

Roadside Vegetation and Weeds: Biosphere Conservation or Threat?

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INTRODUCTION

Many of the weeds of Victoria's roadsides came here from Britain, some as cultivated plants, and some as volunteers. Hawthorn hedges, for example, were established on Victorian roadsides in the 19th century by settlers who considered hedges a key component of a well ordered farm, and whose concept of a well run farm was based on what they had grown up with in the British Isles. William Howitt wrote of gardens near Melbourne in 1852, that hedges replaced post and rail fences "as cultivation and wealth advance."² He wrote also of the beauty of the villages near Hobart in 1854, "All around these villages, which consist of substantial and even elegant houses, extend the richest fields all enclosed with hedges generally of sweet briar, or furze, or broom, but also a good many of honest English hawthorn....It is England all over. ."³

But hawthorn (*Crataegus monogyna*, N. J. Jacq.) proved to be invasive, and was declared a noxious weed for the whole of Victoria in 1965 with an exception for existing hedges not exceeding two metres in height and one metre in width.⁴ Despite this, many hedges of greater dimensions survive. Many examples may be seen near Daylesford, and other central Victorian localities. Many of the plants both native and exotic which were used for hedges in Victoria have proved to be troublesome weeds. As this example demonstrates, despite a tendency to think of weeds of roadsides in terms of alien⁵ colonising species such as thistles, the weeds may also include cultivated plants.

It is outside the compass of this paper to search for a satisfactory definition of "weed". The usual definitions of "weed" are "a plant growing where it is not wanted" or "a plant out of place".⁶ I have argued elsewhere that such definitions are unsatisfactory because they are too open ended, and permit statements such as "weediness is in the eye of the beholder".⁷ We may adopt the common practice found in the weeds literature and pass over the notion that any plant may be a weed depending on human wants. For present purposes it will suffice to deal with plants generally accepted to be weeds. This pragmatic approach is in accord with a feature of weeds discourse which has long been recognised. The agronomist Professor Jack Harlan⁸ with J. de Wet of the Oklahoma State University pointed out forty years ago that it was characteristic of "the professional weed men" that despite adopting the open ended "unwanted" definition, they demonstrated a belief that there is a body of plants which are weeds. They "give long lists of 'weeds' as though weeds were species" and speak of 'weediness' when they do not mean 'unwantedness'.⁹ Despite this paper, which has been widely cited, this pattern of behaviour continues, and may be followed here.

The Australian National Weeds Strategy accepted that "virtually any plant can be a weed." Having stated that "For the purposes of this National Weeds Strategy a weed is considered pragmatically as a plant that requires or may require some form of action to reduce its negative effects", the Strategy proceeded to define a weed as "a

plant which has, or has the potential to have, a detrimental effect on economic, social or conservation values.”¹⁰ This definition has been accepted by the Victorian Weed Management Strategy which is part of the Victorian Pest Management Framework. The Victorian strategy seems to follow the common approach by which it is assumed that we know what the weeds are. This paper adopts the same approach.

Many of Victoria’s most troublesome weeds were noxious weeds declared under previous legislation or are weeds currently listed under the *Catchment and Land Protection Act* 1994. About 150 species are now listed. In a sense the weed status of such plants has been determined by statute; although it would be possible to seek changes in such listing if appropriate. Plants are added to the lists from time to time.

The European settlement of Victoria brought many exotic plants, including weeds. As early as 1860, J. D. Hooker’s *Flora Tasmaniae* listed 139 Naturalized Plants of the Australian Colonies “chiefly compiled from the Melbourne collections and notes of F. Adamson, Esq., to which are added the species enumerated in Mueller’s Reports, and Backhouse’s and Gunn’s MSS.”¹¹ Most of the plants were well known as weeds in Britain. By 1909, Professor Alfred Ewart, the Government Botanist, assisted by J. R. Tovey, listed 364 species in *The Weeds, Poison Plants, and Naturalized Aliens of Victoria*.¹² Naturalized plants now make up 28% of the Victorian flora of approximately 4365 taxa.¹³ It has been claimed that 48% of the State’s exotic flora [some 584 taxa] are weeds.¹⁴

Most of the weeds listed by Hooker in 1860 were British weeds of cultivation, what are sometimes called agrestals.¹⁵ But a few were described as weeds of roadsides. Of *Carduus Marianus*, L. (Spotted or milk thistle), Hooker wrote (it) “has spread amazingly along the great road up country, and at Melbourne, preferring the richest soils.”¹⁶ Infestations of the Milk Thistle in the vicinity of Melbourne had already become so troublesome by 1850 that Superintendent La Trobe issued a Government Notice dated 21 October 1850 seeking that measures be taken to control it.¹⁷ *Carduus Marianus* was one of the plants proscribed in Victoria by the *Thistle Prevention Act* 1856.

