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The Role and Contribution of Private Land in Victoria to Biodiversity Conservation and the Protected Area System

By James Fitzsimons and Geoff Wescott*

The distribution and attributes of properties involved in three major programs for biodiversity protection on private land in Victoria, Australia, was investigated to determine their role in relation to the reserve system. Overlaying of datasets in a geographic information system, with particular emphasis on property distribution in relation to bioregions and population centres, was undertaken. Land for Wildlife agreements had greater numbers of properties and total area protected in all bioregions throughout the State, yet average protected area sizes were lower than those of conservation covenants and Trust for Nature reserves. A combination of large bioregional area and human population size tended to attract more private conservation properties and, to a lesser extent, the total area they protected. The potential contribution that such properties made to biodiversity conservation varied between bioregions. Inclusion of properties within a national reserve framework is proposed to improve the coordination and effectiveness of conservation measures.



Introduction

Wescott (1995) summarised the state of the Victorian terrestrial component of the national reserve (protected area) system as being “substantially complete” in terms of the extent of the public land protected. Fitzsimons (1999a) demonstrated that whilst this may have been true in general, it would be more accurate to note that it was “generally comprehensive” and not necessarily adequate and representative (*sensu* JANIS 1996). This is because several important components (e.g. grasslands and grassy woodlands) are only represented by relatively small protected areas.

Neither Wescott (1995) nor Fitzsimons (1999a) described or discussed in detail the contribution of private land to the reserve system in Victoria. This article examines the role and contribution of private land to biodiversity conservation and the protected area system in Victoria.

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Strict protected areas have long been regarded as the most secure form of protection for biodiversity, and often the most effective (e.g. Pressey *et al.* 1994; Pressey and Logan 1997). However, it is also increasingly recognised that strict reservation alone will not conserve all, or even most, biodiversity within a region. The coordinated management of all landclasses and tenures at a landscape scale and implementation of effective ‘off-reserve’ conservation measures are needed to ensure the effective conservation of species, communities and ecosystems.

Victoria is considered to have one of the most representative and comprehensive conservation reserve systems in Australia (Wescott 1995). It is also the founder of private land conservation programs such as Landcare and Land for Wildlife, which have been used as a model for other Australian States and Territories. In Victoria, there are three main forms of what have been termed ‘private conservation properties’:

- 1) Reserves owned and managed by the Trust for Nature (Victoria);
- 2) Private properties with a Trust for Nature Conservation Covenant attached to the title; and
- 3) Private properties with a Land for Wildlife program accreditation.

Brief descriptions of the distribution of Land for Wildlife properties were documented by Platt and Ahern (1995a,b), as were overall vegetation types protected in Trust for Nature covenants by Todd (1997). However, no study comparing the existing relationships of such properties with one another or with the public reserve system has been undertaken. With many States and Territories recently establishing or upgrading voluntary private land conservation programs based on Victorian arrangements, the findings of this study may also be of assistance in the development of these programs.

This article is also timely in light of the Commonwealth government’s Natural Heritage Trust Fund supplying funds for both reserve purchase and for private land conservation programs, and commitments in the National Strategy for the Conservation of Australia’s Biodiversity to establish a private land reserve system by 2005 (Commonwealth of Australia 1996).

Background

Australia's existing reserve system

As environmental planning and management was not mentioned in the Australian Constitution, the management of Crown land has remained with the States and Territories since the 1890's (Wescott 1991; Worboys *et al.* 2001). This has resulted in the development of nine separate protected area systems, one in each of the six States and two self-governing Territories, and a Commonwealth system.

Reserve selection in Australia has historically tended to be opportunistic and *ad hoc*, favouring areas, environments and habitat types with the least potential for extractive uses (Pressey 1994; Margules 1995). Even when reserves have been chosen for the features they necessarily contain, those features have usually been for scenic, recreational and wilderness values and not for biodiversity (Whitehouse 1990; Pressey & Tully 1994; Margules 1995).

To achieve a more Comprehensive, Adequate and Representative (CAR) system of terrestrial protected areas, two complementary processes, the National Reserve System Program (NRSP) and Regional Forest Agreements (RFA), have been developed. Recognising the need for a bioregional framework to identify gaps and set priorities for the NRS, the Interim Biogeographic Regionalisation of Australia (IBRA) was developed and endorsed by State, Territory and Commonwealth environment agencies involved (Thackway and Cresswell 1995; Thackway 1996).

While focusing mainly on the public reserve system, the NRSP also recognises that in some cases voluntary agreements with private, leasehold property and indigenous property owners, will be needed to make up a CAR reserve system and has provisions for their inclusion (Commonwealth of Australia 1999). Private landholders, councils or organisations can currently apply for assistance for the establishment of protected areas on the properties they currently own, although acceptance is in part based on whether the property is considered to fill a gap in Australia's existing reserve system (Lee and Szabo 1999).

One of the key planks of the RFA process was the development of a *Nationally Agreed Criteria for the Establishment of a CAR Reserve System for Forests in Australia* by JANIS¹ which required 15 per cent of the pre-European distribution of each forest type be

represented in the reserve system. In those cases where it is not possible to achieve this criterion due to past clearing, vulnerable and rare/endangered ecosystems are to have at least 60 per cent and 100 per cent respectively of their remaining extent reserved. Special consideration for old-growth and wilderness areas are also addressed, while the need for a range of off-reserve biodiversity protection measures is also recognised (JANIS 1996). This recognition varies between Agreements from simply stating the conservation of vegetation types not adequately represented in the public reserve system should be "encouraged through extension and support to landholders" in East Gippsland (Commonwealth of Australia and State of Victoria 1997), to the Private Forest Reserves project as part of the Tasmanian RFA. The *Australian Guidelines for Establishing the National Reserve System* have incorporated the principles espoused in the JANIS process where appropriate, but are silent on the issues of reservation targets (Commonwealth of Australia 1999).

Conservation on private land in Australia

As over two-thirds of Australia (approximately 500 million hectares) is managed by private landholders, there is a pressing need for a consistent and integrated approach to nature conservation on all land types (Commonwealth of Australia 1993). Hence, it has been increasingly recognised that the public reserve system is not, and will not, be adequate for Australia to retain current levels of biodiversity and meet its obligations under the Convention on Biological Diversity (Burbidge and Wallace 1995; Margules 1995; Commonwealth of Australia 1996; ANZECC Working Group on Nature Conservation on Private Land 1996; Industry Commission 1996 and many others).

Interestingly, the *National Strategy for the Conservation of Australia's Biodiversity* anticipates that by the year 2005 Australia would have "established a system of voluntary or cooperative reserves, or both, and other management schemes on private lands to complement the protection provided by the public estate in protected areas" (Objective 7.1 (c)) (Commonwealth of Australia 1996 p.42).

In Australia, agreements between a private landowner and public agency to conserve a particular area of vegetation on private land can be broadly divided into two forms - non-binding voluntary programs and voluntary legally-binding management agreements.

1. JANIS: Joint ANZECC (Australia and New Zealand Environment and Conservation Council)/MCFFA (Ministerial Council on Forestry, Fisheries and Aquaculture) NFPS (National Forest Policy Statement) Implementation Subcommittee.

