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Toward Optimal Environmental Policy: The Case of Biodiversity Conservation

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Mike D. Young

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Toward Optimal Environmental Policy:  
The Case of Biodiversity Conservation†  

Neil Gunningham* and Mike D. Young**

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INTRODUCTION

Despite decades of policy experimentation, the holy grail of efficient, effective and equitable environmental regulation has continued to elude policy-makers and regulatory theorists. In the 1990s, the less than satisfactory performance of both the government\(^1\) and market\(^2\)

1. The evidence suggests that the strategy of using regulatory agencies to curb the social excesses caused by the behavior of corporations and others is fraught with difficulty. By the late 1970s it was evident that much classical regulation had not turned out the way the policymakers had intended. EUGENE BARDACH & ROBERT A. KAGAN, GOING BY THE BOOK: THE PROBLEM OF REGULATORY UNREASONABLENESS ix-xiv (1982). Many regulatory agencies, particularly in the United States, were characterized by unnecessary adversariness and delay. See id. at 93-119 (discussing the effects of modern regulations on the regulator/regulated relationship). Moreover, regulations, both in the United States and elsewhere, were often inflexible, unduly strict, and excessively costly for business to comply with. See id. at 58-92 (discussing the unreasonableness of modern regulation). Centralized, bureaucratic standard-setting has been widely criticized for being "an inherently inefficient and cumbersome way to control pollution," E. Donald Elliott, Environmental TQM: Anatomy of a Pollution Control Program That Works!, 92 MICH. L. REV. 1840, 1846-47 (1994), and for failing to deliver many of the social benefits it promised. E.g., BARRY COMMONER, MAKING PEACE WITH THE PLANET 38-41 (1990). Theorists such as Jänicke began to speak in terms of "state failure," calling attention to ineffective post-hoc state interventions in response to market failure. See, e.g., MARTIN JÄNICKE, STATE FAILURE (Alan Braley, trans., Pennsylvania State Univ. Press 1990).

The critique of classic or command-and-control legislation can be overstated. There is evidence that such regulation has often delivered considerable benefits. See Bruce A. Ackerman & Richard B. Stewart, Comment, Reforming Environmental Law, 37 STAN. L. REV. 1333, 1364 (1985); Robert W. Hahn & Robert N. Stavins, Incentive-Based Environmental Regulation: A New Era from an Old Idea?, 18 ECOLOGY L.Q. 1, 1 (1991). However, such gains were often achieved at an unnecessarily high social and economic cost, and there are also some cases where regulation has been demonstrably ineffective. See Eric W. Orts, Reflexive Environmental Law, 89 NW. U. L. REV. 1227, 1338-40 (1995).

2. While deregulation has had some significant successes it has also had some serious failures. Of these, the constellation of events known as the Savings and Loan Scandal of the late 1980s, following the relaxation of prudential controls on small financial institutions in the United States, is perhaps the best well known. See generally MARTIN MAYER, THE GREATEST-EVER BANK ROBBERY: THE COLLAPSE OF THE SAVINGS AND LOAN INDUSTRY (1990); Kitty Calavita & Henry N. Pontell, The State and White Collar Crime: Saving the
approaches to environmental protection has led to a critical re-examination of current regulatory strategies and to an exploration of the role of alternative policy mechanisms such as economic incentives, self-regulation, information-based strategies and "communicative" instruments such as education.

Because each innovative alternative is individually valuable, there remains a tendency to treat the various policy instruments as alternatives rather than as complementary mechanisms; policy analysts too often embrace a single approach without regard to the virtue of others. Predictably, while economists focused on market or incentive-based approaches, lawyers emphasized regulation, and business favored self-regulation.

In this article, we argue that this "single instrument" or "single strategy" approach is misguided. We note that all instruments have strengths and weaknesses, and none have the flexibility and resiliency to successfully address every environmental problem on their own. Accordingly, we argue that an optimal strategy will harness the strengths of individual mechanisms and compensate for their weaknesses through the use of additional and complementary policy instruments. That is most circumstances require a mix of instruments (informational, educational, voluntary, price-based, property right and institutional), tailored to specific policy goals. We also recognize the...

*Savings and Loans*, 28 L. & Soc'y Rev. 297 (1994). In Australia, partial deregulation of the banking industry and the financial markets, alongside an under-resourced regime of companies regulation, facilitated a series of spectacular corporate collapses. See generally *Paul Barry, The Rise and Fall of Alan Bond* (1990); *Trevor Sykes, The Bold Riders: Behind Australia's Corporate Collapses* (1994). In certain areas, such as the environment, substantive deregulation was politically unacceptable, and the most that neo-liberals could achieve was a substantial reduction in the resources of regulators. See *Bardach & Kagan, supra* note 1, at 184-213 (describing the "regulatory ratchet," which prevents deregulation); Peter Christoff, The Environment—Challenges to Public Policy 14-15 (1995) (draft paper for Environmental Workshop, Research School of Social Sciences, Australia National University) (on file with authors). Ironically, despite having deprived regulators of the very resources necessary to avoid such outcomes, they have continued to point to cases of instrument failure and regulatory collapse. See *id*.


role of motivational instruments in changing individual attitudes toward biodiversity conservation.\textsuperscript{6}

However, we do not advocate a smorgasbord approach; nor do we assume that any combination of instruments will be better than a single instrument approach. On the contrary, the introduction of a new instrument to the existing policy mix could have a variety of effects, not all of which may be positive. These range from synergy (enhancement of effect through the interaction of two or more instruments) to neutralization (dilution of effect through the interaction of two or more instruments). For example, the introduction of financial incentives for some landholders, while their neighbors remain subject to mandatory constraints, is likely to generate tensions that undermine the effectiveness of either approach.\textsuperscript{7}

What is needed is not simply the introduction of a broader range of policy tools, but the matching of tools with both the particular suite of environmental and resource management problems at issue and the parties best capable of implementing these tools. The crucial question thus becomes: how, in what circumstances, and in what combinations, can the main classes of policy instruments achieve optimal policy mixes?

In the remainder of this article, consistent with a set of evaluation criteria, we demonstrate how specific combinations of instruments and institutions are most suited to achieve optimal economic and environmental outcomes, and how best to combine the vast array of instruments and mechanisms available. We also identify a set of criteria for designing an optimal policy. We then apply these tools and focus on one particular and pressing environmental problem: biodiversity conservation. Furthermore, we identify a set of design criteria of paramount importance in conserving biodiversity. We argue that a new approach is needed that both incorporates and surpasses conventional instruments and utilizes a broad range of complementary policy instruments.

Our evidence is drawn principally, but far from exclusively, from the Australian experience of biodiversity conservation. For reasons identified below, Australia has a particular responsibility for, and need to protect, biodiversity; in part for those reasons, Australia is exploring a range of innovative and imaginative policy options. However,

\textsuperscript{6} If, as some economists argue, instruments only can be positive (a carrot) or negative (a stick), then the techniques used to change human behavior, such as the issuance of awards to those who make the greatest contribution to biodiversity in a region, are not a policy instrument.

\textsuperscript{7} Similarly, subsidies for certain types of agricultural production and tax deductions for expenditures incurred in land clearance may effectively neutralize incentives for the protection of groundwater quality. \textsc{organisation for economic co-operation and development, water resource management: integrated policies} 112 (1989).
Australia faces dilemmas that are substantially similar to those of other nations. Accordingly, we believe that the lessons drawn, the policy design criteria identified, and the solutions suggested, apply to other developed nations that seek to conserve biodiversity.

I.
THE CONTEXT FOR POLICYMAKING

A. The Importance of Biodiversity Conservation

Biodiversity generally refers to the diverse forms into which organisms have evolved. It is considered at three levels of diversity: genetic, species and ecosystem. Genetic diversity refers to the variation in genes that enable organisms to evolve and adapt to new conditions. Species diversity refers to the numbers, types, and distribution of species within an ecosystem. Ecosystem diversity refers to the variety of habitats and communities of different species that interact in a complex web of interdependent relationships.

Biodiversity is essential for the maintenance of human life on earth, and scientists have long acknowledged that the preservation of biodiversity is, by definition, vital for an ecologically sustainable society. Humanity derives much of its food, medicines, and industrial products from both domesticated and undomesticated components of biodiversity. Biodiversity is also an important source of natural ecosystem processes that are beneficial yet often grossly undervalued, such as water purification, soil fertilization, and groundwater recharge. Furthermore, loss of genetic diversity could frustrate needed improvements in agriculture. As one major policy document points out:

[B]iological diversity is the primary source for fulfillment of humanity's needs and provides a basis for adaptation to changing environments. An environment rich in biological diversity offers the

8. See David Farrier, Conserving Biodiversity on Private Land: Incentives for Management or Compensation for Lost Expectations?, 19 HARV. ENVTL. L. REV. 303, 304 n.2 (1995). Farrier also recognizes a fourth notion of biodiversity—that of associations of species or biological communities comprising the biotic parts of ecosystems. Id.
9. Id.
10. Id.
11. Id.
13. Id. See also EDWARD O. WILSON, THE DIVERSITY OF LIFE 281-310 (1992) (discussing the benefits humanity obtains from biodiversity).
14. AUSTRALIAN NATIONAL STRATEGY, supra note 12, at 1.
15. See id.
broadest array of options for sustainable economic activity, for nurturing human welfare and for adapting to change.16

Apart from the obvious benefits for productivity and the long-term security of the ecosystems that support us, there are aesthetic and ethical arguments in favor of preserving biodiversity. Loss of genetic, species, and ecosystem diversity subsequently invites the loss of cultural diversity. Many indigenous cultures have been driven to extinction by the same forces which have destroyed and continue to threaten nonhuman species. It is estimated that since 1900 more than ninety tribes of aboriginal peoples have become extinct in the Amazon Basin alone.17 Moreover, it has been argued that humanity has a moral duty to avoid the extinction of other species.18 Finally, the existence of natural landscapes contributes to the emotional well-being of a society, and offers many recreational benefits.19

B. Pressures on Biodiversity20

The general worldwide decline in levels of biodiversity is an issue that is of international, as well as national, importance.21 Each year, more than 10,000 species become extinct globally.22 While precise calculation is difficult, it is certain that this rate has increased alarmingly in recent years.23 The causes of biodiversity loss are many, but include habitat loss and fragmentation, human exploitation, and competition from and predation by introduced species.24 Recognition of this loss led to the rapid ratification of the Convention on Biological Diver-

16. Id.
18. AUSTRALIAN NATIONAL STRATEGY, supra note 12, at 2.
19. Id.
22. Biodiversity Resource Center, supra note 17.
23. Id.
24. WILSON, supra note 13, at 253-54; ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, SAVING BIOLOGICAL DIVERSITY: INCENTIVE MEASURES (forthcoming 1997) (manuscript at 33, on file with authors).
Nearly every habitat on earth is at risk: the rainforest and coral reefs of the tropics, the salt marshes and estuaries of the coastal regions, the tundra of the circumpolar north, the deserts of Asia and Australia, the temperate forests of North America and Europe, and the savannas of Africa and South America. In many countries, little natural vegetation remains untouched by human hands: in Bangladesh only six percent of the original vegetation remains; forests around the Mediterranean Sea probably covered ten times their current area; and in the Netherlands and Britain, less than four percent of the lowland raised bogs remain undamaged.

The decline of tropical rainforests is of particular concern. These cover only seven percent of the planet's surface, but within them live fifty to ninety percent of the world's species. About seventeen million hectares of tropical forest are now being cleared annually, either for timber, agriculture, or other development. At these rates, scientists estimate that roughly five to ten percent of tropical forest species face extinction within the next thirty years. Thus, 60,000 of the world's plant species, and perhaps even higher proportions of vertebrate and insect species, could become extinct in this period.

C. Australia's Biodiversity Record

Australia's flora and fauna is "megadiverse"—a term used to describe ecosystems of exceptional variety and uniqueness. There are only eleven other countries within this classification. As the only

27. See Wilson, supra note 13, at 259-72 (describing various "hot spots" of critical habitat loss).
28. WORLD RESOURCE INSTITUTE ET AL., GLOBAL BIODIVERSITY STRATEGY: GUIDELINES FOR ACTION TO SAVE, STUDY, AND USE EARTH'S BIOTIC WEALTH SUSTAINABLY AND EQUITABLY 9 (1992) [hereinafter GLOBAL BIODIVERSITY STRATEGY].
29. Id. at 7.
30. Id.
31. See, e.g., Wilson, supra note 13, at 276-77, 280 (variously estimating that from one-tenth to one-quarter of rainforest species will succumb within thirty years if recent clearing trends continue, and that, out of perhaps ten million species currently living in rain forests, approximately 800,000 will become extinct in the next thirty years).
33. Id. at 3.
developed country in this group, Australia bears a special responsibility to address the problem of biodiversity conservation.

Since European settlement in 1788, Australia's record of species extinction and habitat decline has been disappointing. In this time, Australia has reached the highest known rate of extinction of mammal species in the world.34 Half of all the animal extinctions in Australia have occurred this century.35 Of the 258 known species of mammals in Australia at the time of European settlement in 1788, 138 are now either extinct, endangered, or vulnerable.36

Australia has an equally poor record for plant extinctions. Australia was one of the top ten land clearing countries in the world from 1983-93.37 As a result of this clearing, combined with the introduction of feral animals and weeds, seventy-six species of Australian vascular plants are presumed to have become extinct and 5,031 vascular plant taxa are considered to be rare or threatened.38 These statistics show Australia to be responsible for approximately twenty percent of the world's plant extinctions.39 In addition, Australia has a higher percentage of rare or threatened plant species (22.9%) than South Africa (9.2%), New Zealand (9.3%), Europe (17%), or the United States (22%).40

Ecosystems, ranging from temperate grasslands to coastal heathlands and mangrove communities to a variety of arid communities, require urgent protection. Since 1788, between seventy and ninety-five percent of all vegetation has been modified by human activity, and Australia has lost seventy-five percent of its rainforests and forty percent of its forests.41 Sadly, more than half of all major biogeographic regions in Australia are not protected in any part by a National Park or Nature Reserve.42

34. Id.
35. Id.
36. Id.
37. Andreas Glanznig, Diversity Binds Our Web of Life, WEEKEND AUSTRALIAN, Apr. 20, 1996, at 28. Each year, about 500,000 hectares of native vegetation in the six Australian States are still cleared for agricultural purposes. ANDREAS GLANZNIG, DEP’T OF ENV’T, SPORT AND TERRITORIES, NATIVE VEGETATION CLEARANCE, HABITAT LOSS AND BIODIVERSITY DECLINE: AN OVERVIEW OF RECENT NATIVE VEGETATION CLEARANCE IN AUSTRALIA AND ITS IMPLICATIONS FOR BIODIVERSITY 19 (Biodiversity Series, Paper No. 6, 1995) [hereinafter GLANZNIG, NATIVE VEGETATION]. This figure does not include land cleared illegally, land clearance not requiring a permit, land cleared for urban development, or land cleared in the Territories. Id. at 17-19.
39. Id. at 435.
40. Id.
41. See GLANZNIG, NATIVE VEGETATION, supra note 37, at 20-39.
42. YOUNG ET AL., supra note 32, at 3. See generally AUSTRALIAN NATURE CONSERVATION AGENCY, AN INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA: A
D. Biodiversity’s Special Features

Biodiversity has a number of features that distinguish it from more conventional resource management issues, and which must be taken into account in policy design. First, in many circumstances biodiversity loss is irreversible. Once lost, a species or an ecosystem is lost forever. Second, many species—especially the invertebrates, microbes and viruses—remain undiscovered. As a consequence, biodiversity can be lost before we even know it is there, leaving unknown its ecological role and its potential contribution to humankind.

