between them.

3.1 Unbundling and assigning property interests in aquatic biodiversity

Prior to European settlement the property interests of iwi Maori in natural resource ownership and management were relatively congruent and integrated within each iwi or hapu (Doig 1996). Exceptions included assignment of some use interests to other iwi (such as coastal fishing access rights to inland tribes) and retention of some value interests by displaced iwi (such as mana associated with prior management of a resource).

Following the Treaty of Waitangi, and the establishment of British forms of governance in Australia and New Zealand (Anon. 1989), there has been a progressive statutory separation of property interests in different categories of biota, classes of land and waterbodies, through the creation of new categories of property and through acquisition and trade in these. This process has been associated with the assignment of different regulatory interests to a wide range of new agencies. The current situation is summarised in Table 1.

Fragmentation and separation (or 'unbundling') of specific property interests in water and other elements of aquatic biodiversity has proceeded over the last 150 years, with many nationalisation and other statutes after 1945 contributing to that trend (Boast 1995). There are currently proposals or recommendations to further extend the process of creating and assigning new property rights and responsibilities (for example, Memon 1997). In addition, it is proposed that customary fisheries entitlements be allocated individual transferable quota up to a total allowable customary catch; and that management of the commercial quota registry become the responsibility of quota-holders.

TABLE 1. MAIN COMPONENTS OF UNBUNDLED PROPERTY INTERESTS IN ELEMENTS OF AQUATIC BIODIVERSITY.

BIODIVERSITY ELEMENTS	MAIN PROPERTY INTERESTS	STATUTORY BASIS
Plants attached to beds of lakes, rivers, and seabed (except when defined as a seaweed 'fishery')	•Ownership with owner of waterbody bed •Regulatory interest with Regional Councils	Land Transfer Act 1952 Resource Mgmt Act 1991
Fish in the 'wild' (and other aquatic life such as invertebrates and plants included in the definition of 'fisheries')	•Vested in the Crown (contested by Maori) •Regulatory with MinFish (marine, etc.) or DOC (for freshwater non-commercial) •Various use rights (access /harvest) •Maori customary use right acknowledged •Individual transferable "quota" rights	Early Fisheries Acts Fisheries Act 1996 or— Conservation Act 1987 Commonlaw and in statute Fisheries/Conservation Acts Fisheries Acts 1983 & 1996
'Sports' fish	•Vested in the Crown •Regulatory with Fish & Game Councils	Conservation Act 1987 (except Taupo with DOC)
'Protected species' of aquatic wildlife (birds, frogs, fish, coral, marine mammals)	•Vested in the Crown (contested by Maori) •Limited use rights granted to take or hold	Wildlife Act 1953(s.57(3)) and Marine Mammals Protection Act 1978
Gamebirds	•Vested in the Crown •Regulatory with Fish & Game Councils	Wildlife Act 1953(s.57(3)) Conservation Act 1987
Unprotected species of birds and frogs (includes pest populations)	•Ownership with landowner •Regulatory with Regional Councils	Wildlife Act 1953 Biosecurity Act 1993
Waterbody bed	•Ownership with the Crown for lakes and navigable rivers generally (with some claimed by Maori). •Ownership with riparian landowner to centreline for non-navigable rivers and with title holder for lakelets/wetlands •customary ownership of unceded or returned beds with tribal authorities •Foreshore and seabed vested in Crown (contested) except where customary ownership prevails or bluewater title created	Coal Mines Act 1925/79 (often held under Reserves Act or as unallocated Land of the Crown) Land Transfer Act 1952 and Ad medium filum aquae rule Customary title or special settlement acts (e.g. Taupo) Foreshore and Seabed Revesting Amendment Act 1994
Natural water, incl. geothermal water/energy	•Vested in the Crown (some Maori claims) •Regulatory with Regional Councils •Use interests run with consents •Vested in the Crown	Water & Soil Cons Act 1967 Resource Mgmt Act 1991 Resource Mgmt Act 1991 Geothermal Energy Act 1952, now RM Act (s.354)

Property interests in non-commercialised resources or what remains of the collectively owned 'commons' are less well defined and therefore defended with less certainty of mandate.