Non-binding programs require no legal undertaking on the part of the landholder to participate for any period of time and either party can withdraw from the agreement. The success of the program therefore relies on the enthusiasm and goodwill of the landholder, but the effectiveness of such programs remains unclear (Young *et al.* 1996).

Binding agreements such as covenants and easements essentially limit the current, and possibly future, landholder's ability to exercise certain rights over their land (Young *et al.* 1996). These may include the exclusion of grazing, clearing of native vegetation and subdivision of property. They may be granted for a fixed term or in perpetuity and are usually registered on the title, binding future owners of the property. The terms of the agreement can vary from property to property and can include requirements to *manage* the area to protect the desired features.

Young (1995), believes that some schemes may enable a much more precautionary approach to reserve selection to be undertaken. For example, "it may be wiser" to place 5 per cent of each ecosystem in a reserve and to protect a further 20 per cent in conservation easements until more information becomes available (Young 1995 p. 363).

As with protected area systems, each State and Territory has its own framework for nature conservation on private land, which vary in their range of protection measures (see ANZECC Working Group on Nature Conservation on Private Land (1996) and Young *et al.* (1996)).

Several independent non-profit organisations have also been formed in the last decade with the sole aim being to purchase or manage private land for the purpose of conservation. These include the Australian Bush Heritage Fund at a national level, and Wetlands and Wildlife, Bushland Conservation Pty Ltd and Habitat Conservation Pty Ltd in South Australia.

On and off-reserve conservation in Victoria

As of 30 June 1998, Victoria had 35 national parks, 3 wilderness parks, 32 state parks, 11 marine/coastal parks or reserves and 29 other parks and reserves protected under the *National Parks Act 1975*. The total area of approximately 3.07 million hectares represents 13.5 per cent of the State and almost 35 per cent of all public land (State of Victoria 1997a). In addition, the *Crown Land (Reserves) Act 1978*, protects 415 nature conservation reserves totalling approximately 213,000 hectares, as well as some 1,880 natural features reserves, totalling approximately 200,000 hectares (Cresswell & Thomas 1997). More recently, Regional Forest Agreements have added approximately 790,000 ha of informal Special

Protection Zones in State Forest to Victoria's conservation estate.

While the protection figure of 90 per cent of plant communities represented in Victorian reserves (as of 1990) is considered very high for both Australian and international standards (Wescott 1995), Traill (1997) believes Victoria's reserve system is still not *adequate* and notes that part of the problem is a lack of explicit outcomes set by either conservationists or government bureaucracies on what a 'complete' reserve system should do.

Significantly, two-thirds of Victoria (approximately 15,000,000 hectares) remains under private ownership and management, the highest amongst all States, and of this only 5 per cent retains its natural bushland cover (Woodgate and Black 1988; Bennett 1995). In certain regions, as much as 80-95 per cent of land is privately owned (e.g. Riverina, Victorian Volcanic Plain) because much of the remaining public land is in the arid northwest and mountainous east of the State (Platt and Ahern 1995a; NRE 1998).

As was the case with the rest of the country, European settlement in Victoria has not been a random process, with those landsystems most suited to agriculture being settled first. This has not only resulted in the loss or degradation of those habitats associated with these sites of low altitude, high soil fertility and mesic climate but meant the majority of the land remained in private ownership (Platt and Ahern 1995a). Primarily, it is the grasslands, grassy woodlands, lowland riparian areas and shallow wetlands that remain underrepresented in the Victorian reserve system (Specht *et al.* 1995; State of Victoria 1997b).

Trust for Nature (Victoria)

The Trust for Nature (Victoria) is a statutory corporation established under the *Victorian Conservation Trust Act 1972* formed to receive gifts, bequests and donations for conservation purposes as well as to establish conservation covenants.

While it purchases and manages many of its own reserves, the Trust has been an important body in adding to the public reserve system by transferring land to the Crown for conservation purposes. It has also acted to facilitate land purchase on behalf of State and Commonwealth agencies where the Trust can negotiate as a private buyer, unhindered by government regulations (Whelan 1997).

The Trust's conservation covenant program was initiated in 1978. However, due to a lack of resources, it was not

until 1987 that the first covenant was registered (Todd 1997). Conservation covenants are voluntary agreements between the landholder and the Trust, and are placed on the title of the property in perpetuity (Todd 1997). The Revolving Fund, a relatively new instrument used by the Trust, involves purchasing a property with conservation significance, placing a permanent covenant on the land and then reselling the land to a private purchaser. The proceeds from the sale then go back into the Revolving Fund for the process to be repeated. It is seen as an important initiative as its funds are then available to respond quickly when a significant property enters the market (Safstrom 1995; Whelan 1997).

Land for Wildlife Program

Land for Wildlife is a Victorian Government program for conserving flora and fauna on private land and is run by the Department of Natural Resources and Environment (NRE) and the Bird Observers Club of Australia. It began in 1981 and was substantially upgraded in 1990 (Platt and Ahern 1995a; Young *et al.* 1996). The program, which is entirely voluntary, non-binding and initiated by the landowner, has two main approaches. Firstly, the owners of properties registered with the program form part of a 'club', from which they are encouraged and kept informed. Secondly, a broader program aims to assist landowners find better solutions to management problems that involve the enhancement and protection of wildlife habitat identified on their property (Platt and Ahern 1995a,b). The program is inclusive, in that any farm, bush block, council reserve, school ground, golf course, cemetery, and small or large property that can provide valuable habitat can be registered.

Other Victorian private conservation properties.

A small number of other agreements (Land Management Cooperative Agreements and Wildlife Management Cooperative Agreements) exist but awareness of their existence is poor (Platt and Ahern 1995a; Young *et al.* 1996) and hence they have not been included in this investigation. A few Public Authority Management Agreements protect significant remnants on other public land such as cemeteries, while an Indigenous Protected Area also occurs at Yambuk, in western Victoria.

Methodology

The use of a Geographic Information System (GIS) was considered to be the most appropriate medium for analysing the distribution and attributes of private conservation properties due to the flexible and efficient nature which desired datasets can be overlaid. Geographic Information Systems are used extensively by

nature conservation agencies and are an important tool in reserve design. Pressey and Logan (1997) used GIS to compare geographically discrete off-reserve measures with existing reserves in northeast New South Wales. The ArcView GIS Version 3.0 program, developed by the Environmental Systems Research Institute, Inc. (ESRI), was used for this investigation due to both its availability and compatibility with the datasets used to undertake the project.

Biogeographical regions were used by Specht *et al.* (1995) to assess the deficiencies of plant communities in the reserve system and by Lockwood *et al.* (1997) as the basis for a protected area selection procedure. Considering the NRSP uses the IBRA as a framework for assessing reservation levels, an assessment of the distribution and reservation levels of private conservation properties within this regionalisation was considered appropriate.

Three digital geospatial dataset layers from the Victorian Department of Natural Resources and Environment's Corporate Geospatial Library were used - *Interim Biogeographic Regionalisation of Australia Version 4.0* (polygons), *Public Land Use* (polygons) and *Land for Wildlife Properties* (points). All were current as of July 1998. A further three point layers for Trust for Nature Reserves, Conservation Covenants and regional population centres were created in order to allow overlaying with existing layers. Trust reserves, covenants and Land for Wildlife point localities were overlaid over the three background layers - Public Land Use, IBRA regions, and Regional Centres of Population - to determine possible relationships.