Third, ecosystem diversity exhibits threshold effects. Current scientific evidence suggests that:

[T]here are limits to the ability of ecosystems to withstand the stress imposed by environmental degradation. If stressed beyond these limits, ecosystems will collapse. By reducing ecological resilience, biodiversity loss increases the likelihood that thresholds will be breached. . . . The possibility of a major environmental catastrophe or system collapse cannot be ruled out.

As a consequence, any policy that compromises the resilience of ecosystems may have uncontrollable effects, and even small policy changes can have dramatic but unforeseen results. The problem is exacerbated by the fact that information is extremely limited about species’ responses to biodiversity loss. For example, there is considerable uncertainty about the nature of ecological thresholds and about the consequences of transgressing them.

Fourth, many biodiversity problems cannot be solved merely by proscribing certain behavior. Preserving the integrity of biodiversity requires positive, ongoing management. This management process emphasizes a “custodianship ethic.” Fifth, substantial tensions between public and private interests arise because much of biodiversity has no immediate economic value. Finally, the causes of genetic, species, and ecosystem losses are extremely diffuse and involve many different sectors and forms of economic activity. That is, biodiversity is pervasive to social and economic systems, and is affected by land
and water use decisions, by pollution, and by economic use generally.\(^50\)

**E. Evaluation Criteria**

In assessing guidelines for mixing instruments and mechanisms for conserving biodiversity, various authors have developed lists of evaluation criteria.\(^51\) Our preferred list includes:

- **Dependability or Certainty**—the instrument delivers the desired biodiversity target, even when knowledge about likely responses is uncertain;
- **Precaution**—the instrument avoids the chance of serious or irreversible consequences, especially when there is scientific uncertainty about the outcome;
- **Equity**—the instrument operates without advantage or favor with respect to all groups of people, including future generations;
- **Economic Efficiency**—with regard to implied and actual values, the chosen trade-off between production and conservation is achieved at the least cost (productive efficiency), and no reassignment or reallocation of property rights will improve production or biodiversity objectives without making someone worse off (allocative efficiency);\(^52\)
- **Dynamic and Continuing Incentive**—the mechanism continues to encourage technical innovation as well as improvement of biodiversity beyond the official policy target, and automatically adapts to changing technology, prices and climatic conditions;

\(^{50}\) For example, a site that contains several endangered species might be threatened by agricultural practices such as clearing to plant more crops, pollution from fertilizers and pesticides used on farms several kilometers away, and salinity induced by tree clearing high up the catchment. This same site might also be the source of pollution endangering a fish population in an estuary at the bottom of a catchment. Simultaneously, other policy objectives like enhancement of agricultural and fishery production and the development of ecotourism might be held for the site. Sometimes biodiversity and more general resource management problems coincide. *See Making Markets Work, supra note 20, at 77.*


\(^{52}\) This is the Pareto definition of allocative efficiency. The alternative, less restrictive definition of allocative efficiency is the Kaldor-Hicks version. *See Young, supra note 51, at 27.* Hypothetically, if those who gain from a proposal could fully compensate those who lose and still be better off, then the proposed change is efficient. In this framework we regard this less restrictive definition as one that may compromise our third equity criterion. Equity, as we define it, requires that compensation *is* paid.
• Administrative Feasibility and Cost—monitoring and information costs are minimal (low information cost),\textsuperscript{53} government enforcement is cost-effective and can be financed from available revenue while self-enforcement is encouraged (low administrative cost), the instrument's requirements are simply explained (communicative simplicity),\textsuperscript{54} and the decisionmaking processes associated with the instrument are easily understood (transparency); and

• Community and Political Acceptability—the community is motivated to ensure that biodiversity conservation objectives are achieved, are perceived as being legitimately formulated and delivered, add to social harmony, are consistent with government commitments, and attract bipartisan support.

II.
TOWARDS AN OPTIMAL POLICY MIX

In this part we describe the main instrument categories, identify the strengths and weaknesses of each category, examine the circumstances in which each can most appropriately be used, and suggest the most appropriate combinations of instrument categories.

As indicated in Table One, a vast array of policy instruments might be invoked for biodiversity conservation. Matching the evaluation criteria stated above against these many instruments at a context and threat-specific level would be an impractical, if not overwhelming task.\textsuperscript{55} Consequently, to address policy instruments and mixes at a conceptual level, we have developed a sub-set of instrument categories which, while informative, is not exclusive. The purpose of this categorization, encapsulated in Figure One, is to make it easier to understand the differing roles of instruments and the opportunities that arise to combine them into effective packages.

\textsuperscript{53} Complex, highly technical schemes that require large amounts of information, complex monitoring, or many minor decisions are to be avoided.

\textsuperscript{54} Stakeholders can obtain information about the instrument easily and find the instruments' effects easy to explain to others.

\textsuperscript{55} Because a very large number of variables are involved, it is impractical to account for all the various interactions and permutations that may arise, even in terms of a complex multivariate model. To give an example, fifteen circumstances, each involving two aspects, would produce $32,768$ possible settings. Hans Bressers & Pieter-Jan Klok, \textit{Fundamentals for a Theory of Policy Instruments}, \textit{Int'l J. Soc. Econ.}, Mar.-Apr. 1988, at 22, 23-24.
TABLE ONE
Instruments Available for Biodiversity Conservation and Its Ecologically Sustainable Use

<table>
<thead>
<tr>
<th>Tax Policy</th>
<th>Charges</th>
<th>Financial Programs</th>
<th>Property Rights</th>
<th>Leases &amp; Licenses</th>
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</thead>
<tbody>
<tr>
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<td>Tourist levies</td>
<td>Management agreements</td>
<td>Tradeable quotas</td>
<td>Harvest licenses</td>
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<td>Transferable tax credits</td>
<td>Entry charges</td>
<td>Grants</td>
<td>Tradeable fishing shares</td>
<td>Breeding licenses</td>
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<tr>
<td>Exemption from local government rates</td>
<td>Royalties</td>
<td>Compensation payments</td>
<td>Development rights</td>
<td>Export permits</td>
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<tr>
<td>Exemption from capital gains tax</td>
<td>User fees</td>
<td>Access to free advice</td>
<td>Offset schemes</td>
<td>Conditional resource security</td>
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<tr>
<td>Deductibility of non-income producing expenditure</td>
<td>Hypothecation</td>
<td>Subsidies</td>
<td>Tradeable clearing rights</td>
<td>Bio-prospecting</td>
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<td>Donations</td>
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<td>Rate-rebates</td>
<td>Tradeable drainage rights</td>
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<td>Tradeable easements</td>
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<td>Easements and covenants</td>
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<td>Exclusive use rights</td>
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<tbody>
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<td>Special status agreements</td>
<td>Third party rights to challenge decisions</td>
</tr>
<tr>
<td>Forfeiture of rights</td>
<td>Conditional resource security</td>
<td>Collecting permits</td>
<td>Labeling</td>
<td>Rights of access to information</td>
</tr>
<tr>
<td>Director liability</td>
<td>Assurance bonds</td>
<td>Clearing permits</td>
<td>Industry accreditation</td>
<td>Co-management</td>
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<td>Audit</td>
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<td>Development permits</td>
<td>Prizes</td>
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<td>State of Environment reporting</td>
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<td>Development zones</td>
<td>Self-regulation</td>
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<th>Institutional Mechanisms</th>
<th>Information</th>
<th>Leverage Mechanisms</th>
<th>Awards</th>
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<td>International agreements</td>
<td>Education</td>
<td>Cross compliance</td>
<td>Awards and prizes</td>
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<td>State agreements</td>
<td>Extension</td>
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56. Adapted from T. Panayotou, Economic Instruments for Environmental Management and Sustainable Development (1994) (unpublished manuscript, on file with authors).
A. Motivational and Informational Mechanisms and Instruments

Instruments falling within this general category are a part of almost all programs for the protection of biodiversity. It is useful to differentiate between: (a) motivational instruments that shift individual and community preference functions; and (b) mechanisms that inform people about relationships between resource management practice and the environment. In making this distinction, however, we observe that these two means of encouraging biodiversity conservation are frequently mixed with one another. We perceive that the personal preference functions of those who provide information about biodiversity typically are “greener” than those who receive and use the information; consequently, the processes used often involve conscious efforts to change individual biodiversity conservation attitudes and preferences.
1. Motivational Instruments

Motivational instruments include advertising and education campaigns,\textsuperscript{57} shaming,\textsuperscript{58} and the provision of awards to those who adopt best management practices.\textsuperscript{59} If people are positively motivated and persuaded that biodiversity conservation is worthwhile, then they are more likely to respond positively to the other types of instruments. For instance, those who understand and identify with the reasons for government regulation will similarly be more accepting of it. If school children, for example, can explain why mechanisms are needed to protect native vegetation, then their farming parents may be more likely to accept these regulations because of the pressure they exert on their parents to comply with emerging social norms.\textsuperscript{60} One of the most effective ways to build motivation is to pursue structures that build com-

\textsuperscript{57} Education campaigns which seek to harness the enlightened self interest of resource users are likely to achieve significant success for similar reasons to those indicated in the examples given concerning information supply in Part III.A.2., infra.

However, self interest is not an essential prerequisite for effective educational programs. On the contrary, there is evidence that people are more willing to take action and pay more for conservation when they have an improved understanding of what it is that is under threat and why it may be important—even when their own material interests are not improved by doing so. See Katherine K. Baker, \textit{Consorting With Forests: Rethinking our Relationship to Natural Resources and How We Should Value Their Loss}, 22 \textit{Ecology L.Q.} 677, 720-23 (1995). There are many available examples of altruism in this area, the setting up of land conservation trusts by private environmental organizations being but one. Policy must therefore take account of the fact that beliefs and values may be central influences on decisionmaking. \textit{See generally Robert E. Goodin, Motivating Political Morality} (1992) (focusing on how to best motivate moral behavior in politics).

The nature of both advertising and education campaigns and extension activities will necessarily differ with the nature of the problem and with the target audience. In some contexts, federal and state governments may play a key role, for example, in disseminating education kits to schools and facilitating their use. In other contexts, an advertising or educating campaign specific to a particular local area or region is appropriate, and the appropriate dissemination agencies are likely to be local government and other area-specific bodies, which have both local knowledge and credibility, and a comparative advantage in targeting the audience at the local or regional level. In any case, design is important and programs for attitude change in particular must be consonant with the perceptions, knowledge and moral characteristics of the target audience. \textit{Young et al., supra note 32}, at 108-09.

\textsuperscript{58} \textit{See John Braithwaite, Crime, Shame and Reintegration} 77-79 (1989).

\textsuperscript{59} These can provide a powerful set of incentives (not well developed in the economics literature) with the potential to shift public perception and attitudes to biodiversity. Prizes and awards can raise awareness of biodiversity issues. \textit{See generally Noel Preece et al., Dep't of Env't, Sport and Territories, Two Way Track: Biodiversity and Ecotourism: An Investigation of Linkages, Mutual Benefits and Future Opportunities} (Biodiversity Series, Paper No. 5, 1995); P.N. Grabosky, \textit{Regulation by Reward: On the Use of Incentives as Regulatory Instruments} (1996).

Also, well defined advertising campaigns can fulfill a similar function, serving both to provide information and to influence attitudes and behavior. However, it must be acknowledged that such campaigns have not always been successful and that much depends on the tactics used. \textit{Young et al., supra note 32}, at 107-110.

\textsuperscript{60} \textit{Young et al., supra note 32}, at 109.
To achieve change, individuals and local institutions must be supportive and, preferably, be directly involved in conserving biodiversity. Finally, motivational instruments are one of the most cost-effective instruments because they are generally inexpensive to implement.

2. Informational Instruments

Informational instruments focus on information supply, including the dissemination of the results. There is considerable evidence to indicate that such instruments frequently repay substantial dividends in terms of improving management practice. Appropriately designed information programs may produce substantial benefits where informed resource users have a self interest in protecting biodiversity. If, for example, eutrophication of a lake is due to unnecessary over fertilization by farmers, merely bringing this to their attention may solve the problem. Thus, enlightened self interest may be sufficient to solve, or at least reduce, the problem. Provision of information can improve management of common property resources such as fisheries. Fishers may learn that the continued use of a certain type of net will permanently reduce stocks and destroy their livelihoods. A well designed property right system could persuade them to

61. See id. at 93.


63. YOUNG ET AL., supra note 32, at 110 & app. 2.

64. Information supply is fundamental to decisionmaking. Indeed, certain studies suggest that a great deal of environmentally inappropriate behavior arises not from perversity or selfishness, but rather from ignorance, and that the greater one’s knowledge of environmental issues and/or action strategies, the greater one’s tendency to adopt environmental and resource management practices consistent with social objectives. See, e.g., Jody M. Hines et al., Analysis and Synthesis of Research on Responsible Environmental Behavior: A Meta-Analysis, J. ENVT'L EDUC., Winter 1988, at 1, 6. This finding is entirely consistent with views expressed by many people in the community consultations, as described in chapter 3 of YOUNG ET AL., supra note 32.

65. Central to the provision of information about the effects of different types of activity is research. The costs of research tend to be too high for individuals and are consequently most efficiently conducted by scientists, and the organizations that support them, on behalf of the people involved. Some of the benefits of research are private or, at least, can be recovered efficiently through the sale of goods and services, while other benefits are of a “public good” nature. Recognizing this, Australia has developed a series of research and development corporations to finance selected forms of research on the use of natural resources. YOUNG ET AL., supra note 32, at 108. Equitably, these corporations fund research partly from consolidated revenue and partly from levies on the producers who stand to benefit from the research. Id. Research is usually most cost effective when it is conducted by organizations in association with landholders who have specialist expertise in local land management. Id.

66. See id. at app. 1.
use exclusion devices that reduce their catch and, hence, the cost of sorting, thereby increasing profits.67

Generally, informational instruments are considered to be equitable if the information is widely disseminated in a noninterventionist manner. Where such instruments provide information that harnesses self interest (as in the examples above), they prove financially attractive and self-enforcing, with continuing incentives for biodiversity conservation and sustainable use. Those who have been informed of the advantages of biodiversity conservation in certain contexts, such as ecotourism, will be more inclined to develop self-regulatory mechanisms that seek to maintain biodiversity values—agreements that restrict anchoring on coral reefs and restrict maneuvering to designated tracks, for example.

Motivational and educational instruments are sometimes combined. Victoria's Land for Wildlife Program rewards participants by publicizing the idea that participants are socially responsible citizens.68 The program also provides free advice to participants on ways to protect diversity.69

We believe that motivational and informational instruments are so fundamental to a successful biodiversity conservation package that they should be invoked in almost all circumstances, and be incorporated in almost all policy mixes. They form a necessary foundation upon which all other instruments must rely if they are to achieve their optimal impact. Consequently, we locate them at the base of Figure One.

We do not, however, suggest that this category of instruments is dependable. Nor do we suggest that they can be relied upon in isolation, particularly where there is a substantial tension between the public and private interests. Indeed, we suspect that there is sometimes a considerable gap between public attitudes and private behavior. That is, even when people collectively perceive the need for biodiversity conservation, each individual will not necessarily take appropriate action if it would conflict with other interests. For example, South Australian experience has shown that even when people were well informed of and supportive of the need for biodiversity conservation, many still wanted to clear their own land.70 Only regulation (coupled with compensation) prevented them from doing so.71 This demonstrates the main weakness of motivational instruments: they contain

67. Id. at 108.
68. Id. at 171.
69. Id. at 108.
70. Telephone Interview with John Bradsen, Senior Lecturer, Law Faculty, University of Adelaide, Australia (May 10, 1995).
71. Id.
no precautionary elements and cannot be depended upon to conserve biodiversity when a significant gap exists between the private and social objectives.