Weeds were a problem in Victoria from early in its history, and have been so ever since. It was probably inevitable that the colonization of Victoria would include colonization by weeds. European style agriculture and horticulture were bound to bring their accompanying weeds. What has become clear in hindsight is that many plants deliberately introduced were destined to become weeds. Hawthorn, referred to above is but one example.

An understanding of the weeds in the landscape requires knowledge of the dispersal mechanisms of the plants. Dispersal of seed and other propagules such as bulbs, corms, bulbils, tubers, stem fragments and stolons, is the mechanism by which weeds are spread. Some weeds produce vast numbers of seeds and have natural methods of dispersal by wind and water. Others have long distance dispersal mechanisms by animal agents such as birds which ingest seed or fruit and distribute seeds in their excreta, or by dispersal units such as burrs which attach themselves to animals. Humans have been involved in weed dispersal in many ways, indirectly by the animals and machines they have introduced, and directly by the plants which have been cultivated in agriculture and horticulture, and used to control erosion.¹⁸ Humans,

their domesticated animals and their machines are all weed vectors¹⁹, but weed dispersal also occurs naturally, apart from human activities.

Weeds were already a problem when roads were few, and some weeds have evolved with effective long range dispersal mechanisms. Further, there were human vectors before roads. The question for today is, “What part have roads played in the spread of weeds?”

ROADSIDE WEEDS

It is generally accepted that roads and the motor vehicles that travel on them have played a significant part in the spread of weeds in Victoria. There is much testimony to support this, although not a lot of detailed evidence. For example, a Victorian Parliamentary Committee reported in 1998 that

“In Victoria there are 160,000 kilometers of roads, accounting for 7% of the total area of the State’s public land. Roadside verges provide a variety of habitat types that are susceptible to invasion from weeds. Weeds are spread along roadsides by numerous means including: through vehicle and stock movement; through road building materials; on machinery; and via the movement of water in drains. Burning, clearing, grazing, ploughing of firebreaks and installation of utilities such as electricity and telephone cables also create disturbances along roadsides thereby encouraging weed invasion. Once infested, roadsides provide a source of weed spread to adjoining land...”²⁰

Detailed information about the present distribution of weeds on roadsides in Victoria is hard to find. Much of the knowledge is at a local level, and not readily available. Local government and regional authorities seem likely to have detailed information about the roadside weeds within their areas of responsibility, as does VicRoads,²¹ but public access to such information is limited. The Victorian Department of Sustainability and Environment manages a database which contains thousands of entries on weed infestations and weed management, but the data are “not directly available to private land managers, local Government, other Government departments or utilities for developing weed management plans.”²² There are current programs to improve the situation,²³ but it does not seem that particular attention is being given to roadside weeds.

To put this lack of information in perspective, Kirkpatrick pointed out that “Inventories of species and communities are unavailable for many of our most famous (national) parks, much less for the park systems of whole states.”²⁴ In such circumstances the lack of easily accessible weed inventories of roadsides does not seem surprising.

Winty Calder’s ground-breaking *Peninsula Perspectives*²⁵ contains a great deal of useful information about Mornington peninsula landscapes, including details of the vegetation communities and the plants of which they are comprised. She also provided details of the weeds to be found there. Calder did not pay particular attention to roadsides, although she did refer to the indigenous eucalypts then growing along most roadlines on the peninsula, and recommended the use of indigenous trees in re-planting. General information about the most obvious weed infestations was provided

by *The Threat of Weeds to Bushland*,²⁶ a Report published in 1976 by the Australian Institute of Agricultural Science. This Report paid particular attention to weeds in National Parks, but did not focus on roadsides.

As for more detailed information about weeds of roadsides, existing databases such as Viridians' *Wild Plants of Victoria* (2005) tend to under-report weeds, as John Weiss and Linda Iaconis of the Keith Turnbull Research Institute said in their 2002 Report *Pest Plant Invasiveness Assessment*²⁷. In preparing potential weed distribution maps they noted that roadsides present a particular problem for distribution maps.

“The many weeds recorded as occurring along roadsides presents (sic) another major limitation when predicting potential distribution. Victoria has over 170,000 kilometers of roads, however to include all these roads within the image would not be suitable, as it would be too cluttered and meaningless. Thus, some potential distribution images may not include the occurrence of weeds within a region, if they only occur along roadsides. For example, Horehound (*Marrubium vulgare*) can occur along roadsides within cropping regions, but is unable to withstand cultivation.”

The omission of weeds occurring on roadsides is not satisfactory. Weed mapping projects need to resolve the tension between including sufficient information to be useful, but not so much as to be meaningless. A solution should be sought by which weeds on roadsides are mapped. The resulting database should be widely available.