Statistical analysis was undertaken for properties within IBRA regions and in relation to population centres. The total area 'protected' for each of the three property types was determined, as was the median habitat size protected in each IBRA region. The 'protected area' on Land for Wildlife properties, was the total area set aside on each property for wildlife conservation and included both existing retained habitat and habitat to be restored or revegetated.

After initial examination of the distribution of private conservation properties in relation to regional centres of population, it was decided that the distinctive pattern of all three property types around the Greater Melbourne area warranted further investigation. Subsets of properties occurring within a radius of 60 kilometres from the Melbourne Central Business District were taken, as this distance encompassed the majority of clustered properties in this region.

Analysis of vegetation types protected was limited to conservation covenants, due to a lack of accessible information regarding Broad Vegetation Types (BVTs) on Trust reserves as well as the unavailability of the habitat classifications for Land for Wildlife properties in the received dataset. A statewide summary of habitats protected by Land for Wildlife properties was obtained from NRE, to allow broad comparisons to be made with covenants. While it would have been preferable to use the finer scale Ecological Vegetation Class (EVC) classification, mapping has not yet been completed for the whole of the State.²

Results and Discussion

Attributes of Private Conservation Properties in Victorian IBRA regions - Distribution and Area

In most bioregions, Land for Wildlife had a comparatively greater number of properties than covenants, which in turn were greater in number than Trust reserves for most regions (Fig. 1). Despite this difference in number, similar trends are evident in their distribution throughout the bioregions (Table 1). In particular there was relatively large numbers of all three property types near the junction of the Victorian Midlands, South Eastern Highlands and South East Coastal Plain, and an absence of properties in the northeast of the Murray-Darling Depression, Australian Alps and Furneaux bioregions.

The number and area ‘protected’ by Trust for Nature reserves and covenants and Land for Wildlife properties in each Victorian IBRA region can also be seen in Table 1.

The Victorian Midlands contained the largest number of Land for Wildlife properties (1,333) and covenants (93), and the equal highest number of Trust properties (11). The South East Coastal Plain had the second largest number of Land for Wildlife properties (1,057) and Trust for Nature covenants (67) and third highest number of Trust for Nature reserves (10), while the South Eastern Highlands had the third largest number of Land for Wildlife properties (724) and Trust for Nature covenants (38), and equal highest number of Trust reserves (11). This relationship is similar for most Victorian IBRA regions, with the exception of the Murray-Darling Depression which had the fourth highest number of

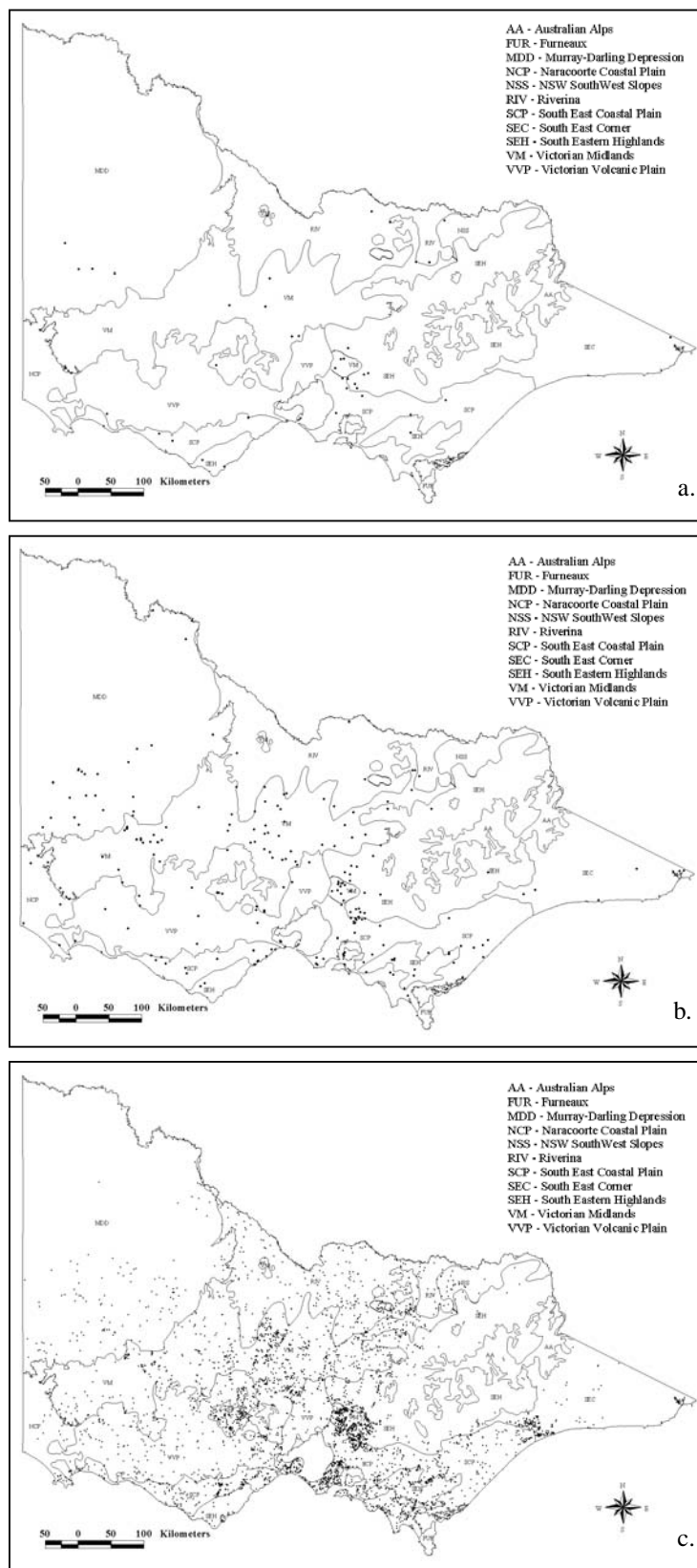


Figure 1. Distribution of (a) Trust for Nature Reserves, (b) Conservation Covenants, and (c) Land for Wildlife Properties in Relation to Victorian IBRA Regions

2. A more detailed description of the methods used can be obtained from James Fitzsimons, email fitzsimo@deakin.edu.au

Table 1. Number and area reserved by private conservation properties in each Victorian IBRA region

IBRA Region	Number of properties			Area (ha)			IBRA Area (Victorian section) (ha)	Public Protected Area (ha)	% of IBRA in Public Protected Areas
	LFW Properties	TFN Covenants	TFN Reserves	LFW Properties	TFN Covenants	TFN Reserves			
<i>Victorian Midlands</i>	1,333	93	11	45,590	2,865	1,727	3,702,585	318,470	8.61
<i>South East Coastal Plain</i>	1,057	67	10	25,465	1,382	254	1,889,208	148,340	8.02
<i>South Eastern Highlands</i>	724	38	11	8,656	849	587	3,179,481	645,870	20.31
<i>Victorian Volcanic Plain</i>	373	19	1	19,867	822	253	2,212,815	32,850	1.49
<i>Riverina</i>	279	8	3	4,450	15	194	2,135,910	63,810	3.08
<i>South East Corner</i>	172	8	1	2,776	392	36	1,408,790	390,450	27.71
<i>Murray-Darling Depression</i>	128	30	4	7,118	3,255	489	6,583,654	1,500,910	22.98
<i>Naracoorte Coastal Plain</i>	40	4	0	1,933	188	0	517,826	64,820	12.52
<i>NSW South Western Slopes</i>	23	0	1	242	0	17	336,705	42,160	12.48
<i>Australian Alps</i>	3	0	0	170	0	0	704,089	306,260	43.49
<i>Furneaux</i>	0	0	0	0	0	0	40,663	40,650	99.86
VICTORIA	4,132	267	42	116,267	9,911	3,557	22,711,726	3,554,590	15.65

Trust for Nature reserves (4) and covenants (30) but seventh highest number of Land for Wildlife properties (128).