Thus, as argued below, an optimal strategy usually utilizes motivational and informational instruments to close the gap between the public and private interests and then uses a mix of voluntary instruments, price-based instruments, and regulatory instruments to provide dependability. Necessarily, the precise combination of instruments will vary with the ecological, social, economic, and political context. Thus, the institutional approach we recommend is one that makes institutional access to each instrument as wide as possible.

B. Voluntary Instruments

A variety of instruments and mechanisms can be classified under this heading but their main characteristic is that the principal resource manager has discretion in deciding whether or not to participate. They rely on voluntarism and self-regulation rather than coercion or continuing financial instruments. These mechanisms include self-regulation within an industry; support for projects undertaken by nongovernment organizations, community groups, or landholders (where the financial support is partial and there is heavy reliance on voluntary effort for successful completion); and personal land man-

72. The case studies contained in appendices 2.1 to 2.7 and summarized in chapter 4 of Young et al., supra note 32, illustrate the benefits, and provide some examples of this approach.

73. Because of the value inherent in various instruments and the desire to maximize results, government departments face the temptation to jealously restrict access to an instrument that would be of value to another department or local community. For example, departments might fight over which of them is able to add a conservation covenant to a land title. In some states, National Parks and Wildlife Services perceive that they should approve each and every conservation covenant. For example, in New South Wales, Conservation Agreements are made under the NSW National Parks and Wildlife Act of 1974, and are initiated by the National Parks and Wildlife Services. Id. at 26. The wider use of this instrument could accommodate relevant government departments or agencies.

74. In some countries, voluntary programs—often linked with community groups—are favored over other arrangements as a mechanism for conserving biodiversity on private property. Making Markets Work, supra note 20, at 78. Voluntary programs do not require any commitment to participation for any set period of time on the part of the landholder or resource user. Rather, program participation relies upon the enthusiasm and goodwill of the landholder or resource user, and withdrawal from a program only results in a cessation of assistance. For example, all states in Australia have programs to assist in the voluntary use of land for the protection of wildlife. See Tim Clairs & Mike Young, Approaches to the Use of Incentives to Conserve Biodiversity 16-19 (Apr. 1995) (unpublished working document, on file with authors). Some of these, such as South Australia’s Private Sanctuary Scheme and Queensland’s Fauna Sanctuary scheme, carry no financial inducements at all. Id. at 16, 19. Examples of voluntary approaches include: membership schemes coupled with active extension programs; “friends of” groups and demonstration projects (which also have a strong motivational component); and the inclusion of wildlife in property management planning. See Bennett, supra note 62, at 122. A voluntary approach may also
have considerable value where monitoring costs are low. Generally, these costs are lowest for species protection plans, and in particular for those which are of short duration, establish conservation targets, and involve few landholders. Young et al., supra note 32, at 111. See generally Jim Crosthwaite, A Review of Potential Financial Incentives to Achieve Nature Conservation Goals on Private and Leasehold Land, in People and Nature Conservation, supra note 62.

Management agreements fulfill a crucial role, given that while bans and clearance controls serve to halt existing degradation, they do not achieve ongoing protection in seminatural systems, nor can they be modified to do so. If it is not economical for land users to maintain biodiversity (the very reason sanctions are contemplated) they may respond by abandoning management altogether or behave, at best, as poor and reluctant custodians. See John Bowers, Incentives and Mechanisms for Biodiversity: Observations and Issues 13 (Apr. 1994) (working document, on file with authors); Farrier, supra note 8, at 399-405 (arguing for paying landowners to manage their land in a manner that promotes biodiversity). The need for ongoing protection is particularly compelling in respect to remnants on private land, because these are frequently small, and, as a result, need more intensive care than more substantial areas. See Daniel B. Botkin, Discordant Harmonies: A New Ecology for the Twenty-First Century 195-96 (1994); K.J. Wallace & S.A. Moore, Management of Remnant Bushland for Nature Conservation in Agricultural Areas of Southwestern Australia—Operational and Planning Perspectives, in Nature Conservation: The Role of Remnants of Native Vegetation 259 (Denis A. Saunders et al. eds., 1987) [hereinafter Nature Conservation]; and Bowers, supra, at 14.

Management agreements have the virtues of being financially attractive, flexible, cooperative, non-intrusive (where voluntary), and easily targeted. Their most obvious limitation is the high administrative cost associated with negotiation and monitoring. To be effective, they also require some periodic oversight, auditing, or other forms of supervision on the part of government. See generally A.J.M. Hopkins & D.A. Saunders, Ecological Studies as the Basis for Management, in Nature Conservation, supra, at 15. Since the distance between properties subject to such agreements may be substantial, and some agreements may need to be tailored to the individual circumstances of land and land users, administrative costs will be significant. However, transferring part of the oversight role to local communities may mitigate costs.

Management agreements as a "stand alone" mechanism are subject to a serious limitation, namely that such arrangements need to be periodically renegotiated, and at each renegotiation the person involved has an opportunity to hold the benefits of their work for ransom. Consequently, to achieve dependability, the most effective management agreements are underpinned by a conservation covenant designed to protect biodiversity in the longer term. For example, a conservation covenant attached to the land title, and negotiated in conjunction with the management agreement, could require the existing landholder and all subsequent landholders to neither damage nor threaten to damage that habitat. Although management agreements are usually regarded as voluntary, market-based incentives, it may be desirable to add a regulatory arrangement in some circumstances. See Farrier, supra note 8, at 391 (arguing that land management promoting biodiversity protection requires a combination of command-and-control regulation and financial incentives).
tor without incurring high administrative costs. For this reason, voluntarism is particularly appropriate in circumstances where there is a collective of people willing to protect biodiversity and areas of value, and where the self interest of individuals in obtaining a financial concession for themselves is therefore limited.

Voluntarism is noninterventionist, has high community acceptability, and raises minimal equity concerns.\(^7\) It also promotes an ethic of land custodianship. But in many cases, land owners will only voluntarily enter into an agreement or program when it is more profitable to do so than to follow market forces. Consequently, when the gap between the public and private interest is large, use of voluntary instruments becomes infeasible. In such circumstances, other instruments can be used to reduce the total cost of achieving biodiversity conservation.

Where landowners perceive their own self interest (short-term as well as long-term) as being to protect biodiversity, (i.e., where society’s interest in protecting biodiversity and the land user’s interest substantially coincide) self-regulation may be a cost-effective and appropriately non-interventionist strategy.\(^7\) However, even here, voluntarism can only work if resource users appreciate the value of biodiversity protection, and their own self interest in protecting it. Motivational instruments that seek to increase the number of people interested in conserving biodiversity and informational instruments that show them how to conserve biodiversity will be extremely important in this respect, again illustrating the point made immediately above: motivational and educational mechanisms can almost invariably reinforce other policy instruments.\(^7\)

Unfortunately, in most circumstances, there is a considerable gap between the public interest in biodiversity conservation and the private interests of individual land users.\(^7\) Although many land users

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76. Young et al., supra note 32, at ch. 111, 113.
77. Id. at 113. See also Bennett, supra note 62.
78. Even when resource users have full awareness of their self interest in protecting biodiversity, there is still danger in relying on voluntarism to the exclusion of more interventionist mechanisms. Not all resource users will behave rationally. Policy should provide a regulatory safety net to take account of the minority who may be irrational, incompetent, or intransigent.
79. The basic problem derives from the fact that private landholders (or indeed other private users of resources) commonly lack any economic incentive to take account of the social costs of their actions. That is, we encounter a classic externalities problem where the direct benefits of biodiversity loss (for example, increased agricultural production from clearing land) go to individual property owners, whereas the costs (in terms of loss of species, ecosystems, genetic resources, and other potential uses) fall on society at large. In collective terms, the problem is that the impact of one landholder clearing his or her land will make little impact on the overall problem, nor will this individual decision influence the behavior of other landholders. Accordingly, each landholder will be tempted to take advantage of the willingness of others to protect the environment while continuing to de-
identify with objectives of voluntary land protection schemes, their self interest in protecting biodiversity is not readily apparent in the short term. More commonly, there is a perceived tension between maximizing the use of productive land and protecting remnant vegetation. Despite providing long-term benefits (acting as a windbreak, reducing dryland salinity, etc.), the benefits of remnant vegetation are less tangible and less immediate than an increase in short-term productivity which remnant removal promises. For land users who are economically marginal, economic theory suggests that short-term production payoffs often outweigh longer-term conservation benefits.

History suggests that in these circumstances, unless backed by payments that make biodiversity conservation the most profitable strategy, voluntarism cannot be relied upon as an exclusive instrument to deliver biodiversity conservation.

Financial incentives are a powerful class of voluntary mechanism, but are not always necessary or wise. Once payments for biodiversity conservation become the norm, withdrawal of these payments threatens the loss of any realized conservation benefits unless measures, like a conservation covenant, are established to protect these benefits. Moreover, removal of the financial support may corrupt a carefully cultivated custodial ethic. Making clear that any payments are transitional reduces this risk. Transitional payments are characterized by statements that they will only be available for a period of time and that their purpose is to bring about a change in social expectations. In Australia, programs such as Land for Wildlife in Victoria have successfully persuaded many landowners to voluntarily manage land as wildlife habitat without offering any financial assistance. Such programs have the added benefit of promoting biodiversity conservation awareness, thereby contributing to motivational change—a factor acknowledged in the Convention on Biological Diversity.

It should be emphasized that financial self interest is not a full explanation of behavior. Altruism and respect for broad conservation objectives may be evident in some. Mechanisms that support and har-
ness such behavior can play a supporting role in the policy mix, provided they can be justified in cost-benefit terms. For example, if limited resources were used to entice voluntary conservation agreements from landholders, this measure might be cost-effective, even if applicable to only a small minority. If coupled with appropriate tax concessions, then many more landholders might be encouraged to participate.

To summarize, voluntary mechanisms should not be used in isolation, except in those limited circumstances where the public interest in protecting biodiversity conservation and private interest substantially coincide, and where biodiversity loss is reversible. In the large majority of cases they need to be supported by mechanisms that ensure dependability and reduce implementation costs. In virtually all cases, other instruments, such as price and property right mechanisms and regulation, should support voluntary mechanisms. Nevertheless, voluntarism still plays an important role, particularly where the threats to biodiversity require active participation. The challenge in designing voluntary mechanisms is to develop a custodial ethic and to make biodiversity conservation part of the “community norm.” Well designed policy mixes use voluntary instruments to harness altruistic behavior.

C. Property Rights and Price-Based Instruments

In the case of biodiversity conservation, market failure is pervasive and results, *inter alia*, from externalities, the absence of markets for some aspects of biodiversity, and inadequately or incompletely defined property rights. Property right mechanisms have the potential to compensate for, or reverse, such market failure through mechanisms that make resource use opportunities consistent with social values. As with other instruments that modify prices directly, the aim “is to alter private costs and benefits so that any unaccounted social costs (and benefits) of environmental degradation can be ‘internalized’ to ensure the desired environmental improvement.” Most property rights begin by defining what may be done and then restrict action through covenants and conditions. For example, easements and other legislative arrangements may grant rights to those other than landowners, a conservation covenant may prohibit clearing, or an individua-

85. Even here, not all will respond rationally, implying a continuing role for regulation as indicated in Part III.D., *infra*.
86. For example, to avoid the possibility that industry self-regulation becomes a sham, it is necessary for it to be underpinned by external oversight and monitoring. The capacity should exist for government to step in and regulate directly, where self-regulation turns out to be ineffective.
ally transferable fishing right might confine fishing activity to a management plan.

A variety of techniques use a property rights approach. These are: exclusive use rights⁸⁹ (of which bioprospecting contracts are a form);⁹⁰ individually transferable property right mechanisms;⁹¹ cove-

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⁸⁹. Economic theory suggests that when people are granted an exclusive right to use and profit from a resource they have a greater incentive to conserve that resource and a lesser incentive to exploit it unsustainably. See generally Anderson & Leal, supra note 3. Examples include private parks and the right to exclude people from areas of high value for recreation. Once a right or value is created, the owner has an incentive to maintain that value so that they can maximize the profits that accrue from selling that right. The principle of exclusive use rights, however, is perceived by some people to conflict with the widespread belief that biodiversity is owned collectively by society at large and not available for people to use for profit. Nevertheless, such exclusive right mechanisms can create a sense of custodianship which may be sufficient to encourage the conservation of biodiversity.

In examining exclusive rights mechanisms, it is important to distinguish a right to use a resource as one wishes from a right to the exclusive benefit of a resource. Many farmers have exclusive rights (via state government trespass laws) to determine who may drive, camp and hunt on their property. In areas of high biodiversity, the ability to control access to natural resources can provide an incentive for investment in biodiversity conservation and to develop nature-based tourism. Zimbabwe's CAMPFIRE program (Communal Areas Management Programme for Indigenous Resources) is perhaps the best known and most effective case of this "exclusive rights" approach to species protection. See Edward B. Barbier, Community-Based Development in Africa, in ECONOMICS FOR THE WILDS 103, 107-18 (Timothy M. Swanson & Edward B. Barbier eds., 1992) (discussing the CAMPFIRE program as a good illustration of the exclusive rights approach but noting the need for modifications before it can be successfully adopted in other areas of Africa); Michael't Sas-Rolfes, Trade in Endangered Species: Is It an Option?, ECON. AFF., Apr. 1994, at 10. However, the exclusive rights approach is only likely to succeed under certain conditions. See Barbier, supra (discussing the Campfire program as a good illustration of the exclusive rights approach but noting the need for modifications before it can be successfully adopted in other areas of Africa). But even in cases where this approach is likely to "succeed," it may still have adverse side effects on populations as they are continuously selected for productivity. For example, fish farming leads to the selection of fish for high fecundancy and when these fish escape into the wild they can overwhelm native stocks.

The major limitation to using exclusive use rights is that only flora and fauna that have commercial value can be protected under this approach. Since there is only a market for a very limited number of species and habitats, the majority of biodiversity conservation cannot be addressed this way. See Robin Eckersley, Rationalising the Environment: How Much Am I Bid?, in BEYOND THE MARKET: ALTERNATIVES TO ECONOMIC RATIONALISM 237, 214-40 (Stuart Rees et al. eds., 1993); Bruce Aylward, Appropriating the Value of Wildlife and Wildlands, in ECONOMICS FOR THE WILDS, supra, at 34.

⁹⁰. Bioprospecting contracts are a form of exclusive right, which is used to maintain equity and encourage people to maintain a resource in the hope that people will develop an asset that can be marketed. They seek to make biodiversity protection the "highest and best use" for a resource. The most prominent biodiversity prospecting contract is a contract between Costa Rica's National Biodiversity Institute (INBio) and Merck and Co. Ltd., a large pharmaceutical firm. See Young et al., supra note 32, at app. 1; John R. Adair, The Bioprospecting Question: Should the United States Charge Biotechnology Companies for the Commercial Use of Public Wild Genetic Resources?, 24 ECOLOGY L.Q. 131, 141-47 (1997). More generally, the intellectual property regime could provide a mechanism for the equitable redistribution of exclusive use rights between resource custodians and resource users, such as bioprospectors. Arguably, the real issue is who has (and should
nants and easements; offset arrangements; and leasing and liens.