3.2 Overlapping or contradictory objectives for management

The fragmentation of property interests in natural resources, including aquatic biodiversity, has led to overlapping and sometimes contradictory management objectives by different public management agencies under different statutes. There is nothing intrinsically wrong with this process provided that the shared responsibilities do not lead to abrogation of accountabilities, and that effective tools exist to fairly resolve and balance conflicting interests and objectives. To assess the situation we need to investigate firstly the range of objectives (both statutory and discretionary); secondly the methods available for implementing objectives, and thirdly the tools available for facilitating some integration or at least co-ordination of objectives and actions.

TABLE 2. EXISTING STATUTORY OBJECTIVES RELEVANT TO AQUATIC BIODIVERSITY.

EXISTING STATUTORY OBJECTIVES	SECTION
Conservation Act 1987	
Preserve all indigenous freshwater fisheries	6(ab)
Administer all aquatic protected areas	6(a)
Protect freshwater fish habitats	6(ab)
Administer all aquatic protected species	6(ab)
Advocate the conservation of aquatic life	53(3)(d)
Protect aquatic habitats by acquisition or otherwise	53(3)(f)
Reserves Act 1977	
Preserve the natural character of the coastal environment and the margins of lakes and rivers	3(1)(b)
Preserve areas of NZ with indigenous (aquatic) flora/fauna or natural features of special value	3(1)(a)
Ensure survival of all indigenous (aquatic) species in their natural communities and habitats	3(1)(b)
Preserve representative samples of all classes of natural ecosystems which gave NZ its original character	3(1)(b)
Fisheries Act 1996	
Conserve/enhance fisheries/aquatic life & avoid/mitigate adverse aquatic environment effects	8
Maintain biological diversity of the aquatic environment	9
Resource Management Act 1991	
Safeguard life-supporting capacity of water and aquatic ecosystems	5(2)(b)
Preserve the natural character of water bodies and their margins	6(a)
Protect areas of significant indigenous vegetation and habitats of indigenous fauna	6(c)
Sustain outstanding values of waterbodies in their natural or other state	199(1)
Safeguard esplanade areas to protect aquatic habitats, water quality, natural functioning and the natural values of the riparian zone itself	229

3.3 Existing statutory management objectives for protecting aquatic biodiversity

The statutory management objectives relevant to aquatic environments are summarised for each primary statute in Table 2.

Several national policies specify management objectives relevant to the statute they were derived under. These are summarised in Table 3.

Regional Policy Statements, Regional Plans and District Plans under the Resource Management Act, and Conservancy-wide Conservation Management Strategies are the primary vehicles for developing and expressing management objectives at regional and local scales. All have explicit or implicit objectives for management of elements of aquatic biodiversity. These range from generic paraphrasing of the Resource Management Act (e.g. 'sustain the life supporting capacity of significant waterbodies') to rare cases of differentiated and site-specific goals.

Tables 1, 2, and 3 show that there are many areas of apparent overlap of objectives by agencies administering different statutes and policies. This is particularly pronounced at the generic ecosystem/process level, while at a species or site level there is more conflict than overlap. There are gaps in responsibilities and objectives for managing some aspects of aquatic biodiversity, such as preventing loss of genetic diversity.

This paper proposes that these gaps and overlaps in management objectives, together with the increasing fragmentation of public interests and private rights, are the cause of a pervasive reduction in accountability for the actual outcomes for biodiversity in aquatic environments. This is different from the

TABLE 3. EXISTING AQUATIC BIODIVERSITY MANAGEMENT OBJECTIVES IN NATIONAL POLICY.

NZ Coastal Policy Statement (1994) Preserve the natural ecological character of coastal marine environment through: • Preventing adverse effects on significant habitats/species/communities • Preventing adverse effects on ecosystem process & biological diversity • Restoring & rehabilitating appropriate components of aquatic ecosystems • Recognising the Crown's interest in lands of the Crown & associated biota
Environment 2010 Strategy (1995) Protect indigenous habitats, biological diversity & indigenous ecosystem quality by: • Developing a network of marine protected areas • Completing the protected area network for wetlands & under-represented ecosystems. • Managing water quality & quantity to meet the needs of ecosystems and human communities. (Fisheries goals were replaced by 1996 Fisheries Act)
Other types of national policy documents New Zealand Geothermal Resources Management Policy (1986) New Zealand Wetlands Management Policy (1986) National Species Recovery Plans National Park Management Plans New Zealand Biodiversity Strategy (draft)

terrestrial situation, where it is generally believed that the 'buck stops' with the 'landowner', for whom the property rights and responsibilities are more clearly defined and understood.