From the point of view of a road manager, roadsides are an extreme example of a linear reserve. As such the long boundaries increase exposure to invasion by weeds and to disturbance which permits weed establishment. The difficulties were discussed in a paper in 1988 on Managing Weeds on Linear Reserves.²⁸ It should be recognised that roadsides may be considered as being weed prone. Further, weeds with air-borne seeds, such as thistles and other members of the family *Asteraceae*, are likely to occur on roadsides without the need for vectors. Recent studies of invasive species have drawn attention to the pathways for invasions. It has been suggested that roadways may be pathways for the introduction of alien organisms, but there do not appear to be studies which test this hypothesis.²⁹

The ecological effects of roads are numerous.³⁰ Some studies have concentrated on negative effects.³¹ But in Australia, road reserves containing remnant indigenous vegetation are common.³² Many of the papers given at the 1989 Western Australian Conference on corridors, *Nature Conservation 2: The Role of Corridors* recognised that road corridors can make an important contribution to nature conservation. But it was also recognised that weed invasions can degrade the vegetation and lessen the value of roadsides.³³ The conservation values of roadsides are considered later in this paper.

This paper will first focus on two of the ways by which weeds are spread along roadsides. It should not be forgotten that there are other ways, such as cultivation. For example, if roadsides are slashed, weeds such as Chilean needle grass (*Nassella neesiana*), a weed of National Significance, may be spread.³⁴

VEHICLES AS WEED VECTORS

The weeds literature contains many references to weeds growing on roadsides. The majority of weed species recorded in national parks occur along roadsides and in disturbed areas.³⁵ What has aroused scientific interest is how they got there. A series of papers since 1959 have reported on work which sought to measure the dispersal of seeds by motor vehicles, with particular attention to weed seeds.

As long ago as 1957 Clifford measured the dispersal of weed seeds by motor vehicles in Nigeria, and published the results in the *Journal of Ecology*.³⁶ He wrote that he was following suggestions by Ridley in 1930 that vehicles spread weeds. The reference is to Henry Ridley's classic work, *The Dispersal of Plants throughout the World*.³⁷ Clifford took samples of mud attached to 75 vehicles and counted and identified 40 species of weeds which germinated. He thus demonstrated that weed seeds carried in mud on vehicles could germinate if removed in suitable conditions.

In 1977 N. M. Wace published an assessment of the car borne flora in Canberra in a paper based on work over more than two years extracting seeds from the sludge in the settling tanks of automatic car washing establishments, growing them, and recording the number [18,566] and species [259] of seedlings which resulted. Many common weeds were included. Wace noted that "many of the car-wash species do *not* grow on roadsides or in other situations which would suggest that they owe their presence there to dispersal of their propagules by car."³⁸[emphasis added] He could not demonstrate that the many viable seeds carried by vehicles resulted in weeds growing by roadsides, although some have regarded his work as presenting a strong circumstantial case.³⁹ In a subsequent paper Wace wrote,

"The motor car is a new human tool. There is not yet an identifiable car-adapted flora as there is a flora variously adapted to animal dispersal. The motor car simply picks up and spreads around the propagules of all sorts of plants indiscriminately: trees, shrubs and herbs, annuals and perennials, natives and aliens, domesticated, cultivated and naturalized species."⁴⁰

This description fits the jumble of plants germinated from the seeds Wace found in the "modern midden" (as he described the carwash sludge tanks), but that assembly was not replicated in the roadside weeds around Canberra. His work established that seeds were picked up but not that they were spread around, although that does seem a likely outcome.

In the 1980's Schmidt collected the mud from a car driven for more than 15000km near Gottingen (FRG) and germinated 3926 seedlings containing 124 plant species; 1234 were *Poa annua* (winter grass), most of the remaining plants comprised 33 species of common roadside plants. But, like Clifford, Schmidt found only a weak correlation between the roadside frequencies of species and their frequencies in mud samples.⁴¹

Lonsdale and Lane (1991) reported on vehicles as vectors of weed seeds in Kakadu National Park. They documented a total of 1511 seeds from 84 species, many alien to the region, which were collected from 222 tourist vehicles between May and November 1989.⁴²