An intellectual property right grants its recipient, for example a bioprospector, with the exclusive right to utilize a biological resource in a commercially packaged form. To encourage biodiversity conservation by resource custodians, it is arguable that access to biodiversity should be made conditional upon the bioprospector recognizing the resource custodian's right to "proportionate ownership" of the intellectual property pertaining to the commercial products developed from biological resources. However, the intellectual property regime has traditionally been associated with the grant of exclusive use rights over inventions of a technical character and may be ill-adapted in its application to wild species. See generally Katherine Old, Utilisation and Conservation of Australian Plant Genetic Resources: The Role of Monopoly Privilege (1994) (unpublished honors thesis, Australian National University); see also Michael A. Gollin, An Intellectual Property Rights Framework for Biodiversity Prospecting, in BIODIVERSITY PROSPECTING: USING GENETIC RESOURCES FOR SUSTAINABLE DEVELOPMENT 159 (World Resources Institute ed., 1993).

91. These are rights to use specified resources, and can be transferred to another person without obtaining prior consent. The most common example is that of tradeable permits and licenses such as transferable fishing quotas. The strength of tradeable permits and licenses is that they offer a dependable means to constrain use within a biodiversity target while still giving industry the opportunity to decide how to accomplish this goal. However, transferrable property rights are limited to resources that are relatively homogeneous. Individually transferable property right mechanisms are well suited to managing threats to biodiversity where the goal is to find a mechanism to keep economic activity within limits set by periodically reviewed management plans. If well designed, their main advantage is that they force administrations to set targets for threats to biodiversity. To date, however, their use has been controversial because many of the systems implemented have not incorporated mechanisms that enable the rights to be modified as circumstances change. Further, insufficient attention has been given to the regulatory and institutional arrangements necessary to make them effective. See generally Mike D. Young & B. McCay, BUILDING EQUITY, STEWARDSHIP AND RESILIENCE INTO MARKET-BASED PROPERTY-RIGHT SYSTEMS (1995).

However, transferrable property right mechanisms are usually preferable to levies and charges because they use institutional mechanisms to work out the optimal trade-off between use and conservation and then market mechanisms to determine how to achieve that trade-off. An added advantage is that any structural adjustment necessary to reduce the threat is achieved through the sale of rights from one person to another. Those who give up their rights are compensated by those who continue to use them. Consequently, they tend to be more equitable than other pricing mechanisms. See id.

92. Covenants (and, in the American terminology, easements as well) are instruments that restrict landowners' ability to exercise particular rights over their property. For example, they can prohibit the clearance of natural vegetation or preserve an area that supports certain types of wildlife. Because they are negotiated on an individual basis, covenants present the opportunity for careful targeting. The experience of a number of countries suggests that covenants and easements offer considerable scope for the establishment of buffer zones, wildlife corridors, and protected area management, although the costs of monitoring and enforcing compliance must be weighed against these benefits. Young et al., supra note 32, at 118. See also Making Markets Work, supra note 70. Easements are particularly cost effective when the areas needing special protection are fragmented and the main requirement is to prevent certain actions such as clearing. Another advantage is that they secure benefits without paying the cost of outright purchase or incurring the maintenance costs of the land itself. Accordingly, they are cheaper for the government institution (or private organization) involved. The acquisition of conservation covenants need not be the sole domain of government and could be extended to nongovernment organizations. For discussion of the Nature Conservancy's experience with conservation
ing. All property right instruments attempt to constrain legal entitlements so that there is a coincidence between social expectations and private self interest. For example, tradeable fishing quotas, identify the maximum quantity of fish that may be taken, and then use market mechanisms to prevent more than that quota from being taken.

The case for property rights instruments is usually presented in terms of the efficiency gains attainable within formal ecological targets. However, the strength of tradeable permits and licenses is that they offer a dependable means to achieve a biodiversity target at minimum cost to individuals. As a mechanism, however, they are limited to resources that are relatively homogeneous. Hence, they are easements, see Farrier, supra note 8, at 350-52. Another and different role for conservation easements is in creating opportunities for people to enjoy biodiversity. This is particularly important in areas where any person entering an area is judged to be trespassing.

93. Under these arrangements, industry is given the choice between offsetting the damage they cause or paying an authority to do it on their behalf. Offsetting arrangements with regards to wetlands-known as wetlands mitigation—has been a prominent part of American environmental policy for over two decades, see White House Office on Environmental Policy, Protecting America's Wetlands: A Fair, Flexible and Effective Approach (1993), but many doubt their value as a means of wetlands protection. See Farrier, supra note 8, at 338-40. It has been argued that such means are simply ecologically ineffective because of insufficient knowledge about the science of creating or restoring wetlands. Id. Even if successful, mitigation efforts can result in fragmented segments of wetlands of far less richness and diversity than the areas which they are intended to replace. Others have criticized the administrative framework used to oversee mitigation projects, claiming that inadequate resourcing has meant that project plans are often not carried out at all, or, if they are implemented, are not monitored or maintained. E.g., Jonathan Silverstein, Taking Wetlands to the Bank: The Role of Wetland Mitigation Banking in a Comprehensive Approach to Wetlands Protection, 22 B.C. Env'tl Aff. L. Rev. 129 (1994). There have been some moves to address these regulatory problems with increased use of mitigation banking, which requires the restoration or creation to be performed in advance of the proposed loss, e.g., id., but this does not address the issue of whether such mitigation is ecologically viable.

94. In their simplest form, licenses, leases, and permits combine economic opportunity with a series of restrictions in the form of conditions tailored to a specific location. As such, they have some characteristics of regulation as well as of property rights. Their prime administrative advantage is that they provide a periodic opportunity to review conditions. They are probably the main mechanism used to control activity that has site specific implications for biodiversity. In theory, a high degree of dependability is offered. In practice, unless careful attention is given to institutional arrangements, administrators are easily captured by license and permit holders, with the consequence that official objectives are poorly achieved. They are, however, a mechanism used routinely by private enterprise and by nongovernmental organizations in countries where these organizations are actively involved in biodiversity conservation. See Ian Hodge, Incentive Policies and the Rural Environment, 7 J. Rural Stud. 373, 378-80, 382-83 (1991) (discussing permits, quotas, and Conservation Amenity and Recreation Trusts—such as the United Kingdom’s National Trust—which manage private lands). A problem with many existing systems is that all the pressure for change is placed on new license holders and not those whose current license conditions are fixed. Another problem is a failure to allocate rights and conditions on an ecosystem basis so that the total impact of all licenses is kept within sustainable limits.

95. See, e.g., Young, supra note 51, at 91-92.
well suited to the control of threats associated with water use, air pollution, fishing, and timber harvesting, but less so to issues involving irreversible losses like wetland drainage.

In contrast to property right instruments, which indirectly influence prices by changing the cost of certain activities and altogether preventing others, prices can be influenced directly via mechanisms such as charges, levies, use fees, and tax instruments. Conceptually, such price-based instruments could control most threats to biodiversity; but this is rarely done in practice. For pricing instruments to produce efficient solutions, it is necessary for transactions to be reversible in that any item consumed can be replaced. In the case of

96. These can be used to change the economic signals given to people whose actions threaten biodiversity values. To this end the OECD has made an important contribution by recommending ways to implement the Polluter-Pays Principle and, to a lesser extent, the User-Pays Principle. See Young, supra note 51, at 30-33. See generally Organisation For Economic Co-Operation and Development, The Polluter-Pays Principle: Definition, Analysis and Implementation (1974). Collectively these principles imply that, wherever possible, the costs of supplying access to biodiversity should be recovered from the direct beneficiaries of biodiversity conservation. Similarly, the costs of controlling and preventing direct threats to biodiversity should be recovered from the people who cause those threats. The money collected through the implementation of these mechanisms can be used both as a means to ration use so that it is kept within sustainable limits, and to finance research, management, and protection. They can also be used as a means to raise government revenue. Links between management and resource users are strengthened. Political pressure for the administering authority to reduce costs emerges. Cost recovery is now being applied routinely in many industries. Young et al., supra note 32, at 123. Use charges, user fees and levies present substantial opportunities for strengthening biodiversity policy. Id.

97. From a tax perspective, biodiversity conservation can be assisted through two mechanisms. The first is by making greater economic use of its attributes. When this occurs, expenditure on biodiversity maintenance is tax deductible because it is an expenditure made in the course of earning income. Use of the attributes of biodiversity also shifts the nature of threats faced. Taxation mechanisms can also be used as a mechanism to change the cost of undertaking various activities, and are already used as a means to close the gap between social and private values. They can also be used as a means to encourage people to contribute to national objectives. The argument for these taxation incentives is that, because they establish an entitlement, people are encouraged to pursue such opportunities without having to prepare submission to and obtain permission from the bureaucracy. They also encourage altruistic behavior, and where there is a national commitment to achieving an objective, like biodiversity conservation, the objective is likely to be achieved at much less cost to government than would be the case if government departments managed all biodiversity conservation of this nature themselves. In short, taxation mechanisms of this kind can provide efficient, dynamic, and continuing incentives for improvement in areas that involve non-market considerations of national importance. They are one of the main mechanisms used to motivate and fund nongovernment organizations in a manner that enables them to search for and identify opportunities where these organizations can operate in a more cost-effective manner than government. Young et al., supra note 32, at 125. However, taxation mechanisms can also work against biodiversity conservation by encouraging people to develop resources rather than conserve. See id. (discussing Australia’s use of land-clearance tax incentives). Another argument against these mechanisms is that, when not channelled through a well developed nongovernment organization or screening mechanism, they are prone to taxation abuses.

98. Id. at 122.
biodiversity, however, many habitats can never be recreated. Moreover, efficient markets need to be able to revise prices continuously through time and across space. In the case of biodiversity, a system must enable government institutions to constantly monitor and, when appropriate, change the prices they set.

Nevertheless, in selected circumstances, pricing mechanisms do have a significant role in revealing the cost of preventing and controlling adverse impacts on biodiversity. In particular, there is a strong case for removing perverse incentives\(^9\) that significantly raise the cost of biodiversity conservation. At the global level, Panayotou has estimated that ninety cents in every dollar invested in biodiversity conservation is spent undoing the unintended effects of government subsidies, such as protecting people from competition, etc.\(^10\) There is also a strong case for charging people for the cost of gaining access to or adversely affecting biodiversity. For example, economic theory suggests that when tourists visit a national park and pay an entrance fee to cover the costs of maintaining board walks, tourism pressures will be reduced. Generally, price-based instruments can be made more effective by hypothecating revenue;\(^11\) introducing performance

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\(^9\) A perverse incentive is any incentive that induces behavior that results in loss of biodiversity or creates a threat to biodiversity conservation. JEFFREY A. MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY: DEVELOPING AND USING ECONOMIC INCENTIVES TO CONSERVE BIOLOGICAL RESOURCES 44-53 (1988). The OECD lists administered resource prices, output pricing, irrigation subsidies, below cost timber pricing, subsidized crop insurance, and agricultural support programs as examples of government intervention that causes perverse incentives. SAVING BIOLOGICAL DIVERSITY, supra note 24, at 6, 105-10. However, care is necessary when perverse incentives are removed, because removal of incentives such as price support, which encourages clearing of unique habitats, can create opposition to the entire notion of conserving biodiversity. From the perspective of a producer, the removal of perverse incentives as a means to improve biodiversity often has negative connotations. Transitional payments have a role to play in maintaining equity, gaining acceptance of the need to remove the perverse incentive, and maintaining a positive community attitude to the conservation of biodiversity.

\(^10\) T. Panayotou, Reducing Biodiversity Expenditure Needs: Reforming Perverse Incentives, Paper presented to an OECD Conference on Incentive Measures for Biodiversity Conservation and Sustainable Use (Mar. 1996) (on file with authors). The OECD lists administered resource prices, output pricing, irrigation subsidies, below cost timber pricing, subsidized crop insurance, and agricultural support programs as examples of government intervention that causes perverse incentives. SAVING BIOLOGICAL DIVERSITY, supra note 24, at 6, 105-10. However, care is necessary when perverse incentives are removed, because removal of incentives such as price support, which encourages clearing of unique habitats, can create opposition to the entire notion of conserving biodiversity. From the perspective of a producer, the removal of perverse incentives as a means to improve biodiversity often has negative connotations. Transitional payments have a role to play in maintaining equity, gaining acceptance of the need to remove the perverse incentive, and maintaining a positive community attitude to the conservation of biodiversity.

\(^11\) One mechanism often used to increase acceptance of charges and levies is to give those whose incomes are affected by the charge or levy a say in determining how the resultant money is spent. Alternatively, a government can promise to commit the money collected to a cause. Known as hypothecation, this mechanism is used to underscore the point that communities should contribute directly to the financing of programs that improve the environment. An argument against hypothecation is that as social and economic needs change, hypothecation arrangements ultimately result in the inefficient allocation of revenue as priorities cannot be redirected. Moreover, communities become dependent upon these allocations in a manner that makes revision administratively difficult. Hypothecation arrangements also make organizations less accountable to the community as the budget formulation and approval processes are not transparent to the wider community. Nevertheless, mechanisms that retain local control of money raised to offset the costs of biodiversity conservation provide a powerful means to increase local acceptance of a program, to empower local communities and to reduce enforcement costs. DEPARTMENT OF FINANCE,
bonds;\textsuperscript{102} making grants and payments conditional;\textsuperscript{103} and requiring cross-compliance\textsuperscript{104} with other performance criteria.

In theory, the virtues of property rights and price-based instruments lie in their ability to influence behavior through price signals without requiring direct intervention in the affairs of individuals. These instruments encourage individuals to seek out the most cost-effective (and often innovative) solution to a problem. Decisionmaking is delegated to fully informed individuals who are assumed to make more efficient decisions than government.\textsuperscript{105} Well instituted, these instruments reduce government enforcement costs as well as the resource user's compliance costs and give resource users an ongoing incentive to develop better environmental approaches.

It is less clear whether these mechanisms necessarily demonstrate these virtues in practice, due to a lack of empirical evidence. Since

\textit{Submission to HORSCERA: Inquiry into Management Arrangements for Inscribed World Heritage Areas (1994); Young et al., supra note 32, at 124.}

\textsuperscript{102} One alternative, which can be used when the arrangement is likely to be transitional, is a performance bond. These entail the user lodging a specified amount of money with the regulating authority, which would be returned to the user at the end of a specified period, but forfeited to the regulatory authority in the event of breach by the user. They are socially acceptable, administratively simple, and incorporate both the "polluter pays" and the precautionary principles. But they are only appropriate for addressing temporary threats, as in the example above. \textit{Young et al., supra note 32, at 123; see generally D. James, Using Economic Instruments for Meeting Environmental Objectives: Australia's Experience (1993).}

\textsuperscript{103} As with all government activities, it is necessary to use instruments that conserve biodiversity as efficiently as possible. Consequently, it is common for governments to make grants and payments on the condition that certain practices are followed, and in the event of breach, that the money be reimbursed. The reasons for doing this are obvious, but in recent years there has been a growing interest in the extension of this principle to one that leverages payments made for other purposes via cross-compliance mechanisms. \textit{See infra note 105.} However, the opportunities in Australia are far less than in the United States, because there is less financial support for agriculture in Australia. From a social viewpoint, the result is a more efficient outcome as it reduces the impact of the perverse policy effects mentioned earlier. Resource users, however, tend to dislike such arrangements as they make it harder for them to qualify for assistance.