In water it is seldom clear who (or which set of omissions) was responsible, for example, for the appearance or disappearance of a key species, or the degradation of its habitat. Such a lack of accountability does not engender the political will needed to pursue an expensive or controversial objective which may be a critical aspect of biodiversity conservation. It is assumed that clear accountability is a desirable state, and that the assignment and acknowledgement of it is necessary for promoting more effective and co-ordinated management of biodiversity.

There is a range of consequences of inadequately co-ordinated or dis-integrated management of aquatic biodiversity, which is best illustrated through examples. Planning and managing for the aquatic biodiversity of the Rotorua Lakes is still waiting for the co-ordinating mechanism promised with the Ministerial establishment of the Lake Guardians in 1973, again with a major interagency Future Options for the Rotorua Lakes project between 1978 and 1981, and ultimately with the Resource Management Act in 1991. A multitude of attempts were made to use formal tools to co-ordinate the planning and management activities of at least nine different agencies with statutory responsibilities or property interests impacting on the lakes; but none have been completed or effective. A current attempt to use non-statutory and informal agreements between three of the parties is in progress and may be partly successful. Meanwhile, each conflict is addressed on an ad hoc partial basis.

Similar examples and frustrations could be outlined for Lake Wairarapa, for which an overarching international property (value) interest is now being sought under the Ramsar Convention on Wetlands; Maketu Estuary (for which there has been recent resolution, through ad hoc multi-agency restoration planning, of a 60 year grievance about the 'theft' of a river through diversion); and the Tarawera River, for which extensive and expensive pre-formal planning has been necessary to facilitate 'rebundling' of a unique property (use) interest allocated to a then Crown-sponsored company in 1953.

Most generic protection measures for aquatic biodiversity are derived from fragmented property (regulatory) interests, and are not easily linked with other measures to establish effect protection. For example, Water Conservation Orders only apply to the wet part of an aquatic ecosystem, not to the bed, banks or biota. Giving effect to the highly protective purpose of a Water Conservation Order also requires co-ordinated action by Crown agencies (reservation) and District/Regional Councils (riparian and catchment landuse controls), such as was eventually achieved for the Motu River. Conversely, the formal 'protection' of the Hamurana Springs and Stream near Rotorua by reserving the bed and designating a Wildlife Refuge and Closed Fishing Area, was not sufficient basis for the Crown to prevent the Regional Council from recently granting to the District Council a resource consent to abstract water from the spring for urban water supply.

Other aquatic biodiversity protection problems associated with dis-integrated management regimes are identified and discussed in the 'issues' sections of Froude (1997) and 'A draft strategy for New Zealand's biodiversity' (Anon.

1998). One of the major problems is that while regional councils have the main responsibility to protect aquatic ecosystems from the adverse effects of landuse practices, for some activities only the territorial local authorities have the powers needed to constrain a practice (e.g. subdivision) or require an action (e.g. establish an esplanade reserve buffer between stream and intensified landuse). Some regional councils oppose district council initiatives to use their own statutory planning tools to resolve the impasse, even though they are not prepared to address the problems themselves.

These overlapping functions and the land/water boundaries between territorial authorities and regional councils can hinder the effective protection and rehabilitation of riparian and aquatic ecosystems (especially estuaries). Relatively few councils work closely together to achieve the best combined mix of policies and methods for aspects of overlapping responsibility (Froude 1997).

3.4 Existing tools for promoting integrated management of aquatic biodiversity

The fragmented or unbundled nature of property interests in aquatic biodiversity has led to a recognition of the need for tools to promote more co-ordinated management. This is often reflected in standardised proposals for integrated management of (coastal, freshwater, marine) zones. Even in New Zealand there has been a recognition for many decades of the risks of fragmented planning, and the provision of minor incentives for attempts to co-

TABLE 4. EXAMPLES OF PLANNING TOOLS INTENDED TO FACILITATE INTEGRATED MANAGEMENT.