The Victorian Midlands, contained a Trust reserve area (1,727 ha) that was almost three times that of any other bioregion and a Land for Wildlife area (45,590 ha), almost twice that of any other bioregion. In general, the areas protected for each type of private land conservation property reflect the number of properties in

each IBRA region as shown in Table 1. However, there are a few notable exceptions. The greatest area protected by Trust covenants occurred in the Murray-Darling Depression (3,255 ha), ahead of the Victorian Midlands. The Victorian Volcanic Plain had 11,211 hectares more Land for Wildlife habitat area than the South Eastern Highlands (more than twice as much), despite having 351 fewer properties registered (almost half as many).

These trends are most clearly seen when displayed as a

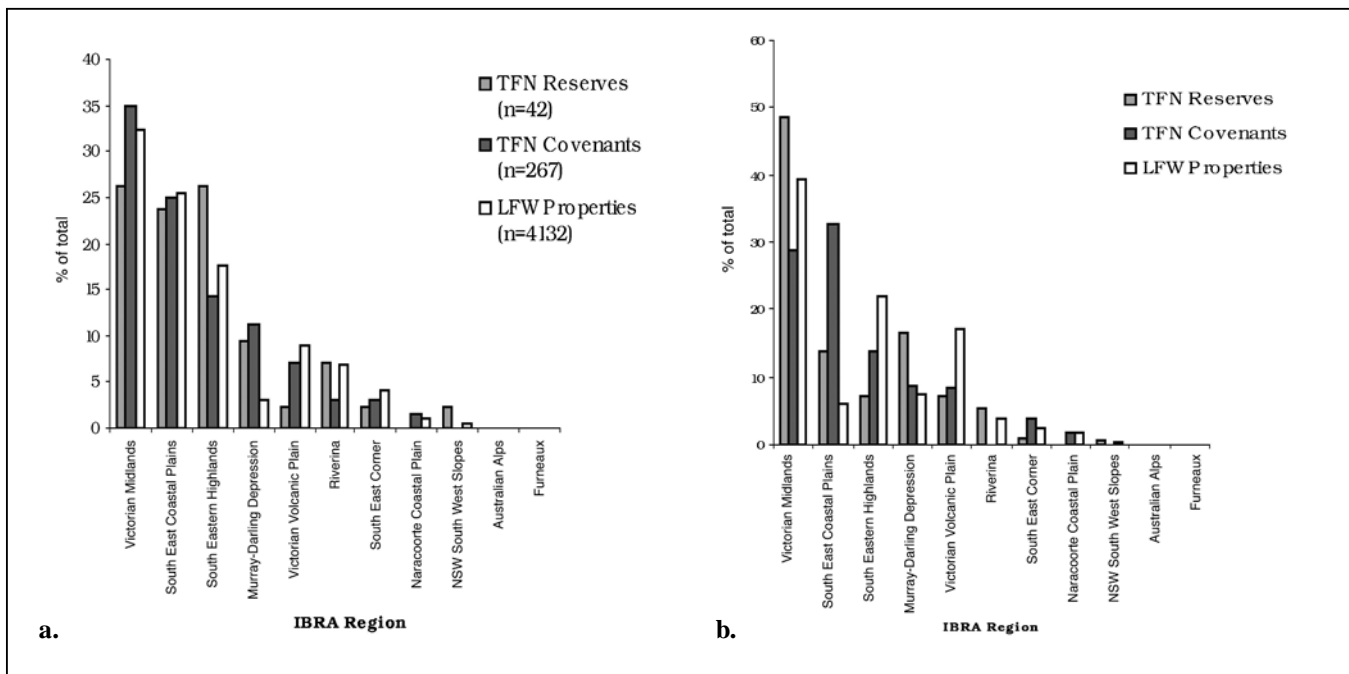


Figure 2. (a) Number and (b) area protected by private conservation properties in each Victorian IBRA region (expressed as a percentage of the total number or area of property type)

Table 2. Median size of ‘protected areas’ for private conservation properties throughout Victorian IBRA regions

<i>Interim Australian Biogeographic Region</i>	Median size of protected area (ha)		
	Trust for Nature Reserves	Trust for Nature Covenants	Land for Wildlife Properties
<i>Murray-Darling Depression</i>	73.0	48.3	21.0
<i>Naracoorte Coastal Plain</i>	-	41.9	15.0
<i>Victorian Volcanic Plain</i>	252.5	28.3	7.5
<i>South East Corner</i>	36.0	41.7	3.0
<i>Riverina</i>	68.8	3.7	12.8
<i>Victorian Midlands</i>	40.3	16.2	6.0
<i>South East Coastal Plain</i>	17.5	8.8	3.5
<i>South Eastern Highlands</i>	9.3	9.9	3.5
<i>NSW SouthWest Slopes</i>	17.3	-	9.0
<i>Australian Alps</i>	-	-	30.5
<i>Furneaux</i>	-	-	-
Victoria	31.8	15.0	4.9

Considering both Land for Wildlife and Trust for Nature covenants were updated at a similar time in the late 1980's, these results indicate that the voluntary, non-binding nature of Land for Wildlife is possibly more attractive to many landowners than a legally-binding agreement. However, Land for Wildlife should not necessarily be judged as a more successful program for habitat conservation, as the size of its ‘protected’ areas were generally lower than covenants, while the lack of legal protection means the commitment can be withdrawn at any time.

percentage of the total number of properties and area protected (Fig. 2).

Size of private conservation properties in Victorian IBRA regions.