\textsuperscript{104} Related to redressing the effect of perverse incentives and market imperfections, cross-compliance involves subjecting support for one objective to prior compliance with another. Cross-compliance can occur at both the administrative level and the level of the resource user. \textit{Young et al., supra note 32, at 127.} At the administrative level, program money may be available only to states that agree to implement a conservation strategy. \textit{Id.} The approach builds consistency between national and state or local government objectives for biodiversity conservation. Stepwise entry mechanisms that give graded entitlement depending upon the degree of participation are possible. \textit{Id.} It is a way of establishing congruency among biodiversity, production and social welfare objectives when perverse incentives cannot be removed. \textit{Id.} Adequate designation, monitoring and enforcement of provisions is an essential part of any effective cross-compliance provision, and the costs of doing this need careful consideration. \textit{Id.} Producers argue that cross-compliance increases application costs. These application costs can be reduced by linking them to an accreditation program. \textit{Id.}

\textsuperscript{105} \textit{See id. at 145-46.}
relatively few financial instruments have been implemented in the biodiversity policy area, and most of these only recently, we have very little knowledge of how they actually work.\textsuperscript{106} Significantly, even a very recent and comprehensive OECD report\textsuperscript{107} on this issue has been unable to reach any general conclusions about the effectiveness, efficiency, equity implications, acceptability, or administrative implications of price-based instruments.

The extent to which property right and pricing mechanisms (market-based instruments) can make a positive contribution to biodiversity conservation is likely to depend substantially upon the particular contexts in which they are applied,\textsuperscript{108} the threats to which they are addressed,\textsuperscript{109} and the particular attributes of individual instruments.\textsuperscript{110}

Nevertheless, there are some generalizations about the role of price-based and property right approaches and about their relationship with regulatory strategies that can be useful. In terms of cost effectiveness or economic efficiency, appropriately designed market-based instruments are likely to be substantially superior to regulatory controls. This is because:

Regulatory instruments require the central authority to determine the best course of action, whereas economic instruments decentralize much of the decision making to the single firm or household, which typically has better information for determining the appropriate individual response to given economic conditions. . . . In addition, market instruments provide cost incentives to adopt 'cleaner' technologies, and 'alternative' resource inputs and processes, or to develop such improvements with time.\textsuperscript{111}

Price-based and property right instruments have a particular advantage over command-and-control mechanisms that tend to be "targeted" on specific outcomes. As the OECD has pointed out:

\begin{itemize}
  \item \textsuperscript{106} Id. at 128.
  \item \textsuperscript{107} See Making Markets Work, \textit{supra} note 20, at 123-27.
  \item \textsuperscript{108} Compare, for example, commercialization of wildlife, performance bonds, and tradeable permits.
  \item \textsuperscript{109} For example, instruments which are appropriate to address pollution may work very differently when applied to other threats to biodiversity.
  \item \textsuperscript{110} For example, management agreements coupled with reimbursement can fulfill a particular function (for which regulation or other instruments are no substitute). Similarly, some property rights mechanisms have the distinctive characteristic of providing the land user with an incentive to protect the environment, and in doing so encourage positive custodianships of biodiversity and support for biodiversity objectives. Experience with the effectiveness of property rights based mechanisms, however, is mixed. For example, the leasing mechanisms used to protect biodiversity on leased pastoral lands are far from perfect. In particular, the effectiveness of property right mechanisms is dependent upon the capacity of the institutional mechanisms used to develop, review and enforce them. \textit{See Young et al., supra} note 32, at 122.
  \item \textsuperscript{111} B\textsc{arbier}, \textit{supra} note 43, at 182.
\end{itemize}
Biodiversity is arguably different as an environmental and economic resource because the causes of species and ecosystem losses are extremely diffuse in nature and involve many difficult sectors. That is, it is pervasive to the economic system, being affected by land and water use decisions, by pollution and by economic activity generally.\textsuperscript{112}

As such, biodiversity conservation policies must themselves be pervasive; they must be capable of filtering through the entire economic system. All other things being equal, price-based approaches are less intrusive, more cooperative, and financially attractive. However, contrary to some claims, they are not self-enforcing and may involve considerable control costs.\textsuperscript{113} Indeed, one commentator recently concluded that "there is no reason to expect that the administrative costs of economic instruments are generally lower than those of regulatory instruments."\textsuperscript{114} It must also be acknowledged that price-based and property right instruments are not generally well understood, and perhaps for this reason, do not rate highly in terms of community acceptance.\textsuperscript{115}

Price-based approaches may also be less appropriate than regulation in addressing two key characteristics of biodiversity. These characteristics are that biodiversity loss is often irreversible, and that ecosystems have limits and, if stressed beyond those limits, will collapse.\textsuperscript{116} We explore the implications of this issue more fully below.

\textbf{D. Regulatory Instruments}

In contrast to price-based instruments, regulation directly controls or restricts environmentally damaging activities by mandating the reduction or restriction of harmful activities. As such it is much more prescriptive than motivational, voluntary, and price-based instruments. The main regulatory instruments are well known and include zoning, land use restrictions, standards and bans, as well as some licenses and quotas.

Although regulation often lacks the flexibility and efficiencies associated with direct market-based approaches, it is perceived as being more certain (when adequate monitoring and enforcement exists).\textsuperscript{117}

\begin{itemize}
\item \textsuperscript{112} Making Markets Work, \textit{supra} note 20, at 6.
\item \textsuperscript{113} Bowers, \textit{supra} note 75, at 9.
\item \textsuperscript{115} See Young et al., \textit{supra} note 32 at 54-55.
\item \textsuperscript{116} See generally Charles Perrings & David Pearce, \textit{Threshold Effects and Incentives for the Conservation of Biodiversity}, 4 \textit{ENVTL. & RESOURCE ECON.} 13-28 (1994).
\item \textsuperscript{117} See generally Latin, \textit{supra} note 4 (discussing the advantages of a uniform regulatory system).
\end{itemize}
At a general level, regulation also provides an efficient means of discouraging the recalcitrant, the incompetent, or the intransigent, who may prove unresponsive to motivational, educational, voluntary, property right, and price-based instruments. Regulation in these circumstances may also be necessary to preserve the viability of other mechanisms. If all but one ecotourism operator are complying with a voluntary code of practice, then regulation to stop the recalcitrant offender might offer the most efficient way of protecting biodiversity at least administrative cost.

Regulation is often referred to as a "command-and-control" approach because of the presence of a prohibition or restriction coupled with a direct "control" mechanism such as a fine, license revocation, or other penalty for contravention. This approach is commonly criticized by economists for being inefficient, unnecessarily intrusive, and unduly expensive to administer. Some regulations limit innovation and discourage people from searching for new, more efficient ways to achieve the intent of a regulation. Moreover, regulatory instruments may be inequitable, and are difficult to revise as new information becomes available. They may therefore build a sense of false security.

Notwithstanding these shortcomings, regulations have a particular role to play when biodiversity loss has proceeded so far that any further net loss is deemed unacceptable. In principle, regulation's strength is the greater certainty it provides, particularly where it takes

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118. Of course, the recalcitrant, incompetent, or intransigent could also ignore regulation. However, for a variety of reasons, they are far less likely to do so. The techniques that regulators can invoke to achieve compliance are far more compelling than those available for other categories of instruments. For example, rather than relying on the rational balancing of costs and benefits (upon which most economic instruments rely) regulators can unleash a range of penalties that are likely to confront even the most sluggish or recalcitrant. Those who may not respond rationally to a tax may nevertheless respond to the threat of incarceration or a range of other sanctions under the criminal law. See J.F. Dimente, *Environmental Law and American Business: Dilemmas of Compliance* 42-47 (1986). As to the literature which examines the suggestion that regulatory law deters violations in ways superior to other approaches, see Robert A. Kagan & John T. Scholz, *The "Criminology of the Corporation" and Regulatory Enforcement Strategies*, in *Enforcing Regulation* 67 (K. Hawkins & John M. Thomas eds., 1984).

119. The danger in applying voluntary and regulatory resources in tandem is that the latter overwhelms or effectively negates the value of the former. However, in carefully designed systems this may be avoided either by an enforcement strategy that only escalates to invoking the regulatory sanctions where voluntary resources fail, or whereby those who are demonstrably responsible are entrusted to regulate themselves under voluntary codes, leaving regulators free to focus on the irresponsible.

120. See Ackerman & Stewart, *supra* note 1, at 1333 (arguing that regulation "wastes tens of billions of dollars every year, misdirects resources, stifles innovation, and spawns massive and often counterproductive litigation"). See generally Teitenberg, *supra* note 3.

121. See Ackerman & Stewart, *supra* note 1, at 1336.

122. See id. at 1336-37.

the form of direct bans on destructive activity coupled with Sanctions.\textsuperscript{124} In practice, the most common form of regulation has been to ban an activity while providing for exceptions (for example, for those who obtain a license). But past experience shows that the exemptions are so routinely granted that the ban's conservation objectives often are undermined.\textsuperscript{125}

Even without the licensing exception, there will remain a temptation to cheat, particularly where breaches are not obvious.\textsuperscript{126} The strength of this temptation and the likelihood of people to succumb to it depends, in part, on the perceived legitimacy of the regulation (reinforcing the need for education and motivation) and, in part, on the likelihood of detection and the severity of any sanctions.\textsuperscript{127}

In spite of these constraints, regulation coupled with the moral force of law will, in some circumstances, provide greater assurance of

\begin{itemize}
\item \textsuperscript{124} Perrings & Pearce, \emph{supra} note 117, at 20-23.
\item \textsuperscript{125} For example, the experience under New South Wales endangered species legislation, at least until the issue of State Environmental Planning Policy 46 in August 1995, was that licenses were very commonly granted, thereby defeating the biodiversity aims of the legislation to a significant extent. \textit{Young et al.}, \emph{supra} note 32, at 131.
\item \textsuperscript{126} For example, a ban on clearing is likely to be more effective than a ban on killing endangered species because the administrative costs of monitoring clearing are likely to be lower than those of watching the fate of a species. The American experience is that when an endangered species is present, the maxim "shoot, shovel, and shut up" still prevails despite regulation. \textit{Id.} at 134.
\item \textsuperscript{127} Five general guidelines apply to the use of penalties in a regulatory setting. First, if the regulatory objectives and the means with which to achieve them do not appear reasonable, then restrictions, requirements, or prohibitions are likely to engender resistance on the part of potential regulatees. Second, if the application of negative sanctions in individual cases does not appear fair, then sanctioning can inspire defiance and future noncompliance. \textit{See generally Lawrence Sherman, Defiance, Deterrence, and Irrelevance: A Theory of the Criminal Sanction}, 30 J. Res. Crime & Delinq. 445 (1993); \textit{Tom R. Tyler, Why People Obey the Law} (1990). Third, compliance will be higher if negative sanctions are imposed in a graduated fashion, only after financially attractive incentives and persuasion have been tried and have failed. \textit{Ian Ayres & John Braithwaite, Responsive Regulation: Transcending the Deregulation Debate} 19-53 (1992). Ayres and Braithwaite argue that negative sanctions should be carefully calibrated according to the wrongdoer's previous track record of compliance, the nature of the immediate offence, and the apparent willingness of the offender to prevent a recurrence. Fourth, compliance will be higher if recalcitrant offenders are penalized severely and publicly so that the effectiveness and the attractiveness of less interventionist and more financially attractive instruments is maximized. Fifth, in some circumstances where community values favor protection of biodiversity, then other alternatives may be available. In particular, it may be possible to shame wrongdoers into compliance, perhaps by publicizing their wrongdoing or forcing them to appear in court. \textit{Andrew Hopkins, Making Safety Work: Getting Management Commitment to Occupational Health and Safety} 24 (1995). Shaming should be carefully delivered and followed by restorative reintegration; indiscriminate stigmatization can be counter productive. \textit{See Braithwaite, supra} note 58, at 54-55. One example of this approach can be found in South Australia where those caught breaching recreational fishing regulations have their names published in a magazine that is distributed free throughout the state. \textit{Young et al.}, \emph{supra} note 32, at 135.
\end{itemize}
compliance (certainty) than price-based instruments. Regulations also help establish the boundaries of permissible activity. For example, it may be desirable to legislatively outlaw discharges of extremely hazardous substances, rather than set emission charges at a level that makes discharge uneconomic. Generally, regulatory approaches provide an efficient means to stop actions that need to be completely prevented or excluded across large areas—obvious examples include bans on shooting endangered species and dumping toxic waste.

As with other instruments, the effectiveness of regulation is likely to be context specific. For example, regulation reinforced by sanctions cannot serve to achieve biodiversity maintenance on privately managed semi-natural systems. As Bowers demonstrates, "where maintaining biodiversity requires people to perform actions that are not economic, sanctions will not in general work since primary operators (farmers or foresters who work the land) are likely to respond by abandoning management altogether."

In contrast, when attempting to preserve a natural system by preventing use, a regulatory sanction is more effective than any other single instrument because it prevents certain types of land use change. Because land use change usually "cannot be brought about by doing nothing, the land-holder ... cannot frustrate the intentions of the controlling authority by passive resistance," and defiance can be both identified and punished by law. Notably, however, some positive management will be necessary to protect biodiversity from feral animals and other threats, and management agreements can often achieve such protection in a way that regulation alone cannot.

E. The Role of Precautionary Regulation

There is one other role for regulation: to guide the administrative process and warn when greater precaution is necessary. In the face of the uncertainty and complexity that characterizes biodiversity, regulations and the standards associated with them can be used to indicate the need for existing institutions to use different administrative processes. For example, regulation, rather than proscribing behavior, can prescribe that once a certain threshold has been exceeded, the onus is on the landholder to justify further clearing of land. Conseq-

128. See Barbier, supra note 43, at 181-82.
129. See generally Perrings & Pearce, supra note 117.
130. However, it must be acknowledged that for political reasons, it is only rarely that legislation is enacted in this form. Exceptions are commonly permitted under license, thereby undermining the "certainty" rationale. See supra note 125 and accompanying text.
132. Young et al., supra note 32, at 135.
134. Infra Part II.F.
quently, in the case of biodiversity conservation, rather than seeing regulations as offering a “safe minimum standard,” it can be more useful to envisage a continuum: beginning with a precautionary regulation (such as a requirement to obtain a permit), which is used to indicate the presence of an irreversible threshold, precautionary standards which indicate the need to change administrative procedure, and ending with minimum standards and targets.

Precautionary standards offer an effective means to trigger the adoption of different instruments and administrative procedures. As such, they should not imply a need to choose between regulation and other instrument categories, but rather an opportunity for complementary combinations of instruments. For example, a precautionary regulation, such as a requirement to apply for a clearing permit, might result in approval of clearing in one area conditional upon a conservation covenant being placed on another area and further supported by a management agreement that would reimburse the landholder for the cost of completing special fencing requirements. This last example reveals another problem for biodiversity conservation—the tyranny of small decisions. As the total quantity of biodiversity declines, the value of that which remains increases and becomes more vulnerable in both an ecological and an economic sense.

F. Mixing Voluntary, Property Right, Price-Based, and Regulatory Approaches

In this Part, we explore the overall role of property right, price-based, and regulatory instruments in the broader policy mix, and the optimal relationship between these instruments. Before entering the details of this debate, it is important to recognize that the distinction between regulation on the one hand, and economic instruments on the other hand, is not always a clear one. For example, the recently introduced Western Australian and New South Wales clearing controls provide examples of this approach. In each case a precautionary regulation requires people to obtain a clearing permit before they clear significant areas of vegetation. Young et al., supra note 32, at 132-34. In Western Australia two precautionary standards are then set. Id. In each local government area where less than twenty percent of native vegetation remains, the onus is on the proponent to demonstrate why clearing should be allowed to proceed. Glanznig, Native Vegetation, supra note 37, at 20-24, 34-35. Each farm is subject to a similar precautionary standard. Id. These mechanisms seek to build a “safety net” designed to prevent and exclude actions that destroy biodiversity values.