EXISTING MECHANISMS	APPLICATION AND RELEVANCE	LIMITATIONS
National Policy Statements under RM Act, such as NZ Coastal Policy Statement 1994	Applies to RM Act processes only, but requires compliance with a national standard	No linkages to objectives or planning processes under Conservation or Fisheries Acts
Regional Policy Statements Compulsory for each region	Applies to RM Act processes only, but can integrate all agency objectives, assign roles	Unilateral right of agencies to have objectives and priorities not subject to joint process
Joint Plans under RM Act between Councils of all types	Potential for integration where management is shared	Requires participant Councils to agree, so not popular or used
Combined Plans (for Unitary Authorities to combine related plans to integrate management)	Potential to facilitate integrated management of land with water and coasts	Very few Unitary Authorities, and those that do use combined plans have few resources.
Conservation Management Strategies under 1991 Conservation Act	Compulsory for all DOC conservancies, to facilitate integration between DOC functions and activities	No linkages to objectives or planning processes under other statutes. Cannot constrain any party except DOC.

ordinate. Table 4 summarises the planning tools potentially available to promote more integrated management.

Other types of tools include: amending legislation to clarify or change property rights and responsibilities, or to require use of integrated planning or decision making; establishing co-ordinating committees; delegating or devolving authority to other agencies or committees with linked responsibilities.

3.5 Suggested principles to promote more integrated management of aquatic biodiversity

Preventing the loss of our common heritage in aquatic biodiversity will require both working together towards common objectives, and taking separate responsibility for the roles and actions each are accountable for. The following set of principles is put forward to promote more integrated management of aquatic biodiversity.

- The community needs to acknowledge risks as well as benefits associated with unbundling property interests in aquatic biodiversity.
- Resolution of conflicting property interests in biodiversity is more robust and sustainable when all of the relevant interests are fully taken into account by decision makers.
- Responsibility and authority must be matched to generate accountability, so avoiding the historical 'all care, no accountability' posture of some agencies.
- Conservation of aquatic biodiversity in New Zealand depends primarily upon protection of habitat from destruction and invasion, and control of overharvest of aquatic biota.
- Effective habitat protection requires both effective representation of stakeholder interests, and managerial co-ordination and accountability.
- Achieving more co-ordinated and accountable management, while retaining existing unbundled property interests, requires attitudes and policies based upon collaboration rather than parochialism.
- Increased accountability and political commitment will be needed to ensure full use of the range of tools designed for promoting integrated management.
- Sustainable solutions will require giving effect to Treaty principles through fully integrating the kawanatanga of the Crown with the rangitiratanga of iwi Maori in aquatic biodiversity management.
- Legislation should clearly specify the rights and responsibilities inherent in specific property interests, both public and private, to facilitate the integration of these with those of others.

4. SUMMARY AND CONCLUSIONS

Many elements of our aquatic commons have, over the years, been assigned to separate management regimes and administrative authorities. In addition, new types of property interests in water and aquatic biodiversity have been established, and these have been allocated to a variety of collective and private

parties. Together, these processes constitute a pervasive unbundling of property interests, which continues unabated today because of the potential benefits to the interest-holder of having simplified and singular objectives and obligations.

Unfortunately, progress has been much slower with development, in the public interest, of effective tools to co-ordinate management roles and to resolve conflicting objectives. A variety of planning tools have been created to facilitate more integrated management, but the different statutory instruments do not provide any linkages to planning processes under other legislation which controls other elements of aquatic biodiversity, and are seldom used. A number of attempts have been made to develop ad hoc and informal planning tools to facilitate better co-ordination of management across all statutory functions. Many of these fail because there are few guarantees of outcome, which deters commitment to and investment in the process, and because there are no rights to independent arbitration of disputes.

There are few incentives for aquatic biodiversity interest-holders to co-ordinate roles and planning with other associates having shared responsibilities. The disincentives include reduced autonomy and bringing forward the costs of conflict resolution, while the risks include the likelihood that accountabilities will be more clearly defined and specifically assigned, with implicit costs. Meanwhile, many non-sustainable uses (or abuses) of aquatic resources are encouraged by perverse incentives in the form of environmental subsidies. These exist where the impacts of an activity create costs to other interest-holders which are not recovered or otherwise included in the price for the service or the charge for the consent to use the resource (Roodman 1997). For example, the drainage and conversion of wetlands to agricultural uses results in marketable products which do not include in their prices the costs associated with loss of flood detention, nutrient retention, fish and wildlife production and other ecosystem services.