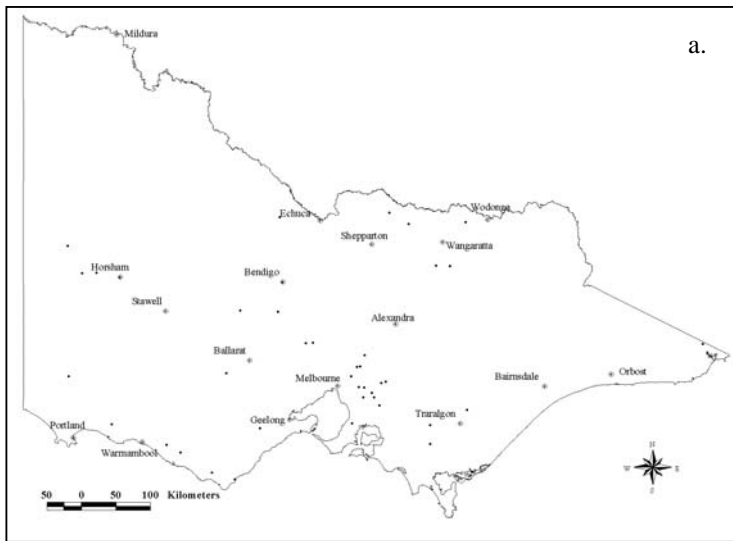
In contrast to the number and total area, Trust reserves had a greater median area than covenants in six of the eleven regions. In turn, covenant sizes exceeded those of Land for Wildlife properties in almost every region in which they occurred. However, those trends observed between property types and individual bioregions in Table 1 are not evident for the average size of properties. This was in part due to the presence of only a small number of quite large properties in some bioregions, which resulted in a relatively high median area protected. This was the case for Trust reserves in the Victorian Volcanic Plain (252.5 ha), Land for Wildlife in the Australian Alps (30.5 ha), and Trust covenants in the Naracoorte Coastal Plain (16.5 ha).

The Murray-Darling Depression had the largest sized Trust covenants (48.3 ha) and second largest sized Trust reserves (73 ha) and Land for Wildlife (21 ha). The Victorian Midlands had relatively high median sizes for Trust reserves (40.3 ha), medium sizes for covenants (16.2 ha) but small sizes for Land for Wildlife properties (6.0 ha). Significantly, the South Eastern Highlands and South East Coastal Plain, both highly represented by all three types of properties, had some of the lowest median sizes for all three property types. The remaining bioregions showed few notable trends between the various property types.

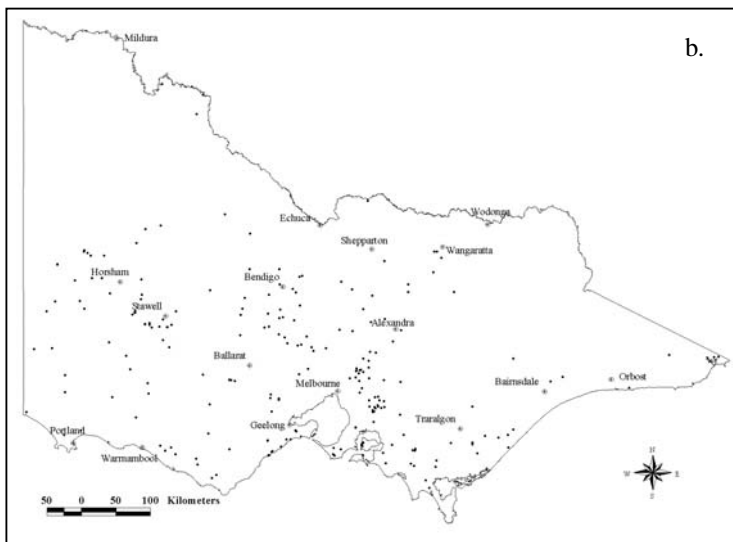
Trust reserves are somewhat different entities in that they are selected by a single body, with properties purchased either to be managed by the Trust, donated to the Crown for addition to the reserves system, or covenanted and resold as a part of the Revolving Fund. The larger sizes of Trust reserves reflects the difference between an organisation purchasing or obtaining properties which it believes are worthwhile and manageable and individual landowners protecting an area of habitat on their own property.

The potential ‘contribution’ that private conservation properties could make to biodiversity conservation in terms of area can be determined at three levels - i) total area protected for each property type; ii) area for each property type as a percent of the bioregional area; and iii) private reserve area for each property type in comparison to public reserve area. It should be noted that many covenants also contain a Land for Wildlife registration, such that deriving a ‘total’ area for private land conservation would constitute ‘double-counting’ and has not been undertaken. Whilst it recognised that the extent of a bioregion protected in reserves (or on private land in this instance) is not necessarily equivalent to its effectiveness for protecting biodiversity (State of the Environment Advisory Council 1996), it is one criterion used by the National Reserve System when assessing the representativeness of bioregions (Thackway & Cresswell 1995).

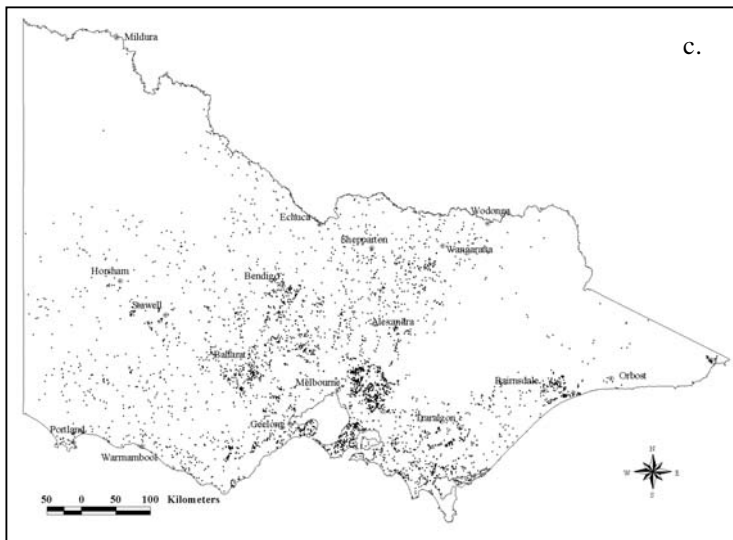
Fitzsimons (1999b) reported on the potential contribution that private conservation properties made to the area ‘protected’ at a bioregional scale. The most



a.



b.



c.

Figure 3. Distribution of (a) Trust for Nature Reserves, (b) Conservation Covenants, and (c) Land for Wildlife Properties in Relation to Regional Centres of Population in Victoria

notable examples are recorded below. (See Fitzsimons (1999b) for more detailed background information).

Properties in the Victorian Midlands and South East Coastal Plain are considered to make the greatest contributions to both the total area protected in those regions and area protected as a per cent of the bioregional area (Victorian Midlands - Land for Wildlife 1.23 per cent, Conservation covenants 0.08 per cent and Trust reserves 0.05 per cent of the bioregion; South East Coastal Plain - Land for Wildlife 1.35 per cent, Conservation covenants 0.07 per cent and Trust reserves 0.01 per cent of the bioregion). However, the influence of some very large properties should be taken into account when considering the potential contribution that properties make to the region in general. For example, the large total area for Land for Wildlife and Trust reserves was significantly influenced by two large properties in the Victorian Midlands - the 20,000 hectare Puckapunyal Military Area which represented nearly 50 per cent of the Land for Wildlife area in this region, and the Terrick Terrick grassland reserve (now part of the Terrick Terrick National Park) which represented 74 per cent of the Trust reserve area. This was also the case for a large Land for Wildlife property (10,821 hectare) in the South East Coastal Plain, which represented over 40 per cent of the total Land for Wildlife habitat in that region.