Precautionary standards can also indicate areas where expenditure on recovery and rehabilitation might be justified. Periodic review of these precautionary regulations and standards is necessary to ensure that they are set at appropriate levels since most decisions to permit further biodiversity loss decrease the margin of safety left in the system. Regulatory mechanisms that are not reviewed periodically are unlikely to be dependable.

135. Faced by uncertainty and the need for dependability, regulations can contribute to biodiversity by signalling where precaution is necessary. The recently introduced Western Australian and New South Wales clearing controls provide examples of this approach. In each case a precautionary regulation requires people to obtain a clearing permit before they clear significant areas of vegetation. Young et al., supra note 32, at 132-34. In Western Australia two precautionary standards are then set. Id. In each local government area where less than twenty percent of native vegetation remains, the onus is on the proponent to demonstrate why clearing should be allowed to proceed. Glanznig, Native Vegetation, supra note 37, at 20-24, 34-35. Each farm is subject to a similar precautionary standard. Id. These mechanisms seek to build a “safety net” designed to prevent and exclude actions that destroy biodiversity values.

136. Individually defensible small decisions may, in the aggregate, result in indefensible levels of biodiversity loss.
other, is commonly overstated. In practice, there is no strict dichotomy between these two categories of instruments because economic instruments commonly rely on a substantial underpinning of government regulation for effective implementation.\textsuperscript{137} Individually transferable quotas, for example, incorporate the flexibility and cost-effectiveness of market approaches but are supported by a degree of government regulation that reduces the risk of systematic breach.\textsuperscript{138} Nevertheless, some general conclusions can be drawn about the optimal relationship between these instrument groups.

We begin with property rights. As indicated above,\textsuperscript{139} property right mechanisms encourage people to conserve biodiversity and limit its use to that which is sustainable. They do this by either constraining or expanding the opportunities available to resource users. Where markets for these rights can be created, change can often be achieved with less cost to society and with greater equity than is achievable under other mechanisms. Particular strengths of property right instruments are their lack of intrusiveness and their ability to be tailored to site-specific problems in an administratively efficient manner.\textsuperscript{140} These virtues of property right instruments suggest that they should play a central role in most policy mixes.

There are also strong arguments favoring the use of price-based instruments. Mechanisms such as user charges and levies can change the economic signals given to those whose actions threaten biodiversity values. Furthermore, they embody the user-pays and polluter-pays principles.\textsuperscript{141} But should property right and price-based instruments be combined solely with voluntary and/or motivational instruments, or do they also require underpinning by regulation?

This last question is central, because price-based instruments have considerable virtues yet lack dependability. For example, a key characteristic of some price-based approaches is that a price is set and the market then decides how much biodiversity conservation to deliver.\textsuperscript{142} This encourages people to find efficient ways to profit from this trade-off and seek ways to do more or less damage depending upon the instrument's operation. However, setting prices at the optimal level to influence behavior is a "hit and miss" approach, with the result that if the price is set too low (which may only be apparent with hindsight) it will not have the anticipated effect on behavior.\textsuperscript{143}

\textsuperscript{137} Young et al., supra note 32, at 146.
\textsuperscript{138} Id.
\textsuperscript{139} See supra Part II.C.
\textsuperscript{140} See Panayotou, supra note 56, at 15-20.
\textsuperscript{141} Young, supra note 51, at 162-63.
\textsuperscript{142} Levies, use fees, taxes, and grants are all examples.
\textsuperscript{143} See Young, supra note 32, at 144-46.
Another problem with relying on prices rather than regulatory compulsion is that prices are not well suited to dealing with the wide range of responses people make to the same price signal. It may be that only those "at the margin" respond in the preferred direction. But for a variety of reasons, ranging from incompetence or ignorance to intransigence, there is likely to be a minority who, in the absence of more directive or even coercive policies, will continue to behave in a manner which threatens biodiversity conservation. While probably relatively small, this minority cannot be ignored. If left unchecked, it will have a substantial impact on biodiversity, not just directly through its own behavior, but also through its impact in demotivating other target group members—particularly with respect to voluntary mechanisms. For example, there is evidence that land users and others who contribute to voluntary programs such as the Australian Landcare program may become dispirited if others are free to continue to degrade adjoining land. In many circumstances, the creation of a level playing field may be an essential prerequisite to the success of the sort of positive, less interventionist approach that we envisage for the large majority of circumstances.

In contrast, regulatory approaches mitigate both the uncertainty and irrationality problems. They decide how much conservation is required and then let the market reveal the action's economic consequences. The regulatory approach is often preferred over pricing policies because changes in physical processes and quantities, not prices, affect ecosystems most directly. Arguably, there is more dependability when ecological constraints are set and then price, demand and technological forces are allowed to work themselves out.

Voluntary management agreements, property right mechanisms, and regulations all do this. Voluntary management agreements can have the disadvantage, however, of creating an atmosphere where people are only prepared to conserve biodiversity when paid and implying that people are entitled to destroy biodiversity irrespective of social expectations. Moreover, because such agreements may create the impression that people have a right to destroy biodiversity, voluntary approaches can be expensive. By combining instruments together, however, these weaknesses can be overcome. Clearing native vegetation, for example, may be banned, transitional compensation offered to those adversely affected, and management agreements used

144. Id. at 145.
145. The existence of such a minority has been acknowledged by a wide diversity of stakeholders in Australia. See id. at 39-56, 146.
146. Id. at 146.
147. Id.
148. See supra Part II.B.
to reimburse the costs of any new management procedures that may be required. At the same time, any perverse incentives that encourage biodiversity loss, like some land rating systems, might be removed.\textsuperscript{149}

In summary, where persuasion and education fail, where enterprises are unwilling to improve their environmental performances voluntarily, and where economic instruments or voluntarism lack dependability, then regulation may be the only technique capable of exerting pressure and compelling resource users and others to protect biodiversity. Thus, even those who do not behave with economic rationality or respond to economic instruments can still be persuaded to halt destructive practices. A further advantage of regulation is the moral and educational influence that economic-based incentives lack. In some circumstances, proscription by law may be sufficient to create moral inhibitions against certain behavior.\textsuperscript{150}

Our conclusion is that there is a tension between achieving dependability (which implies a need for regulation) on the one hand, and cost-effectiveness, flexibility, and non-intrusiveness (through property right and price-based instruments and voluntarism) on the other. This raises the question: how should this tension be resolved?

The extent to which property right or price-based instruments (often in conjunction with voluntary and/or motivational instruments) need to be underpinned by regulation will depend on whether there is a danger of irreversible biodiversity loss, and whether that loss gives rise to the possibility of a major environmental catastrophe or system collapse.\textsuperscript{151} In the latter circumstance, any policy which compromises the resilience of ecosystems may have uncontrollable effects, and even small policy changes can have dramatic but unforeseen results. Therefore, dependability becomes the most important objective when irreversibility or threshold breach is at stake, but not otherwise.

In these circumstances, we conclude that financial instruments are rarely adequate on their own and often need to be reinforced by precautionary instruments and, ultimately, by a regulatory safety net to address recalcitrant resource users (who should be few in number

\textsuperscript{149} In Australia, local government is funded partially from revenue raised from a tax on the unimproved value of land. See Young et al., supra note 32, at 126. In assessing the amount of tax to be paid, land is assessed at its value if it was being used for its highest and best use in the market place. Id. Thus, those who have not cleared their land are forced to pay tax as if they had cleared it. This gives them a clear and unintended signal that this land should be cleared irrespective of its biodiversity value.

\textsuperscript{150} Johannes Andenaes, Punishment and Deterrence 110 (1974).

\textsuperscript{151} Barbiер, supra note 43, at 184.
in well designed systems).\textsuperscript{152} We explore the implications of this conclusion in the following part on design criteria.\textsuperscript{153}

To summarize the discussion, we have moved through a series of arguments that began by pointing out the need for instrument mixes. We pointed out how the strengths of each instrument can be harnessed to build a framework that is as dependable as possible in terms of preventing irreversible losses yet trades off criteria like efficiency, equity, precaution, dynamism, administrative costs, and community acceptability. We have argued first for dependability, which implies the need for precautionary regulations and precautionary standards underpinned by a firm regulatory safety net that prohibits irreversible actions. However, we have also emphasized the importance of mechanisms that build community support.

Finally, we have emphasized the importance of using property rights and price-based and regulatory instruments in a complementary manner. In particular, the mere fact that a government makes clear its willingness to resort to regulation if other mechanisms fail, means that the latter are likely to work more effectively since resource users' decisions concerning the utilization of voluntary and property right instruments will be colored by their aversion to regulation. Thus, the threat of regulation is likely to render positive instruments more attractive to industry, and thus more effective.

III.
DESIGN CRITERIA

Having outlined the main instrument categories and the interactions between them in general terms, it remains to address more specific design issues. In this part we will argue that, drawing from the above analysis, eleven guidelines are paramount in designing policy mixes that promote active conservation of biodiversity and its ecologically sustainable use.

A. Designing for Precaution

To account for irreversibility and lack of knowledge, mixes building in dependability and involving more rather than fewer instruments will be necessary.

Perrings and Pearce have argued that the irreversibility of threshold effects (and often fundamental ignorance about the implications

\textsuperscript{152} Another, more radical response to irreversible loss would be to take the habitats into the public sector and hold them either as natural reserve in which no economic activities are permitted or for the principal government itself to undertake those activities which are necessary to maintain the resource. J. Bowers, The Choice of Instruments for Conserving Biodiversity 12 (1994) (unpublished manuscript, on file with authors).

\textsuperscript{153} \textit{See infra} Part III.
of crossing a threshold) introduces uncertainty that renders the development of economic instruments to achieve biodiversity conservation objectives problematic.\textsuperscript{154} If price-based instruments do not work as predicted, it may be too late to save the ecosystem concerned. Perrings and Pearce argue that regulation is probably the most dependable strategy.\textsuperscript{155} Note, however, that most tradeable right systems use regulations to place limits on acceptable behavior.\textsuperscript{156}

Unfortunately, Perrings and Pearce may have an overly optimistic view of the virtues of regulation. While regulation does have considerable advantages over incentive-based mechanisms, regulations are not dependable enough to rely upon alone. Regulatory failure is not uncommon.\textsuperscript{157} In circumstances of biodiversity protection, where valued attributes are widely dispersed, enforcement resources are thin, and regulation is often left unsupported by the local community, the possibility of regulatory failure is substantial.

Our view differs from Perrings and Pearce. We do not suggest that regulation alone—or indeed any other policy instrument—has sufficient dependability to act as an effective safety net. On the contrary, we view regulation as a fallible last line of defense. Accordingly, one of the functions of other instruments and mechanisms is to dissuade resource users from actions that could result in irreversible changes in an ecosystem, the demise of a species, or the loss of genetic traits.\textsuperscript{158} Regulation, in this context, is like an elastic safety net with holes in it: the greater the weight imposed on the safety net, the larger the holes become. One role of other instruments is to keep the weight off the safety net.

Accordingly, given the severity of the consequences of policy failure and the limited dependability of regulation, we argue for a mixed approach that uses the full suite of instruments available. The logic is similar to that of aircraft design. Because the consequences of the failure of a single system without backup would be catastrophic, air-

\textsuperscript{154} This is in part because threshold effects invalidate the normal test for efficiency in the allocation of resources. See generally Perrings & Pearce, supra note 117.

\textsuperscript{155} \textit{Id.}

\textsuperscript{156} See supra note 95.

\textsuperscript{157} For a general discussion of regulatory failure, see Neil Gunningham, \textit{Negotiated Non-Compliance: A Case Study of Regulatory Failure}, 9 L. & Pol'y 69 (1987). Much of the existing legislation is supported by grossly inadequate budgets, leaving enforcement agencies with an almost complete incapacity to discharge some of their statutory functions. When this problem is compounded by a lack of political will and a desire on the part of politicians not to offend rural constituencies, then the impact of the legislation may be very modest indeed. On the other hand, in South Australia, where the law is clear, simple, and well known, it has had a very substantial impact and may well have succeeded, over time, in making the prohibition of broad acre clearing acceptable to local communities. \textit{Young Et Al.}, supra note 32, at 142.

\textsuperscript{158} See supra note 136 and accompanying text.
craft design deliberately incorporates multiple systems to compensate for the possible failure of any one in particular. Generally, those mixes that involve more rather than fewer instruments are likely to be more effective in preventing irreversible loss. Put differently, emphasis on dependability and precaution means that the most effective instrument mix will include mechanisms and instruments that appear to be redundant because, from time to time, some are expected to fail. Under this approach, nonregulatory instruments increase dependability by reducing the need for regulatory mechanisms to be used as the first line of defense.

B. Preference for Underlying Causes

As much as possible, policy changes should reduce underlying causes of threats to biodiversity such as institutional failure, market failure, or incompletely specified property right structures, as well as threatening processes. An important question for biodiversity policy is: at what level or levels should conservation instruments be directed? In broad terms, biodiversity policy might be directed at threats, underlying causes, and, to a lesser extent, fundamental causes. Illustrations of these levels are provided in Table Two.

<table>
<thead>
<tr>
<th>Fundamental Causes</th>
<th>Underlying Causes</th>
<th>Threatening Processes</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>population</td>
<td>market failure</td>
<td>ecosystem &amp; habitat</td>
<td>species extinction</td>
</tr>
<tr>
<td>population growth</td>
<td>property right failure</td>
<td>ecosystem &amp; habitat</td>
<td>lost ecological function</td>
</tr>
<tr>
<td>inequality</td>
<td>institutional deficiency</td>
<td>decline</td>
<td>lost ecological community</td>
</tr>
<tr>
<td>economic growth</td>
<td>political deficiency</td>
<td>direct species loss</td>
<td>loss of value</td>
</tr>
<tr>
<td>poverty</td>
<td>information failure</td>
<td>gene loss</td>
<td>loss of options</td>
</tr>
<tr>
<td>knowledge deficiency</td>
<td>climate change</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The case for treating underlying causes and, if possible, fundamental causes has been discussed at length by the OECD.\(^{159}\) As fundamental causes, like human population growth, are deeply entrenched in complex policy agendas, in the short term faster progress and fewer irreversible consequences are attainable through a focus on the underlying causes of threatening processes.\(^{160}\) In the long

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159. See, e.g., Saving Biological Diversity, supra note 24, at 37-51. 
160. See id.
run, however, greater certainty is attained if fundamental causes are removed.\textsuperscript{161}

Removing the underlying causes of a threat reduces the incentive for people to harm biodiversity by reducing the pressures that encourage people in that behavior. Often this is achieved via changes that affect market prices. When resource users are made to pay for the true costs of biodiversity degradation to society, they have an incentive to avoid causing that degradation.\textsuperscript{162} Removal of perverse incentives can have a similar impact.\textsuperscript{163} If, for example, a tax concession is causing unacceptable vegetation clearance then, all other things being equal, it is more economically efficient to remove the tax concession than to attempt to prohibit clearing.

As a general rule, instruments and policy approaches that reduce or remove the underlying cause of a threatening process will be more effective than those that act directly on the threat.\textsuperscript{164} In many situations, however, because adjustment takes time, simple treatment of the underlying cause of the threatening process may be insufficient to prevent further loss of biodiversity. Thus, in practice, the most dependable strategy will require paying attention to the threatening process as well as the cause—at least until the threatening process is no longer observable. In the case for treating fundamental and underlying causes illustrated above in Table Two, the dependable strategy will include both removal of the tax concession and the introduction of clearing controls and other mechanisms designed to retain a positive attitude towards biodiversity conservation.