This 'failure of the market', together with the difficulties in providing workable planning tools to co-ordinate the actions and roles of administratively fragmented interest-holders, have aggravated the threats to aquatic biodiversity by limiting the effectiveness of the institutional responses. Accordingly, much of New Zealand's aquatic biodiversity heritage or commons is becoming less common as species, populations, and habitats decline. We are also seeing the results of many years of progressively removing many biodiversity elements from the wider commons, and assigning them to other interest-holders with narrow roles and objectives.

This paper suggests principles which could be used as a basis for safeguarding our aquatic biodiversity commons, particularly through increasing the co-ordination of objectives and actions towards more integrated understanding and management.

5. REFERENCES

Anon. 1989. An environmental handbook: The land and water management system. Department of Water Resources Victoria, Melbourne, Autralia.

Anon. 1998. A draft strategy for New Zealand's biodiversity. Department of Conservation and Ministry for the Environment, Wellington. 140p.

Boast, R.P. 1995. Geothermal resources in New Zealand: A legal history. *Canterbury Law Review 6(1)*: 1–24.

Doig, S.M. 1996. Customary Maori freshwater fishing rights: An exploration of Maori evidence and Pakeha interpretations. PhD Thesis in History, University of Canterbury, Christchurch.

Department of Justice 1994. Crown proposals for settlement of Treaty of Waitangi claims: Detailed proposals. Office of Treaty Settlements. Government Printer, Wellington. 51p.

Jones, B.; Renaut, R.W.; Rosen, M.R. 1997. Vertical zonation of biota in microstromatolites associated with hot springs, North Island, New Zealand. *Palaios 12*: 220–236.

Froude, V.A. 1997. Implementing the biodiversity protection provisions in the Resource Management Act: A review of Council progress to date. Pacific Ecologic Resource Management Associates, Paremata, Wellington. 116p.

Kamenev, G.M.; Fadev, V.I.; Selin, N.I.; Tarasov, V.G.; Malakhov, V.V. 1993. Composition and distribution of macro and meiobenthos around sublittoral hydrothermal vents in the Bay of Plenty, New Zealand. *New Zealand Journal of Marine and Freshwater Research 27*: 407–418.

Memon, P.A. 1997. Freshwater management policies in New Zealand. *Aquatic Conservation: Marine and Freshwater Ecosystems* 7: 305–322.

Nelson, W.A.; Gordon, D.P. 1997. Assessing New Zealand's marine biological diversity: A challenge for policy makers and systematists. *New Zealand Science Review 54 (3–4)*: 58–66.

Norse, E.A. 1993. Global marine biological diversity. A strategy for building conservation into decision making. Island Press, Washington D.C. 383 p.

Patterson, M.; Cole, A. (in press) Assessing the value of New Zealand's biodiversity. Paper presented to Australia New Zealand Society for Ecological Economics Conference, Melbourne, November 1997. *School of Resource and Environmental Planning Occassional Paper No.1*. Massey University, Palmerston North.

Roodman, D.M. 1997. Getting the signals right: Tax reform to protect the environment and the economy. *Worldwatch Paper 134*.

Schiffman, I. 1996. The Property Rights challenge: What's a planner to do? *Planning Commissioners Journal Issue 21.*

Skinner, H.C.W.; Banfield, J.F. 1997. Microbes all around. *Geotimes, August 1997.*

Tarasov, V.G. 1990. Scientific report Research Cruise 18 to New Zealand. Academy of Sciences of the USSR, 17 April–8 May 1990. (Copies held in DOC Libraries, Wellington and Rotorua.)

Taylor, R.; Smith, I. 1997. The state of the New Zealand environment report. Ministry for the Environment and Government Print, Wellington.

Winterbourn, M.J. 1969. The distribution of algae and insects in hot spring thermal gradients at Waimangu, New Zealand. *New Zealand Journal of Marine and Freshwater Research 3*: 459–465.

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