On a different level, private conservation properties, which made up 0.90 per cent (Land for Wildlife), 0.04 per cent (Trust covenants) and 0.01 per cent (Trust reserves) of the Victorian Volcanic Plain, also made a potentially significant contribution to biodiversity conservation when considering that public reserves constituted only 1.49 per cent of that region.

Private conservation properties and regional centres of population

Significant clusters of all three private conservation property types occur around the outer east and northeast of the Greater Melbourne metropolitan area, while notable concentrations of Land for Wildlife properties also occur around the Mornington and Bellarine Peninsulas, Ballarat, Bendigo and Bairnsdale (Fig. 3). Trust for Nature covenants appeared less clustered in other localities, perhaps as a result of their fewer numbers, but were still notable around the Surf Coast area (south of Geelong), Stawell and Bendigo. Other than around the outer

Table 3. Attributes of private conservation properties within and outside a 60 km radius of the Melbourne Central Business District

Property Type	No. of Properties		Total Area protected (ha)		Median Size of Property (ha)	
	Melbourne	Rest of Victoria	Melbourne	Rest of Victoria	Melbourne	Rest of Victoria
Trust for Nature Reserve	12	39	333	3,224	7.5	23.9
Trust for Nature Covenant	49	218	695	9,216	6.4	17.5
Land for Wildlife Property	677	3,469	17,316	99,094	2.3	5.8

east and north-east of Melbourne, Trust for Nature reserves showed no obvious distribution pattern in relation to regional centres.

Those properties occurring within a 60km radius of the Melbourne CBD consist of a relatively large proportion of the statewide occurrence (Table 3), varying from 28.6 per cent of Trust reserves to 18.4 per cent and 16.4 per cent of covenants and Land for Wildlife, respectively. Also of note is the relatively low median size of all three property types in this region in comparison to the IBRA regions. For example, more Trust reserves (12) were recorded in the Greater Melbourne region than in any bioregion, while the median property sizes were lower around Melbourne than in any bioregion for both Trust reserves (7.5 ha) and Land for Wildlife properties (2.3 ha).

The high number of small-sized properties recorded around Melbourne is likely to impact on the number, total area and size of properties recorded in the three IBRA regions (Victorian Midlands, South East Coastal Plain and South Eastern Highlands) which occur to the outer east and northeast of Melbourne.

The large number of people living in and around Melbourne (3.3 million) and other large regional centres such as Ballarat and Bendigo (150,000 people between them) suggests that there is likely to be an increased number of people willing to nominate their properties for protection in a relatively small area. However, there are a number of other social and environmental factors that are likely to have contributed to this trend.

Firstly, the clusters usually occur on the outskirts of the residential area, where vegetation is still present but in private ownership. Property sizes generally fall between the smaller subdivisions of the suburban areas and larger allotments of the agricultural districts beyond them. Secondly, and importantly for many landholders in these areas, relatively easy access to the city and inner suburbs is available, particularly for employment purposes. This suggests that salary earners can afford to keep their properties for conservation whilst farmers need to use their land for a livelihood. The recent expansion of areas

devoted to rural living and hobby farms, especially within commuting distance of Melbourne, Bendigo and Ballarat (State of Victoria 1997b), may also have an influence on this distribution.

The presence and effectiveness of regional coordinators is also likely to influence the distribution of Land for Wildlife properties and conservation covenants. The distribution of Trust reserves in the Melbourne area may be a combination of bequeathed land and/or the past acquisition of immediately threatened remnants.

The concentration of private conservation properties and, to a lesser extent, the total area they protect is related to a combination of large bioregional area and population size. The high percentage of public land in some regions (e.g. Australian Alps and Furneaux) has also influenced the distribution of private conservation properties.

Impact of property size

While the optimal size of conservation reserves depends not only upon the taxa in question but also on the absolute scale of the geographic region of interest (Lynch 1987), the Office of the Commissioner for the Environment (OCE, 1991) considered remnants under 10 hectares to be too small to be self-sustaining, to be almost invariably weedy, and to be structurally different from the original vegetation. Small and isolated patches of habitat generally support fewer species of wildlife, and their populations tend to be more prone to disturbance and extinction than those of larger patches (Bennett 1991). Ford and Barrett (1995) proposed that patches of 20 hectares or larger would be an achievable and worthwhile aim for conservation on private properties. Small remnants do however, provide habitat for individual species of flora and fauna, and although these are usually the more common and robust species (Loyn 1987), rare or threatened taxa will sometimes survive only in these areas (OCE 1991). Lindenmayer (2000), more recently found that small patches (0.5-3 ha) support considerably higher levels of vertebrate fauna than might be expected.

It is, however, important to note that in seven of the ten IBRA regions containing Land for Wildlife properties, average habitat sizes were *less than* 10 hectares. Furthermore, while the South Eastern Highlands contained a relatively high number of properties, the average protected habitat for *all three* property types in

this region was below 10 hectares. The Murray-Darling Depression was the only region where median sizes for all three property types were above 20 hectares. This suggests that the potential contribution from private properties to biodiversity conservation in the long-term may differ between bioregions based on the size and viability of the protected area.

This, in turn, presents the somewhat vexed problem of whether there should be a focus on establishing private conservation properties in areas which have large remnants and greater ecological integrity, but which have vegetation types already well-represented in the reserve system, or whether there should be more focus on highly underrepresented ecosystems or IBRA regions, despite the size and or quality of the remnant. The targeting of *both* of these types of remnants for conservation as suggested by Gilfedder and Kirkpatrick (1995) for Tasmania, is likely to be needed to achieve the most desirable return for the private land conservation network in Victoria.

This issue also highlights the significant underlying problem in attempting to establish a comprehensive, adequate and representative reserve system. While each ecosystem may be *represented* in the reserve system, even to a desired level (e.g. 15 per cent of original extent or 90 per cent of current extent for rare and endangered ecosystems), ensuring that adequately-sized self-sustaining areas are included in regions where only small remnants remain will be almost impossible.

However, the size and shape of private conservation properties should not be the only measure of ecological integrity and their value should also be judged in relation to their placement within the landscape and quality of vegetation and ecological processes present. Private reserves would almost certainly increase the protection of genetic diversity and ecosystem variations not represented in the public reserve system. Private reserves may also provide habitat or linkages for seasonally migratory species or extensive-habitat species. The ability to effectively manage these private properties for desired conservation goals both in the short and long term is the next major challenge.

Possible influence of financial incentives

The need to provide financial incentives for private landholders for the conservation of significant remnant vegetation has been widely recognised (e.g. Crosthwaite 1995; Farrier 1995; Binning and Young 1997; Todd 1997; Lockwood and Walpole 2000; Lockwood *et al.* 2000, Worboys *et al.* 2001 and many others). With the exception of South Australia, where financial assistance of over \$75

million has been provided by the South Australian Government for the management and fencing of areas covered by Heritage Agreements from 1987-1997 (Industry Commission 1997), strategic financial assistance from government has only relatively recently been implemented (e.g. Private Forest Reserves component of the Tasmanian Regional Forest Agreement - see Smith 2001).