Another reason for focusing on underlying causes is that when they are removed, the need for ongoing enforcement programs is diminished. Dynamic and continuing incentives for improvement are left in place and ongoing administrative costs are lower than would otherwise be the case.

\textbf{C. Institutional Mixes}

It is our position that institutional arrangements combining bottom-up administrative processes with top-down ones tend to be most dependable. Central government has a vital role to play in the implementation of both national and international obligations concerning biodiversity protection and holds most of the significant purse strings. From a biodiversity conservation perspective, the role for central governments includes: setting the agenda of broad policy objectives to be achieved; providing resources and distributing funds; building a safety

\begin{itemize}
  \item \textsuperscript{161} See \textit{id.} at 6-8.
  \item \textsuperscript{162} See \textit{supra} Part II.C.
  \item \textsuperscript{163} See \textit{supra} notes 100-02 and accompanying text.
  \item \textsuperscript{164} \textit{Saving Biological Diversity}, \textit{supra} note 24, at 6.
\end{itemize}
net that can take over when local processes fail to conserve biodiversity; co-coordinating policy, in particular inter-regional, state, and national plans and strategies on biodiversity; ensuring biodiversity input into other government programs (like salinity, timber, mining, and telecommunications); funding biodiversity research where information is unlikely to be provided through the market; regulating; monitoring and providing accountability (keeping in mind the vital role community groups can have in this area); and establishing necessary institutional arrangements that will ensure meaningful community participation.

However, to meet its biodiversity obligations, central government need not be intimately involved in all aspects of the programs created. Indeed, there are compelling reasons why the role of central government, at least in respect to some instruments, should be that of steering the boat rather than rowing it. One failure with the top-down approach to biodiversity conservation is that if the “top levels” are accountable for biodiversity conservation, any failure to achieve this on their part could mean an entire system failure without institutional backup. Consequently, mixes that combine bottom-up administrative processes with top-down ones tend to be more dependable than pure top-down ones.

Furthermore, direct and substantial community and industry involvement is essential because, ultimately, all conservation occurs at the local level. Moreover, the success of biodiversity protection programs largely depends on the attitudes of local people, the capacity to harness local knowledge, and local ownership of locally devised solutions. This approach also reduces the costs of dealing with the lack of homogeneity and the complexity of many biodiversity problems. How, then, can central and local roles in protecting biodiversity best be accommodated?

One means of achieving an appropriate combination of top-down and bottom-up mechanisms is by invoking the principle of subsidiarity: the transfer of strategic authority and responsibility to the lowest level at which it can be exercised effectively. Subsidiarity often implies consultation and the direct participation of the community and industry in decisionmaking and implementation at local or regional levels. This approach recognizes that central government roles will be most effective if they use instruments and mechanisms that encourage local governments, industry, and community to accept broad responsibilities. One way of creating responsibility is to set targets that

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165. See Young et al., supra note 32, at 91-103.
166. This is a term used commonly in the European Community in discussions about the most appropriate level of government at which to make decisions.
167. See id. at 91-92.
must be achieved by those responsible for protecting biodiversity. Another way is to specify the nature of decisions that must be taken in consultation with central government.

In applying these principles, it is important to recognize that there may be circumstances where community decisionmaking should be local rather than regional. There may be grounds, for example, for locating both biodiversity and implementation of decisionmaking more narrowly at the local level if there is a "community of common concern," but even then regional oversight will usually be necessary. Similarly, it may sometimes be appropriate to divide a catchment into an upper area and a lower area, or into even smaller divisions, if this is necessary to generate effective local involvement.

In other cases, an industry-focused structure may be more appropriate.

Adding to this consideration is the fact that bioregions (which may arguably be the most appropriate level to locate much biodiversity policy) rarely coincide with other administrative boundaries used by local government for the management of natural resources such as forests, fish, and rangelands. The size and nature of a "region" will also vary with the types of threat and land use and with the socioeconomic context.

168. The problems of corruption (for example, in respect to land use decisions) are believed to be greatest at the local level.

169. The Lockyer Watershed Management Association in the Australian State of Queensland, for example, suffered from low response from lowland irrigators until the watershed was divided into ten subgroups "each focusing on the common interests and problems of different groups within the Valley." Margaret Chapman, Integrated Catchment Management and Agricultural Communities, Austl. J. Soil & Water Conservation, May 1994, at 4.

170. A bioregion for these purposes may be defined as an area: (1) large enough to maintain the integrity of its biological communities, habitats and ecosystems; (2) having cultural identity and a sense of home to its local residents; (3) containing a mosaic of land uses; and (4) having components that are dynamic and interactive. See Global Biodiversity Strategy, supra note 28, at 97-100. Indeed, on one view, bioregions form the most appropriate unit for decisionmaking, because they enable an appreciation of the inherent ecosystem diversity to be conserved within each broad geographic unit that is responding to a particular set of environmental determinants; the use of a scale that is practical in terms of nature conservation and land use planning; and recognition of the major threats to biodiversity on a regional basis and possible interrelationships with other land management issues. Jane Elix & Judy Lambert, Bioregional Planning for Biodiversity Conservation, 24, 75-82.

In many cases the region may be best defined in terms of its catchment, because a catchment provides a logical and natural planning unit, with readily identifiable boundaries and characteristic patterns of water movement. F. Irwin & I.R. Williams, Catchments as Planning Units, 42 J. of Soil Conservation New South Wales 6, 7 (1986).

171. Note that "different regionalisations are likely to be appropriate for different priority issues." Commonwealth Env't Protection Agency, Development of a National State of the Environment Reporting System 14 (1992).
Given the dangers of failure at every level of decisionmaking, and the potentially serious consequences of such failure for biodiversity conservation, we conclude that the entire mix is likely to be more dependable if each level in the administrative hierarchy has full access to the suite of instruments available for biodiversity conservation, and no level of government has the power to override a decision to protect biodiversity.\textsuperscript{173} At times, most levels in the administrative hierarchy need not act. However, whenever one level fails, another is empowered to step in and fill the void left by failure at another level.

One must also consider the costs of aggregating information and opportunity for initiative. In a significant number of cases, it can be more cost effective to use nongovernment organizations to manage and implement programs.\textsuperscript{174} Because of altruistic activity induced by such arrangements, experience suggests that money diverted through such channels can deliver between three and ten times as much activity as that managed solely by government.\textsuperscript{175}

**D. The Tinbergen Principle**

The Tinbergen Principle suggests that at least one policy instrument should be used to alleviate each threat and to pursue each objective.\textsuperscript{176} In biodiversity situations, where there are multiple objectives and problems, at least one policy instrument should be used to alleviate each biodiversity threat. Compliance with this principle ensures that as knowledge, prices, technology, and social values change over time, the resultant package can be adjusted efficiently and equitably.\textsuperscript{177} If separate instruments are used for each link between a threat and an objective, then it may be easier to readjust the policy mix as circumstances change. In particular, any part of the mix can be adjusted (by modifying or replacing the instrument utilized to address a particular threat or objective) without compromising other objectives or the instruments intended to achieve them.

There are reasons for requiring at least one instrument per threat or objective. First, each organization interested in biodiversity may wish to modify the emphasis given by other organizations. This is only possible if the mix of policies enables them to either add weight to an existing policy or add an additional policy. Second, if the advantages of community and industry-initiated conservation are to be pursued

\textsuperscript{173} Effectively, this gives each level of government a power of veto over development that is not ecologically sustainable in the sense that it destroys biodiversity values.
\textsuperscript{174} See supra note 74 and accompanying text.
\textsuperscript{175} YOUNG ET AL., supra note 32, at 112.
\textsuperscript{176} See generally J. TINBERGEN, ON THE THEORY OF ECONOMIC POLICY 37-42 (1955) (arguing there should be at least one economic instrument to address each policy goal).
\textsuperscript{177} See id. at 41-42.
seriously, the number of instruments must be sufficient to accommodate each level of biodiversity and the web of institutions acting to conserve it. Industry, as well as local and state governments, require separate access to the means to protect an ecosystem of importance to them. As there are many threats and several objectives, the combination will involve more rather than fewer instruments. This principle clearly applies to the multi-level, complex world of biodiversity protection; any successful biodiversity strategy will require a complex web of instruments and mechanisms.

E. The First-Mover Problem

Lack of public knowledge about the distribution of biodiversity values gives rise to opportunistic behavior on the part of individuals. This necessitates control measures which, in concert, make the incentive for (most) individuals to act in the public interest greater than the incentive to pursue private gain.

Against the backdrop of considerable uncertainty about the consequences of biodiversity loss, and ignorance about its extent, one particular problem which must be addressed in choosing instrument options is that of deterring opportunistic behavior that could inflict irreversible damage. As Bowers has pointed out, from time to time unforeseen contingencies may arise which offer opportunities for profit at the expense of biodiversity. These situations give rise to the first mover problem: if others seize private opportunities and seek to profit from them by masking public values from the control authority, then they may damage biodiversity before the authority responsible for protecting biodiversity can act.

The first mover problem may occur on a small or large scale. If, for example, a farmer discovers that remnant vegetation on her property contains an endangered species or, more seriously, one thought to be extinct, then she has a strong financial incentive to hide this fact from the community unless there is a guarantee of compensation. Similarly, there is a strong temptation for a person who applies for a clearing permit not to disclose the presence of an endangered species within the area, or for a forester to shoot an endangered animal and remove all evidence of this in the area he wishes to log.

178. There is, however, a danger here. If all have access to controls over biodiversity, then unless preeminence is given to the organization that sets the highest standard, each can act to offset the efforts of the other. The result might be attainment only to the lowest level acceptable to all—the lowest common denominator problem.
180. Id.
181. See id. at 13.
There are three ways to deal with the first mover problem. The first calls for government investment in detection, monitoring, and information gathering to reduce the risk of first mover losses occurring. Given the limited capacity of most bureaucracies to anticipate and respond quickly to change, this strategy is not a dependable one. Moreover, the collection of information and subsequent action takes time to implement. By the time the information is collated, an irreversible biodiversity conservation threshold may have been passed.

The second means involves the introduction of control instruments which, in concert, make the incentive for (most) individuals to act in the public interest greater than the incentive to mask it in pursuit of private gain. Management agreements that encourage people to renegotiate the contract when circumstances change are the most common method used to reduce the first-mover problem. Another common method is to offer compensation for the value of the income opportunity lost as a result of the discovery of a public interest greater than the expected private one. This latter option, however, runs the risk of encouraging people to hold out for bigger and bigger rewards.

Finally, while planning would not overcome the first mover problem, it might at least serve to mitigate it. Specifically, a staged approach, beginning with environmental studies to identify the nature of the threats to species and habitats in need of protection and followed by a regional plan (incorporating both prohibitions on clearance in some areas and permission to clear in others), might preempt some problems by identifying biodiversity considerations (endangered species, for example) in advance, and providing a strategy to protect them.

F. Moral Hazard

A related issue that illustrates the unreliability of regulations is the issue of moral hazard. Moral hazard arises from the fact that, for biodiverse resources, the chance of being detected while breaching a regulation or agreement can be very low; the principal has no means of knowing whether or not the agent has done what was required or has cheated. One means of dealing with the moral hazard problem

182. Id. at 19.
183. Id.
184. Id.
185. Id.
186. Id.
187. Id. at 20.
188. Moral hazard can arise whenever the outcomes of an agent's actions are in part dependent on exogenous factors—states of nature—which the principal cannot wholly observe. A practical example from Australia might be where protection of indigenous species
is to build institutional capacity and responsibility for preserving biodiversity at the industry and local level. If, through comanagement and astute property right arrangements, biodiversity conservation is seen as a community and industry responsibility, then arguably the risk of discovery will be greater and the incentive to cheat less. Industry and community responsibility can be further developed by using motivational instruments such as prizes, awards, and accreditation.\textsuperscript{189}

Another means of dealing with the moral hazard problem is to link a reward to the performance of the actual objective. Thus a management agreement might, for example, pay people for the number of birds breeding in an area and not the cost of getting them to breed there. Under such an arrangement, the work required to attract and retain birds would not be specified, and hence the moral hazard problem would not arise. Payment would be made if and only if the birds were there.

\textit{G. Instrument Ordering}

In some circumstances, instruments should be introduced in a particular order likely to vary with the context and the nature of the addressed threat. Even assuming that complementary instruments are available and that an instrument mix is preferred to single instrument approaches, there may be reasons for ordering the introduction of the various instruments. For example, it would seem sensible to first remove existing perverse economic incentives since these would otherwise distort or reduce the effectiveness of new policy instruments. Again, where more than one instrument or combination of instruments might achieve the intended policy outcome, and dependability is not of the essence, it would also be appropriate to introduce less intrusive and interventionist instruments before more intrusive ones so that motivational forces remain strong.

Generally, less interventionist incentive mixes, underpinned by regulations to prevent and exclude irreversible actions, are likely to deliver more efficient outcomes than more interventionist mixes. The reason is that less interventionist incentives permit trade-offs and encourage innovation. They also address underlying causes of threats to biodiversity which if removed or countered by a compensating mechanism make further administrative action rarely necessary.

of animals depends on control of alien species, but population levels of both indigenous species and aliens are in part determined also by uncontrollable climate and other factors, which may not be fully understood. If the agent, probably the landholder, is required on penalty of a legal sanction to control aliens, the moral hazard is manifest. \textit{See generally Bowers, supra} note 75.

Beyond this, appropriate ordering is likely to emerge as each threat to biodiversity is individually addressed. For example, if the policy concern is with ecosystem sustainability and there is a serious possibility of ecological thresholds being crossed irreversibly, then the imposition of precautionary standards will be essential, so that decisions are taken before an irreversible loss occurs. However, in the longer term, it will be important to complement these standards with more positive instruments, including those which encourage ongoing management, provide additional information, promote adjustment away from practices that threaten biodiversity, and change the prices so that biodiversity values are embodied in goods and services.

H. Which Parties Should Implement Policy Mixes?

Implicit in the use of a broader range of instruments is the use of a larger range of actors to implement them. It is important to take advantage of both the democratic benefits which direct stakeholder participation can bring, and the leverage in implementation which broader third-party engagement can provide.

Expanding the field of participation means not only the involvement of governments (first parties) and landholders or other users (second parties), but also a range of other interested actors (third parties). It is important to note that scrutiny on the part of citizens and public interest organizations can exceed vigilance by government agencies. There is advantage in both the democratic benefits that direct stakeholder participation can bring and the leverage in implementation that broader third-party engagement can provide.

The effort to broaden involvement should occur at all levels. The credibility and balance of biodiversity audits would be considerably strengthened if the audit team included not only scientific experts and local resource users, but also a representative of a community group or other appropriate nongovernmental organizations. Similarly, if clearing restrictions are challenged by landholders who wish to argue a case for clearing beyond the legislative threshold, then third parties such as environmental groups should have a right of standing, thereby acting as a countervailing force. For example, in the United States, the right to bring citizen suits can enable local conservation groups to sue private developers where their activities threaten endangered species. This approach has the particular virtue of compensating for a lack of resources and, sometimes, a lack of political will on the part of

190. Biodiversity audits would involve a small audit team containing scientific expertise and including respected members of the local community. Their role would be to assess the biodiversity significance of land in the area. Young et al., supra note 32, at 109.

government enforcement agencies; furthermore, it substantially leverages the increased enforcement capability. The "whistle-blower" or "dob-in" factor is also important, capable of being harnessed in the public interest, although it may be of limited value where illegal activity corresponds with local community mores.