These studies demonstrated a mechanism for plant dispersal associated with motor vehicles, but few studies have measured the actual spread of weeds by such means. The studies leave as suppositions the depositing of seeds and their germination by roadsides. An anecdotal observation, when combined with detailed information about the actual spread of a weed may have more explanatory force. Ridley provides a memorable example of the spread of a member of the Senecio family, *Senecio squalidus*, L., from the Oxford Botanic Gardens via the rail corridor.⁴³ The related *S. vulgaris*, L. (Groundsel) and *S. Jacobaea*, L. (Ragwort) are cosmopolitan weeds; Ragwort has been a proclaimed noxious weed in Victoria since 1903.⁴⁴ *S. squalidus* has small one seeded fruits (achenes) which are described as silky hairy.⁴⁵ Ridley described the plant as a native of the volcanic rocks of Sicily and South Italy, and by no means common even there. It was introduced into the Oxford Botanic Gardens in 1699. A century later it grew on more of the Oxford walls, and by 1833 had reached Wytham. When Ridley was an undergraduate at Oxford in 1875, he knew of it growing on walls in a corner of the town. It eventually (1877) reached the railway track. Ridley quoted from Druce's *Flora of Oxfordshire*, who wrote that "The track was made of clinker ash, which suited the plant as much as the lava soil in its home on the Sicilian volcanoes. ...I have seen them (the plumed achenes) enter a railway carriage near Oxford and remain suspended in the air till they found an exit at Tilehurst⁴⁶." It then, travelling by train, reached Reading where it is now (1930?) extremely abundant on the walls of the ruined Abbey and elsewhere, It got to Swindon in 1890, and went on to Bristol, Cardiff, Fishguard and Cardigan. It is recorded as plentiful in Bletchley in 1915, and reached Denbighshire in 1916. Ridley concluded with the observation that this formerly very scarce and local species was then more common in England than anywhere else in the world.⁴⁷

Dr W. Parsons and Dr E. Cuthbertson, in their monumental *Noxious Weeds of Australia*, provide examples of the spread of weed seeds by road and rail transport, such as skeleton weed (*Chondrilla juncea* L.)⁴⁸ - infestations of which they describe as common throughout much of southern Australia - and curled dock (*Rumex crispus* L.)⁴⁹. But they do not refer to detailed causal studies of such infestations. Both men wrote on the basis of a lifetime's work on weeds, so that their remarks should be given great weight.

There was a study in the 1970's by R. Amor and P. Stevens from the Keith Turnbull Institute, Frankston on the spread of weeds from an old roadside into sclerophyll forests at the Dartmouth dam-site. Their paper has been recognised in the literature as introducing the term "environmental weed."⁵⁰ Although it is true that Amor and Stevens refer to 'environmental weeds', they do so only once in their discussion of the spread of alien plants, which they "loosely regard as weeds". They also refer to "alien species", and "colonizing species."⁵¹ One does not get any sense that they were setting out to introduce a new term or to change the way we talk about weeds. The relevant passage is from their introduction,

"Although the spread of weeds from roadsides has received little attention in Australia, there is an increasing awareness of the aesthetic value of roadsides and of the need to conserve endemic ecosystems. South African boneseed *Chrysanthemoides monilifera* L. T. Norlindh has been proclaimed a noxious weed in Victoria because it colonizes uncleared vegetation and suppresses the

native species, and pressures are arising in other states for the control of ‘environmental weeds’”.

The 13 alien species they tracked into three sclerophyll forest communities were, in order of their successful colonizing:

<i>Hypochoeris radicata</i> ,L.	cats ear, flatweed
<i>Rubus procerus</i> ,Muller	blackberry
<i>Briza minor</i> ,L.	quaking grass
<i>Trifolium dubium</i> , Sibth.	yellow suckling clover
<i>Holcus lanatus</i> ,L.	Yorkshire fog
<i>Trifolium repens</i> ,L.	white clover
<i>Rosa rubiginosa</i> ,L.	sweetbriar
<i>Anagallis arvensis</i> ,L	scarlet pimpernel
<i>Cerastium glomeratum</i> ,Baumg.	mouse-ear chickweed
<i>Rumex brownii</i> , Campd.	swamp dock
<i>Cirsium vulgare</i> , (Savi) Ten.	spear thistle
<i>Sonchus asper</i> ,L.	prickly sow thistle
<i>Rumex acetosella</i> ,L.	sorrel

Many of these plants are weeds of common occurrence in cultivated ground, waste places and pastures. Most if not all have been naturalised in Victoria for many years.⁵² The most successful, cats ear or flatweed (*Hyperchoeris radicata*) was so well established at Heidelberg by 1890 that Arthur Streeton included it in the foreground of his well known landscape *Spring*. Streeton may have thought the plant to be an indigenous Australian wildflower.⁵³

The only declared noxious weeds among the plants identified by Amor and Stevens were *Cirsium vulgare*, *Rosa rubiginosa* and *Rubus procerus*. They reported that relative frequency of alien plants declined with increasing distance from the road, with marked decreases within distances of less than 50 metres from the roadside. The drier *Eucalyptus dives* (Broad-leaf peppermint) community was most resistant to invasion. The sclerophyll forests which they monitored were not untouched wilderness. Disturbance in the area had been caused not only by the old road, but by manual digging for gold in the 1870’s, which had included the construction of water races; and subsequently, by grazing of beef cattle with associated occasional burning of the forest to increase herbiage. However Amor and Stevens considered that weeds had spread from the road.

More detailed studies of the weeds growing on and near roadsides are needed.