The absence of incentives offered to Trust covenantors is seen as a particularly big hurdle in rural districts where the areas for covenanting are often large, the district sentiment is often anti-conservation and the property has been held by the one family for several generations (Crosthwaite 1995; Landy pers. comm. in Safstrom 1995). Safstrom (1995) and Todd (1997) note landowners are generally unwilling to set aside sections of their properties for nature conservation if there is no financial relief from the land rates incurred. Lockwood *et al.* (2000) suggest a combination of funding for fencing, management plans, rate relief and, in the case of binding agreements, annual payments for management costs. While a number of municipal councils in Victoria have begun to introduce rate rebates for owners with a conservation covenant on their property it remains to be seen whether it is enough to encourage higher rates of protection. Whelan (1997) believes that while the total cost for each individual landholder is not high, it is a sufficient deterrent to prevent many landowners from entering into a conservation covenant. This situation ultimately favours those landowners that do not earn a living from their property and may in part account for the distribution of properties around metropolitan population centres. Furthermore, this may result in a bias away from underrepresented habitats occurring on agricultural land, such as grasslands and grassy woodlands.

The introduction of incentives may ultimately improve the influence of Trust for Nature or Land for Wildlife extension officers when actually seeking out and negotiating the protection of specific underrepresented habitats on properties, and would allow greater direction for the private reserve network.

Private conservation properties and Broad Vegetation Types (BVTs)

Moist and Dry Foothill Forests were recorded on the greatest number of Trust covenants (53 and 50 respectively). However their distribution was not spread evenly throughout the IBRA regions, with properties in the Victorian Midlands accounting for the bulk of Dry Foothill Forest and properties in the South Eastern

Table 4. Number of Trust for Nature covenants containing Broad Vegetation Types in each Victorian IBRA region

Broad Vegetation Type	Victoria	Victorian Midlands	Murray-Darling Depression	South East Coastal Plain	South Eastern Highlands	Victorian Volcanic Plain	South East Corner	Riverina	Naracoorte Coastal Plain	NSW South West Slopes	Australian Alps	Flumeaux
Box-Ironbark Forest	29	26				1		1	1			
Coastal Scrub & Grasslands	12			10	1		1					
Dry Foothill Forest	50	32		4	6	7	1					
Farmland – Garden	9	2	1	3			1	2				
Grassland	3	2				1						
Heath	3			3								
Heathy Woodland	30	5	5	15		1	1		3			
Herb-rich Woodland	9	7	2									
Historic Marker	2	1				1						
Inland Slopes Woodland	15	12	2		1							
Lowland Forest	23			19	1	2	1					
Mallee	6	2	4									
Mallee Heath	6		6									
Mallee Woodland	1		1									
Moist Foothill Forest	53	5		18	29		1					
Plains Grassy Woodland	22	6	7	1		3		4	1			
Riparian Forest	19	8		3	7		1					
Riverine Grassy Woodland	3		2					1				
Sedge-rich Woodland	2		2									
Swamp Scrub	16	1	1	9	3		2					
Valley Grassy Forest	2	2										
Wet Forest	4			1	2		1					
Wetland	5		1	2		2						
Wimmera-Mallee Woodland	9		9									
Not Listed	5	1		1		2	1					

Note: 1) Some covenants contained more than one BVT, in which case a record has been made against each vegetation type.
2) BVTs listed are those designated by Trust for Nature. 'Farmland-Garden', 'Historic Markers' and 'Wetlands' are protecting features other than BVTs, while 'Wet Forest' is not a recognised BVT.

Highlands accounting for the majority of the Moist Foothill Forest (Table 4).

Those bioregions which had high numbers of covenants tended also to have a high diversity of BVTs protected, namely the Victorian Midlands, Murray-Darling Depression and South East Coastal Plain. Of those BVTs designated as *high priority* for protection by the Trust for Nature, Plains Grassy Woodland occurred on 22 covenants, Swamp Scrub on 15, Wimmera Mallee/Woodland on 9 and Grassland on 3.

Todd (1997), noted that most Trust covenants represented communities already well represented in the existing reserve system. However, the results of this study, while measuring only the *presence* and not the *area* of vegetation types on a covenant, do not necessarily support this, especially when considering the JANIS

criteria for a CAR reserve system (JANIS 1996).

Of the six Broad Vegetation Types (BVTs) occurring on more than 20 covenants, only two, Moist Foothill Forest and Dry Foothill Forest have over 15 per cent of their pre-European extent represented in conservation reserves at a statewide level (Appendix 1). Two others, Plains Grassy Woodlands and Box-Ironbark Forest have had their past extent significantly depleted and are thus severely under-represented in public reserves at a statewide level. The occurrence of other extremely under-represented BVTs on covenants varied from intermediate (Swamp Scrub) to low (Grassland).

Land for Wildlife properties also contained a number of ecosystems that are not well represented in the reserve system. The most notable of these were Box-Ironbark Forest (20,000 ha), Grasslands

(nearly 8,500 ha), and Red Gum Woodland (6,800 ha). The large area of Box Ironbark Forest is strongly influenced by the presence of the Puckapunyal Military Area, while the representation of Grasslands by Land for Wildlife properties is proportionally much higher than on covenants and suggests a possible reluctance to *permanently* protect potentially high value agricultural land.

However, the complementarity and/or duplication of BVTs represented on covenants and in the reserve system is more accurately assessed at the bioregional level.

In largely cleared bioregions, such as the Riverina and Victorian Volcanic Plain, almost all BVTs are severely underrepresented in the public reserve system (NRE 1998) (see Appendix), and any representation in covenants thus increases the representativeness of the system. Conversely, nine of the sixteen BVTs in the South East Corner IBRA

region are adequately represented in the reserve system, most significantly so, and covenants add little to those underrepresented BVTs. In the Victorian Midlands, South East Coastal Plain, and Murray-Darling Depression, only a few covenants contained adequately protected BVTs, while significantly underrepresented BVTs had relatively high occurrences on covenants.

It should be noted, however, that current private conservation properties only protect a small amount of the total remnant vegetation and associated fauna that currently exist on private land. These 'unprotected' remnants still make a major contribution to biodiversity conservation in Victoria.

Limitations to results

The results obtained in this project are a snapshot in time, with the numbers of both covenants and Land for Wildlife properties expected to increase (Platt and Ahern 1995a). The Trust's property estate is unlikely to increase at the same rate, particularly with the advent of the Revolving Fund.

The broad nature of the BVT classification, where a number of different communities or EVCs can occur under one BVT, does prevent accurate conclusions regarding protection within the public and private reserve system. It is also important to note that mapping of the finer scale EVCs as part of the RFA process in Victoria has identified a number of vegetation types which are considered a 'high priority' for increased protection on private land. This will influence the focus of private land protection mechanisms in the future.

Reserve and off-reserve selection processes

As was the case in *some* bioregions in this investigation, Pressey *et al.* (1996) found that those ecosystems covered by all mappable off-reserve protection measures in northeast New South Wales was more strongly biased away from vulnerable ecosystems than strict reservation alone. The *ad hoc* manner in which reserves have been selected had been similarly applied to off-reserve measures in this instance, with similar disadvantages (Pressey and Logan 1997).

Pressey and Logan (1997) believe that this pattern is the result of a lack of regional coordination between off-reserve management as well as the under-use of some forms of protection due to political or economic reasons. Pressey and Logan (1997) also note that reserve selection processes, which have been developed in recent years to more systematically select

conservation reserves, can be applied to off-reserve measures to increase their effectiveness.