Finally, it is important to emphasize that some economic instruments can be redesigned to honor third party participation. For example, tradeable permits have the potential, when appropriately designed, to encourage adaptive approaches to resource use that give industry and community the opportunity to become involved in setting and achieving regional targets. Figure Two presents one such arrangement, developed for New South Wales Fisheries. It gives each fisher a stake in the periodic revision of management plans. In building any biodiversity strategy, tradeable permits and licenses offer a means to strengthen bottom-up community and industry processes in a manner that increases the dependability of the entire policy mix. A tradeable fishery-share system grants fishers a legal share of a management plan that is revised every five years and allocates gear entitlements and quotas in proportion to the number of shares held. Shareholders have the option of accepting the plan as soon as it is released or, alternatively, losing fifteen percent of their shares in return for a decision to accept it at a later date.\textsuperscript{192}

\textsuperscript{192} \textit{Young et al., supra} note 32, at 117.
Different mixes will be appropriate in different socio-economic circumstances. Socioeconomic and biological conditions also influence the choice of mechanisms. Obviously, marginal agricultural land will provide a different economic context and require a different instrument mix than an area on the verge of intensive tourist development. All else being equal, transferable tax credits and subsidies will be more appealing to those (such as the subsistence farmer) who are “up to their ears in red ink” and receive little or no taxable income. By contrast, voluntary mechanisms and management agreements will be more attractive to the economically secure primary producer for whom autonomy and incentives may be more important than direct financial support. Accreditation and labeling schemes will be more applicable to those interests (such as the ecotourism industry) which may be influenced by purchasing power.
J. Financially Attractive Instrument Mixes

Where ongoing and active contributions to the conservation of biodiversity are desired, financially attractive instrument mixes\(^{193}\) should be preferred to ones that reduce the welfare of those asked to conserve biodiversity.

The overall success of a policy regime will be substantially higher and the prospects for biodiversity conservation will be greater if direct regulatory approaches are overlain with a web of mechanisms that create a financially attractive and voluntary atmosphere encouraging cooperation and sharing of information. For reasons described below,\(^{194}\) only the latter approach is likely to induce resource users and communities to actively contribute to the maintenance of biodiversity values.

There are a variety of ways in which financially attractive instrument mixes can be created. For example, in many countries it has become common to use financial instruments to close the gap between the private and public demands for biodiversity conservation.\(^{195}\) Often the incentive offered is less than the full cost of an action. In Western Australia, landholders are offered fifty percent of the cost of fencing out remnant native vegetation and, if they sign a thirty-year memorandum of understanding to maintain that remnant, a significant local government rate rebate applies.\(^{196}\)

One important use of financial instruments is to act as a ‘circuit breaker’ during a transition to a new regime. In South Australia, the introduction of widespread clearing controls was made politically palatable by coupling it with a provision of compensation; in turn, this compensation provision was removed after a transitional period in which the land clearing controls gained a widespread acceptance.\(^{197}\) Financial inducements may achieve even more when initial participation is voluntary because community acceptance of the circuit-breaking change to a new regime is strengthened. The result, even when financial support is removed or phased out, is a more genuine and more durable attitude toward change. Once agreement has been reached over the new regime, however, the mix can involve significant penalties.

Financially attractive mixes are particularly important where there is a need to encourage ongoing management of a resource. Another key to ensuring ongoing management of resources is some

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193. We define a financially attractive mix as one that, at the point of introduction, has the potential to increase the wealth or income of those who participate.
194. See supra Part II.F.
195. See Young et al., supra note 32, at 140-41.
196. Id. at 62.
197. See id. at 130.
mechanism (for example, a covenant or easement) to ensure that protection does not cease with the termination of the management agreement. Policy instruments which merely halt existing biodiversity loss are important, particularly in gaining breathing space during which more constructive policies can be developed, but they do not ensure that resources will be appropriately managed so as to preserve biodiversity. For example, although the South Australian experience suggests that compensation backed by legislation can have considerable success,¹⁹⁸ even this mix is seriously inadequate in one aspect. The South Australian model is essentially one of prohibition on clearance coupled with compensation, with only a modest provision for the management of land subject to clearance controls.¹⁹⁹ For this reason, it is far more likely to be successful in preventing clearance than in ensuring effective ongoing care of native vegetation and woodland habitat on private land.

One commentator has argued that those who are forcibly constrained from clearing land are unlikely to be enthusiastic land managers, and for this reason, regulation must be combined with adequate financial instruments but that "these should take the form of forward looking payments for management rather than backward looking compensation."²⁰⁰ He suggests reordering current land protection initiatives to meet this objective.²⁰¹ In his view, [t]he priorities of these initiatives need to be adjusted to ensure that greater emphasis is placed on the retention of existing native vegetation rather than replanting, and that restructuring in local communities is not based exclusively on short term productivity concerns, but also takes into account the much longer term economic interest that the community has in conserving biodiversity.²⁰²

To summarize the lessons of this part: make instrument mixes financially attractive and largely self-enforcing; maximize acceptance; and create a dynamic incentive to search for more cost-effective solutions. Often, these mixes also provide a continuing incentive to im-

¹⁹⁸ See, in particular, the South Australian approach under the Native Vegetation Management Act 1985 (subsequently replaced by the Native Vegetation Act 1991) described in John Bradsen, The "Green Issues": Biodiversity Conservation in Australia, in ENVIRONMENTAL OUTLOOK: LAW AND POLICY 187, 205-07 (Ben Boer et al. eds., 1994).
¹⁹⁹ A permit is required to clear native vegetation, which is likely to be refused in most cases. D. Farrier, Policy Instruments for Conserving Biodiversity on Private Land, in CONSERVING BIODIVERSITY: THREATS AND SOLUTIONS 337, 348-49 (R.A. Bradstock et al. eds., 1995). Payment of compensation, which was automatic under the 1985 Act, is no longer so under 1991 legislation. Id. at 349. Nevertheless, the system still offers financial incentives for foregoing development rights, and financial assistance for managing reserved stands of native vegetation, and planning revegetation. Id. at 350.
²⁰⁰ Id. at 337.
²⁰¹ Id. at 344-46.
²⁰² Id. at 337.
prove beyond the target. Such incentives are essential where there is a need to ensure ongoing management of a resource.

**K. Making Biodiversity Conservation Cost Effective**

Biodiversity conservation must be achieved at the least cost to government. In cases where a permanent financial incentive is offered, particular questions of efficiency and administrative feasibility need to be addressed. The case for continuing use of financial instruments is dependent upon the gap between public concern and private interest and opportunities to close that gap via the use of other instruments. As indicated above, the greater that gap, the greater the need for financial instruments to encourage ongoing management. Recognizing that the administrative costs of any scheme involving annual payments are high, in many cases it may be more cost effective to change property rights, either with or without a compensation payment, than to pursue annual payments.

The goal of cost effectiveness is particularly challenging in the area of property rights. Property rights are often incompletely specified, but governments, on behalf of the community, usually retain the right to respecify the rights and obligations associated with a property entitlement. Where property rights are unclear, the introduction of financial payments can turn a property right still held by society into one held by a title holder. Several Australian states, for example, have introduced regulations that require people to obtain a permit to clear native vegetation. Prior to the introduction of these regulations, most landholders thought they had a right to clear land. In the United States, people are paid to keep land in Conservation Reserves, which implies that these landholders have a legal right to destroy biodiversity values in the absence of such a provision.

Recognition of these issues leads us to the conclusion that it is critical to distinguish between reimbursement of nonmarketable costs associated with protecting biodiversity values for society, compensation for lost property rights, and pricing policies that either internalize or subsidize the costs of controlling and preventing threats to biodiversity associated with economic activity.


204. See supra Part III.2.A.


206. *Id.* at app. 1.

207. *Id.*

208. *Id.* at 33-34.
L. Reimbursement of Nonmarketable Costs

The first question we address is the case for reimbursing biodiversity conservation costs that cannot be recovered from the marketplace. Examples include fencing out an area of value to an endangered species so that it cannot be grazed and keeping the area free of vermin. As no market exists for the protection of habitats occupied by most endangered species, it is efficient for the beneficiaries of species protection (taxpayers on behalf of society) to reimburse those who incur the cost of protecting them. Efficiency criteria would indicate that reimbursement should be only for those costs incremental and recoverable through market processes.\(^{209}\)

This concept might be described as one of reimbursing the incremental costs of providing benefits to society. The notion is simply one of paying people to do work which, if they did not do it, would be undertaken by government. Payments should be limited to expenditures that cannot be recovered from the marketplace.\(^{210}\) Costs can be reimbursed either by periodic payments, a single payment associated with a conservation covenant, or other similar arrangements that are binding on future land holders. In practice, such arrangements are also supported by a provision of periodic advice and a program creating pride in the contribution made to society’s biodiversity conservation objectives.

M. Limiting Compensation for a Transitionary Period

On equity grounds and to encourage efficient investment, most developed nations provide a right to compensation for the removal of a right that is being exercised.\(^{211}\) At the same time, however, most nations also reserve the right, from time to time, to redefine the bundle of unfettered economic opportunities embodied in a property right, and these nations have encouraged people to speculate on the profits and losses associated with them.\(^{212}\) Thus, establishing a precedent for the payment of compensation for declines in land values

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209. Young has suggested that this should be called a Beneficiary-Compensates Principle. Young, supra note 51, at 30-32. We stress the idea that following an appropriate transition period, payment should be limited to reimbursement of costs incurred in the course of maintaining biodiversity values. See id. at 32.

210. Where the objective is to prevent activity (not cover ongoing costs), it may be more effective to change the use rights that attach to the land. Otherwise the landholder has an incentive to maximize profits by holding the biodiverse attributes for ransom. Without such a mechanism, a landholder who may be protecting the last site for an endangered species could threaten to make it extinct unless society buys that species’ future from him or her.

211. There is a specific clause in the Commonwealth Constitution prohibiting the removal of property without just compensation, but this right is not guaranteed by any State Constitution. See AustL. Const. ch. 1, pt. 5, § 51(www) (1980).

212. Young et al., supra note 32, at 148.
should be seen as a fundamental reform with immense budgetary implications. If speculation is allowed, then the case for compensation collapses to one of the need to achieve and retain political and community acceptability when incompletely specified property rights are defined. As a guideline, where compensation is necessary, it should only be offered for a transitionary period as an equitable means of bringing about a faster and irreversible transition.

As with voluntary financial instruments for biodiversity conservation on land that remains in private ownership, the role of limited-term compensation is largely one of a circuit breaker to bring about the transition to an institutional and property right regime that promotes biodiversity while maintaining motivation, equity, and community acceptance. Administrative costs may be less if the initial policy change is accompanied by a plan to diminish the proportion of compensation payable by, say, twenty percent per annum. When this is done the transition is speedier and, as the threat is reduced more quickly, the mix may be more dependable and, also, more cost effective.

Another way to reduce the cost of biodiversity conservation is, wherever possible, to charge for access to biodiverse areas and biodiverse resources. In the case of a national park, for example, there is an argument for making visitors pay for the costs of providing and maintaining the resources. Pricing policies of this kind are consistent with the User Pays Principle and can significantly reduce the public cost of maintaining biodiversity values. Similarly, there is a case for making water users meet the full cost of providing water to them in a manner that does not compromise biodiversity values. If this means that fish ladders, for example, have to be built so that fish can migrate through a dammed river then, according to the User Pays Principle, the costs of providing these ladders should be recovered from water users.

CONCLUSION

The challenge for regulatory strategy in the late 1990s is to move beyond the market-government dichotomy to devise better ways of achieving environmental protection at an acceptable economic and social cost. Such an approach would still involve government intervention, but selectively and in combination with a range of market and nonmarket solutions.

In the case of biodiversity protection, we have argued that a variety of mechanisms exist that have only been used in a limited fashion but hold the potential to make a substantial contribution. In broad
terms, these can be categorized as motivational, voluntary, property-based, price-based, and regulatory instruments.

In most circumstances, the multiple objectives of biodiversity conservation will be achieved most effectively through a mix of these instruments, targeted to the suite of threats extant at any location. An optimal strategy will harness the strengths of individual mechanisms while compensating for their weaknesses by using additional and complementary policy instruments. We have sought to indicate the circumstances in which each category of instruments might most appropriately be used and to suggest optimal instrument combinations suited to particular contexts. We have also identified a set of design criteria which we believe should be paramount in constructing policy mixes.

For biodiversity to be conserved adequately, it will be necessary for the mix to accommodate a vast array of ecological, political, social, and economic concerns. So complex and various are the causes of biodiversity loss and the circumstance in which they arise that no single instrument, and indeed no single mix of instruments, could be successful in addressing all or even most of them. As a result, generalizations are extremely hazardous. The next stage of research needs to address these issues at a lower level of generality: to identify particular social problems in their specific social, economic, and institutional contexts.

In short, the complexities of social, economic, and ecological processes preclude simple broad-brush solutions. The only answer to the question: "what is the optimal combination of instruments and mechanisms?" is: "it all depends—the optimal combination will change with time and context." As one recent study put it, "[a] priori general rules are inferior to case-by-case analysis." Rather than seeking to identify optimal mixes in the abstract, a context and threat-specific approach is preferable.

213. See Turner & Opschoor, supra note 115, at 33-37 (drawing conclusions which imply the complex nature of economic instruments for environmental policy).
214. For example, tradeable rights can operate effectively where natural resources are not site-specific and where "acceptable overall-impacts can be determined," but they are not appropriate where resources are site-specific, as is commonly the case with habitats or ecosystems.
216. The OECD suggests that the key variables include: (1) the structure of existing conservation laws, regulatory techniques, and property rights to land and resource use; (2) the distribution of the benefits and costs of biodiversity across key target groups; (3) government administrative structure and capacity; (4) public awareness of biodiversity values; (5) characteristics of the biodiversity values to be conserved (local or national public good; relative importance of use and passive use values); and (6) characteristics of uncertainty, potential for threshold effects, and the need for safe minimum standards and "threshold" instruments. See Saving Biological Diversity, supra note 24, at 67-74.
Even so, a number of guidelines do emerge out of our broader conceptual analysis which will be of value and can be applied in more specific contexts.

- in virtually all situations, a mix of instruments will be more effective than any single instrument;
- preference should be given to mixes that motivate communities and industry to conserve biodiversity;
- less interventionist instruments are better than more interventionist instruments;
- where ongoing and active contributions to the conservation of biodiversity are desired, financially attractive instrument mixes are better than ones that reduce the net welfare of those asked to conserve biodiversity;
- as far as possible, policy changes should reduce underlying causes of threats to biodiversity such as institutional failure, market failure or incompletely specified property right structures, as well as the direct threatening processes;
- where there are multiple biodiversity objectives and problems, separate policy instruments should be used to alleviate each threat and pursue each objective;
- efforts should be made to design control instruments which reduce the first mover problem, so that when an individual perceives an opportunity to profit by destroying valued biodiversity unknown to others, she acts instead to save this attribute;
- precautionary standards and regulations have an important role in making all other instruments more effective;
- regulations should be used as a safety net to underpin most incentive packages and prevent irreversible loss;
- motivational instruments and mechanisms are fundamental to a successful instruments-based biodiversity conservation package, and should be incorporated in almost all policy mixes;
- for dependability, and because all mechanisms can fail in the presence of uncertainty, well designed strategies will include instruments that are rarely used and would in other circumstances be regarded as redundant; and
- policy instruments that halt existing biodiversity loss are important, particularly in gaining breathing space during which more constructive policies can be developed, but they do not in themselves ensure that resources will be appropriately managed so as to preserve biodiversity.