ROAD CONSTRUCTION

The use and movement of gravel and earth materials in the construction of roads have also resulted in the dispersal of many weeds along roadsides. Propagules such as bulbs, bulbils, burrs, stolons, rhizomes, or fragments of them, when contained in soil or gravel moved in road grading or making will re-establish themselves in new areas.

Many weeds are frequently found along roadsides as a result. The many examples provided by Parsons and Cuthbertson⁵⁴ are set out in the following table:

Common Name	Botanical name	Page Reference
African daisy	<i>Senecio pterophorus</i> DC.	307
African feather grass	<i>Pennisetum macrourum</i> Trin.	118
African lovegrass	<i>Eragrostis curvula</i> (Schrad.)	107
angled onion	<i>Allium triquetrum</i> L.	86
boneseed	<i>Chrysanthemoides monilifera</i> L.	275
Californian burr	<i>Xanthium occidentale</i> L.	316
Cape broom	<i>Genitsa monspessulana</i> L.	479
castor oil plant	<i>Ricinus communis</i> L.	432
Columbus grass	<i>Sorghum x almum</i> Parodi	124
English broom	<i>Cytisus scoparius</i> L.	471
feathertop	<i>Pennisetum villosum</i> R.BR	122
gorse or furze	<i>Ulex europaeus</i> L.	482
hemlock	<i>Conium maculatum</i> L.	169
Johnson grass	<i>Sorghum halepense</i> L.	127
one leaf Cape tulip	<i>Homeria flaccida</i> Sweet	76
perennial ragweed	<i>Ambrosia psilostachya</i> DC	251
soursob	<i>Oxalis pes-caprae</i> L.	531
spiny rush	<i>Juncus acutus</i> L.	83
St John's wort	<i>Hypericum perforatum</i> L.	389
topped lavender	<i>Lavandula stoechas</i> L.	494
whisky grass	<i>Andropogon virginicus</i> L.	94
wild mignonette	<i>Roseda luteola</i> L.	563
wild watsonia	<i>Watsonia bulbifera</i> Mathews & Bolus	80

Professor Jamie Kirkpatrick has given a vivid account of the role of road-making and its machinery in the spread of cinnamon fungus (*Phytophthora cinnamoni*):

“...the fungus is transported by the largest and fiercest inhabitant of the Australian bush since the extinction of the megafauna. The bulldozer is the ideal vector. The justification for its existence is its ability to tear the surface of the earth, and in doing so it collects large amounts of soil in its many recesses, soil that can easily be dislodged in the churning of the next job.”⁵⁵

Road-making also involves the deliberate movement of soil, and soil or gravel infected with the fungus pathogens has been used to make roads. As Kirkpatrick says,

“As a result, the fungus experienced an accelerated expansion along road verges, from which it was further disseminated as machinery moved into adjacent bush for logging operations.”⁵⁶

Much of Kirkpatrick's account applies to the distribution of plant propagules by road making activities.

The soil disturbance from roadworks has also been associated with expanding populations of *Acacia* species (*A. pycnantha*, *A. montana* and *A. decora*) in the agricultural landscape of southern New South Wales.⁵⁷

CONSERVATION VALUE

More than 50 years ago Edna Walling drew attention to the ecological value of the remnant vegetation on roadsides, and demonstrated its great aesthetic appeal by her photographs in *The Australian Roadside* (1952).⁵⁸ Her primary aim was to preserve the natural herbiage on roadsides from thoughtless destruction. She argued the ecological importance of leaving well alone on the roadside:

“... only in places where growth has been permanently destroyed or in sections that are badly eroded is planting ever desirable, and then it must be done not necessarily with trees but with the most appropriate material for each specific site, frequently some low- growing native plant instead of trees.”⁵⁹

Walling wrote that she had been influenced by the American landscape architect Mr Olmstead, whom she described as “one of the world’s greatest landscape architects,”⁶⁰ in advocating natural scenery and the use of native plants along the borders of highways. In addition to quoting from Olmstead, she also referred to Lewis Mumford’s *The Culture of Cities*. Walling’s outstanding black and white photographs of roadside vegetation made a strong argument by demonstration for the beauty which she sought to conserve. Sadly, much of that beauty has been lost in the intervening years, although roadmakers have perhaps moved some way towards her ideal of the “fitted highway” as the highway of the future.

Since Walling’s time ecological conservation has become the avowed policy of State and Federal governments, and the subject of much discourse.⁶¹ The significance of remnant vegetation has been increasingly recognised.⁶² For example, Stella Humphries, Richard Groves and David Mitchell wrote in their Report to the Australian National Parks and Wildlife Service, *Plant Invasions :The Incidence of Environmental Weeds in Australia* ,

“Natural vegetation over most of the southern and eastern populated zone of Australia is severely fragmented. The remnants consequently have high conservation value. Ninety per cent of South Australia’s forests have been cleared; only 25 per cent of the original rainforests of eastern Australia remain after clearing for agriculture (Winter & Atherton, 1987). The remnant status implies an incidence of rare or threatened species (Bower,1987).⁶³

Many of the remnants are on roadsides which were spared the clearing of native vegetation for agricultural purposes. However, it does not appear that detailed attention has been given to roadside remnants.