However, it is important to note that some forms of off-reserve conservation, such as the voluntary conservation of habitat, are often the result of the landowner making an application for property registration and not the coordinating body selecting the properties. Nonetheless, as the results of this study into one facet of off-reserve conservation indicate similar trends in distribution and size between the three main types of private conservation properties in Victoria, there may be a need for better coordination of these, and other off-reserve conservation measures in future. It also highlights the need to consider both public and private reserves as part of a single 'system'.

Concluding Remarks

The above results suggests three trends:

- 1) The distribution and median sizes of three quite different types of private conservation properties found in Victoria show a distinct relationship throughout the State and its IBRA regions, despite having markedly different property numbers.
- 2) The presence of private conservation properties appears to be influenced by the size and distribution of human population centres and by the extent of public land in a bioregion. When it is realised that denser population centres supported smaller private conservation properties, this is significant. The absence of financial incentives for private land habitat protection and the 'all-inclusive' nature of both Land for Wildlife and Trust for Nature covenants are likely to be underlying influences of this.
- 3) While private conservation properties have not necessarily accounted for the deficiencies in the public protected area system in Victoria, some bioregions, such as the highly-disturbed Victorian Volcanic Plain, potentially contribute significantly to both the comparative area and vegetation types protected. However, further research is required at a finer scale to determine the influence that quality of habitat, position within the landscape, and management regimes have on their overall effectiveness for biodiversity conservation.

The findings of this study lead us to suggest the following:

- There is a need for greater coordination of on and off-reserve conservation through some mechanism which reports and quantifies the contribution that private land is making to conservation. Models such as those proposed by Binning and Young (1997) and Thiele and

Prober (2000) would be useful at a local or ecosystem scale, and the incorporation of existing covenants and Trust reserves into a national reserve system of public and private conservation land (if the property owner so desired) would allow more accurate reporting of land protected. Thackway and Cresswell (1995) noted that information on alternate conservation measures was necessary for integrating the NRS with other funding programs and off-reserve initiatives. Without including these private conservation properties within a national reserve system an integrated approach is not taking place, possibly to the detriment of existing public protected areas. While the primary means of developing the NRSP is through the land purchase of underrepresented habitats for addition to the public reserve estate (Thackway and Cresswell 1995; Thackway 1996), property purchases made without a knowledge of what is already protected in the private reserve network are less than ideal for planning.

- There is a need to set more specific aims and targets in order to judge the relative success of the private reserve systems. While an often stated function of off-reserve conservation measures is “to complement the public reserve system” (e.g. National Strategy for the Conservation of Australia’s Biodiversity 1996 p. 42), the term ‘complement’ is rarely defined. ‘Complement’ could mean; a) to protect those ecosystems or features underrepresented in the existing public reserve system; b) to provide further replication and greater genetic representation of habitats already adequately represented in the existing system; or c) to provide a buffer around or link existing reserves. However, fulfilling one of these definitions of ‘complement’ will not necessarily ensure the achievement of the others.

To summarize, an integrated approach to the National Reserve System which considers the public and private land components together is likely to lead to a better outcome for biodiversity than the current view that the private system is only ‘complementary’ to the public protected area network.

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Appendix. Percent of Pre-European Extent of Victorian Broad Vegetation Types in Conservation Reserves

Broad Vegetation Type	% of Pre-1750 Broad Vegetation Type in Conservation Reserves.											
	Victoria	Australian Alps	South Eastern Highlands	Furneaux	South East Corner	NSW SW Slopes	Victorian Midlands	South East Coastal Plain	Riverina	Victorian Volcanic Plain	Naracoorte Coastal Plain	Murray-Darling Depression
Coastal Scrubs & Grasslands Complexes	11.5	-	-	-	78.0	-	-	3.5	-	0.0	20.6	-
Coastal Grassy Woodland Complexes	9.2	-	0.0	79.6	0.0	-	-	9.4	-	-	0.0	-
Heathy Woodland Complexes	14.8	-	49.3	96.0	41.7	-	1.7	16.6	-	55.3	12.3	11.7
Lowland Forest Complexes	6.9	-	2.5	-	18.9	-	-	1.9	-	3.1	1.1	-
Heath Complexes	13.4	-	1.8	95.5	-	-	0.0	7.5	-	-	-	-
Swamp Scrub Complexes	0.1	-	3.8	-	-	-	-	0.1	-	0.1	-	-
Box Ironbark Forest Complexes	2.7	-	0.0	-	-	3.3	2.6	-	0.0	-	-	11.7
Inland Slopes Woodland Complexes	21.3	-	-	-	100.0	12.8	26.1	-	0.0	0.0	-	1.0
Sedge-rich Woodland Complexes	3.4	-	-	-	-	-	-	-	-	-	-	3.4
Dry Foothill Forest Complexes	18.7	49.8	22.1	-	21.2	21.9	12.9	20.3	-	0.1	-	37.2
Moist Foothill Forest Complexes	21.6	55.0	16.7	96.5	37.6	-	6.5	-	-	-	-	-
Montane Dry Woodland Complexes	32.7	48.2	29.6	-	12.1	-	-	-	-	-	-	-
Montane Moist Forest Complexes	30.3	50.6	23.0	-	34.4	-	-	-	-	-	-	-
Sub-alpine Woodland Complexes	61.9	68.9	47.9	-	3.4	-	-	-	-	-	-	-
Grassland Complexes	0.1	0.0	-	-	0.5	-	0.0	0.3	0.3	0.0	-	0.2
Plains Grassy Woodland Complexes	0.3	68.9	0.2	-	3.4	2.5	0.6	0.2	0.2	0.2	0.4	0.2
Valley Grassy Forest Complexes	3.8	0.0	9.0	-	0.5	0.0	1.2	0.0	-	0.0	-	-
Herb-rich Woodland Complexes	4.1	-	-	-	-	-	8.2	0.0	0.4	3.0	-	1.2
Sub-alpine Grassy Woodland Complexes	64.2	68.9	49.3	-	31.5	-	-	-	-	-	-	-
Montane Grassy Woodland Complexes	12.4	43.0	13.8	-	1.3	-	-	-	-	-	-	-
Riverine Grassy Woodland Complexes	7.5	-	2.5	-	0.0	0.9	0.2	9.1	4.3	0.0	-	13.7
Riparian Forest Complexes	2.2	-	0.8	100.0	22.1	-	-	0.1	-	0.0	-	-
Rainshadow Woodland Complexes	37.9	-	0.0	-	67.3	-	-	-	-	-	-	-
Mallee Complexes	29.4	-	-	-	-	-	11.0	-	0.0	-	-	29.8
Mallee Heath Complexes	71.6	-	-	-	-	-	-	-	-	-	-	71.6
Boinka-Raak Complexes	17.3	-	-	-	-	-	-	-	-	-	-	17.3
Mallee Woodland Complexes	20.1	-	-	-	-	-	-	-	-	-	-	20.1
Wimmera Mallee/Woodland Complexes	0.1	-	-	-	-	-	-	-	0.0	-	-	0.1

Source: NRE (1998)