In his paper on Urbanisation and Transport, P. Adam notes the substantial impacts on biodiversity of roads and the vehicles which travel on them. He refers to studies of the fragmentation of habitat by roads, and to Wace’s study of vehicles as potential vectors discussed above. Adam also notes the major disturbances caused by road construction, including the transport of weed organisms and pathogens. Roadside verges may also provide habitat for weeds and pest animals. But on the positive side he notes that , “Within an agricultural landscape road corridors may support the last

remaining remnants of native vegetation.” Further, he recognises the habitat conservation value of remnant native vegetation along roadsides. “...road margins support many examples of communities and species not represented in conservation reserves and additionally provide networks of habitat corridors through the landscape.” He concludes that road corridors are important for biodiversity conservation.⁶⁴ This view is supported by numerous studies.⁶⁵

WEEDS AND HERITAGE CONSERVATION

There is another aspect of roadside weeds which should be considered.

At the beginning of this paper I noted, from the example of hawthorn and other hedges, that some roadside weeds have been planted by humans. Roadside plantings have contributed to significant landscapes and may have cultural heritage significance in their own right. For example, a number of Avenues of Honour, such as that on the Western Highway from Ballarat to Burrumbeet, are being included in the Heritage Register. The 3700 trees in the Ballarat Avenue are Elms (*Ulmus* spp) and poplars (*Populus* sp). Roadside plantings have been an important feature of places such as Bickleigh Vale and Ranelagh Estate now included in the Register for their landscape values; and of landscapes classified by the National Trust. Further, many of the trees included in the National Trust’s *Register of Significant Trees* are on roadsides. For example, the significant pepper-corn trees (*Schinus molle* var. *areira*) registered by the National Trust are nearly all on roadsides. On the Mornington Peninsula, the Monterey pines (*Pinus radiata* var. *radiata*) have been recognised in heritage studies as making an important contribution to significant landscapes.

However, many of the exotic species used in the roadside plantings which are acknowledged to be of cultural heritage significance are included in lists of environmental weeds. Monterey pine (*Pinus radiata* var. *radiata*), Dutch elm (*Ulmus x hollandica*), pepper-corn tree (*Schinus molle* var. *areira*) and Lombardy poplar (*Populus nigra* var. *italica*) are all listed in *Environmental Weed Invasions in Victoria*⁶⁶. That listing was adopted by the Victorian Parliamentary Committee in its Report, *Weeds in Victoria*.⁶⁷ Monterey pine and Pepper-corn tree are also included in Kate Blood’s *Environmental Weeds*⁶⁸, although elm and poplar are not. The concept of environmental weed is of comparatively recent origin, as indicated above; but it has now gained widespread acceptance in Australia.⁶⁹ Thus, roadside trees of heritage significance are, in the eyes of some, simply environmental weeds. The conflict of values which is involved seems likely to become increasingly sharp.

CONCLUSION

Sustainable landscape conservation recognising cultural and/or natural values requires more detailed attention to roadsides in many cases. The environmental impact and ecological role of roadside plantings should be considered together with the cultural heritage significance of the landscapes. Roadside vegetation which is significant, either in terms of nature conservation or cultural heritage or both, requires appropriate management.

The edges which are an inevitable feature of the long boundaries of roadside reserves increase their vulnerability to weed invasions. We need to know both what weeds are on roadsides, and how they got there. Weed invasions of remnant vegetation on roadsides and of intact landscapes from roadsides require further study. The part played by motor vehicles as vectors in such invasions has not yet been fully investigated. The existing studies referred to above should be complimented by further studies of vegetation growing on roadsides to ascertain which plants are attributable to car borne propagules. Detailed inventories and maps of roadside weeds should be compiled and made available to the public.

The role of roadsides in biosphere conservation has not been fully assessed and further work is necessary. On balance it may well be that the contribution made by roads to nature conservation outweighs the harm done by the spread of weeds. That harm should, of course, be ameliorated.

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ENDNOTES

¹ QC MA LLB (Melb) Cert. Hort. (Burnley) I am grateful to Dr Janet Schapper who read and commented on an earlier draft of this paper.

² Howitt, W. *Land, Labour & Gold* p30 (London 1855, republished Kilmore 1972)

³ Howitt, p437; see also p32 (1972)

⁴ Parsons, W. *Noxious Weeds of Victoria* p234 (Melbourne 1981)

⁵ For the concept of introduced or alien plants see Michael, P. "Alien Plants" pp57-83 in *Australian Vegetation* R. H. Groves ed (Cambridge 2001)

⁶ See eg Parsons, p3; Zimdahl, R. *Fundamentals of Weed Science* p14 (San Diego 1999)

⁷ Dwyer, J. "What is a weed? Should we continue to say that 'a plant is a weed in the eye of the beholder'?" *Proceedings Second Victorian Weeds Conference*, R. G. Richardson ed (Melbourne 2005)

⁸ An obituary of Professor Jack Harlan was published in *Economic Botany* **52** pp225-7 (1999)

⁹ Harlan, J. and de Wet, J "Some Thoughts About Weeds" pp16-24 *Economic Botany* **29** (1965)

¹⁰ Anon. *The National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance*. (Canberra 1997, revised 1999)

¹¹ Hooker, J. D. *Flora Tasmaniae* cv-cix (London 1860); Frederick Andamson was a Melbourne resident who sent extensive botanical collections to Sir William Hooker at Kew in the 1840's and 1850's. Willis, J. and Cohn, H. "Botanical exploration of Victoria" 61-78 in *Flora of Victoria* Vol 1, D. B. Foreman and N. G. Walsh eds (Melbourne 1993)

¹² Ewart, E and Tovey, J. *The Weeds, Poison Plants, and Naturalized Aliens of Victoria* (Melbourne 1909)

¹³ Carr, G. "Environmental Weed invasions and their Conservation Implications" 26-33 in *Flora of Melbourne* M. Gray and J. Knight eds (Flemington 2001)

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- ¹⁴ Carr,G., Yugovic,J. and Robinson,K. *Environmental weed Invasions in Victoria* (Melbourne 1992)
- ¹⁵ From the Latin, *agrestis*, meaning “of the fields.” See Usher,G *The Wordsworth Dictionary of Botany* (Ware, Hertfordshire 1996) p11
- ¹⁶ Hooker(1860) cviii. The road was probably Sydney Road, see Allan,J. “The Greater Highways of Melbourne” *The Victorian Historical Magazine* pp77-86, **XVII** 1939
- ¹⁷ *Port Phillip Government Gazette*, p945, Wednesday November 6, 1850
- ¹⁸ This brief account is based on Carr, Yugovic and Robinson supra pp10-11. For a more detailed study see Harper,J. “The seed rain” in *Population Biology of Plants* pp33-60 (London 1994)
- ¹⁹ “Vector” from the Latin meaning “one who bears, or a carrier” was used in Biology for animal carriers of pathogens [see Usher supra p393]; but it is suggested that current usage simply adopts the Latin meaning.
- ²⁰ Anon *Weeds in Victoria* Chapter 10 “Roadside Weeds Management” (1998)
- ²¹ Horlock,J. “The management and threat of weeds – a VicRoads perspective”, *Plant Protection Quarterly* 20(3), 112-113 (2005)
- ²² McLaren,D., Backholer,J., Cooper,J., Welsh,S. and Scardamaglia,D. “Community weed mapping – a vision for the future” 648-651 *Proceedings of the 14th Australian Weeds Conference*, eds B. M. Sindel and S. B. Johnson (New South Wales 2004)
- ²³ McLaren et al p650 (2004)
- ²⁴ Kirkpatrick,J. *A Continent Transformed* p44 (South Melbourne 1999)
- ²⁵ Calder,W. *Peninsula Perspectives*, First edition 1975 (Mount Martha 1986)
- ²⁶ Anon *The Threat of Weeds to Bushland: a Victorian Study* (Melbourne 1976)
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- ²⁸ Seymour,N. “Managing Weeds on Linear Reserves” in *Weeds on Public Land : An Action Plan For Today* R. G. Richardson ed (Parkville 1988); see also Humphries, S., Groves,R. and Mitchell,D. *Plant Invasions:The Incidence of Environmental Weeds in Australia* 44 (Canberra 1991)
- ²⁹ Ruiz,G. and Carlton,J. *Invasive Species* (Washington 2003)
- ³⁰ For a useful survey see Forman,R. *Land Mosaics: the ecology of landscapes and regions* Chapter 5 (Cambridge 2003)
- ³¹ eg Trombulak,S. and Frissell,C. “Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities” *Conservation Biology* **14** pp18-30 (2000)
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- ³⁴ Iaconis,L. “How is the national Chilean needle grass program progressing?” pp 636-643 in *Proceedings of the 14th Australian Weeds Conference* eds B. M. Sindel and S. B. Johnson (Sydney 2004)
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- ³⁶ Clifford, H. “Seed dispersal by motor vehicles” *Journal of Ecology* **47**,311-315 (1959)
- ³⁷ Ridley,H. *The Dispersal of Plants Throughout the World* (Ashford 1930). Ridley, as Director of the Botanic Gardens at Singapore in about 1890, successfully tapped Para rubber trees (*Hevea brasiliensis*) growing in the gardens from seedlings supplied by Kew in 1877. This was the foundation for the rubber industry in the colonies of

- Celon and Malaya based on plants native to the Amazon but dispersed via Kew Gardens. *Oxford Companion to Gardens* p519 (1986). See also Brockway, L. *Science and Colonial Expansion* (New York 1979)
- ³⁸ Wace, N. "Assessment of dispersal of plant species – the car-borne flora in Canberra." *Exotic species in Australia – their establishment and success*. D. Anderson, ed; *Proc. Ecol. Soc. Australia* 10 (Adelaide 1977)
- ³⁹ eg Adam, P. "Urbanisation and Transport" 55-75 at 65 in *Conserving Biodiversity: Threats and Solutions* R. A. Bradstock et al eds (Chipping Norton NSW 1995)
- ⁴⁰ Wace, N. "Human modification of the natural ranges of plants and animals" 225-244 in *Biology and Quaternary Environments* D. Walker and J. Guppy eds (Canberra 1978)
- ⁴¹ Schmidt, W. "Plant dispersal by motor cars" *Vegetatio* **80** pp147-152 (1989)
- ⁴² Lonsdale, W. and Lane, A. "Vehicles as vectors of weed seeds in Kakadu National Park." *Plant Invasions: The incidence of environmental weeds in Australia* Humphries et al eds (Canberra 1991)
- ⁴³ Ridley p629 (1930)
- ⁴⁴ Parsons pp110-115 (1981)
- ⁴⁵ Bentham, G. and Hooker, J. *Handbook of the British Flora* 8th ed p245 (London 1904)
- ⁴⁶ Tilehurst is about 25 miles from Oxford, on the outskirts of Reading.
- ⁴⁷ Ridley p629 (1930)
- ⁴⁸ Parsons, W. and Cuthbertson, E. *Noxious Weeds of Australia* 266 (Collingwood 2001)
- ⁴⁹ Parsons and Cuthbertson, p550 (2001)
- ⁵⁰ Adair, R. "The threat of environmental weeds to biodiversity in Australia: a search for solutions" in *Conserving Biodiversity: Threats and Solutions* R. A. Bradstock et al eds (Chipping Norton, NSW 1995)
- ⁵¹ Amor, R. and Stevens, P. "Spread of weeds from a roadside into sclerophyll forests at Dartmouth, Australia" *Weed Research* **16**, 111-118 (1975)
- ⁵² Most are listed in Ewart, A. and Tovey, J. *The Weeds, Poison Plants, and Naturalized Aliens of Victoria* (Melbourne 1909); and in Hooker, J. "On some of the Naturalized Plants of Australia" *Flora Tasmaniae* cv-cix (London 1860)
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- ⁵⁴ Parsons, W and Cuthbertson, E. *Noxious Weeds of Australia* (Collingwood 2001)
- ⁵⁵ Kirkpatrick, p80 (1999)
- ⁵⁶ Kirkpatrick, p80 (1999)
- ⁵⁷ Spooner, P., Lunt, I., Briggs, S. and Freudenberger, D. "Effects of soil disturbance from roadworks on roadside shrubs in a fragmented agricultural landscape" *Biological Conservation* **117** p393-406 (2004)
- ⁵⁸ Walling, E. *The Australian Roadside* (Melbourne 1952); now republished as *Country Roads: The Australian Roadside* (Lilydale 1985)
- ⁵⁹ Walling, p34 (1985)
- ⁶⁰ Walling, p28 (1985). The reference is probably to Frederick Law Olmstead [1857-1903], the designer of Central Park, New York; but could be to his son F. L. Olmstead Jr [1870-1957] who carried on the Olmstead office. See Jellicoe, G. et al *The Oxford Companion to Gardens* 325 (Oxford 1986); Jellicoe, G. & S. *The Landscape of Man* 279-283 (London 1998)

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- ⁶¹ See *Environment Protection and Biodiversity Conservation Act 1999* [Cth]; Williams, J., Read, C., Norton, A., Dovers, S., Burgman, M., Proctor, W. and Anderson, H. *Biodiversity, Australia State of the Environment Report* (2001); *Flora and Fauna Guarantee Act 1988* [Vic]
- ⁶² Williams et al., p52 (2001)
- ⁶³ Humphries, S., Groves, R. and Mitchell, D., p43 (1991)
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- ⁶⁵ Most of the studies deal with fauna. See eg Cale, P. "The value of road reserves to avifauna of the central wheatbelt of WA" in *Australian Ecosystems: 200 years of Utilization Degradation and Reconstruction* D. A. Saunders et al eds 359-67 (Chipping Norton NSW 1990); see also Andrews, A. "Fragmentation of habitat by roads and utility corridors; a review" *Australian Zoologist* **26**, 130-141 (1990)
- ⁶⁶ Carr, G., Yugovic, J. and Robinson, K. *Environmental Weed Invasions in Victoria* (Melbourne 1992)
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